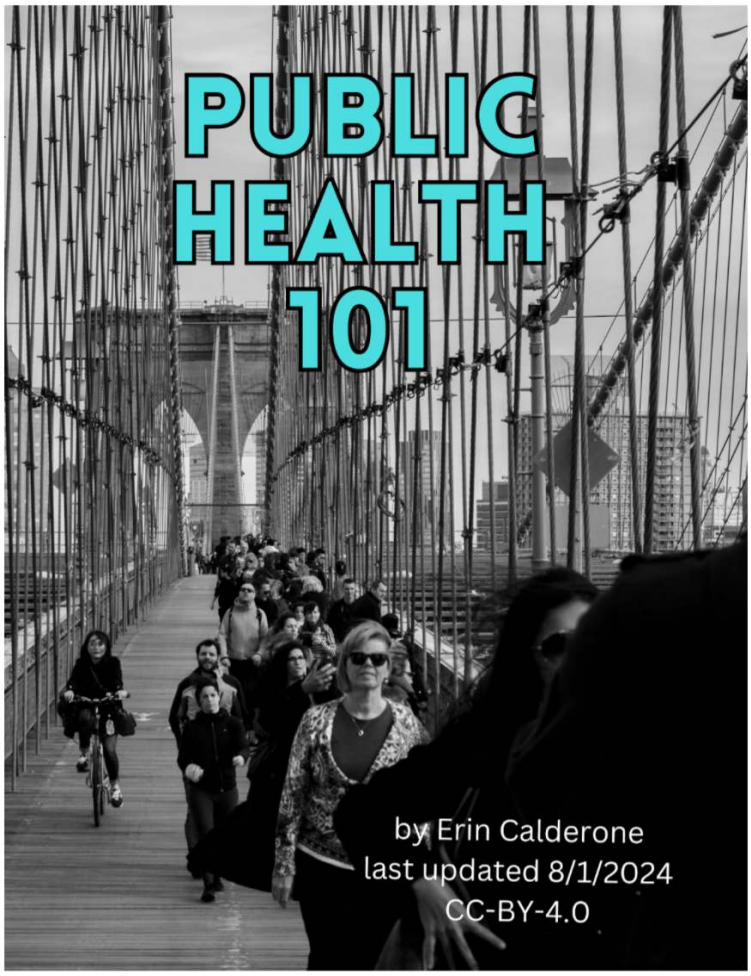
PUBLIC HEALTH 101



Erin Calderone
Glendale Community College





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Public Health 101

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Licensing

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CHAPTER OVERVIEW

1: What is Public Health

Learning Objectives

- Define important fundamental concepts in community and public health.
- Distinguish the difference between personal and public health.
- Distinguish how preventative health differs from the traditional Western medicine approach to treating disease and illness.

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1.1: Introduction- Public Health in Daily Life

As a student, perhaps you don't think too often about public health. After all, you are very busy: your alarm wakes you up just in time for a quick shower, before you head out the door to grab coffee on your way to class. Maybe you commute by car or bus to get to campus, where you sit in several lectures with your classmates, with barely enough time to visit the restroom between classes, and grab a snack from the vending machine before you head off to work. At the end of your shift you're so tired that you decide to skip the workout you had planned and go straight to bed - maybe falling asleep as you "doom-scroll" on social media.

You may not realize it, but public health is involved in almost every minute of your day. If you have electricity, clean water and a working toilet, these all enable you to avoid infectious diseases and environmental toxins. If a classmate or coworker is sick, you may catch their cold and pass it on to your family members or friends. Perhaps you'd like to eat something besides what is available in the vending machine, since you know how important nutrition is for your health, but you are limited by the options in front of you. When you go to work, both you and your employer have to follow specific safety rules - especially if you handle food being served to the public or work with dangerous machinery. Your mental health may be affected by the fact that you feel too stressed to exercise, and instead you engage in "revenge bedtime procrastination" by scrolling on your phone. And nowadays, the health information you come across on social media is a blend of current science with misinformation and disinformation. All of these are important issues in public health.



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1.2: What Does It Mean to Be Healthy?

First, we should probably define what health is. If we are not sick, does that mean we are automatically healthy? This perspective is called the **medical model**; that is - looking for any disease or injury to treat. If none are found, the patient is deemed "healthy". They may not *feel* or *function* their best in every area, but as long as they don't have a diagnosable disease or injury then they are considered healthy. This model leaves out everything besides illness, and doesn't recognize varying degrees of healthiness - or how a person might not just want to be "ok" but to optimize their health in different areas. It also doesn't take into account a person's own perception of their health, or their health-related-quality of life (which we'll discuss more below). Apparently the medical model doesn't accurately describe the entirety of health, much less a sense of well-being.

The World Health Organization (WHO) provides a more comprehensive definition of health:

> *"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"*
>
> *(Constitution of the World Health Organization, 1948).*

This definition recognizes that in order to truly thrive, a person has health needs in multiple dimensions, and these needs are beyond preventing or treating illness. These dimensions include physical, mental/emotional, intellectual, social, environmental, and occupational health. For example: someone might not have a clinical depression diagnosis, but they could be experiencing loneliness that prevents them from feeling their best mentally and emotionally. They still need to nurture and enjoy relationships with friends and/or family members in order to feel their best. They may not have any bodily disease or injury, but they feel and function better when eating a balanced diet and getting some daily physical activity.

This person needs a job that supports their cost of living, and a place to live where they feel safe and they're not exposed to environmental hazards. Thus, a state of **well-being** is not only above and beyond the medical model of health, it's also somewhat subjective because it's based on our own experience. In order to measure well-being, we might ask folks to tell us about their **quality of life (QOL)** or **health-related quality of life (HQOL)**. These two subjective measures can vary in different dimensions. And just because someone is living with a chronic condition or disability doesn't mean they can't experience well-being. Different folks may need more support in certain areas; like accessible walkways and restaurants, affordable medication, or well-trained personal aides.

Health and well-being are probably better represented by a continuum. On one end of the continuum a person can experience the highest health-related quality of life, the other end is marked by illness or death. Different factors like genetics, behaviors, and environment can move that person's health and HQOL either direction along the continuum (see Fig. 1.2.1). By having a more holistic definition of health and/or focusing on improving well-being, we can work towards a better life *experience* for ourselves and those around us (*Well-Being Concepts*, CDC. n.d.).



Figure 1.2.1: Health Continuum

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1.3: What is the Difference Between Personal and Public Health?

Many people think of health as mostly an individual responsibility. Shouldn't a person make sure that they take care of their own hygiene, nutrition, physical activity, and protect themselves from diseases or accidents? Another common viewpoint is that health is mostly the "luck" of genetics - hopefully longevity runs in your family. Certainly, a person's health is heavily influenced by their genetics, personal beliefs, knowledge and behaviors - this is a good definition of **personal health.** Yet, a person's beliefs, knowledge and behaviors are all influenced by their family, community, environment, and the larger social and cultural context in which they live. The health of the individual and that of their community is inextricably interconnected. Take for example, a community's access to foods that support healthy eating patterns: such as fresh fruits and vegetables, whole grains and lean proteins. If a community has grocery stores, farmer's markets, and/or food co-ops, there will be a lot of access to these foods without having to travel far. However, if there are no grocery stores conveniently located, and an abundance of fast-food options in the community, individuals will have fewer options to choose from. This access affects the individual's nutritional behaviors, which in turn can affect their health(*Access to Foods That Support Healthy Dietary Patterns - Healthy People 2030*, n.d.). Public health therefore focuses on groups or communities; the environments, education, access to healthcare, programs and policies that affect the health of individuals in the community.

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1.4: Population and Community Health

When a person goes to their doctor's office, the physician's primary goal is to diagnose and treat the individual. By contrast, public health focuses on population health or community health (Centers for Disease Control and Prevention (CDC), 2014). While *population* and *community* are often used interchangeably in public health, they can also mean different things. A population is often used to describe a group that is larger and more defined by shared characteristics, such as age, sex, occupation, or geographic location. For example, a public health worker might be concerned about trends in poor maternal and infant health outcomes - thus the population they are focusing on is those who are pregnant or who have recently given birth and infants under age 1. **Population health** is concerned about identifying the distribution of diseases and the risk factors associated with them across and between different populations. A community is more often describing a geographically smaller group, like a town or neighborhood. Someone working in community health might focus their efforts on providing HIV tests to unhoused people in a specific area. **Community health** is seen as more of a "grass-roots" effort that takes into account the community culture and perceptions (*Community and Population Health*, n.d.). Both population and community health are important for public health efforts at the county, state, national and global levels. Public health also tends to focus more heavily on *prevention* of poor health outcomes rather than treatment of diseases or illnesses that already exist like the medical model does (Schneider, 2020, p. 5).

Because public health tends to focus on preventative actions and works at so many different levels, public health successes often go unnoticed or taken for granted. Take just one example: the success of flouridation of public drinking water at improving dental health. Flouride is a naturally occuring mineral that is found in drinking water around the world, but was added to drinking water in America after studies in the 1940's demonstrated its efficacy at protecting tooth enamel. Around 2/3 of Americans are served by municipal water sources that flouridate the drinking water pumped into homes, schools, and workplaces. Flouride is added at the recommended amount of 0.7 parts per million, and epidemiological studies have found that this practice has reduced dental caries (cavities and tooth decay) significantly since the 1960s. Those who benefit the most tend to be people living in poverty and children, who may not have access to regular dental care (HHS, 2015, Public Health On Call - John's Hopkins Bloomberg School of Public Health, 2024). Yet many people may not recognize the protection of flouridated drinking water because they and their families *don't* have a high number of cavities and haven't lost teeth.

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1.5: Defining Public Health

According to one of the early innovators of public health, Charles Edward. A. Winslow, the definition of **public health** is:

The science and the art of preventing disease, prolonging life, and promoting physical health and efficiency through organized community efforts for the sanitation of the environment, the control of community infections, and education of the individual in principles of personal hygiene, the organization of medical and nursing services for the early diagnosis and preventive treatment of disease, and the development of the social machinery which will ensure to every individual in the community a standard of living adequate for the maintenance of health. (Schneider, 2020, p. 4)

A unique characteristic of this definition of public health identifies a minimum "assurance" of the opportunity to maintain personal health - an adequate standard of living. In other words, we owe it to each other to make sure that each person has the opportunity to live a healthy life. The WHO takes this collective obligation further in defining health as a human right in its constitution (*Const. of the WHO, 2020)*:

> *"The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition."*



Figure 1.5.1: (*Photo by Jack Moreh from Freerange Stock*)

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1.6: Determinants of Health

One particular part of public health attempts to identify causes and risk factors of diseases and illness, or negative **health outcomes.** A health outcome is any change in health status, positive or negative. Negative or "poor" health outcomes are those that result in disease, injury, or death. Positive health outcomes could include being alive and living longer, not contracting an infectious disease or improving HQOL. Epidemiology is the study of how widespread a health outcome is, and its *etiology* or causes (Centers for Disease Control and Prevention, 2018). Epidemiologists research the distribution of diseases as well as what factors might affect a particular population's health outcomes (we'll discuss epidemiology more in future chapters). Factors that affect health outcomes are also called **determinants of health**. These determinants may increase (risk factor) or decrease (protective factor) a person's risk for developing a specific disease, either independently or in combination with other factors. Determinants of health typically fit into the following 5 categories (Seabert et al., 2021, p. 5):

- Biological factors: genetics, personal or family history of illness or infection, sex assigned at birth, hormone levels, age, etc.
- Behavioral factors: nutrition, physical activity, smoking, alcohol and drug use, seatbelt wearing, sexual activity, etc.
- Social-Economic factors: income, socioeconomic status (SES), education, social support, systemic racism, discrimination, access to preventative care, etc.
- Environmental factors: geography, neighborhood structure, safety, environmental hazards, clean air/water/sanitation, etc.
- Medical care: the type and quality of medical treatment available.

A single risk factor is rarely a stand-alone cause of a specific health outcome. Rather, determinants of health are often identified in combination as risk factors. Take the example of the behavior of cigarette smoking. It has been well established that cigarette smoking is a factor in 80-90% of all lung cancer deaths, and smoking also increases the risk of bladder, pancreatic, and other cancers, as well as the risk of coronary heart disease and stroke (*What Are the Risk Factors for Lung Cancer?*, 2023, *Diseases and Death*, 2022). Since smoking is a behavior, it logically fits into the behavioral category above. However, this behavior is also connected to other determinants of health. The nicotine present in cigarette smoke is highly addictive, so the smoking behavior is influenced by the biological dependency created after just a few cigarettes. Still other social factors influence the likelihood of someone picking up the habit of cigarette smoking - such as cultural attitudes toward smoking, or personal knowledge about the harms of smoking. Many smokers indicate that smoking reduces stress, and stress may be higher in communities with less job security or public safety. There are likely environmental factors such as access to cigarettes that could also be involved. If we only look at the disease of lung cancer, there are also other environmental exposures (such as asbestos) which increase the risk of developing the disease. So the process of identifying risk factors and determinants of health outcomes can become complicated.

Another example, this time of a protective effect, would be physical activity. Individuals who regularly engage in physical activity tend to have lower risks of chronic diseases and lower their risk of developing severe responses to some infectious disease as well, like COVID-19 (Steenkamp et al., 2022). Similar factors may influence an individual's physical activity levels - such as family and cultural attitudes toward physical activity, socioeconomic status and leisure time, neighborhood safety and greenspace, education level, and whether the person is living with musculoskeletal conditions or disabilities. However, physical activity alone does not prevent all cases of chronic disease. And other determinants like genetics, healthy nutrition, clean air and regular medical screenings may work in conjunction with physical activity to protect against chronic disease.

Public health research often examines the community or population at risk for developing a certain disease, and then works to identify and address commonly-shared determinants associated with that disease. Because public health is focused on prevention, this includes developing public policies that attempt to reduce the incidence or prevalence of a certain disease, ensuring resources are available to respond to health issues and emergencies, and implementing programs and interventions to reduce risk factors and increase protective factors in those determinants of health. All of these actions depend on appropriate research in order to justify their funding and ensure they are working effectively, so gathering and analyzing data on health outcomes and determinants is at the heart of public health. We'll discuss the different roles and responsibilities of public health later on in this text.

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1.7: Models of Public Health

As discussed in the previous section, finding out what causes negative health outcomes and how to change these outcomes is a complicated process. Fortunately, there are different models that we can use when we try to understand and solve health problems. These models provide a framework with which public health professionals can identify different points at which to intervene in order to prevent diseases and improve health outcomes.

The **Biomedical Model** addresses health issues “as a function of risk factors, symptoms, diagnoses, and treatments” (Acolin & Fishman, 2023). A doctor using the biomedical model might ask you about your symptoms and health-history, order different lab tests for you and ultimately make a diagnosis. This model attempts to identify a *causal* relationship between risk factors and diseases, ultimately to identify treatments and solutions. The biomedical model can also be used in public health. For example, we might identify that the leading cause of death for Americans is heart disease. Scientific literature identifies that one of the major risk factors for heart disease is obesity. Therefore, we might fund research into anti-obesity drugs, create clinical weight-loss programs, or create other policies to prevent obesity in the population (such as requiring labeling on high-calorie foods for example).



Figure 1.7.1: (*Photo by Freerange Public Domain Archives from Freerange Stock*)

The **Social Ecological Model** identifies health outcomes as influenced by “the interaction between the individual, the group/community, and the physical, social, and political environments" (Clinical and Translational Science Awards (CTSA) Consortium’s Community Engagement Key Function Committee 1997/2011). A great illustration of the social ecological model is in our individual dietary habits. What we eat on a daily basis is often our familiar foods, perhaps those we grew up enjoying, or can be influenced by close relationships such as friends, roommates or a significant other. In this way, the individual’s behaviors are influenced by their close relationships - what they were fed as a child growing up, what they tend to eat-out with friends, or what their significant other eats. These are all influenced by the community in which they live - which could be their geographical location but also includes cultural, and/or religious norms. In turn, this community food is also influenced by the society at large: what food is grown, produced and sold in that region, what is affordable and accessible, etc. Using the social-ecological model, a public health practitioner might attempt to address policies to prevent obesity, like banning sugar-sweetened beverages of a specific size. Or they might address access to fruits and vegetables by coordinating a public-private partnership to put a grocery store in a neighborhood that doesn't have one, in order to change that community’s access to health-promoting foods. Perhaps a healthy cooking class might be offered at a community center - thus hopefully having a positive effect on the individual’s nutritional knowledge and skill, and also on the nutritional habits of the attendee’s families. The diagram in Figure 1.7.2 was developed by the CDC in 2007, and is used to visually represent the social-ecological model.

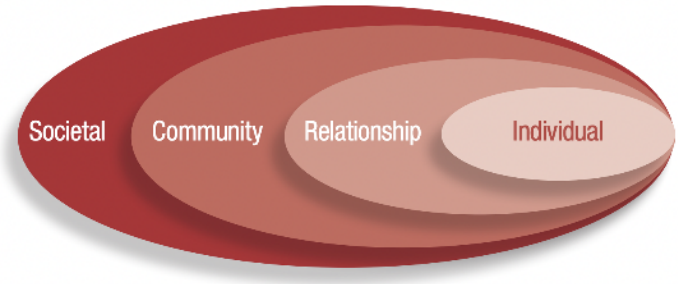


Figure 1.7.2: The Social Ecological Model - A Framework for Prevention

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1.7.1: Case Study- Applying Models to a Pandemic Response

Perhaps there will be new iterations of these models or entirely new models developed in the future. Authors Acolin and Fishman identified challenges with applying both the biomedical and social-ecological model to the COVID-19 pandemic response in a 2023 paper. While the biomedical model looks for specific biological causes or risk factors of a disease in order to prevent or treat them, the social ecological model looks for specific structural or social causes or risk factors and attempts to resolve them. These authors hypothesize that both models miss the agency of the individual, and therefore can fail to anticipate the human response to large-scale public health issues. The authors analyzed the public health response during the COVID-19 pandemic as an example. Public health guidelines called for social distancing and masking, which are biologically effective at reducing the spread of SARS-CoV-2, the virus which causes COVID-19. Socioeconomic inequities were amplified during “lockdowns” as many minimum-wage jobs were simply eliminated, and businesses forced to cut-back or close. Those considered “essential” workers were forced to risk their health or income, while office-workers were often able to work from home and avoid exposure. Other down-stream effects of school and work closures to the economy and mental health caused many individuals to resent public health measures and choose to ignore guidance. Subsequently, politics began to co-opt public health, and opposing ideological camps were formed - behaviors like masking became a signifier for political affiliation. Acolin and Fishman suggested that individual agency in pursuit of meaning and life satisfaction should be considered in population health science, both to understand health outcomes and when designing policies and interventions. They proposed a structural model that accounts for the agency of the individual and promotes resiliency of the environmental, organizational, and social environments within the population (Acolin & Fishman, 2023).

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1.8: Summary

Summary

Public health focuses on the health of communities and populations and is invested in preventing diseases and improving overall quality of life. This includes identifying determinants of health and developing ways to improve health outcomes for communities and populations. In the next chapter, we will explore the roles and essential functions of public health.

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CHAPTER OVERVIEW

2: The Core Functions of Public Health

Learning Objectives

- Define important fundamental concepts in community and public health.
- Identify different public health disciplines, professions and organizations, and explain how each contributes to the field of public health.
- Distinguish how preventative health differs from the traditional Western medicine approach to treating disease and illness.

2.1: Introduction
2.2: Prevention is the Best Medicine
2.2.1: Three Types of Prevention
2.3: The Core Roles of Public Health
2.4: What Does “Evidence-Based Practice” Mean?
2.5: Evidence Will Evolve
2.6: Summary
2.7: References

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2.1: Introduction

To many, public health may seem like an enigma, a figureless “they” that stamps food-safety ratings on restaurants or approves pharmaceutical drugs. But public health does much more both in the public view and behind the scenes to protect the health of countries and the world. In this chapter we’ll go over how public health functions and some of its responsibilities.

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2.2: Prevention is the Best Medicine

Using the medical model (see Chapter 1), the current U.S. healthcare system is set up to focus on diagnosing and treating diseases, and correcting injuries through surgery and rehabilitation. Because it focuses on treating illnesses and injuries after they occur, perhaps a better term to use would actually be “sick-care”. In contrast, public health uses the socio-ecological model, and is focused on *prevention* and improvement of population health. The public health concept of health is also more holistic: health is multidimensional and on a continuum. Therefore, prevention is also on a continuum. Public health works within governments, public education, healthcare systems and philanthropic organizations to promote well-being along the health continuum. This work can be broken down into three different types of prevention.



Figure 2.2.1: (Photo by National Cancer Institute on Unsplash)

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2.2.1: Three Types of Prevention

Primary prevention works to prevent a disease, condition, or injury from ever happening in the first place. This may include creating policies, researching and developing vaccines and preventative measures, and developing preventative programs Some examples include:

- smoking bans in public places (to prevent lung disease),
- enforcing food-safety regulations in agricultural and food processing (to prevent food-borne illnesses),
- making critical vaccines free - especially for vulnerable groups (to prevent infectious diseases),
- designing traffic flow patterns (to reduce vehicle accidents),
- providing accurate health information to the public (such as recommendations for nutrition and physical activity).

Many primary prevention programs and policies can also improve health-related quality of life for apparently healthy individuals too. DPP example*

Secondary prevention kicks in after the disease, condition, or injury has occurred already in some part of the population. This type of prevention can help prevent further health issues or transmission of the disease. Such actions could include:

- quarantine measures for individuals with an infectious disease to prevent them from spreading it to others,
- screening programs for the early detection of cancers to help patients initiate treatment sooner,
- seatbelts and airbags in cars to help prevent injuries when car accidents do happen,
- referral to a diabetes prevention program (DPP) for people with pre-diabetes, which can help slow the progression of this chronic disease.

Although secondary prevention may not necessarily prevent a negative health event from occurring, it can lessen the impact to both the individual and to the community.

Tertiary prevention aims to reduce the hardship and disability experienced by individuals with the disease or injury with medical and rehabilitation services. Although this sounds like medical treatment (which it can be), the overarching purpose of tertiary prevention is to prevent subsequent issues from causing even more harm. Some examples might include:

- ensuring adequate hospital beds are available during an epidemic,
- researching, developing, testing, and approving new treatment methods for specific diseases,
- providing physical therapy for wounded veterans,
- providing court-ordered mental health and drug rehabilitation programs.

We might think of tertiary prevention as being the role of the medical field, but public health plays an integral role in ensuring health services are funded and delivered to those in need.

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2.3: The Core Roles of Public Health

In 1988 the Institute of Medicine defined the **3 core roles** of public health: assessment, policy development, and assurance (Centers for Disease Control and Prevention (CDC), 2014, p. 28).

- **Assessment** includes the surveillance of diseases, collecting data on community health and making this data available to the public and researchers.
- **Policy Development** includes using scientific evidence to support the creation of rules, regulations, and programs, as well as the budgeting of resources.
- **Assurance** means making sure that policies and programs are effective at improving health, and that community members get the help that they need.

According to the Centers for Disease Control and Prevention (CDC), these three roles align with the Public Health approach outlined in Fig. 2.3.1.

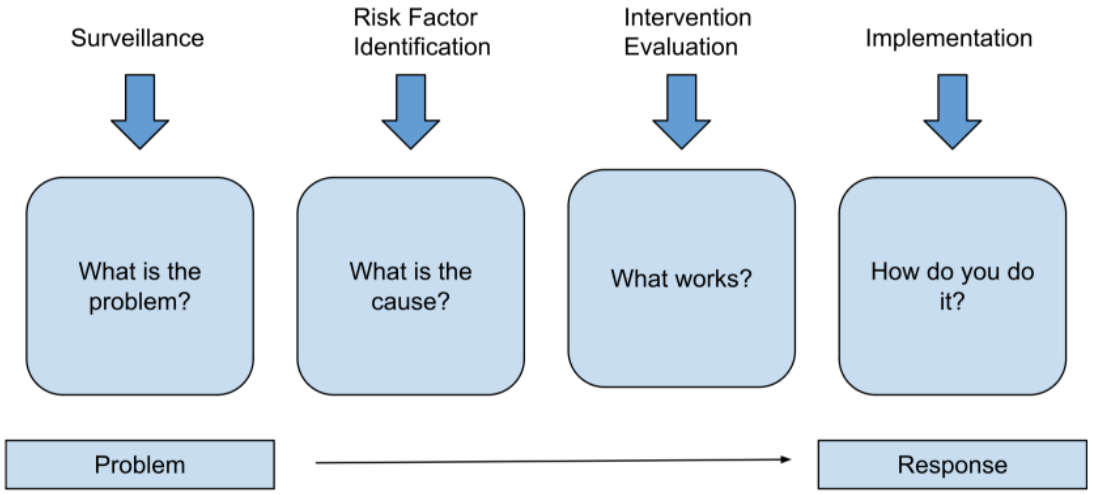


Figure 2.3.1:A Public Health Approach. Adapted from the *Centers for Disease Control and Prevention (CDC), 2014, p. 17*

Assessment strives to answer “what is the problem?” and “what is the cause?” Policy development identifies “what works?” and “how do you do it?” and then puts those plans into action. Assurance also answers the “what works?” question - perhaps even adding the qualifier of “what works *best?*” when multiple interventions exist.

The public health response to any problem may involve primary, secondary, and tertiary prevention. Let’s pretend we are a local public health agency. If a new infectious disease is discovered, we would first want to identify the cause (a virus, bacteria or other pathogen), and how it is transmitted - from animals to humans, from one person to another, or via the food and water supply, etc. Perhaps we discover the new disease is a foodborne illness, caused by a novel (new) bacteria. We may already have primary prevention in place with safe food handling regulations in food processing plants and restaurants. With secondary prevention, we would want to identify if there was a single or multiple sources of this infectious disease; such as a particular contaminated vegetable that was purchased by several restaurants, and then subsequently consumed by those affected. We would want to ensure there were ways to prevent the spread of the infection - perhaps with quarantine measures for people already infected, or recalling contaminated foods. For tertiary prevention, we would want to make sure that those who were already infected got treatment that was proven to be effective, or evidence-based - sometimes this is much easier said than done for a disease we know little about. But our work isn’t done at this point - we would also want to ensure that measures were in place to prevent an outbreak like this from happening in the future, such as scheduling regular testing of food sources for this novel pathogen or developing better food-safety regulations. This hypothetical situation demonstrates that the roles of public health are dynamic and involve many different public and private sectors.

As shown in the figure provided by the CDC below, these 3 core roles can be further broken down into 10 essential public health services. See Fig. \(\PageIndex{2}\.

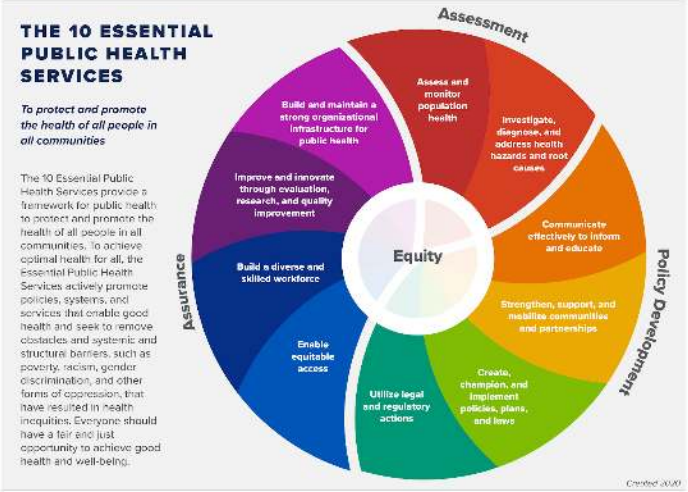


Figure 2.3.2: Ten Essential Public Health Services. (Nroserich, CC BY-SA 4.0, via Wikimedia Commons)

Assessment includes:

- Monitoring the health of communities to understand what health problems are the most important and who is most vulnerable. This monitoring is also referred to as surveillance.
- Diagnosing and investigating new health problems or potential hazards in the environment. For example, doctors may come across novel symptoms in a new patient or several patients and provide case reports to public health officials.

Policy Development includes:

- Informing, educating, and empowering communities and individuals about their own health. This can be done through health education in schools and community centers, and public health messaging via websites, advertising, news media, etc.
- Mobilizing community partnership to involve businesses, and non-profit organizations to address specific health issues and help solve them in a way that is meaningful to that community. There may be issues that are really important to a community, and many people who live and work there are willing to get involved.
- Developing policies that support health efforts in communities. These policies can be local, state or national level, or even global efforts.

Assurance includes:

- Enforcing laws and regulations that prevent ill health and promote safety. These could have to do with regulating food processing and handling, automobile production standards, or TB testing and vaccination requirements in school settings.
- Linking to and/or providing care to increase awareness and access to healthcare. For example: *Promotores de Salud* in Los Angeles County connect Spanish-speakers with mental health resources in communities where seeking mental healthcare is often stigmatized.
- Assuring a competent workforce through creating standards for public health professionals, and providing education and professional development.
- Evaluating policies, programs, and healthcare services for their efficacy and feasibility.

The 10th and final service supports all of these roles is **research.** Adequately funding and conducting high-quality research helps public health assess current health issues, develop strong effective policies and programs, and ensure that these policies and programs are doing what they are intended to do. Although all of the essential public health services are conducted by government agencies, nonprofit organizations and private companies also contribute to these functions.

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2.4: What Does “Evidence-Based Practice” Mean?

We often use this term “evidence-based practice” in public health when it comes to policies, programs, or healthcare services. A lot of people have what seem to be great ideas on how to solve health problems, but as the saying goes “ideas are a dime a dozen”. How do we know if this idea will really work? And especially when it comes to funding with government grants - which are taxpayer dollars - we need to make sure that we’re not just throwing money at random ideas and hoping they are effective.

Evidence-based practice means “systematically finding, appraising, and using evidence as the basis for decision making” (Seabert et al., 2021, p. 115). This means that before we create programs or propose policies, we should gather as much evidence on the problem and potential solutions as possible, assess the applicability of available evidence to the current problem, and then use this knowledge to help guide decisions on whether or how to move forward. There may have been programs or policies similar to our ideas that have already been tried in the target population, or in other communities. What if there is evidence that this particular solution doesn’t work well? We certainly wouldn’t want to propose a program or policy that had already been proven to be ineffective. Or perhaps there is evidence that certain implementation methods were more effective than others. We would want to use that insight to make our interventions or policies more likely to work.



Figure 2.4.1: (Photo by CDC on Unsplash)

Two types of evidence can be used in this process: **objective** and **subjective**. Objective evidence comes in the form of scientific studies and data collection, whereas subjective evidence may be in the form of expert advice or personal experiences and observations from community stakeholders. Typically objective evidence includes things that can be measured or observed, and is often expressed in numbers or percentages. Subjective evidence includes personal accounts, individual experiences and stories - this type of evidence is often based on the perceptions of the person observing something or being interviewed. In practice, objective evidence is often valued more highly than subjective evidence, in large part because well-done research uses several methods to reduce bias and misinterpretation. Objective data also tends to be more reliable than individual experiences or opinions. For example, a community member might perceive that homelessness is not a problem for their city, because they used to see many tents and makeshift shelters on sidewalks in their neighborhood, and recently the sidewalks have been clear. But the objective data may show a more complex picture: perhaps the individuals who had been living in those makeshift shelters had been forced to relocate, but were still unhoused.

Care should also be taken in interpreting research and applying objective evidence to different situations. Just because a particular program worked for one community doesn’t mean it will work in another. Subjective evidence from stakeholders in the community, or professional experience from public health workers, should still be valued. For example, a community health worker may know from their work that many of the unhoused are not living on the street - they are living in their cars or “couch-surfing”, and therefore they might not be aware of or have access to social services. Scientific studies may leave out certain populations, or we

may not yet have scientific research available for a specific health problem. Therefore, it's important to consider all sources of evidence when using an evidence-based approach to public health.

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2.5: Evidence Will Evolve

As we try to solve health problems with evidence-based practice, we must also consider the time it may take to establish evidence through research, and the risks involved with waiting for an abundance of evidence to be established before we take action. Certainly our understanding of the determinants of health is far better now than it was in the last century. Advances in technology and research methods continue to elucidate the drivers of health outcomes. As Sir Austin Bradford Hill (one of the researchers who first established the link between cigarette smoking and lung cancer) stated:

All scientific work is incomplete - whether it be observational or experimental. All scientific work is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to demand at a given time. (Hill, 1965, p. 300)

Pivotal research like the *British Doctors Study* conducted by Hill and Doll provided the foundation for the surgeon general's warning about cigarette smoking causing lung disease. Since then, decades of research has supported this causal relationship, and been the practical basis for cigarette advertising bans, lawsuits against tobacco companies, warning labels on cigarettes, smoke-free policies in public spaces, and public health messaging campaigns to reduce smoking. While efforts to reduce smoking have been successful over the decades, newer, similar threats have emerged - in the form of e-cigarettes and nicotine vape products. While smoking rates have declined from 20.9% of adults in 2005, to 11.5% in 2021 (CDC, 2023), e-cigarette sales have skyrocketed - increasing by over 46% between 2020 to 2023 (CDC, 2024).

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2.6: Summary

Summary

Public health philosophy is firmly rooted in prevention as the best “cure” for the causes of disease and death. There are 3 roles of public health: assessment, policy development, and assurance, which further include 10 essential functions carried out by government, private, and nonprofit entities. In all of its functions, public health efforts should use evidence-based practice to ensure that these actions are effectively improving community health outcomes.

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CHAPTER OVERVIEW

3: History and Accomplishments of Public Health

Learning Objectives

- Describe the historical achievements in public health and their impact today.

3.1: Introduction
3.2: Early Community Health Measures
3.3: Medieval Public Health
3.3.1: The Black Death
3.4: The Scientific Renaissance and Colonization
3.5: Industrial Revolution
3.5.1: Germ Theory
3.6: The Modern Era of Public Health
3.7: The 20th Century and Beyond
3.7.1: The “Spanish” Flu
3.7.2: Antibiotics
3.7.3: Vaccines
3.7.4: Labor Movements and Working Conditions in the United States
3.7.5: Tuskegee Syphilis Study
3.7.6: The Indian Health Services (IHS)
3.7.7: British Doctor’s Study/Smoking
3.7.8: Nutrition and Food Safety in The United States
3.7.9: Margaret Sanger, Title X, Abortion, and Birth Control
3.7.10: Health Administration in America
3.7.11: Medicare
3.7.12: Medicaid
3.7.13: The Affordable Care Act
3.7.14: HIV/AIDS Epidemic
3.8: The Healthy People Initiative- 1990-2030
3.9: Summary
3.10: References

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3.1: Introduction

Public health has a long history alongside science and medicine. The philosophy that we can not only treat and cure but prevent many diseases and deaths as a society, and that we owe it to each other to do so - continues to fuel the evolution of public health. This chapter is a very brief history of public health, and attempts to highlight the pivotal advances made within the discipline. At the same time, we should recognize that the Western history of public health tends to center European, cis-gender, (gender expression the same as sex assigned at birth) male historical figures. This historical account will not adequately cover the contributions of other societies and individuals, such as those of Eastern, African and American Indigenous societies. Once we get to the 21st century and beyond, this chapter will specifically focus on the history of public health in the United States. Thus, further study of other histories is recommended.

Although there are many advances in medicine and public health which have helped populations and saved countless lives, public health also has a history of harming specific individuals and communities, and at times exacerbating health disparities based on race, ethnicity, gender, and wealth. Some examples of this are included in this chapter. Yet, across the centuries, many individuals and organizations have also defied systemic injustice and advocated for health equity and human rights as the core purpose of public health.

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3.2: Early Community Health Measures

There is evidence of early societies taking steps to reduce and treat illnesses, particularly as hunter-gatherers evolved into agricultural communities. Writings from ancient China, India, and Egypt record medical practices and documentation of diseases, laws and building codes, and agricultural practices used to prevent infectious disease spread. Many health-related laws were tied to religious beliefs, as evidenced in the Hebrew Mosaic Law which listed rules for personal and community hygiene, food preparation, waste disposal, and isolation of the sick. The Greeks are credited with originating medical philosophy and ethics, and although religion was still closely tied to medicine, there began to be a recognition of environmental factors as causes for disease. These philosophies were continued by the Romans, who developed aqueducts to deliver fresh water to cities and sewage systems to carry waste away. Many of the public health traditions like urban planning and organized medical care can be traced back to the Romans (Tulchinsky & Varavikova, 2014, pp. 1–4). In all of these ancient societies, there were stark differences in health, and both length and quality of life depending on ethnicity, wealth, class, enslaved status, and gender.



Figure 3.2.1:Nicopolis Roman Aqueduct in Greece. (Jennikann, CC BY-SA 4.0, via Wikimedia Commons)

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3.3: Medieval Public Health

In early medieval times (5th to 10th centuries), medicine was often practiced by monks, and hospitals run by monasteries. The concept of charitably caring for the injured, sick, and dying, was closely tied to the responsibility of the church - however the wealthy still employed private doctors. At the same time, Arabic countries had government-run hospitals. The most common causes of death was infectious diseases, which killed 75% of children before age 5 (Tulchinsky & Varavikova, 2014).

After the Crusades, leprosy spread across Europe and the Middle East, peaking during the 13th and 14th centuries. Nowadays, we know that leprosy is a bacterial disease, the cause of which was first discovered in the 1800s by a Norwegian doctor named Gerhard Armauer Hansen, (which is why it is also referred to as Hansen's disease). Currently, leprosy is rare and treatable, and has a low risk of spreading between people (typically only with long-term contact and a depressed immune system). However, in the middle ages, little was known about the disease, and there was no cure. Despite a lack of knowledge about the disease, isolation of sick people was still considered the best practice in order to contain it - a tactic that is used to this day with communicable diseases (can be transmitted between humans). Unfortunately, this practice also led to a fear of people with leprosy, who were ostracized from the general society and were often only cared for by the few clergy who considered it their moral responsibility (*The History of Leprosy*, n.d.), (Contributors to Wikimedia projects, *Leper Colony*, 2023a).

As feudalism declined in the late medieval period (up to the 15th century) and people moved from rural farmlands to towns and cities, this created new issues of sanitation and crowding. Even as progress was made in medical education (universities were established across Europe and the printing press increased educational opportunities,) these towns and cities were beset with plagues of communicable diseases. Cholera, measles, and smallpox epidemics were exacerbated by poverty and unsanitary living conditions. Plagues, wars, and famines decimated the populations of the European and Asian continents. The causes of these plagues were largely unknown, and the "miasma theory" (handed down from ancient Greek doctors) was still the most accepted explanation. Miasma theory suggested that diseases were caused by "bad airs" - which were associated in different time periods with rotten food waste, wetlands, fog, or infected individuals (not necessarily from respiratory transmission) (Contributors to Wikimedia projects, *Miasma Theory* 2023e). Although the discovery of pathogens and wide acceptance of germ theory would not take place until the mid 19th century, *some* of the public health measures suggested by miasma theory were still effective. This is a great example of how societies can still take actions to prevent disease even if the disease is novel or little is known about it. Let's take a closer look at one of the most famous plagues and the evolution of public health responses to it.

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3.3.1: The Black Death

A bacterial infection caused the infamous pandemics known as the bubonic and pneumonic plagues throughout Europe, Asia, Russia, India, and the Middle East from the 14th to 20th centuries. The bacteria that caused the bubonic version first infected fleas, which were carried on rats (this type of transmission is called vector-borne transmission - the flea is the vector, the rats are the reservoir). Victims developed “buboes” or swelling of the lymph nodes, as the bacteria tended to proliferate there. Another type of bubonic plague caused gangrene of the extremities. The pneumonic version infected the respiratory tract and was spread between humans via breathing, coughing, or sneezing. All types of this disease were initiated with a fever and flu-like symptoms, then rapidly progressed over the course of a few to several days. Before antibiotics were made available in the early 20th century, this disease was quite deadly - killing an estimated 25-50 million people in Europe and half of the population of China between the 12th and 15th centuries (Tulchinsky & Varavikova, 2014, Glatter & Finkelman, 2021).

Responses to the black plague were characterized by fear and superstition. Cats were suspected of carrying the disease, which led to their extermination. Oddly enough, the cat population could have helped cull the rats that actually carried the infected fleas (Tulchinsky & Varavikova, 2014). Nowadays we know that cats are also susceptible to the plague as well, from eating infected rats or being bitten by fleas (CDC, 2022). Another, potentially more effective strategy involved quarantining ships for 30-40 days in port before allowing any goods or people to disembark. (The word “quarantine” actually derives from this practice - in Italian, *quarantina = 40 days*.) Additionally, social distancing measures were attempted by some governments with the ban on religious functions or funerals, but these measures were often resisted heavily by the public (Tulchinsky & Varavikova, 2014).

Jewish communities seemed to have lower rates of infection from the bubonic plague, the recognition of which stoked anti-semitism among the Christian Europeans. Jews were blamed for spreading the plague, persecuted, and massacred throughout Europe as a result of this superstition. Although Hebraic hygiene practices could have played a role in reducing the spread of plague in these communities, it was later discovered that a genetic mutation caused by a rare disease (familial Mediterranean fever), provides immunity to the plague bacteria. This genetic mutation is found most often in people of Israeli, Armenian, Arab, and Turkish descent (Glatter & Finkelman, 2021).

Although we may think of the plague as a long-past historical disease, it is still endemic (recurring seasonally) in several parts of the world. It can be treated if caught early with antibiotics, and those exposed can also use antibiotics as a prophylactic (preventative) measure. However, there is still some concern about the pneumonic plague being used for bioterrorism, as it causes such swift illness and death, and can be transmitted easily between humans (Ansari et al., 2020).



Figure 3.3.1.1: The plague of Florence in 1348, as described in Boccaccio's Decameron. Etching by L. Sabatelli after himself.. (Copyright; CC-BY-4.0 , via Wikimedia Commons)

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3.4: The Scientific Renaissance and Colonization

Along with the age of enlightenment came the scientific renaissance in Europe, including the invention of the microscope, and the expansion of knowledge of human anatomy. Increasingly doctors were more educated even though they often had conflicting theories of disease and treatment practices. The agricultural revolution brought more people into the cities, requiring innovations in plumbing and sanitation. At the same time, colonization efforts required long journeys overseas, which carried unfamiliar diseases to new continents.

In the late 16th century, parishes (villages or neighborhoods with their own church) began keeping records of births and deaths, which in England eventually became the *Bills of Mortality.* In 1629, this weekly publication and annual abstract began to include causes of death, which opened up the possibility of studying the most common causes of death from a population perspective. In 1662, John Graunt published the first such analysis, demonstrating that statistics of death rates for different diseases could be connected to living conditions - higher death rates from infectious disease were to be found in the poorest slums. Current epidemiological techniques still employ vital statistics (like the *Bills of Mortality*), to research things like average lifespan and common causes of death, and track them over time.

From the 15th through 18th centuries, several European countries were heavily involved in expanding their empires and economies through conquest in the Americas, Asia, Africa and the South Pacific. This was followed by the colonization of these lands, and the enslavement of Africans and the indigenous peoples. Long voyages by ship, often with scarce or spoiled food, also introduced a new disease: scurvy. Scurvy was so common on seafaring expeditions that it wasn't unusual for ships to return from long voyages with less than half their crew alive. In what is considered the first experimental human study in 1747, James Lind, a doctor in the British Royal Navy, tested a hypothesis that scurvy was caused by a dietary deficiency. Lind isolated 12 sailors who had the condition and fed them different diets. The two sailors who consumed citrus recovered so quickly that Lind had to conclude that citrus fruits contained some sort of cure. The Royal Navy eventually provided a lemon or lime juice supplement to all sailors and eliminated scurvy from their fleet. Even though the reason for this cure wasn't fully understood (vitamins wouldn't be discovered for another 150 years), Lind's experiment was exemplary of the development of a clinical research process.



Figure 3.4.1:James Lind, conqueror of scurvy. Image by Robert Alan - Parke, Davis & Company. (Copyright; CC BY-SA 4.0, via Wikimedia Commons)

The devastating effects of these colonizing voyages to Native American and African peoples cannot be overstated. Even after experiencing violent conquest, famine and displacement, many tribes were devastated once again by communicable diseases brought over by European armies and settlers. While Europeans whose ancestors (or they themselves) had survived epidemics of smallpox, cholera, and measles had already developed some immunity, indigenous peoples had never been exposed to these infectious diseases. It is estimated that epidemics of these infectious diseases killed 90-95% of the Native American population. Smallpox devastated South African, New Zealand, and Australian communities as well, such that these original peoples could do little to resist their conquest by Europeans (*Guns Germs & Steel: Variables. Smallpox*, 2005). Some of these disease were transmitted by vulnerable African slaves in the transatlantic slave trade, which had already devastated Africa's economic and agricultural opportunities and perpetuated atrocities of physical and mental violence to enslaved individuals. Around 15-25% of enslaved Africans bound for the Americas perished aboard the ships due to both epidemics and violence from their captors (*Transatlantic Slave Trade*, n.d.).

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3.5: Industrial Revolution

While smallpox continued to devastate indigenous and enslaved populations, one of the reasons many Europeans had immunity to it by this time, was due to a popular medical practice called *variolation*. This process involved gathering fluid from smallpox pustules of a currently infected person and inoculating the next person by rubbing the material into small scratches in the skin. The purpose was to cause a milder form of the disease in the recipient which would be far less deadly. Although the workings of the human immune system were not yet understood, the process worked for the most part, although it was still risky (Contributors to Wikimedia projects, *Variolation*, 2023d). In 1796, an English doctor named Edward Jenner discovered that cowpox infections could provide immunity against smallpox as well. This discovery led to the development of the first vaccine - which was eventually provided freely by the English government and adopted across Europe (Contributors to Wikimedia projects,*Edward Jenner*, 2023g). Due to worldwide vaccination efforts over the next two centuries, the World Health Organization declared smallpox completely eradicated in 1980 (Tulchinsky & Varavikova, 2014, p. 11). The eradication of smallpox is considered one of the greatest achievements of global public health efforts.

Along with the aforementioned effects of colonization, enslavement, and westward expansion on the spread of disease, now the consequences of the industrial revolution further exacerbated disease transmission and created new health concerns. Factory jobs often utilized dangerous machinery and had little oversight to occupational safety. These same jobs brought more people into cities with crowded living quarters. In the 1830's, Edwin Chadwick, a British Lawyer, gathered data and demonstrated the correlation between poverty, poor living conditions, and disease. He also advocated for better sanitation to prevent the spread of infectious diseases. Chadwick and others began what historians refer to as the sanitary movement - public and private efforts to improve health by improving living conditions related to clean water, plumbing, and waste removal. This prompted cities to rebuild whole neighborhoods throughout Europe and North America (*HIST 234 - Lecture 11 - The Sanitary Movement and the "Filth Theory of Disease,"* n.d.).

These social determinants of health like poverty, environment, and education, have been recognized for centuries, and those who advocated for the remedies to health disparities were often considered politically radical. In 1848 there was a Typhus outbreak in a rural area among an ethnic Polish community. A young and politically active doctor, Rudolph Virchow, was tasked by the Prussian government with determining the cause of this outbreak. Although Virchow was notably obsessed with cellular pathology in his other work, he identified social, environmental and political factors as the causes of disease in his report on the Typhus outbreak. "Medicine is a social science, and politics nothing but medicine on a grand scale," noted Virchow (Taylor & Rieger, 1985, p. 548). In his report, he advocated that diseases could be reduced with adequate employment and income, sufficient housing and sanitation, and proper nutrition. Although he disagreed with Louis Pastuer's germ theory that bacteria were the cause of infectious diseases like typhus, we now recognize that both social-economic determinants and infectious pathogens are causal factors in outbreaks of communicable diseases. Virchow is perhaps most well-known for proposing the philosophy of health as a human right - a concept that can still seem revolutionary. A century later, it was one of the founding principles of the constitution of the World Health Organization (WHO): "The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition." (World Health Organization, n.d.-a).

In the early 1800s a cholera epidemic broke out in India and was soon transported to Europe and North America. In London, a young doctor by the name of John Snow began one of the first epidemiological surveillance projects in 1854. Through door-to-door interviews, Snow determined that the rates of cholera were higher in specific neighborhoods. He found that the homes with higher infection rates had been provided with water by one of the water supply companies, which had an intake valve in a particularly polluted section of the Thames river. Without understanding the microorganism that causes cholera (this would not be discovered for another 20 years), he gathered sufficient evidence to convince authorities to remove the handle of the Broad Street water pump. This effectively decreased the cholera cases in those homes, demonstrating that public health actions to benefit the community could be taken even without a complete causal explanation of the disease. Snow's actions also assisted in the discovery of waterborne pathogens, reinforced the sanitation movement, and prompted filtration requirements for public water. A replica of the Broad Street pump stands to this day as a memorial of this feat of public health (Seabert et al., 2021, Tulchinsky & Varavikova, 2014).



Figure 3.5.1: Broad Street Pump. (Copyright; Jamzze, CC BY-SA 4.0, via Wikimedia Commons.)

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3.5.1: Germ Theory

Although microorganisms had been proposed as a potential cause of disease since the 1500s, it wasn't until better microscopes were developed in the early 19th century that germ theory became a strong rival and eventually replaced the prevailing miasma theory of disease. The work of two rival microbiologists finally solidified germ theory: Louis Pasteur's experiments in France and Robert Koch's in Germany. Pasteur discovered microorganisms which were affecting the silk industry, then in wine, beer, and milk. He also came up with the concept of killing or deactivating these microorganisms by heating the liquid; a technique which is named after him - called pasteurization. Pasteur was involved in studying anthrax (a bacteria) and creating vaccines for both animals and humans for a variety of infectious diseases. One of his greatest achievements was developing a vaccine for rabies, which at that time was a death sentence. Koch also researched anthrax and developed a vaccine for it, discovered the microorganisms responsible for tuberculosis and cholera, and created guidelines for establishing a specific pathogen as a causative agent of a disease - called "Koch's postulates" (Tulchinsky & Varavikova, 2014).

Perhaps one of his greatest feats, Robert Koch discovered the bacteria that causes Tuberculosis (TB), which at the time killed 1 in 7 people in the U.S. and Europe. "Consumption" as it was often called, was a deadly infectious disease that could be spread between people via breathing and coughing, and for which the only known treatment was "warmth, rest, and good food". In the 19th century, sanatoriums were established to isolate infected individuals, and prevent the disease from spreading to family members. The first attempt to combat TB was with a vaccine: the Bacille Calmette-Guérin (BCG) vaccine was developed in 1923, yet it was not entirely effective at preventing TB infections. Finally, several antibiotics were discovered in the 1950's and 60's that became an effective treatment cocktail. Tuberculosis cases in the U.S. decreased substantially over the 21st century, but even though it may seem like an "old timey" disease it has not been eliminated yet. Standardized testing, tracking, and treatment of TB cases are the current protocol until a more effective vaccine is developed (CDCTB, 2023b). Worldwide, TB is still the second leading cause of death from an infectious disease, and is the leading cause of death for people with HIV/AIDS. It can also become resistant to the 2 most effective drugs, particularly if they are improperly prescribed or the patient quits taking them too early. Newer treatments and expanded access to testing and treatments are part of the WHO priorities to work toward eliminating TB (World Health Organization, 2023).

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3.6: The Modern Era of Public Health

Many advances were made in the mid-19th century in hospital care and record-keeping. For example, a Hungarian obstetrician performed one of the earliest case-control studies and identified that women who were attended by physicians during labor and delivery had a higher odds of contracting “childbed fever” (a streptococcal infection) than those attended by midwives. This was due to the fact that physicians also conducted autopsies on victims of this disease and were in fact spreading the infection due to a lack of handwashing and sterilizing practices. Another example was Florence Nightingale’s work tending to injured soldiers during the Crimean War, from which she and others developed standards for hospital care. She later began the first nursing school, and established that profession as essential to medicine (Tulchinsky & Varavikova, 2014). Mary Seacole, born to a British soldier and Jamaican “doctress” mother, treated hundreds of British soldiers during the cholera pandemic and Crimean War in the 19th century. Her legacy has been largely overshadowed by Nightingale's in the history of nursing (Contributors to Wikimedia projects, 2024).

Treatment of sick and wounded soldiers was one of the priorities of the first of the Geneva Conventions in 1864, an international treaty which also established the International Committee of the Red Cross (ICRC). This neutral entity was created to provide international medical services to wounded soldiers and prisoners of war, and advocate to prevent humanitarian atrocities for both soldiers and civilians in areas of conflict. American nurse Clara Barton provided relief to soldiers injured during the Civil War, and then volunteered with the ICRC during the Franco-Prussian war. Upon her return to the U.S. she founded the American Red Cross in 1881 (*Clara Barton*, n.d.). During WWII the ICRC was hamstrung by its ties to the neutral Swiss government and failed to provide cohesive action on behalf of Jews during the Holocaust. In 1949, it urged the addition of a fourth protected group to the Geneva Conventions: civilians living in occupied territories. Currently, the ICRC includes the National Red Cross and Red Crescent movements of 192 nations, forming the International Federation of Red Cross and Red Crescent Societies (IFRC). These international and national organizations combined provide emergency response to wounded soldiers, prisoners of war, and victims of disasters, and distribute humanitarian aid across the globe. The symbols used include a red cross, crescent, or crystal on a white background to indicate protection of international law for those providing humanitarian aid (not any religious affiliation) (International Committee of the Red Cross, 2017).



Figure 3.6.1: Clara Barton. (Copyright; NPGallery, Public domain, via Wikimedia Commons)

In 1872 the American Public Health Association (APHA) was established. This association has and continues to: lobby the U.S. government for public health policies, publish well-conducted research in the American Journal of Public Health, and provide education (as well as set standards) for public health professionals. While advocating for federal public health responsibilities, the APHA has long supported state, county, and local control of public health, while still supporting federal assistance. The mission of the APHA is to “improve the health of the public and achieve equity in health status” (American Public Health Association, 2023).

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3.7: The 20th Century and Beyond

Public health continued to take major steps in the 20th century, much of which was spurred on by the previous century's advances in medicine, responses to wars and military medicine, and subsequent changes in the most common causes of disease and death. As infectious diseases were the primary focus of most public health efforts in the early 1900s, this evolved to necessarily address chronic health conditions, behavioral health, environmental health, and social determinants of health by the 2000s. Although worldwide public health efforts were equally as complicated and important, this section of the chapter will shift to focus on the history of public health in the United States, highlighting several key advances, catastrophes, and controversies that have shaped public perceptions and discourse of public health in the current century.

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3.7.1: The “Spanish” Flu

The incorrectly named Spanish Flu is believed to have originated in the United States in 1918. The influenza virus is endemic to the world, and each year there are different mutations in the virus from the previous year - this mutation is called “antigenic shift”. Enough of the right mutations can cause a virus that can overwhelm the immune system, making that virus particularly contagious and/or deadly. In the case of the Spanish Flu, infection was so quick that a person could die within hours or days, and unlike other flu strains, healthy adults were hit the hardest. Soldiers sent to fight in WWI were likely to have brought the Spanish Flu to Europe, and the warring countries suppressed information about how many soldiers were ill or dying from it - with the exception of Spain. This propagated the moniker of Spanish Flu, even though the virus originated in the U.S. and spread around the world (Francis Fujimura, 2003).

In the first year the Spanish Flu killed more Americans than both World Wars, the Korean War and the Vietnam War combined. The subsequent death toll is somewhere around 50 million people worldwide (Francis Fujimura, 2003), (The U.S. National Archives and Records Administration, n.d.). Eventually it subsided as most of those remaining had developed immunity from previous infection, as researchers could not work fast enough to develop a vaccine. In 1933 a vaccine was developed for the Spanish Flu, but it was soon discovered that it did not protect against multiple variants that had subsequently evolved. Since then, extensive public health surveillance (tracking and monitoring) of influenza has contributed to the modern techniques used to create modern flu vaccines. These annual vaccines target the predicted influenza variants of the coming flu season (World Health Organization, 2022).



Figure 3.7.1.1:Emergency hospital during influenza epidemic, Camp Funston, Kansas. Otis Historical Archives, National Museum of Health and Medicine. (Copyright; Public domain, via Wikimedia Commons)

Emergency hospital during influenza epidemic, Camp Funston, Kansas. Otis Historical Archives, National Museum of Health and Medicine, Public domain, via Wikimedia Commons

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3.7.2: Antibiotics

Microorganisms that have antimicrobial powers have been used since ancient times, everywhere from Greece to China. However, antibiotics were not officially “discovered” until the early 20th century. Paul Ehrlich, a German doctor, is credited with first discovering an antibiotic to treat syphilis, and Andrew Fleming stumbled upon penicillin while haphazardly allowing mold to grow in his staphylococcus research. In the late 1930s, Selman Waksman studied microbes as the producers or antimicrobial agents, which led to the development of two treatment methods for tuberculosis which ushered in the “Golden Age” of antibiotic discovery. During the 1940s, 50s, and 60s, antibiotics were discovered and developed for many different bacterial infections, from a variety of natural products as well as synthetic sources. However, the overuse of antibiotics and mutations of pathogens has led to multi-drug resistant diseases, which are a high-priority focus for researchers today (Hutchings et al., 2019, Microbiology Society, n.d.).

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3.7.3: Vaccines

In the first half of the 20th century, children were commonly stricken with poliomyelitis (commonly referred to as “polio”), a potentially deadly virus that could spread between people and was endemic - tending to break out each summer. Polio could cause paralysis of the limbs or even the diaphragm, leading to death or a lifelong sentence to an iron lung - a large iron chamber which causes air pressure changes, allowing those with a paralyzed diaphragm to breathe. Building on the work of Elise Ward, a zoologist who was able to grow the poliovirus in cell cultures, and Dr. Isabel Morgan, who successfully created the first killed-virus vaccine for polio (previous vaccines simply used a weakened version), Dr. Jonas Salk was able to create and test a vaccine which had 80-90% efficacy at preventing infection. Later, Dr. Albert Sabin created an oral version with attenuated (weakened) virus, which was even more effective and easier to administer. During the 1950s, these vaccines were widely circulated, such that 1979 saw the last case of polio in the U.S. However, the initial vaccine production had serious problems. Salk’s vaccines produced by a specific pharmaceutical company were found to have live virus in them instead of properly killed virus. A female virologist, Bernice Eddy, sounded the alarm but was ignored, and subsequently several hundred children were infected, paralyzed, or killed by the vaccine itself. This obviously produced distrust in the vaccine, which was supplanted by Sabin’s oral vaccine. Subsequently, infection with wild polio has been eradicated in all but a few countries where vaccine uptake has had challenges; largely due to misinformation regarding vaccines and resistance from the dominant political party (Martin, 2020, Contributors to Wikimedia projects, *Polio vaccine*, 2023f). See Figure 3.7.3.1 below. In very rare cases, Sabin’s vaccine also caused paralysis from the weakened virus itself reproducing in the intestines. The U.S. ceased its use in the year 2000, and have only used the inactivated version since. However, in some parts of the world the weakened vaccine is still used, and sometimes the vaccine-derived virus can be passed to unvaccinated people as well (Offit, 2023). Even with huge public health successes like the polio vaccines, caution and continued vigilance for viral mutation is warranted.

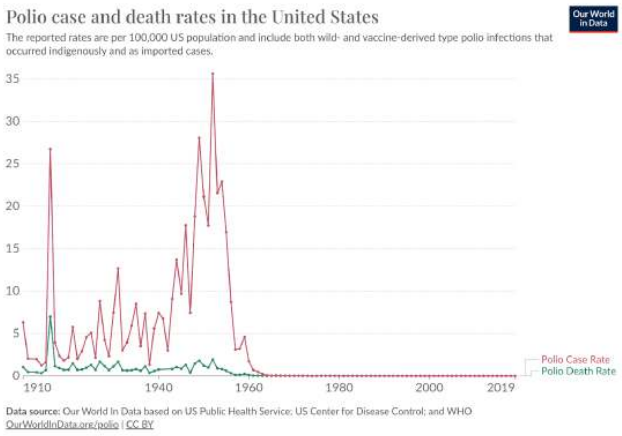


Figure 3.7.3.1: Polio Case and Death Rates in the U.S. 1900-2019. Data source: Our World In Data based on US Public Health Service; US Center for Disease Control; and WHO. (Copyright; CC-BY OurWorldInData.org/polio)

Many of our modern vaccines were first developed in the 1950s and 60s, and can be traced back to the researcher Dr. Maurice Hilleman. During his doctoral studies at the University of Chicago, he was the first to demonstrate that chlamydia was a bacterial and not viral infection (which meant it could be treated with antibiotics). Hilleman went on to develop vaccines for influenza, hepatitis b, pneumococcus, meningococcus, chicken pox, measles, mumps, and rubella, and also pioneered the combined measles, mumps, and rubella (MMR) vaccine. The mumps vaccine was actually developed from a strain of the mumps he gathered from his daughter, who at the time seemed to be coming down with the infection. This strain of the mumps is still used to create vaccines to this day. Although Dr. Hilleman was not one to revel in the spotlight, it is estimated that his work has prevented the deaths of more than 8 million people each year (The Children’s Hospital of Philadelphia, 2023).

Since the days of Jenner’s cowpox experiments, vaccine research has been one of the priorities of public health. This is because vaccines can often prevent severe diseases, infection, or even potentially eliminate a pathogen from circulating in humans. New technologies include using parts of a pathogen rather than the whole pathogen and/or using DNA or mRNA (messenger RNA) to elicit the immune system response, as was used in several of the COVID-19 vaccines (The College of Physicians of Philadelphia, 2023).

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3.7.4: Labor Movements and Working Conditions in the United States

Occupational health hazards have been recognized for centuries - particularly in high-risk jobs such as mining. During the industrial revolution(s) spanning the 19th and 20th centuries, the use of large machinery increased health risks to workers, who were often immigrants, women, and children. In the middle 19th century, the first U.S. child labor laws were passed, protecting children under 10 years of age from being hired and exploited. In 1908 the first worker's compensation laws were passed for federal government employees, followed over the next several decades by state laws for private employees (Seabert et al., 2021). Yet many workers still faced hazardous and deadly conditions for decades before government oversight was created.

A tragic example of the exploitation of workers and lack of care for their safety was the Triangle Shirtwaist Factory fire in 1911. The factory employed mostly immigrant Jewish and Italian girls and young women to sew shirtwaists and the owners kept the exit doors of each floor locked to prevent unauthorized breaks and theft. The employees worked 9 hour shifts on weekdays and 7 hour shifts on Saturdays, earning less than minimum wage. When a fire broke out on a Saturday afternoon, the owners of the company and some employees were able to escape, but others were trapped in the burning building due to the locked exits and shoddy fire escapes. Many jumped or fell to their death, and the rest succumbed to the smoke and flames; all in all 146 employees perished. This horrific event did spur investigations into garment factory safety, as well as increased support for union membership and workers rights legislation (Contributors to Wikimedia projects, *Triangle Shirtwaist Factory fire*, 2023h).

Alice Hamilton was a pioneer of industrial health research and eventually became the first female faculty member at Harvard Medical school during the turn of the century. After studying medicine in Europe, she moved back to Chicago and began living at Hull-House - a social settlement founded by Jane Addams. Hull-House was the first of several social houses which were created in immigrant neighborhoods. These homes became community centers for education, childcare, and organizing for civil and workers rights - particularly women's suffrage, children's labor laws, immigrant protection, and juvenile justice reform (*About Jane Addams and Hull-House — Jane Addams Hull-House Museum*, n.d.). From her experience at Hull-House, Hamilton realized that very little attention was given to industrial medicine and workers' health. Prior to her faculty appointment at Harvard, she worked for the Occupational Diseases Commission of Illinois to investigate industrial health issues. Over 40 years she exposed occupational health hazards such as heavy-metal poisoning and other occupational illnesses (National Institutes of Health, n.d., Seabert et al., 2021).

While early labor movements had initiated and enhanced worker protections, it was still an uphill battle to achieve safe and healthy working conditions. The Department of Labor was created in 1913, and some concerns about a healthy workforce were amplified due to the necessity of having healthy soldiers in WWI. In the 1920's, much of the power shifted back to corporations - some health and safety measures put in place were really a protection for the corporations against lawsuits. To fight back, labor unions became more organized and sought the expertise of leading public health doctors of the time; including the aforementioned Alice Hamilton and another public health pioneer - C.E.A. Winslow. Winslow, a famous overachiever, also founded the Yale School of Public Health, was a writer, editor, and activist, and is credited with creating the modern definition of public health as presented in Chapter 1 (Rosner & Markowitz, 2020),(Kemper, 2015). Winslow viewed public health through a model of social activism and community service for the public good, which conflicted with the more capitalist philosophies found in medicine at the time (Kemper, 2015).

During the Great Depression (1929-1939), workers were often at the mercy of corporations if and when they could find jobs. Concurrently, corporations were often aided in covering up gross negligence to their worker's health and safety by local governments, physicians, and inspectors. A quintessential example of health and safety violations was the Hawk's Nest Tunnel disaster. The Union Carbide company and its contractors caused what is considered to be one of the largest industrial disasters when it hired 3,000 workers, the majority of whom were black and from the south, to divert a river for hydroelectric power supply. In digging the Hawk's Nest Tunnel, workers were exposed to silica dust without protective gear - sometimes for 10-15 hour shifts. Workers who later testified to Congress also indicated they were denied breaks and sometimes forced to work at gunpoint. Later, many developed the deadly lung disease silicosis, some perishing within a year of the tunnel's completion. Death estimates from silicosis ranged from 109 (the official report by the company) to potentially 700 or more (Contributors to Wikimedia projects, *Hawks Nest Tunnel disaster*, 2023i, Rosner & Markowitz, 2020).



Figure 3.7.4.1: Hawks Nest Tunnel Gravesite Marker. Jarek Tuszyński. (Copyright; CC BY 4.0 via Wikimedia Commons)

In the 1960s a large push for government oversight on occupational hazards, consumer protection, and environmental health led to several important pieces of legislation. In 1969 the Coal Mine Health and Safety Act was passed and was followed in 1970 by the Occupational Safety and Health Act - which established the Occupational Safety and Health Administration (OSHA), and the research arm of this organization: the National Institute for Occupational Safety and Health (NIOSH). The Environmental Protection Agency (EPA) was also established in 1970, and the Consumer Product Safety Act was passed just two years later. The public had been made more aware of the health hazards of things like asbestos, coal workers' pneumoconiosis, pesticides (thanks in part to migrant labor activists like Cesar Chavez) and lead poisoning - especially in children.

In the decades that followed, both OSHA and the EPA have been alternatively bolstered or attacked and undercut, depending on the political party in power. Conservative lobbies pursue the interests of large businesses and argue that too much regulation decreases profits and company growth. Unions, epidemiologists, and public health entities tend to advocate for more oversight due to the continued environmental hazards that workers and communities are exposed to in the name of corporate profits. To this day, there is an obvious tension between the interests of capital and those of workers, and the government entities tasked with ensuring public health (Rosner & Markowitz, 2020).

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3.7.5: Tuskegee Syphilis Study

Although many actions of U.S. government health agencies have attempted to improve health, some have in fact caused harm - particularly to vulnerable populations. In 1932, the United States Public Health Service (USPHS) began a 40-year study with the Tuskegee Institute - the first university for Black Americans which had been founded by Booker T. Washington in 1881. The original title of the study was “Tuskegee Study of Untreated Syphilis in the Negro Male” (renamed to: “USPHS Untreated Syphilis Study at Tuskegee”) and the purpose of the study was to investigate the progression of syphilis. Hundreds of African American men were recruited from rural Alabama for the study - nearly 400 with syphilis and a little more than half without - and were provided medical exams, food, and burial insurance. Eleven years later, penicillin became widely available and was quite an effective treatment for syphilis, yet it was not provided to the men in the study. Not only were the researchers not honest with the subjects on the purpose or details of the project when it began, they also withheld proven medicine when it became available, and allowed an infectious disease to spread to the subjects’ families.

It was not until journalist Jean Heller of the Associated Press broke the story in 1972 that a national outcry prompted a federal review of the study. An independent panel appointed by the Assistant Secretary for Health and Scientific Affairs concluded that the project had been unethical by not ensuring that the participants had given *informed consent.* (Informed consent refers to the full knowledge of the patient of the potential risks and benefits of a treatment, and their agreement to participate in that treatment with the understanding of these risks and benefits). Subjects of the Tuskegee study had agreed to the treatments at the beginning of the research, but were not made aware of risks of the treatments, the risks of transmitting syphilis to their families, nor were they given the choice to exit the study once penicillin became available. At a time when scientific racism was abundant, researchers took advantage of the poverty and lack of education in their study participants. The study was immediately halted (albeit 4 decades since it began) and a lawsuit awarded over $9 million to the victims and their families. Yet it wasn’t until 1996 that an official apology was made by President Clinton at the behest of the Tuskegee Syphilis Study Legacy Committee (*About the USPHS Syphilis Study*, n.d.), (*Tuskegee Study - Timeline - CDC*, 2023).



Figure 3.7.5.1: An African American male is tested and treated during the Tuskegee Study of Untreated Syphilis in the Negro Male. According to the Centers for Disease Control and Prevention, the study began in 1932 as U.S. Public Health Service medical personnel conducted these tests without the benefit of patients’ informed consent. (Courtesy photo from the Centers for Disease Control and Prevention/Released) Centers for Disease Control and Prevention. (Copyright; Public domain, via Wikimedia Commons)

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3.7.6: The Indian Health Services (IHS)

The United States has had a long history of mistreatment of its indigenous peoples. Early colonization efforts and the Westward Expansion movement caused the decimation of tribes, reappropriation of their lands, obliteration of food sources, and forced relocation of those that remained. Additionally, European settlers introduced infectious diseases and harmful substances like alcohol - to which many Native Americans have genetic predispositions to heavy dependence (Ehlers, 2013). Up until the early 20th century, the U.S. still had a warring relationship with different tribes. The Bureau of Indian Affairs, originally housed in the War Department, was moved to the Department of the Interior in 1849. It still wasn't until 1921 that the Snyder Act created an official public health agency specifically for American Indians and Alaska Natives, and later in 1954 when it was settled within the United States Public Health Service (now part of the U.S. Department of Health and Human Services).

Some of the actions of different health initiatives both before and after the Snyder Act were beneficial - such as providing smallpox vaccines. Yet many others were incredibly harmful, and further damaged the psychological and social health of tribes. Poverty, substance abuse, and lack of resources on reservations, and incidences of child abuse and neglect prompted health agencies to attempt to "assimilate" young Native Americans. One of the ways that this was accomplished was by taking children from their parents and tribes and placing them in boarding schools, where they were punished for speaking their native tongue or engaging in tribal practices. Even after these boarding schools were shut down in the 1960s, children were still often taken from their families (sometimes for purposes of child protection) and placed into foster care. In 1978 this practice was ended, yet the traumatic impact to individuals, families, and tribes persists.

The present iteration of the IHS allows for more local control of funds and services, and has helped to decrease disparities in health outcomes of Indigenous Peoples, yet several challenges still exist. The program still uses a discretionary funding model (in contrast to the entitlement model of Medicare and Medicaid) and skilled professionals are difficult to recruit and retain - especially in remote or rural areas (Kruse et al., 2022).

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3.7.7: British Doctor's Study/Smoking

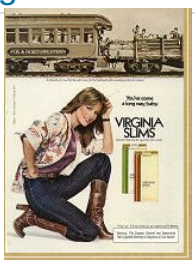


Figure 3.7.7.1:

Virginia Slims Advertisement . (Copyright; Elana Centor, CC BY-SA 2.0, via Wikimedia Commons)

Smoking cigarettes had become a large part of American culture during the early 20th century. Cigarette advertising included cartoons and even children smoking, and many examples of physician endorsements, although lacking any support from scientific evidence. Smoking was concurrently portrayed as "manly" and "rugged" with characters like the Marlboro Man, and also as classy or even feminist with the Virginia Slims "you've come a long way, baby" campaign. At the same time, lung cancer deaths were increasing exponentially - a phenomenon revealed in two case-control studies published in 1950 which also correlated smoking to lung cancer. Two British doctors, Richard Doll and Austin Bradford Hill, had conducted one of these studies and found a significant dose-response relationship between smoking and lung cancer - the more cigarettes were smoked, the higher the risk. The next year they began a cohort study (see Chapter 5 for more on cohort studies) of British doctors to make this correlation even more clear.

Within just 10 years they had proven not only was smoking a strong risk factor for lung cancer, but also increased the risk of other lung disease and cancers as well - and that the risk was reduced when doctors quit smoking. Following up at each decade, this correlation continued, demonstrating that a smoker's risk of dying was 2-3 fold higher than nonsmokers depending on their age and smoking habits (Di Cicco et al., 2016). This risk was recognized by the U.S. Surgeon General in 1957. Several private health associations including the American Cancer Society, American Heart Association, and American Public Health Association sent a letter to President Kennedy requesting he develop a commission on smoking. This commission was created in 1962 and reviewed over 7,000 research studies over the next two years.

In 1964 the U.S. Surgeon General produced a comprehensive report recognizing that the risks of developing lung cancer were 10-20 times higher for smokers than non-smokers, and smoking also increased the risk of several other chronic diseases. This hit the media like a bombshell. Subsequently, Congress created legislation to require health warning labels on cigarettes and banned cigarette advertising on TV. In the 1980s another Surgeon General report was published regarding secondhand smoke, which began a slew of smoking restrictions in public places (The 1964 Report on Smoking and Health, n.d.). For example, in the state of California, bans include smoking in workplaces, restaurants, and bars, near building entrances, around playgrounds, and in a car while driving with a minor. Several state beaches prohibit smoking and many cities have also banned smoking in public places (California Tobacco Laws That Reduce ETS Exposure, n.d.).

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3.7.8: Nutrition and Food Safety in The United States

Cigarettes are not the only products that have labeling requirements. In 1906, the Pure Food and Drugs Act was passed by Congress, setting governmental regulations and oversight over the food industry. This first iteration of what eventually became the Food and Drug Administration (FDA) oversight was quite simple and required accurate labeling of foods. Any food or medicine that contained certain psychoactive drugs (like caffeine, morphine, cocaine or cannabis), had to be accurately labeled with amounts and dosage. At the time, medicines and "cure-alls" containing these ingredients were often sold as proprietary formulations (Contributors to Wikimedia projects, *Pure Food and Drug Act*, 2023c). The USDA also began inspecting meat transported between states thanks to a new law in the same year. Later, in 1938 the Federal Food, Drug, and Cosmetic act was passed, and amendments were made afterward, which provided federal oversight on drug testing and approval, and further established the role of the FDA in ensuring safety and quality of foods, medicine, and cosmetic products (Boston University , n.d.). Nutritional supplements like vitamins and herbal remedies have some FDA oversight to ensure appropriate labeling but are not tested for efficacy and side effects in the same way that pharmaceutical drugs are.

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3.7.9: Margaret Sanger, Title X, Abortion, and Birth Control

Margaret Sanger was one of 11 children born to her parents in 1879. Her mother was frail due having experienced 18 pregnancies in total - which she believed contributed to her mother's death from tuberculosis at the age of 50. This galvanized Sanger's mission to become a nurse and provide women access to birth control. In 1921 she founded the American Birth Control League, which would eventually become the Planned Parenthood Federation. At the time, there were only two barrier methods of birth control - the rubber condom and the diaphragm - and neither were widely used. By the 1950s, Sanger turned her focus toward promoting research and development of a contraceptive pill. Funded by her friend, Katherine McCormick - who had inherited a fortune from the International Harvester company - Sanger supported research conducted by two doctors: Gregory Pincus in developing the pill, and John Rock in testing it. The researchers used progesterone derived from certain wild yams which had been traditionally used by the Aztecs for birth control and menstrual cramping. The pill went through clinical trials with women in Puerto Rico as subjects (since it would not have gotten approval in other states) and was approved by the FDA in 1960. Since then, it has been discovered that much lower doses of estrogen and progesterone are just as effective at preventing pregnancy and cause much fewer side effects (Planned Parenthood Federation of America, Inc., 2015).

The importance of sexual and reproductive health as a public health service was recognized in the next decade. Title X was signed into law by President Nixon in 1970, and provided funding for family planning clinics. These clinics could provide contraceptives and reproductive health services to people who could not afford them. Screening services for sexually transmitted infections, reproductive cancers could also be provided, as well as education on preventing HIV and other STDs - but importantly, funding by Title X is prohibited from being used to provide abortion services. Further regulations subsequently added to Title X during conservative presidencies made it difficult for healthcare providers to even discuss abortion as an option for reproductive healthcare (Seabert et al., 2021).

Two key court cases solidified access to both contraceptives and abortions for women in the 60's and 70's. *Griswold v. Connecticut* in 1965 prevented states from banning contraceptives, citing the right to privacy derived from several constitutional amendments but most notably the 14th amendment (LII, n.d.). In 1973, *Roe v, Wade* struck down a Texas law which criminalized helping a woman get an abortion, again citing the right to privacy. This effectively legalized abortion federally, but only up to the age of fetal viability (the age at which the fetus could possibly survive outside the uterus), with exceptions beyond if there is risk to the mother's health. It is important to note that the age of fetal viability is influenced by a variety of factors including sex, weight, availability of medical support, etc. and the current consensus places fetal viability between 23-25 weeks of pregnancy (The American College of Obstetrics and Gynecologists, 2023). In 2022, the *Roe v. Wade* ruling was overturned in *Dobbs v. Jackson*, allowing the conservative legislature in many states to enact abortion bans between 6 and 15 weeks of pregnancy (Contributors to Wikimedia projects, *Griswold v. Connecticut*, 2023b). Within the same year, the ripple effects of these laws was apparent - exemplified by a lawsuit against the state of Texas where several women testified that they were denied abortions for pregnancies risking their health, and nonviable pregnancies (including fatal fetal growth complications) - resulting in traumatic illness and birth experiences (Varney, 2023). Fears around lawsuits and navigating obstetric care have also been cited as reasons for some hospitals to close their maternity wards (Kekatos, 2023). This is a contemporary example of how legislative decisions can have immediate effects on medical care.

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3.7.10: Health Administration in America

In 1965 the Medicare and Medicaid bills were passed by congress and signed into law by president Lyndon B. Johnson. These were each amendments to the Social Security Act of 1935 which not only kept seniors out of poverty, but also allocated funds for state health departments and programs. Along with social security, unemployment, and other welfare programs, both Medicare and Medicaid are what are called government “entitlements”, funded at least partially by taxes.

Efforts to create a universal healthcare system - perhaps by expanding Medicare to those under the age of 65 - have been attempted since the late 19th century. Some of these efforts were both supported and opposed by labor unions, yet the majority of them have been fervently opposed by the American Medical Association (AMA) and health insurance lobbies. President Franklin D. Roosevelt originally intended to include healthcare in the New Deal in 1935, but removed it from fears of conservative politicians painting it as “socialist”. At the time, fears of anything considered remotely close to communism or socialism were high, and subsequent efforts to enact universal healthcare legislation were squashed (Palmer, 2009). It was only by focusing on the elderly and poor that Medicare and Medicaid were passed. Since then, these two programs have become increasingly viewed as invaluable by the public. Particularly since the 1970s, the costs of healthcare have increased over each decade, as well as the amount that both employers and individuals are required to pay for it (with premiums and deductibles). Administrative costs of privatized healthcare in the U.S. are the highest in the world. The debate over how to effectively regulate and/or provide healthcare continues to be at the forefront of political agendas (Reich, 2022).

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3.7.11: Medicare

Medicare specifically covers healthcare for people over the age of 65. Originally it provided only hospital insurance (part A) and medical insurance (part B). Medicare Advantage plans now allow private insurance to supplement coverage (called Part C), and since 2003, drug costs are now covered (with Part D). To fund this program, workers pay medicare taxes, and those who may not have paid enough medicare taxes over their working years will pay premiums while using Medicare insurance once they retire. Additionally, Medicare only *assists* with paying for healthcare costs, they are not covered entirely. There are still deductibles, co-insurance and copayments for many healthcare services. However, some expenses like drug costs can be kept significantly lower (for both Medicare and Medicaid), due to government mandated negotiations with pharmaceutical companies.

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3.7.12: Medicaid

Medicaid covers people with disabilities, low income families, pregnant women and those with long-term care needs. Medicaid is funded by both states and the federal government, but administered by states, so each state can decide how to extend coverage to its citizens. There is also a healthcare coverage program for children called the Children's Health Insurance Program (CHIP), which covers eligible children whose families earn too much money to qualify for Medicaid but who are not covered under a private insurance plan (Centers for Medicare and Medicaid Services, 2023, Seabert et al., 2021).

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3.7.13: The Affordable Care Act

The Affordable Care Act (ACA, and also referred to as Obamacare) was signed into law in 2010 by President Barack Obama, and included some of the most recent major efforts to expand access to healthcare. This plan created a marketplace for health insurance plans that were subsidized by government funds for people with lower incomes. Insurance companies were prevented from denying coverage for pre-existing conditions or setting limits on how much they would pay for healthcare on a yearly or lifetime basis. In this law, children were allowed to stay on their parent's insurance until age 26 - protecting these young adults who tended to be the largest group of uninsured individuals. Preventative care was also provided for free, including important health screenings for chronic diseases (like type II diabetes) and sexually transmitted infections (STIs) as well as many other health concerns - a big step towards a more preventative healthcare model. The original law also had an "individual mandate", which required individuals to either sign up for health insurance on the marketplace, provide proof of private or employer-funded health insurance (or Medicare/Medicaid coverage), or pay a fine on their tax bill. The rationale for this individual mandate was to encourage as close to 100% healthcare coverage as possible and to help to pay for the program by including healthy individuals in insurance pools (since healthy folks cost less for insurance companies and their premiums subsidize costs for those who are ill). In 2017, under president Donald Trump's administration, the tax penalty was eliminated, thereby essentially eliminating the individual mandate. Otherwise, most of the legal provisions of the ACA remained (Anderson, 2021).

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3.7.14: HIV/AIDS Epidemic

In 1981, a report was published of a rare lung infection in five young, otherwise healthy, gay men. On the same day the report was published, the CDC got a call from a physician in New York city, who reported a rare, aggressive cancer in several patients with weakened immune systems. Eventually, more cases were discovered of what would eventually be known as Human Immunodeficiency Virus (HIV), which could lead to Acquired Immune Deficiency Syndrome (AIDS). The disease was spread through unprotected sex, and the use of infected needles or direct exposure to infected blood (through a blood transfusion, for example). It attacked the human body's immune system, weakening the ability to fight off other infections and diseases, so that many people died from things like pneumonia or cancers that progressed rapidly. Although cases were found in women, infants, and people of all races across the globe, the disease rapidly reached epidemic proportions in the gay community, and soon became known in America as the "gay white man's disease". This fueled anti-LGBTQ rhetoric, and left other populations out of research and preventative measures. HIV/AIDs was so deadly that nearly half of the cases reported in the first year perished by the end of the year.

In 1983 the virus was isolated in a French lab, increasing hopes of a vaccine being developed. But the first blood test developed would only detect antibodies in the blood supply - and was at first primarily used to test blood in blood banks rather than diagnose individuals with the infection. While initial efforts focused on safe-sex education, prevention, and harm-reduction, it took several years of advocacy from civil rights groups, celebrities, and minority leaders to prompt the U.S. government to focus funding on AIDS research and healthcare. The Aids Coalition to Unleash Power (ACT UP) protested against the slow progress that was being made and the narrow definition of the disease as affecting only gay men (*Timeline of the HIV and AIDS Epidemic*, n.d.).

The first drugs to be developed for AIDS treatment were antiretroviral therapies (ARVs), and were not particularly effective. In the 1990s, a combination of ARVs was found that decreased the risk of death by 60-80% yet it was still sold at a high cost which excluded many poorer countries from providing it to their citizens. Over decades, and with extensive pressure, both testing and drugs have become more accessible. The World Health Organization (WHO) expanded testing and treatment access in the 2010s and set continued goals with the hope to end AIDs altogether by 2030. Early treatment with ARVs can suppress the virus to an undetectable level, preventing sexual transmission to partners. By 2015, some ARVs were also approved for prophylactic use, decreasing the risk of contracting the virus from a partner or injection use. While research, testing, and treatments have expanded to this date, the stigma around HIV (and its association with homosexuality and drug injection) still persists - and prevents adults and children from getting care (World Health Organization, n.d.-b).



Figure 3.7.14.1: ACT UP Demonstration on the lawn of Building 1. A mass "die-in" on the lawn of Bldg. 1 closed the demonstration as ranks of uniformed officers, some on horseback, protected NIH headquarters during the "Storm the NIH" demonstration on May 21, 1990.. (Copyright; NIH History Office from Bethesda, Public domain, via Wikimedia Commons)

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3.8: The Healthy People Initiative- 1990-2030

The Healthy People Initiative began in 1979 due to another landmark surgeon general report titled: “Healthy People: The Surgeon General’s Report on Health Promotion and Disease Prevention” (Office of Disease Prevention and Health Promotion, n.d.-a) Each decade, the initiative sets targets for improving different areas of public health, and measures these outcomes to see if those targets have been hit. The overarching goals have changed over the years, but most have included decreasing or eliminating health disparities, and promoting health for all across the lifespan. The latest iteration - Healthy People 2030 - emphasizes the social determinants of health, including: economic stability, education access and quality, healthcare access and quality, neighborhood and built environment, and social and community context (more on these in Chapter 8). There is also a new focus in the 2030 objectives of health literacy - the ability to find, understand and use information to make well-informed health decisions. An emphasis is also placed on the responsibility of health organizations to provide equitable access to health information and support its use in individual decision-making. The Healthy People 2030 website offers descriptions and the latest data on each health-related objective. (Office of Disease Prevention and Health Promotion, n.d.-b).

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3.9: Summary

Summary

Public health efforts have been complicated, controversial, and an essential part of the social fabric for eons. While the intentions of many public health efforts have been noble - to prevent diseases and improve living conditions - the implementation of public health strategies is not always equitable or effective. As public health practitioners, we must learn from both the achievements and failures of the past in order to create the kind of future that will benefit health for all.

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CHAPTER OVERVIEW

4: Public Health Agencies and Organizations

Learning Objectives

- Identify different public health disciplines, professions and organizations, and explain how each contributes to the field of public health.

4.1: Introduction
4.2: U.S. Public Health Agencies
4.2.1: Centers for Disease Control and Prevention
4.2.2: The FDA and USDA
4.2.3: The Environmental Protection Agency
4.3: Quasi-Governmental Organizations
4.4: State and County Health Agencies
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4.1: Introduction

This chapter goes over the primary governmental organizations responsible for public health in the United States at the national, state, and local levels, and discusses their main roles and actions. We will also describe some non-governmental organizations and professional organizations that have contributed to public health.

This chapter was written with the assistance of ChatGPT 3.5. Edits and additions were made by the author.

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4.2: U.S. Public Health Agencies

4.2 U.S. Public Health Agencies

The U.S. Department of Health and Human Services (HHS) is a federal executive department responsible for promoting and protecting the health and well-being of all Americans. Its primary mission is to enhance the health and human services available to the U.S. population, ensure the safety of food and drugs, advance medical research, and administer various social welfare and healthcare programs. HHS plays a crucial role in shaping and implementing policies related to healthcare, public health, and human services in the United States. The president of the United States appoints secretaries to their cabinet to lead HHS and its agencies. Therefore, the leadership and focus of each of these agencies can change with each new federal administration.

Agencies that HHS oversees include these listed below. We'll go over a few of them in more detail later on in this chapter.

- The **Food and Drug Administration (FDA)**: This agency is responsible for regulating and ensuring the safety of food, drugs, medical devices, vaccines, cosmetics, supplements, and tobacco products. Prescription drugs, medical devices, and biologics (like vaccines) have to go through rigorous testing to get approval by the FDA. If people are getting sick from a particular food or infant formula, or if the food company did not correctly label the food for potential allergens, it is part of the FDA's role to investigate where the contaminated food is coming from and issue recalls. It is important to note that nutritional supplements and herbs are regulated by the FDA but not in the same way as drugs (Office of the Commissioner, 2023).
- The **Centers for Medicare and Medicaid Services (CMS)**: CMS administers the nation's major public healthcare programs: Medicare and Medicaid. Medicare is primarily for people over 65 years of age, and Medicaid is designed to provide healthcare for people in poverty and those with disabilities. Sometimes seniors who are also living in poverty are supported by both systems. The Children's Health Insurance Program (CHIP) is also a part of Medicaid - both of which are funded by both the federal government and state governments. CHIP supports healthcare for children whose parents may make too much money to qualify for Medicaid, but not enough to afford private health insurance (Centers for Medicare and Medicaid Services, n.d.). Medicare and Medicaid are the largest payers of healthcare in the US. For example, over 40% of all births are paid for by Medicaid (Valenzuela & Osterman J.K., 2023).
- The **National Institutes of Health (NIH)**: This is the primary agency for conducting and supporting medical research, including funding research into diseases, public health, and medical innovation. The sprawling NIH campus located in Bethesda, Maryland, includes a clinical research hospital and laboratories focused on specific areas of cutting edge health research - called "intramural research". But the NIH is also responsible for funding "extramural research" through grants . These grants fund research in health and science at universities, medical centers, laboratories and other institutions, both in the U.S. and abroad (NIH, 2025).
- The **Centers for Disease Control and Prevention (CDC)**: The CDC is probably the most familiar public health agency to Americans. This is because it is the primary national public health agency which focuses on disease prevention, emergency preparedness, and the tracking of public health data. The CDC is also the nation's primary epidemiological center, and conducts surveillance of current health issues affecting Americans. Headquarters of the CDC are located in Atlanta, GA.
- The **Administration for Children and Families (ACF)**: This agency administers various programs and services aimed at promoting the economic and social well-being of children, families, and communities. These programs include financial assistance like the Temporary Assistance for Needy Families (TANF), support for children with disabilities through the Head Start program, support for foster kids, or help paying for childcare or utilities (ACF, 2024).
- The **Substance Abuse and Mental Health Services Administration (SAMHSA)**: SAMHSA works to improve mental health and reduce the impact of substance abuse and addiction. This agency has 9 regional offices around the U.S., and collaborates with regional and local agencies to support initiatives tackling substance abuse, suicide prevention, and other behavioral health issues (SAMHSA, 2024).
- The **Agency for Healthcare Research and Quality (AHRQ)**: Established in the 1990s after several reports found that medical errors contributed to a large number of deaths, this agency conducts research to improve the quality, accessibility, and affordability of healthcare services in the U.S. The agency's focus is on patient safety and preventing medical mistakes, as well as reducing healthcare costs and improving efficiency (AHRQ, 2025).
- The **Indian Health Service (IHS)**: Established in the 1950s, this agency provides healthcare services to more than 2 million American Indian and Alaska Native populations. The IHS comprises not only hospitals and clinics in rural and urban tribal

areas, but also tackles the complex public health needs of tribes including water fluoridation, pandemic response, and diabetes management (Kruse et al., 2022).

HHS as it exists today was established in 1979. However, its origins can be traced back to the early 20th century when the federal government started to take an active interest in public health and welfare issues. The predecessor agencies and departments that eventually merged to form HHS include the United States Public Health Service, the Social Security Administration, and various other federal agencies responsible for health and welfare programs. Over the years, HHS has played a pivotal role in shaping healthcare policy, conducting research, and administering various programs to improve public health and human services across the United States. It has been instrumental in the implementation of significant healthcare reforms, including the Affordable Care Act (aka “Obamacare”).

Update

In 2025, the second Trump administration took drastic steps to cut federally funded programs, including reducing employees by 20,000 (through firings and early retirement), closing 5/10 regional offices around the country, and collapsing several agencies into one titled the “Administration for a Health America” (AHA). This new agency will contain these former agencies: Office of the Assistant Secretary for Health (OASH), Health Resources and Services Administration (HRSA), Substance Abuse and Mental Health Services Administration (SAMHSA), Agency for Toxic Substances and Disease Registry (ATSDR), and National Institute for Occupational Safety and Health (NIOSH), with the promise of creating a more efficient use of taxpayer dollars (HHS Press Office, 2025). Some programs have been eliminated entirely or their funding moved to the new AHA agency, including those that focus on chronic disease prevention, global health, HIV prevention and research, birth defects, developmental disabilities, injury prevention, and occupational safety and health (Gold & Ingram, 2025). The NIH is slated to lose around 43% of their budget that funds cutting edge biomedical research, threatening the discovery and development of new treatments and drugs, which will eventually translate into shorter lifespans and a significant economic impact (Cutler & Glaeser, 2025). Other cuts under this administration threaten the Environmental Protection Agency which is losing both funding and staff, including the majority of their scientific staff - including biologists and toxicologists (Daly, 2025). The small Agency for Healthcare Research and Quality (AHRQ) is likely to also be eliminated (Allen, 2025). Public health experts warn that these cuts to funding will have immediate, profound, and likely deadly effects. Food safety, children’s health, senior programs, emergency preparedness, drug treatment, and cutting edge research will all suffer, leading to a rise in preventable disease and death (For Our Health, 2025).

Without a good understanding of what each of these agencies do, it may be difficult to anticipate the impact that these cuts and firings will have on the future of public health in America. In the next few pages, we’ll focus specifically on a few agencies and what they do to protect our population’s health.

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4.2.1: Centers for Disease Control and Prevention

Centers for Disease Control and Prevention

The Centers for Disease Control and Prevention (CDC) is a critical agency within the U.S. Department of Health and Human Services, dedicated to safeguarding public health and promoting the well-being of Americans. The CDC's primary responsibilities include:

- **Disease Surveillance and Control:** The CDC monitors, tracks, and investigates the spread of diseases, both infectious and non-infectious. It works to identify and control outbreaks of diseases, providing guidance and recommendations to prevent their spread. This includes timely communications about the rates of disease or health conditions to the public. For example, The Morbidity and Mortality Weekly Report (MMWR) is the “voice of the CDC”, providing public health practitioners around the country with up-to-date statistics, information, and evidence-based practical recommendations (CDCMMWR, 2025).
- **Health Promotion and Education:** The CDC conducts public health education and awareness campaigns to inform the public and healthcare professionals about health risks, preventive measures, and healthy behaviors. This includes initiatives to combat smoking, obesity, substance abuse, and other health-related issues.
    - ✔ Current Example 4.2.1.1

      The CDC has run an anti-smoking ad campaign called “Tips from Former Smokers” since 2012 which features real stories from people suffering the negative health effects of cigarette smoking. At the end of each television or streaming ad, a phone number is provided to connect people to quitting smoking resources in their own state - and a recent study suggests that calls to the quit smoking line increase when more ads are played (CDCTobaccoFree, 2025, Mann et al., 2024). Unfortunately, recent cuts to the CDC budget are threatening this program and many others (Edwards, 2025).

- **Vaccine Development and Promotion:** The CDC is involved in the development, testing, and distribution of vaccines. It plays a crucial role in promoting immunization and vaccination programs to prevent and control vaccine-preventable diseases.
    - ✔ Current Example 4.2.1.2

      The CDC hosts the Advisory Committee on Immunization Practices (ACIP); a group of virologists and immunologists who discuss and recommend evidence-based vaccine schedules that are then disseminated to physicians and other healthcare professionals. That has been the role of ACIP historically, although recently it was disbanded and new members (some of whom are public anti-vaccine activists or have conflicts of interest with anti-vaccine groups), were put in place by RFK Jr., the current HHS secretary who is also known for his anti-vaccine rhetoric (Ducharme, 2025, Schnirring & Van Beusekom, 2025). These and other recent changes to vaccine recommendations have caused several medical and public health organizations - including the American Academy of Pediatrics (AAP), the American College of Physicians (ACP) and the American Public Health Association (APHA), among others - to sue the administration (AAP, 2025).

- **Chronic Disease Prevention:** The CDC focuses on preventing and managing chronic diseases like heart disease, diabetes, and cancer by promoting healthier lifestyles and supporting research in these areas.
    -

Current Example 4.2.1.3

The Diabetes Prevention Program (DPP) trains and certifies lifestyle coaches and provides curriculum for local organizations to support people diagnosed with prediabetes (the precursor to Type II diabetes). Lifestyle changes like improving nutrition, increasing physical activity, and losing weight (if obesity is present), can reduce the risk of Type II diabetes by over half. The DPP also partners with Medicare to fund access to this program for seniors (CDC, 2025b).

- **Global Health:** The CDC works on a global scale to combat infectious diseases worldwide. It collaborates with international partners and organizations to strengthen public health systems and respond to global health crises.
- **Environmental Health:** The CDC assesses environmental health risks, including exposure to hazardous substances, and provides guidance to protect public health from environmental threats.
- **Emergency Preparedness and Response:** The CDC plays a crucial role in preparing for and responding to public health emergencies, including natural disasters, bioterrorism, and infectious disease outbreaks. In fact, the CDC is at the forefront of coordinating the country's national response to epidemics and pandemics: including tracking the spread of the disease, providing resources, guidance, and information to local public health agencies, developing and distributing tests and protective equipment, and supporting the development of vaccines and treatments, as well as coordinating with other countries around the globe (CDC, 2025a).

The CDC's history dates back to 1946 when it was established as the Communicable Disease Center in Atlanta, Georgia. The organization was initially focused on preventing the spread of malaria. Over the years, its mission expanded to address a wide range of communicable diseases. In 1970, it was renamed the Centers for Disease Control to reflect its broader responsibilities in health protection. In 1980, the CDC was integrated into the U.S. Public Health Service and became part of the U.S. Department of Health and Human Services. The "Prevention" was added to its name, making it the Centers for Disease Control and Prevention, to emphasize its comprehensive role in public health.

The CDC has been at the forefront of numerous public health challenges and breakthroughs, such as the successful eradication of smallpox and the control of diseases like polio and HIV/AIDS. It continues to be a vital institution in safeguarding public health, conducting research, and responding to emerging health threats, including the COVID-19 pandemic. The CDC's work has a profound impact on the health and well-being of people in the United States and around the world.

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4.2.2: The FDA and USDA

The Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA) are two distinct federal agencies in the United States, each with its own set of responsibilities related to the regulation of food and drugs for public health purposes.

The FDA is a federal agency within the U.S. Department of Health and Human Services, responsible for protecting and promoting public health by regulating various products, including food, drugs, medical devices, vaccines, and other health-related items. This agency was created with the 1906 Pure Food and Drugs Act, and its role was more defined with the Federal Food, Drug, and Cosmetic Act in 1938. When it comes to the regulation of food and drugs, the FDA has the following key roles:

- Drug Regulation: The FDA evaluates and approves new drugs for safety and efficacy before they can be marketed and sold to the public. It also monitors and regulates prescription and over-the-counter medications to ensure ongoing safety.
- Food Safety: The FDA is responsible for regulating and ensuring the safety of most of the food supply in the United States, except for meat, poultry, and egg products, which are regulated by the USDA (see below). The FDA establishes and enforces standards for food labeling, inspections, and safety measures to prevent foodborne illnesses and ensure food products meet established quality and safety standards.
- Medical Devices: The FDA regulates medical devices to ensure their safety and effectiveness, from simple devices like bandages to complex ones like pacemakers. The agency classifies medical devices into different categories based on risk, and each category is subject to specific regulatory requirements.
- Vaccines and Biologics: The FDA evaluates and approves vaccines and biologic products to ensure they are safe and effective for use in preventing and treating diseases.
- Cosmetics and Dietary Supplements: The FDA regulates cosmetics and dietary supplements, ensuring that they are safe for consumer use and that product labels provide accurate information to consumers. Supplements don't have to go through the same rigorous testing for safety and efficacy that drugs do. Although manufacturers can state evidence-based claims about physiological function, for example: "calcium builds strong bones." But most nutritional supplements also have the caveat on their label that the supplement is not intended to “diagnose, treat, cure or prevent any disease”. The FDA can take action against any company that sells misbranded or adulterated products (Center for Food Safety & Nutrition, n.d.).

The USDA is a federal agency responsible for overseeing various aspects of American agriculture, including the production and safety of meat, poultry, and egg products. In the context of food and drug regulation, the USDA primarily focuses on the following areas:

- Meat and Poultry Inspection: The USDA's Food Safety and Inspection Service (FSIS) is responsible for inspecting and regulating meat, poultry, and egg products. FSIS ensures that these products are safe for consumption and that processing plants meet established safety standards.
- Food Labeling: The USDA sets labeling standards for meat, poultry, and egg products, ensuring that product labels provide accurate information to consumers.

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4.2.3: The Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) plays a significant role in public health by addressing environmental issues and hazards that can impact the well-being of the American population. The EPA's responsibilities related to public health include:

- Regulating Air Quality: The EPA sets and enforces national air quality standards to reduce the levels of harmful pollutants, such as particulate matter, ground-level ozone, sulfur dioxide, and nitrogen oxides. By reducing air pollution, the EPA helps lower the risk of respiratory and cardiovascular diseases, asthma, and other health problems associated with poor air quality.
- Safe Drinking Water: The EPA establishes and enforces regulations for the safety of drinking water supplies in the United States. This includes setting standards for contaminants in drinking water and ensuring that public water systems comply with these standards, thereby reducing the risk of waterborne diseases and exposure to harmful chemicals.
- Toxic Substances Control: The EPA regulates and assesses the risks of toxic substances and hazardous chemicals in the environment. This includes evaluating the potential health risks associated with exposure to these substances and taking measures to reduce or mitigate these risks.
- Waste Management and Cleanup: The EPA oversees the management and cleanup of hazardous waste sites and chemical spills to protect public health from exposure to toxic materials. This work helps prevent contamination of soil, water, and air in affected areas.
- Lead Poisoning Prevention: The EPA is involved in lead poisoning prevention efforts, such as enforcing regulations related to lead-based paint in homes and public facilities. Reducing lead exposure is vital for preventing developmental and health problems, particularly in children.
- Environmental Justice: The EPA addresses environmental disparities and injustices by ensuring that all communities, regardless of their socioeconomic status or demographic makeup, have equal protection from environmental hazards. This promotes public health equity.
- Research and Data Collection: The EPA conducts research and collects data to better understand the health impacts of environmental factors. This research informs policy decisions and public health recommendations.
- Emergency Response: The EPA plays a role in responding to environmental emergencies, such as chemical spills, natural disasters, and acts of terrorism, to minimize public health risks associated with these incidents.
- Public Education and Outreach: The EPA conducts public education and outreach efforts to raise awareness of environmental health issues, inform the public about risks, and provide guidance on ways to reduce exposure to environmental hazards.

By addressing these and other environmental concerns, the EPA contributes to protecting public health, reducing the incidence of environmentally related diseases, and improving overall well-being. Its work is critical for safeguarding the health and safety of the American population and ensuring that people have access to clean air, safe drinking water, and a healthy environment.

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4.3: Quasi-Governmental Organizations

In addition to government agencies like the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH), there are several quasi-governmental organizations involved in public health in the United States. Quasi-governmental organizations have some government ties but may also operate independently or have public and private sector partnerships. Some prominent quasi-governmental organizations in the field of public health in the U.S. include:

- **The American Red Cross:** While officially a nonprofit organization, the American Red Cross often collaborates closely with the federal government, particularly during disasters and public health emergencies. It provides disaster relief, blood donation services, and health and safety training.
- **The National Academy of Medicine (NAM):** Part of the National Academies of Sciences, Engineering, and Medicine (NASEM), NAM provides expert advice and recommendations on various health and medical issues. Its work informs health policy and public health efforts in the U.S.
- **The National Quality Forum (NQF)**: NQF is a non-profit organization that focuses on healthcare quality and measurement. It works with public and private stakeholders to develop and endorse national standards for healthcare quality.
- **The Joint Commission:** The Joint Commission is a non-profit organization that accredits and certifies healthcare organizations and programs in the United States. It sets and enforces standards for healthcare quality and patient safety.
- **The National Patient Safety Foundation (NPSF):** NPSF, now part of the Institute for Healthcare Improvement (IHI), focuses on improving patient safety and reducing medical errors through education, research, and advocacy.
- **The National Association of County and City Health Officials (NACCHO):** NACCHO is an organization that represents local health departments across the United States. It works to advance public health at the community level, addressing local public health needs and priorities.
- **The American Public Health Association (APHA):** The APHA is a non-profit organization established in 1872, that serves as a voice for public health professionals and advocates for public health policies and practices. It also publishes public health textbooks and important public health research in the *American Journal of Public Health (AJPH)*, as well as a podcast with guest public health practitioners and researchers.

These quasi-governmental organizations play important roles in advancing public health in the United States by conducting research, setting standards, providing healthcare services, and promoting public health initiatives. While they may operate independently, their work often aligns with the goals of government agencies and helps shape public health policies and practices.

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4.4: State and County Health Agencies

State and local health agencies play essential roles in protecting and promoting public health within their respective jurisdictions. These agencies are responsible for a wide range of public health activities and services to ensure the health and well-being of the communities they serve. Here are some of the key functions and responsibilities of state health agencies:

- Disease Surveillance and Control: State health agencies monitor the prevalence of diseases, conduct investigations, and implement control measures to prevent the spread of infectious diseases within the state.
- Health Regulations: They develop and enforce health regulations and guidelines related to areas such as food safety, environmental health, and healthcare facilities to protect public health.
- Immunization Programs: State health agencies administer immunization programs, ensuring that residents have access to vaccines to prevent vaccine-preventable diseases.
- Health Data Collection and Analysis: They collect, analyze, and report health data to inform public health policies, track health trends, and respond to emerging health issues.
- Emergency Preparedness and Response: State agencies coordinate and plan responses to public health emergencies, such as natural disasters, disease outbreaks, and bioterrorism threats.
- Health Education and Promotion: They engage in public health education and awareness campaigns to promote healthy behaviors and prevent chronic diseases.
- Maternal and Child Health Services: State agencies provide services and programs to support the health and well-being of mothers and children, including prenatal care and child health programs.
- Regulatory Oversight: They regulate healthcare facilities, healthcare providers, and health insurance to ensure quality and safety standards are met.

Local Health Departments are typically responsible for:

- Primary Care and Clinical Services: Local health departments offer primary care services, immunizations, family planning, and other clinical services to the local community.
- Community Health Assessment and Planning: They assess the health needs of the local community and develop health improvement plans in collaboration with community stakeholders.
- Health Inspections: Local health departments conduct inspections of restaurants, food establishments, swimming pools, and other public facilities to ensure compliance with health and safety regulations.
- WIC and Nutrition Programs: Many local health departments administer the Women, Infants, and Children (WIC) program, which provides nutrition support to low-income pregnant women and young children.
- Emergency Preparedness and Response: They play a critical role in local emergency preparedness, working with state and federal agencies to respond to public health emergencies.
- Health Promotion and Education: Local health departments engage in health promotion activities, including smoking cessation programs, substance abuse prevention, and injury prevention initiatives.
- Disease Investigation and Reporting: They investigate and report cases of notifiable diseases, collaborate with healthcare providers, and implement control measures as needed.
- Environmental Health Services: Local health departments address environmental health concerns such as water quality, air quality, and sanitation to protect public health.

State and local health agencies work in tandem to deliver essential public health services to the community. They collaborate with federal agencies, healthcare providers, non-profit organizations, and community partners to address a wide range of public health challenges and promote the overall health and well-being of their populations.

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4.5: Non-Profit Organizations

There are several major non-profit and philanthropic public health organizations in the United States that play vital roles in addressing various public health issues and advancing healthcare and well-being. Here are some of the notable organizations:

- **Bill & Melinda Gates Foundation:** This is one of the world's largest philanthropic organizations, focusing on global health, poverty alleviation, and education. The foundation has made substantial investments in areas such as infectious disease control, vaccine development, and healthcare delivery improvement.
- **Robert Wood Johnson Foundation (RWJF):** RWJF is dedicated to improving health and healthcare in the United States. It supports research, policy initiatives, and community-based programs aimed at reducing health disparities, promoting health equity, and addressing social determinants of health.
- **The Pew Charitable Trusts:** Pew's health and healthcare program focuses on improving the quality and cost-effectiveness of healthcare in the U.S. It conducts research, advocates for evidence-based policies, and supports initiatives to advance public health and healthcare delivery.
- **KFF:** Originally KFF was part of the Kaiser Family Foundation as it was founded in 1948 by Henry J. Kaiser, but now has no connections to Kaiser Permanente. KFF is a non-profit journalism and research organization that publishes information and analyses on a wide range of healthcare and health policy topics (KFF, 2023).
- **The California Endowment:** This philanthropic organization works to improve the health of underserved communities in California. It supports initiatives to promote health equity, access to care, and overall well-being.
- **The MacArthur Foundation:** The MacArthur Foundation supports a variety of initiatives, including those related to juvenile justice reform, mental health, and criminal justice reform, that have public health implications.
- **The Clinton Foundation:** The Clinton Foundation addresses global health challenges and domestic public health issues through initiatives like the Clinton Health Access Initiative. It focuses on improving access to healthcare and treatment for various diseases.
- **The W.K. Kellogg Foundation:** While primarily focused on children's well-being and development, this foundation's initiatives often have a public health component. They invest in programs to address health disparities and promote healthy lifestyles.
- **The Duke Endowment:** This organization supports healthcare and public health initiatives in the southeastern United States. It funds efforts to improve healthcare delivery, reduce health disparities, and enhance overall well-being.

These non-profit and philanthropic organizations contribute to public health in various ways, including funding research, supporting policy advocacy, conducting public health campaigns, and implementing programs that address pressing health issues. Their work complements the efforts of government agencies, academic institutions, and healthcare providers in improving the health and well-being of individuals and communities.

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4.6: The World Health Organization

The World Health Organization (WHO) is a specialized agency of the United Nations responsible for international public health. It was established on April 7, 1948, with its headquarters in Geneva, Switzerland. The creation of the WHO followed the devastation of World War II and aimed to prevent future global health crises. The WHO's Constitution came into force on April 7, 1948, making it the directing and coordinating authority for international health within the UN system.

The World Health Organization serves as the global authority on public health, overseeing and coordinating international efforts to improve health and well-being worldwide. Its functions and responsibilities include:

- **Health Policy and Guidance:** The WHO provides leadership on international health matters, sets global health standards and guidelines, and promotes evidence-based policies to improve public health.
- **Disease Surveillance and Response:** The WHO monitors and responds to disease outbreaks and health emergencies, providing guidance and support to affected countries.
- **Health Systems Strengthening:** The organization assists countries in building and strengthening their healthcare systems, ensuring access to quality healthcare services.
- **Research and Innovation:** The WHO supports and conducts research in various health areas and facilitates the development of new treatments, vaccines, and interventions.
- **Health Promotion and Education:** It promotes health education, campaigns, and awareness to address health risks and improve health behaviors.
- **Emergency Response:** The WHO plays a key role in responding to global health emergencies, such as pandemics, natural disasters, and humanitarian crises.
- **Health Equity and Social Determinants:** The organization works to reduce health inequalities and addresses the social determinants of health, such as poverty, education, and access to clean water and sanitation.

The World Health Organization has achieved numerous significant accomplishments throughout its history:

- **Smallpox Eradication:** In 1980, the WHO declared the successful eradication of smallpox, one of the deadliest diseases in human history, through a global vaccination campaign.
- **Poliomyelitis Eradication:** The WHO has played a leading role in the Global Polio Eradication Initiative, which has made substantial progress toward the eradication of polio worldwide.
- **Global Health Regulations:** The organization has developed and implemented international health regulations to prevent and control the spread of diseases and health emergencies.
- **HIV/AIDS and TB Control:** The WHO has contributed significantly to global efforts to control the spread of HIV/AIDS and tuberculosis through research, prevention, and treatment programs.
- **Vaccine Development:** The WHO has been instrumental in the development and distribution of vaccines, including those for measles, rubella, and other preventable diseases.
- **Tobacco Control:** The WHO Framework Convention on Tobacco Control is a landmark international treaty aimed at reducing tobacco consumption and its health impact.
- **Pandemic Response:** The WHO has played a central role in responding to global pandemics, such as the H1N1 influenza pandemic in 2009 and the COVID-19 pandemic in 2019.

The World Health Organization's work has had a profound impact on global public health, contributing to the prevention of diseases, the promotion of health equity, and the improvement of healthcare systems worldwide. It continues to address evolving health challenges and support countries in achieving better health outcomes for their populations.

Update

Upon assuming office in January of 2025, President Trump signed an executive order to remove the United States from the WHO, citing the large financial contributions that the U.S. makes to the WHO and alleged mishandling of the Covid-19 pandemic response (The White House, 2025). Leaving the WHO is not immediate, as withdrawal requires a 1-year notice.

> However, public health professionals warn that the potential impacts of this action not only affect the WHO's health and humanitarian efforts around the globe, but also the capacity of the U.S. to respond to future global health threats (Public Health On Call, 2025).

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CHAPTER OVERVIEW

5: Sources of Information in Public Health

Learning Objectives

- Interpret and evaluate public health and medical information from general and subject specific library and credible Internet sources.

5.1: Introduction
5.2: Public Health and the Fight Against Misinformation
5.2.1: Internet, Social Media, and the Age of Algorithms
5.3: Public Health Messaging
5.4: Is Science Even Trustworthy?
5.5: Types of Research Studies - Ecological and Case-Control Studies
5.6: Types of Research Studies - Retrospective or Case-Control Studies
5.6.1: In Real Life- A Case-Controlled Study
5.7: Types of Research Studies - Prospective or Longitudinal Studies
5.7.1: In Real Life- A Cohort Study
5.8: Types of Research Studies - Experimental Studies
5.8.1: Approving Drugs, Vaccines, and Devices
5.9: Where Can We Find Current Public Health Statistics?
5.10: Summary
5.11: References

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5.1: Introduction

What people believe about their health is highly personal and directly impacts their health-related behaviors. Perhaps this is because many cultures, religions, and ideologies attach morality to health behaviors, or perhaps this is because of the high value a person ascribes to their own health. Whatever the reason for strongly held health beliefs, the ways people get health information and guidance to develop these beliefs is of utmost importance. Providing accurate health information is one of the essential services of public health, and this role is becoming increasingly important as the contemporary infoscape is rife with disinformation, misinformation, conspiracies, and grifts.

So where do we get trustworthy public health information? We might go to the Centers For Disease Control and Prevention (CDC), National Institute of Health (NIH), or World Health Organization (WHO) websites to read the current public-facing guidelines on healthy living, news articles on health discoveries or advancements, or toolkits for doctors, nurses, and community health workers. But let's say we wanted to go deeper and read original research or even find surveillance reports. Where would we look for these types of ? And what do we need to know about research processes to understand this type of information? In this chapter we'll go over the "infodemic" of health misinformation, the nuances of public health research, where to access trustworthy information, and how to understand it better.

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5.2: Public Health and the Fight Against Misinformation

One of the essential public health services is to inform, educate, and empower communities and individuals about their own health. But what should be done if other sources are putting out conflicting and potentially harmful information? Being barraged with confusing and conflicting information can cause people to lose trust in public health agencies, and they may resist complying with public health guidance or policies. To add to the noise, some individuals use conspiracies and purposeful disinformation for their own gain - to sell books and supplements, or to increase their followers on social media and podcasts for ad revenue. Public health now has a new epidemic to address: the “infodemic” of misinformation.

It is important to define the types of incorrect information shared by whether or not there is a clear intention to mislead the public. The term “misinformation” is an umbrella term that includes errors in the interpretation of data, research, or messaging, or perhaps information that was considered accurate and true at one point in time, but which has since been discovered to be false. Misinformation may be believed and shared naively. Disinformation on the other hand is a type of misinformation which is shared intentionally and with an ulterior motive - which could be for social, political or financial gain. However, it is difficult and sometimes dangerous to assume the intentions of whomever is sharing. Unless the intentions of the sharer are obvious and nefarious, we should use the term misinformation to give them the benefit of the doubt (Swire-Thompson & Lazer, 2020).

Historically, erroneous health messaging ranged from the classic “snake-oil salesman”of the 19th century, to the invention of Coca-Cola as a tonic for a variety of health complaints (the original version had cocaine in it), to doctors promoting the health “benefits” of smoking in cigarette advertisements. In 1998, a well known “infodemic” ensued after two scientific publications in the Lancet proposed a link between the measles, mumps, and rubella (MMR) vaccine and Autism Spectrum Disorder (ASD). The papers were subsequently critiqued and found to be faulty, the Lancet retracted them (albeit nearly a decade later), and the author - Dr. Andrew Wakefield - was stripped of his medical license - although he continued his anti-vaccine messaging on any platforms that would host him. A plethora of different studies were subsequently done that refuted the link between vaccines and ASD. Yet, this misinformation began to spread across the globe and was endorsed by celebrities, causing parents to delay or decide not to vaccinate their children at all. And eventually, this had an impact on population health outcomes. Even though measles had been declared eliminated in the U.S. in the year 2000, vaccine hesitancy led to several measles outbreaks over the next two decades (DeStefano & Shimabukuro, 2019).

More recently, misinformation and conspiracy theories about the SARS-CoV-2 virus, the COVID-19 vaccine and other public health measures such as lockdowns and masking were virulently spread; primarily online via social media, but occasionally also picked up in mainstream media like TV news channels and news publications as well. The original conspiracy theories were most often associated with extreme political ideology (at both ends of the spectrum). Yet as they were picked up by celebrities, podcasters, and content creators, they became more mainstream in the public consciousness. Many of these theories were overtly or covertly racist, and beyond expressing a general distrust of science and public health, they inferred that public health measures were the result of corrupt political agents (Walter et al., 2023). With the rapidity of internet and social media communication misinformation has the opportunity to change population behaviors, eventually also muddying political identity and health belief norms (Seymour et al., 2015).

The COVID-19 pandemic was a short term study in how misinformation and politicization of health beliefs can have a significant effect on population behaviors. The novelty of the virus and shifting guidance from government health agencies did not bolster public confidence in official messaging, which created a prime environment for conspiracy theories to grow. Combined with generalized anxiety about the virus itself, it’s no wonder that there was a significant loss of trust in public health agencies and more broadly, in science as well. Combined, misinformation and lack of trust in public health agencies had a direct effect on individual behaviors. Violent confrontations occurred around masking requirements (Hutchinson, 2020), and later vaccine requirements at workplaces became equally controversial (Bardosh et al., 2022).

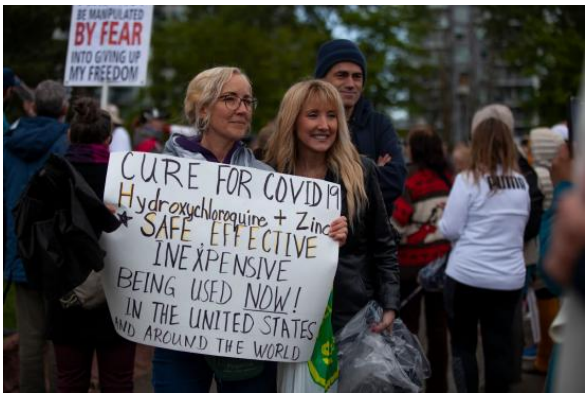


Figure 5.2.1: COVID-19 Anti-Lockdown Protest in Vancouver, May 3rd 2020. Photo credit: GoToVan from Vancouver, Canada. (Copyright; CC BY 2.0, via Wikimedia Commons.)

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5.2.1: Internet, Social Media, and the Age of Algorithms

As we might already assume, most people get health information via internet sources in the 21st Century. When faced with a new symptom or health decision, the first action is often a simple internet search. Which websites top the results list may be determined by advertising dollars, or by search engine algorithms that tailor results to the person's past search history. Further direct-to-consumer advertising by medical and pharmaceutical companies can be a result of a search, viewing a website or post on social media. These algorithms and targeted ads may affect our health decisions far more than we realize (Stark & Fins, 2013).

Algorithms also affect our social media experience. Although a user may initially choose whom to follow, social media platforms will typically recommend similar pages based on that individual's use data. User-generated content can be quickly shared with a broad audience, often without the identification of the original source or any verification of the information. And social media platforms are often used to spread an ideology or sell products. Take, for example, the anti-vaccine sentiment after the COVID-19 vaccine rollout. It was discovered that a majority of the anti-vaccine misinformation posts on social media sites Facebook and Twitter were created by the same 12 individuals (many of whom had been sharing health disinformation for years already) (Bardosh et al., 2022). When these posts garner equal - if not more - attention in the media than posts from reputable sources, misinformation spreads farther and faster than correct information. Similar to the analogy of attempting to put out a million small fires at once, it can be difficult to combat this type of misinformation with well-researched rebuttals in a timely fashion. As a result, it is still left up to the viewer to do the due diligence of validating the information presented to them, which is often a more lengthy task than most people are willing to take on.

As humans, we already struggle with a variety of cognitive biases that cloud our decision-making. Availability bias (more of "it" must make it true), confirmation bias (searching for evidence to support what we already believe), and overconfidence bias (feeling we know more than we do), are all exacerbated by the social media and search engine algorithms (Stark & Fins, 2013). Our "engagement" with certain posts is tracked, and we are subsequently fed similar posts - thus cementing our own personal "reality bubble". With the advent of readily available artificial intelligence the access to information is potentially limitless, but the quality of that information remains malleable by both commercial interests and machine learning algorithms.



Figure 5.2.1.1: (Copyright; Photo by Sara Kurfeß on Unsplash)

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5.3: Public Health Messaging

So how do reputable sources get correct information out to the public? How can government agencies and scientific communities regain and maintain the public trust?

Many of the government organizations described in Chapter 4 maintain public-facing websites, describing their work, policies, news reports, and guidance developed from that work. Some agencies maintain social media pages as well and provide traditional media with press releases on emerging health concerns. Several also produce toolkits to aid health workers and educators in their own communications with the public, such as the CDC, WHO, FDA etc. The CDC also posts guidelines, toolkits, and professional development modules to assist health professionals in creating clear and equity-focused communication materials.



Figure 5.3.1: Example of a health communication social media post promoting condom use. (Downloaded from https://www.cdc.gov/sti/php/communication-resources/index.html)

After the COVID-19 "infodemic" surrounding public health measures and vaccine myths spread rapidly, government agencies have recognized misinformation as a significant public health concern. In fact, in 2021 the U.S. Surgeon General released a report summarizing the threat of health misinformation and a call to action for individuals and organizations, stating: "Health misinformation is a serious threat to public health. It can cause confusion, sow mistrust, harm people's health, and undermine public health efforts. Limiting the spread of health misinformation is a moral and civic imperative that will require a whole-of-society effort" (Murthy, 2021). In April of 2022, the CDC launched an initiative to improve their communication practices, including:

- *To provide timely and accurate data to the American public, CDC is working to share scientific findings and data faster by releasing information more quickly with the American public and partners about CDC's current level of understanding of the science and data.*
- *To make science and data easier for broad audiences to interpret, CDC is translating science into practical, easy to understand policy by clarifying and presenting scientific language so that anyone can understand it and standardizing guideline development across the agency.*
- *To help CDC speak in one voice during and across public health emergencies, CDC is prioritizing public health communications by improving how the American public interacts with CDC, including a review of the entire CDC.gov website to assess content and functionality. (CDC, 2023)*

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5.4: Is Science Even Trustworthy?

As information becomes more and more accessible, it can also become more confusing. It almost seems that people can use the phrase “studies say ____” and then insert whatever factoid they want to be true. This line works in sales pitches for everything from mattresses to coffee, online arguments for “*which diet is best”*, and of course starting new drama at the family gathering over the effectiveness of vaccines. To be fair, if a person has access to Google they may be able to dig up a random research article that “proves” their point, no matter what that point is. But do we really know if it is quality research? Or if it's being interpreted correctly? This is where a lot of health “influencers” - and even researchers themselves - can end up spreading misinformation, even with good intentions.

First, let’s be clear that “the science” - or what we should more accurately call scientific consensus - *does* change over time, and it *should*. Scientific consensus is merely what scientists and researchers can mostly agree on, based on the available evidence, at a given point in time. As new research is performed, or new methods of investigation become available, and we learn more about ourselves and the world, the scientific consensus should be updated. A hallmark of the scientific method is that it recognizes the limitations of research and promotes an open mind to learning and testing new discoveries. “Good science” is constantly testing and trying to prove ourselves wrong in as many ways possible before we can consider our conclusions “correct”.

Two ways to ensure that a particular research study is done well are to make sure that the research methods are **valid** and **reliable.** Validity refers to how we are measuring outcomes. Does the testing method actually measure what it is supposed to? Another way to think of validity is the accuracy of an arrow hitting a target. If the test hits the “bullseye” of the target (thing we are trying to measure) consistently, then it is accurate or valid. Most testing methods have to be validated or compared to a “gold standard” - which is the best measurement we have at the time. For example, if we are using the 1.5 mile run to estimate a person’s cardiorespiratory fitness level (CRF), it should have been validated against a VO2max test - which is the gold standard for measuring CRF. All of our study participants who score high on the 1.5 mile run would presumably also have scored high on a VO2max test, and there needs to be ample evidence that the 1.5 mile run score is based on the subject’s ability to perform cardio exercise.

Reliability simply means that the test will give us the same results each time it is used. There are two kinds of reliability: intertester and intratester reliability. *Inter*-tester means between testers, so for example, if we had two coaches at the finish line with the stopwatch measuring the 1.5 mile run, they would get the same results for the same subject. If the test is too subjective or open to interpretation by the tester, we are going to get different scores from different testers, and therefore the test is unreliable in the way it is performed. We should also be able to get the same score by the same tester, if the test is repeated. This is called *intra*-tester reliability. If the same researcher gets a significantly different outcome each time they repeat the test on a subject, then the test itself is not reliable and shouldn’t be used. To use our previous analogy with arrows and the bullseye on a target, a reliable test is one that will cluster all of the arrows closely around the same area. See Figure 5.4.1 for a visual representation of this analogy.

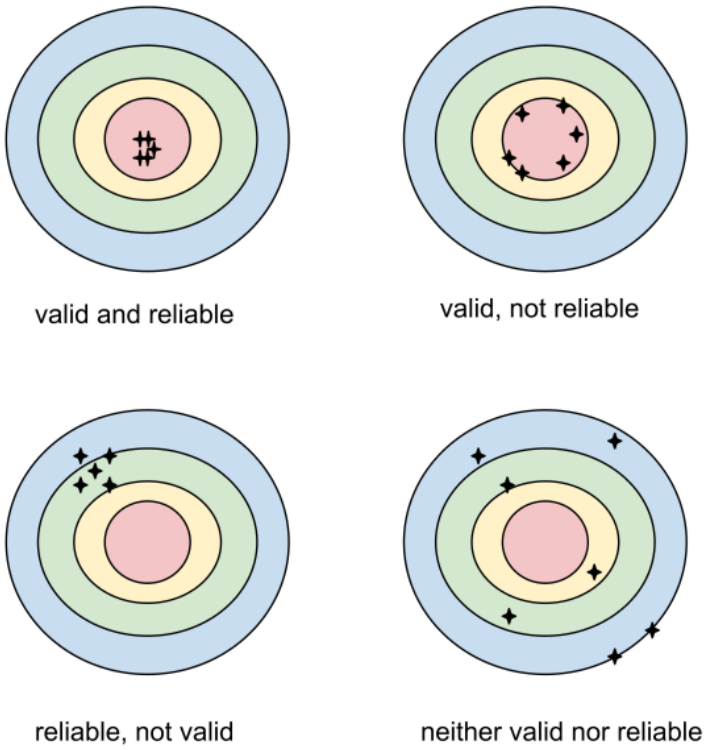


Figure 5.4.1: Validity and Reliability Analogy.

Another requirement for good research lies in the interpretation of the research by the researchers themselves. Researchers are human just like everyone else, and the conclusions they draw from their own studies may have errors. The goal of the **peer-review** process is to try to identify errors and weaknesses in the study methods or in the interpretation of the results and correct those before the study is published. This is one reason why research articles often don't get published for months - or even years after the research study was completed. And even though we have other scientists - the peers of the researchers, who are experts in the area being studied - reviewing their articles before publication, sometimes mistakes still slip through or the conclusions are debated. Scientists often have lengthy debates over the interpretation of research results. Over time, these studies may be repeated, and new studies will be published perhaps providing new insights. Once a lot of research has been done that supports a particular conclusion, often scientists will get together and develop a consensus. This consensus is simply an agreement between the folks who know the most on a particular topic, that they are confident in their conclusions. Sometimes a consensus isn't reached, because there are too many research studies with conflicting evidence, or the evidence is *equivocal* - which means it is open to several different interpretations.

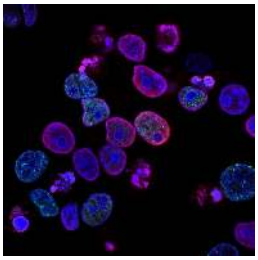


Figure 5.4.2: Human colorectal cancer cells treated with a topoisomerase inhibitor and an inhibitor of the protein kinase ATR (ataxia telangiectasia and Rad3 related), a drug combination under study as a cancer therapy. Cell nuclei are stained blue; the chromosomal protein histone gamma-H2AX marks DNA damage in red and foci of DNA replication in green. , 2014. (Copyright; Created by Yves Pommier, Rozenn Josseauthor via National Cancer Institute on Unsplash)

A historical problem with high-quality research is that it is often behind a paywall. The most reputable scientific journals often require expensive annual professional membership fees from the readers. Sometimes these fees can be overcome during enrollment in higher education, through the college or university's library access to scholarly journals - but then the college or university is footing the bill. Once a student graduates, they no longer have access to these library databases and are forced to pay professional fees in order to have access to a particular journal's current or back issues. Researchers also typically have to pay a fee to submit their research for publication, and peer-reviewers scrutinize their work without compensation. All of these practices amount to an

inequitable “gatekeeping” of information to the professional communities or academic institutions who can afford membership and researchers who can afford publication. In response to this inequity, many publications are becoming *open-access*, or freely available online. While this is a positive response, there are still challenges faced by open-access publishers. In an effort to collect revenue, some have reduced (or entirely eliminated) their peer-review process and require researchers to pay even more exorbitant fees for publication. This calls into question the scientific rigor of these “predatory” publications, even though they are freely accessible. Not all open-access publications are this untrustworthy, but sometimes it is hard for the average internet-surfer to tell the difference. Academics, librarians, and universities across the globe are calling for a revolution of sorts to make high-quality, peer-reviewed scientific research publications free to the public (Resnick & Belluz, 2019).

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5.5: Types of Research Studies - Ecological and Case-Control Studies

The two general types of research studies are either observational or experimental. Observational studies come in many forms, but the researcher is always recording and analyzing information on the subjects - never interfering in any way. This differs from an experimental study, in which the researcher's primary goal is to determine whether a specific intervention causes a measurable outcome or not. Observational studies include ecological, cross-sectional, case-control and cohort (or longitudinal) studies. Experimental studies are often referred to as clinical trials, or randomized controlled trials (RCTs).

Ecological studies are very basic statistical analyses of incidence or prevalence of some disease, risk factor or protective factor within a population or group. These types of studies are helpful in identifying a potentially vulnerable population, and/or the need for more research for particular risk factors. A hypothetical ecological study might find that counties with more office workers also had higher rates of back pain. We couldn't conclude any causation from this type of study though. It could be that office work causes back pain, or it could be that people with back pain change careers so that they can work in an office, or it could be that office workers have better healthcare plans and therefore go to the doctor more often for musculoskeletal issues like back pain… there could be many indirect ways these two things are associated, or there could be no association at all. What if the people who had back pain aren't also those who work in offices? Ecological studies are helpful at generating ideas for populations of interest or possible relationships between risks or protective factors and health outcomes. See Fig 5.2 for a diagram of ecological studies.

Cross-sectional studies are those that take a snapshot of a population at one point in time. This can be imagined similarly to a cross-sectional view of a limb in anatomy; it's almost like you're taking a "slice" of the population and looking at their current prevalence of specific risks or protective factors and health outcomes. A lot of times we may want to do a cross-sectional study to identify a specific need in a population. For example, we might do a cross-sectional study to identify how many office workers in a particular area currently have low back pain. Perhaps we survey these workers or offer a screening at each office location. The difference between an ecological study and a cross-sectional study is that the ecological studylooks at prevalence statistics in groups, whereas a cross-sectional study uses individual data - so in our own hypothetical example we can be sure whether it's the office workers who have the low back pain. See Fig 5.3 for a diagram of cross-sectional studies.

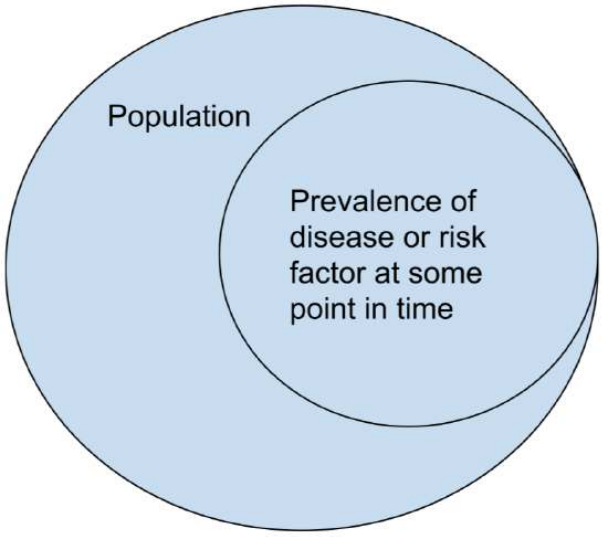


Figure 5.5.1: Cross-Sectional Study.

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5.6: Types of Research Studies - Retrospective or Case-Control Studies

Case-control studies start by identifying a group of people who have experienced a specific outcome, and then look for specific exposures, health behaviors or other factors to try to determine the cause or causes. Looking backwards like this is termed *retrospective*. Although we can perform other studies that are retrospective, case-control studies are always retrospective because they start with the outcome and work backwards. Let's say for example we wanted to find out if smoking was a risk factor for lung cancer. For a case-control study, we would start by identifying cases - perhaps find a group of lung cancer patients at a hospital - and then ask them whether or not they had ever smoked. If we found that a large number of them had smoked, we might think that this indicates that smoking is a risk factor for lung cancer.

But wait - what if lung cancer rates were also high in non-smokers too? This identifies the need for the *control* part of the case-control study. We'll have to find similar people for our control group who *don't* have lung cancer, and ask them if they have ever smoked. If the number of smokers is much greater in the cancer group vs. the non-cancer group, then we might conclude there is an association between smoking and lung cancer after all.

Sometimes a single exposure of any amount is the risk factor, but other times the "devil is in the dose". If there is a *dose-response relationship* between smoking and lung cancer, then those people who smoked more would have a higher risk of lung cancer. So perhaps instead of asking our cases and our controls whether or not they had ever smoked, we would ask them how many cigarettes they smoked per day, and for how many years. We would probably also want to know if they had quit smoking, and if so, how long ago.

There can be many issues that a researcher has to consider when performing a case-control study. We might have a selection bias for example. Perhaps the control group was selected from the same hospital and the controls were exposed to second-hand smoke or air pollution in that city or neighborhood. Perhaps the controls aren't similar enough to the cases in terms of age, sex, socioeconomic status, etc. If we were to compare a young control group with an older case group for example, the younger controls might just not have developed the disease *yet*. Thus, the selection of the controls can cause a bias in the research.

Another issue is that researchers must control for other variables that could influence the outcome instead of the one being studied. For example, if a researcher wanted to find out if coffee consumption decreased the risk of obesity, they might find a case group of individuals with obesity, and a control group of individuals without obesity, and then ask them about coffee consumption. Maybe those people who drink coffee tend to also exercise or eat more pastries. If the researchers do not ask their study subjects about those habits, those could be affecting the person's body weight independent of the coffee consumption. Yet another pitfall is called *reverse causality*; when the variable is actually caused by the outcome. Taking the coffee/obesity example, it could be that people who have obesity often try to lose weight, and may do so by consuming coffee (since it is a mild stimulant). Therefore, it wouldn't be the coffee consumption that had an effect on obesity, but obesity that had an effect on coffee consumption.

Last but not least, all humans tend to have some *recall bias*. As case-control studies often depend on surveys or interviews, it's important to identify which participants might be inclined to remember or not remember certain details, or perhaps fudge some of what they report on a survey. For example, many people overestimate their height and underestimate their weight on self-reported data (Jain, 2010). If the study uses self-reported height and weight to determine obesity, then this data could be inaccurate. When someone has received a diagnosis, they are often "looking" for something in their past that caused it, which might make them more likely to remember specific things that happened to them - simply because they are "looking" through their memory for a cause (Lewallen, 2018).

Case-control studies are often considered simple and inexpensive to perform, since data can be gathered from interviews, surveys, or databases. They can help a researcher develop or confirm a suspicion, and if the study is designed well, they may even allow for an association to be inferred. However, typically they need to be replicated and/or bolstered by other types of studies (like randomized controlled trials) in order for a causal association to be confirmed. Many times, case-controlled studies may actually contradict each other, depending on the methods used and how well the researchers controlled for biases and other variables. It's important to review the methods used, and keep in mind common biases and confounding factors when reading a case-control study article. See Fig. 5.6.1 for a diagram of case-control studies.

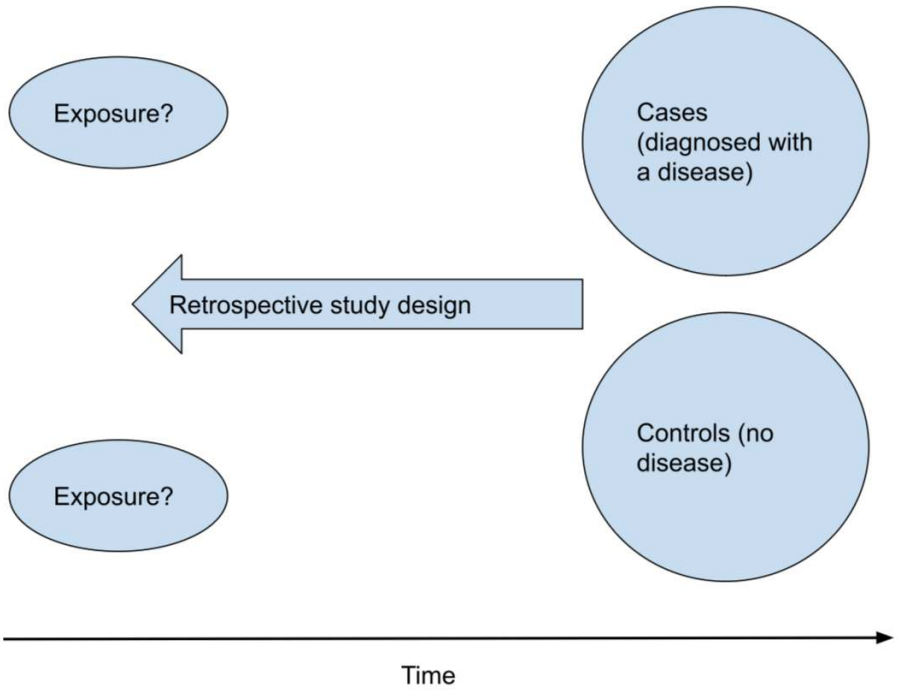


Figure 5.6.1: Case-Control Study

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5.6.1: In Real Life- A Case-Controlled Study

In 2015 there was an outbreak of infants born in Brazil with microcephaly, a devastating condition characterized by an abnormally small head size and severe brain damage. This condition is typically rare, which led researchers to hypothesize that it was related in some way to a Zika virus infection in the mothers during pregnancy. There had been an outbreak in northeastern Brazil of the Zika virus, which is mostly transmitted via mosquitos, but can also be transmitted sexually and from mother to fetus (*Zika Virus*, 2014). The researchers recruited 91 cases (babies born with microcephaly) and 173 controls (babies without microcephaly, born around the same time), and then investigated their exposure to the Zika virus. What the researchers found was a strong association between a Zika infection during pregnancy and microcephaly: 32 of the 91 cases were Zika positive, and 0 of the 173 controls had contracted the disease. The researchers also noted that Zika tests often produce a false negative, so it is likely that many more of the mothers whose babies were born with microcephaly had indeed contracted the virus during pregnancy (Schneider, 2020, p. 63).

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5.7: Types of Research Studies - Prospective or Longitudinal Studies

Cohort studies are often also referred to as longitudinal studies, and these are typically much more expensive and time consuming than other observational studies. In contrast to a case-control study which starts with the health outcome and then looks "backwards" in time for a risk factor, the cohort study starts by identifying risk factors - or exposures - in a group (or cohort) of people and then follows this group over time to see what health outcomes occur. Thus, cohort studies are typically *prospective*, which means tracking data forward in time with follow-up data collection on the same cohort. There are "retrospective" cohort studies, but these still begin with identifying exposures or risk factors from historical data in a particular group, and then following up with this group later on to determine outcomes (Celentano & Szklo, 2018). See Fig. 5.7.1 for a diagram of cohort or longitudinal studies.

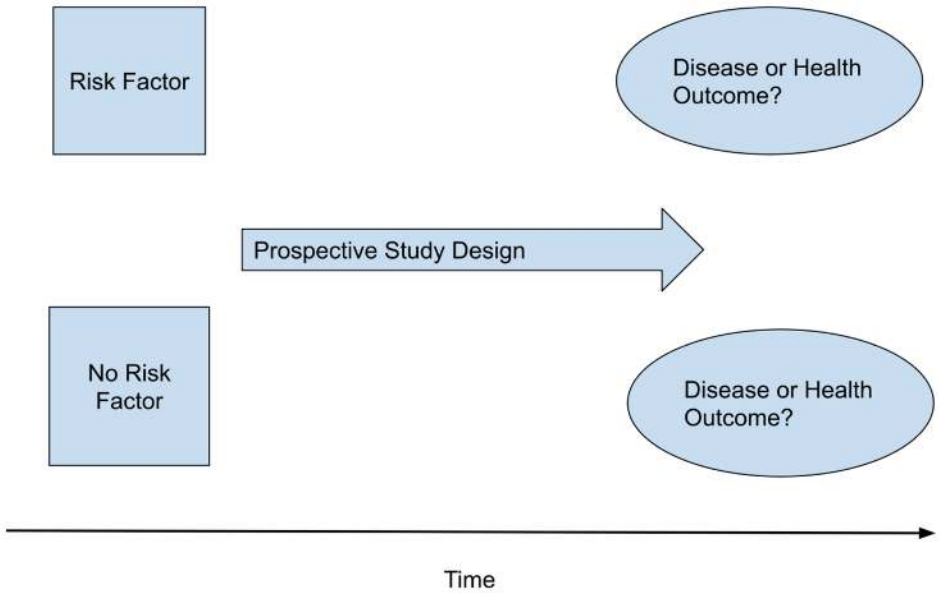


Figure 5.7.1: Cohort or Longitudinal Studies

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5.7.1: In Real Life- A Cohort Study

A classic example of a cohort study is the Framingham Heart Study, which began in 1948 with just over 5,000 participants, and is now gathering data on its 3rd generation of participants. The initial cohort was recruited from the town of Framingham in Massachusetts. These participants received medical exams, lab tests, and provided information on their health history and behaviors at regular intervals over the decades. The researchers then investigated whether any of these measurements or behaviors were associated with an increased risk of cardiovascular disease. This prospective cohort study provided evidence that cigarette smoking, high cholesterol, diabetes, obesity, and physical inactivity are all risk factors for cardiovascular disease - knowledge that has become so mainstream that we often take it for granted now. Over time, new cohorts and metrics were added to the study, to help identify genetic risk factors for cardiovascular disease, osteoporosis, and dementia (National Institutes of Health Office of Science Policy, 2018).

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5.8: Types of Research Studies - Experimental Studies

Experimental research includes interventions and randomized controlled trials or clinical trials. When researchers are testing whether or not a particular health program works, or a particular drug is effective, they use these types of experimental studies. The hallmark of an experimental study is that the researchers are testing a certain metric before and after the intervention to determine whether or not their experimental protocol or drug caused a specific outcome. Studies like these often have three steps: a pre- test, the experimental protocol, and then a post- test.

Interventions are often done to test a drug, medical technique, or health program and see if it can lead to a positive health outcome. Let's take a common public health behavioral intervention like exercise, with a goal of improving a health outcome like reducing blood pressure. In this example perhaps we wanted to find out if offering a free exercise program in a particular community would decrease blood pressure readings in participants. We would test the participants blood pressure before offering the exercise program, offer the exercise program for a number of weeks, and then test blood pressure again at the end of the program. Some of these types of intervention studies are done simply to see if that program is feasible for the community. If it's the very first time an intervention is implemented in a specific community, they might start with a smaller group to test for feasibility. This is called a *pilot study.* Some interventions and pilot studies have control groups as well. For our example, including a control group might require testing blood pressure in subjects in another neighborhood that did not have the exercise intervention. Control groups are a hallmark of well-conducted interventions, because they compare the experiment to a similar situation without the experiment. How do researchers know that the outcome wouldn't have happened anyway without their experimental intervention? The control group provides that comparison.

Randomized controlled trials (RCTs) are a type of experimental study/intervention which is considered the highest level of research in determining cause and effect. This is for several reasons. First, by randomizing the selection of subjects, this removes selection bias and assumes that the subject pool (experimental group and control group) will be as similar to each other and the general population as possible. Second, RCTS have a control group, or perhaps a placebo group. Third, a controlled trial attempts to "control" the study for as many potentially confounding variables as possible. To some extent, this can be done after the fact via statistical calculations, but this can also sometimes be done in the study design. Let's say for example we were measuring weight loss with our exercise intervention. What else could cause weight loss in either our experimental or control subjects? If several of them went on a diet, or started taking weight-loss medications, or did extra exercise outside of the program, these factors could "confound" our results - i.e. their weight changes would be a result of these other things, not the exercise program itself. As the researchers, we would therefore have to take steps in designing the study in order to reduce these confounding factors (such as asking participants not to change their diet or requiring that subjects are not on weight-loss medication in order to be a part of the study). Additionally, many RCTs are blinded or double-blinded, where the participants and/or the researchers are unaware of which participants are in the experimental and control groups. This helps to eliminate researcher bias (as the researchers might unknowingly treat the experimental participants differently), and it also helps to account for the placebo effect. The placebo effect is a real - not imagined - phenomenon of thinking one is taking some sort of treatment for a disease, and actually experiencing a positive outcome (Harvard Health Publishing, 2021). Using a placebo for the control group allows for the possibility of positive psychological effects from receiving treatment to be experienced by both groups. Thus, any additional improvement experienced by the experimental group could be attributed to the treatment itself, not a placebo effect. See Fig. 5.8.1 for a diagram of randomized controlled trials.

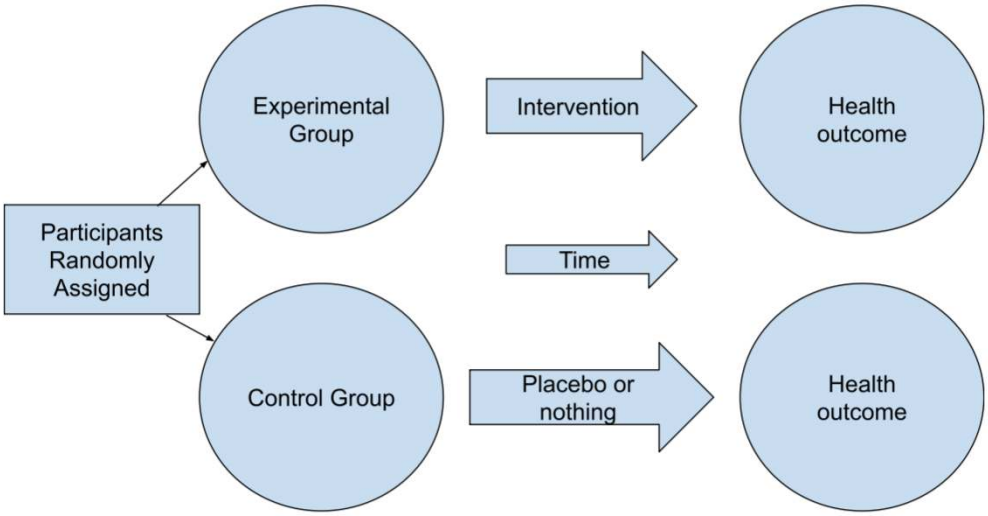


Figure 5.8.1: Randomized Controlled Trial

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5.8.1: Approving Drugs, Vaccines, and Devices

The process used to develop pharmaceutical drugs, medical devices, and vaccines go through rigorous testing steps overseen by the U.S. Food and Drug Administration (FDA). The first phases are the preclinical phases in a laboratory setting, where the drug is developed, then tested on animals to determine absorption, metabolism, and toxicity of the drug. If it is approved for human trials, there are several stages:

- Stage 1: 20-100 subjects with the disease or condition. This stage is crucial to further establish the safety and dosage of the drug.
- Stage 2: Several hundred subjects with the disease or condition. This stage is used to determine the efficacy of the drug and any side effects.
- Stage 3: 300-3,000 subjects with the disease or condition. This stage is meant to further evaluate the efficacy and side effects in a larger population. Very few drugs actually make it to this stage.
- Stage 4: Several thousand subjects. This stage occurs after FDA approval, to continue to monitor the safety and efficacy of the drug (Office of the Commissioner, U.S. FDA n.d.).



Figure 5.8.1.1: A scientist working at the National Cancer Institute. (Copyright; Photo by National Cancer Institute on Unsplash)

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5.9: Where Can We Find Current Public Health Statistics?

Where do the statistics presented by news media and health educators come from? Besides targeted research conducted by the National Institutes of Health (NIH) or universities, there are also a lot of freely available data sources for public health practitioners contained in national, state, and county records. The primary source of national public health information and data is the Centers for Disease Control and Prevention (CDC), an agency of the U.S. Department of Health and Human Services (HHS). Local public health departments may also provide reports to the public on outbreaks and health concerns, research, programs, and health services.

Vital statistics are public records like birth certificates, death certificates and marriage licenses or divorce filings. These get reported to the county clerk and are often a baseline source of data to determine population health status. Each of the 50 states, plus 2 individual cities (New York and District of Columbia) along with the 5 U.S. territories (Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands) are responsible for collecting and maintaining these records. The National Center for Health Statistics (NCHS), which is a part of the CDC, tracks these vital records from each state/territory and produces statistics and reports housed in the National Vital Statistics System (NVSS). Data, graphs and charts, and more detailed reports are available to the public online. For example, we can find data on death rates and causes of death for the previous year, statistics on birth rates for women of different age groups, and reports on life expectancy by state (*NVSS*, 2023).

Certain diseases are classified as *notifiable diseases*, requiring doctors, labs, and healthcare workers to report them to health officials. This system of disease surveillance is used to track epidemics and can be a source of data for epidemiologists to use in determining attack rates (more on epidemiology in the next chapter). The list of notifiable disease changes as novel diseases are discovered and older diseases are managed or eradicated. Some diseases or conditions require immediate investigation and response (like foodborne disease outbreaks) and others can be reported on an annual basis (like cancers). This data is collected and managed by the National Notifiable Diseases Surveillance System (NNDSS), another division of the CDC (Seabert et al., 2021, p. 66). As a way to determine its priorities for health investigations and research, the CDC publishes a weekly report called the Morbidity and Mortality Weekly Report (MMWR). You can find these reports published online at www.cdc.gov/mmwr.



Figure 5.9.1: (Copyright; Photo by Clay Banks on Unsplash)

The NCHS is also the hub for several national health surveys.

- The National Health Information Survey (NHIS) has been conducted continuously since 1957 and it provides the largest in-depth cross-sectional analysis of population health. The NHIS consists of an interview-style survey which is updated every 15-20 years, and is administered to randomly sampled households in all 50 states. Individuals not included in these samples are those incarcerated, those residing in long-term care or nursing homes, and those without housing (*NHIS*, 2022).
- In the early 1960s the National Health and Nutrition Examination Survey (NHANES) began as a project of the NCHS and has continued ever since. This survey includes an interview as well as medical, dental, and physiological assessments conducted on a nationally representative sample of 5,000 people. The data from this survey can be used by epidemiologists to research different diseases and health risks, as well as dietary habits. This project has also helped to develop specific health measurement

standards, such as healthy and hypertensive blood pressure ranges. Results can also inform policies and programs to improve health outcomes.

- For adolescents, the Youth Risk Behavior Surveillance System (YRBSS) tracks specific health behaviors and conditions for students in grades 9-12. Things like sexual activity, mental health, nutrition, physical activity, tobacco use, and social experiences are measured. This survey is conducted both at the national level and the state and local levels as well. As of 2021, surveys have been conducted for over 5 million adolescents. These data help to inform not only epidemiologists but also educators and lawmakers in how to support the health of youth. An example project developed from the YRBSS is the CDC's *What Works in Schools*, designed to help reduce risky sexual behaviors and teen pregnancies (*Youth Risk Behavior Surveillance System (YRBSS)*, 2023).

Local reports, disease surveillance, vital statistics, and national surveys comprise a basis of data from which epidemiological work can be done. In the next chapter, we will discuss epidemiology - i.e. the study of epidemics - and how epidemiologists work to discover trends, causes, risks and protective factors for different types of health issues.

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5.10: Summary

Summary

One of the important roles of public health is to communicate accurate and up-to-date health information to the public. Now more than ever, it is apparent how easily misinformation can spread quickly and change human behavior, eventually causing harm. This “infodemic” also promotes distrust in public health agencies and science in general. Well-conducted research and clear communication are essential tools in the battle against misinformation and supporting public health.

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CHAPTER OVERVIEW

6: Epidemiology

Learning Objectives

- Demonstrate the use of basic epidemiological methods, such as the analysis of rates, and the definition of cases, population at risk, risk factors, incidence, prevalence, natality, morbidity, and mortality.
- Outline strategies for prevention, detection and control of infectious conditions and chronic disease.

6.1: Introduction
6.2: Epidemiologic Triangle
6.2.1: Case Study- COVID-19
6.2.2: Other Applications
6.2.3: Case Study- The Haddon Matrix and Motor Vehicle Accidents
6.3: Vital Statistics
6.4: Life Expectancy and Leading Causes of Death
6.4.1: The top 10 leading causes of death for Americans in 2023
6.5: Incidence vs. Prevalence
6.6: Surveillance
6.7: Notifiable Diseases
6.7.1: 2023 National Notifiable Conditions (Historical)
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6.8: Rates
6.9: Hypothetical Case Study- Foodborne Illness Outbreak
6.10: Outbreaks and Epidemics
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6.11: Summary and Interview With an Epidemiologist
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6.1: Introduction

Epidemiology is the study of diseases, health-states, and health outcomes. Epidemiologists are especially interested in how diseases and conditions are distributed throughout populations, and finding those factors that increase or decrease the risk of a particular disease - or in fact actually cause the disease or condition. The word “epidemiology” comes from the Greek word “epidemia”, which means the “prevalence of a disease”. So naturally those studying diseases have a lot of questions, such as:

- Does a disease affect one population more than another? Do the number of people affected increase or decrease over time?
- What are the associations between biological factors, exposures to pathogens or toxins, the environment, and behaviors that could influence disease states and health outcomes?
- Are there ways to increase the average lifespan and make those years healthy and enjoyable?
- Can we still identify and stop a disease or condition from hurting more people even if we don’t know the exact cause?

All of these questions - and others - spark the curiosity of someone interested in epidemiology. Historically, epidemiology was first used to help identify causes and risk factors for infectious diseases. This is still an essential role for epidemiologists around the world, especially as we experience new and re-emerging contagious diseases. However, chronic diseases, behavioral health problems, injuries, and violence are now also studied using epidemiology techniques. In this chapter, we’ll go over some of the basic tools that epidemiologists use to understand health problems, and potentially how to solve them.

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6.2: Epidemiologic Triangle

Like the early epidemiologists, let's start by looking at infectious diseases. If we're trying to understand a certain infectious disease, we need to know the factors that lead to a person's contracting it. The epidemiologic triangle is a good visual representation of the different factors required for an infectious disease to spread. There has to be some sort of pathogen that causes the disease - this is called the "agent". This agent is usually one of the following pathogens: bacteria, virus, fungi, protozoa, or prion (we'll go over these pathogens more in another chapter). This agent has to have a host in order to cause disease in that host. Assuming we are worried only about human hosts (not animals at this point), their risk and severity of disease is influenced by many factors, including their age, sex, susceptibility, immune system function, and other diseases or conditions that they might already have. The third corner of the triangle is the environment, and how it may encourage or discourage disease transmission. If the disease is transmitted through a vector (like a flea, tick, or mosquito bite, or another animal bite), then a fourth factor could be added to the middle of the triangle. The epidemiological triangle helps to identify questions that need to be answered in order to help prevent the spread of infectious diseases. See Fig. 6.2.1 for some examples.

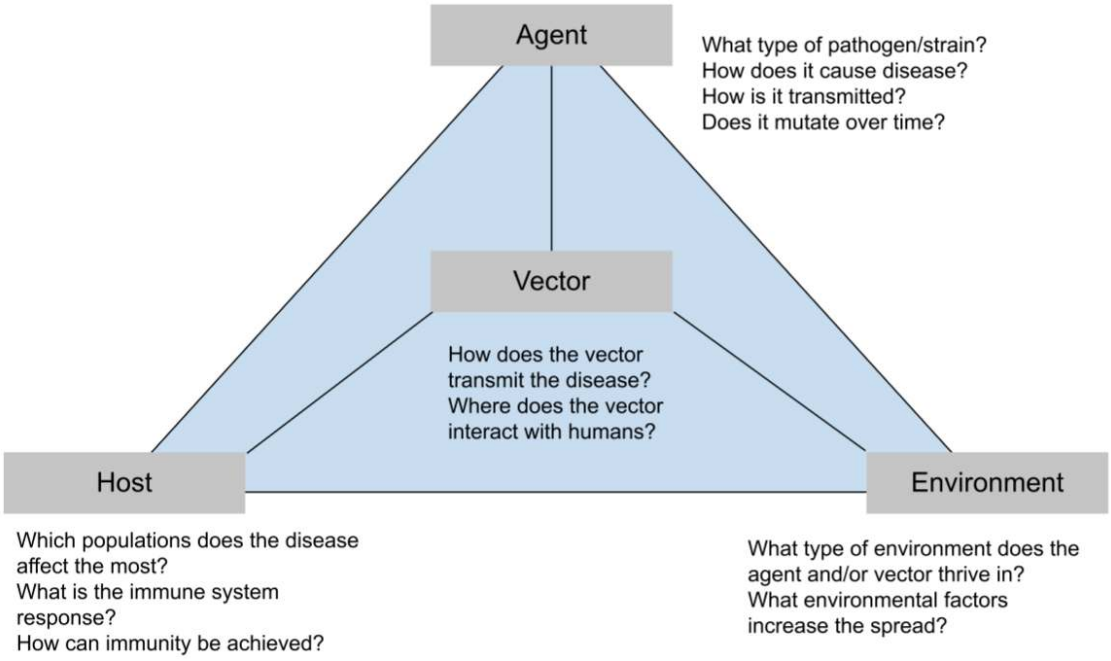


Figure 6.2.1: The Epidemiologic Triangle

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6.2.1: Case Study- COVID-19

Let's use a recent example of a pandemic - which is a worldwide outbreak of a specific infectious disease. In 2019, a novel (new) virus, SARS-CoV-2, was discovered that caused an acute respiratory disease, which was named COVID-19. The agent in this case was SARS-CoV-2, the host was humans (although the virus was originally thought to come from bats, which would also make it a zoonotic disease with bats being the reservoir), and the environment was any place where aerosols (tiny air droplets containing the virus) could be transmitted from an infected person to others. Strategies to prevent the spread and reduce the harmfulness of the disease could be taken at different points on the triangle, and even at the interactions between two points. For example, one strategy to reduce community spread that addresses the risk of the host (agent-host interaction) is vaccination. If the host has developed acquired immunity to the virus, it is less likely that they will experience significant illness. Another community strategy that interrupts the environment-host interaction is social distancing or gathering outdoors in open air, which dilutes aerosols and increases the distance the infected air must travel to reach others. Yet another strategy to create a less hospitable environment for the virus is to wear masks or increase airflow and filtration. Hospitals were particularly concerned about these measures since many people with severe COVID-19 were being treated in hospital settings, and the medical process of intubation (performed on the sickest) releases a lot of viral aerosols into the air. See Fig. 6.2.1.1 for an adaptation of the epidemiological triangle as applied to COVID-19 and hospital procedures (like intubation).

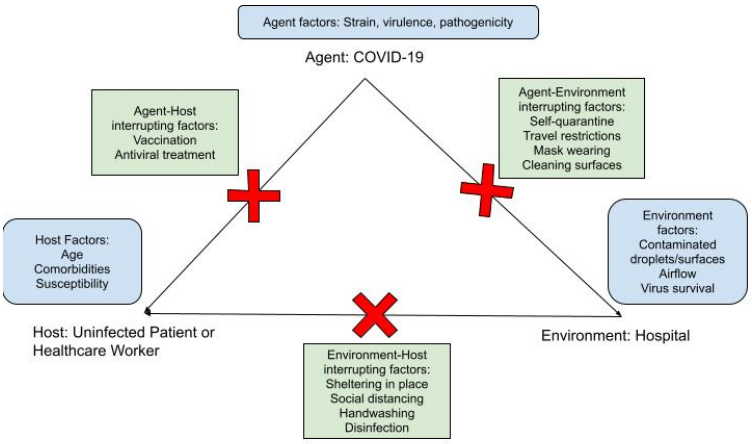


Figure 6.2.1.1: Epidemiological Triangle for COVID-19 risk mitigation in community and hospital settings, as well as when performing medical procedures such as intubation which release aerosols (AGMP = aerosol generating medical procedures). Adapted from (Tsui et al., 2020).

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6.2.2: Other Applications

Consider how we might organize an epidemiological triangle for another infectious disease. We would need to learn the answers to several questions: What kind of pathogen is the agent? How does the disease get transmitted between humans? What type of environment is hospitable to the agent or increases the likelihood of transmission? What characteristics of the host make them more susceptible to disease? These factors help epidemiologists and policymakers develop policies, interventions, and harm-reduction strategies for different outbreaks.

Now consider how we might apply the epidemiological triangle to something other than an infectious disease. What about a disease caused by an environmental exposure such as radiation or lead? What about diseases caused by alcohol consumption, or cigarette smoke? Or what about traumatic injury or violence? Each of these could fill the role of the “agent”. And each of these epidemiological triangles would have different agent, environment and host factors.

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6.2.3: Case Study- The Haddon Matrix and Motor Vehicle Accidents

William Haddon Jr. was a prominent accident and prevention researcher in the 1960's and 70's, and became the first director of the National Highway Traffic Safety Administration (Associated Press, 1985). He developed a matrix using the epidemiological triangle and integrating the concepts of primary, secondary, and tertiary prevention (discussed in Chapter 3). Applying these concepts to an automobile crash, we can create an epidemiological triangle with points for human factors, vehicle factors, and environmental factors. Thus, there are factors that influence the likelihood and severity of injuries at phases before, during, and after the crash - which Haddon titled pre-event, event, and post-event. An example Haddon matrix can be seen in Table 6.1.

Table $PageIndex(1)$: Example of a Haddon Matrix. Adapted from Contributors to Wikimedia projects. (2022, April 9). *Haddon Matrix*. Wikipedia.

Phase	Human Factors	Vehicle Factors	Environmental Factors
Pre-Crash	Information Attitudes Impairment Police Enforcement Attention	Vehicle condition Lighting Braking Tires Speed control	Road design Speed limits Pedestrian accommodations Weather
Crash	Impaired driving Seatbelt wearing	Airbags Seatbelts Other safety devices	Guard rails/road safety barriers
Post-Crash	First aid skills EMS response	Access to passengers Fire risk	Rescue facilities/hospitals Traffic

At each phase there are strategies that could be applied to adjust these different factors in order to improve safety and reduce injuries. For example, educational campaigns can remind people of the risks of texting while driving, and rideshare and taxi service availability can reduce the incidence of impaired people getting behind the wheel - which could address human factors pre-crash (perhaps preventing a crash from occurring at all). Vehicle factors could begovernment regulations requiring seat belts, airbags, windshield wipers, and antilock brakes, or the crash-test safety ratings on that particular make and model could affect both the ability of the driver to avoid a crash and how much impact is absorbed by the driver and passengers if there is one. Environmental factors could be addressed with the design of the roads, including median barriers (to separate opposing traffic), speed limits, traffic signals, and pedestrian bridges or walkways. And the access to an efficient emergency response system along with the distance to a hospital could affect how well crash injuries can be treated, and lives can be saved.

Public health initiatives can focus on one particular factor in the triangle or perhaps several at once. But in order to understand these problems and factors, we need data - and gathering and analyzing data is at the core of epidemiological work.

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6.3: Vital Statistics

Some of the primary types of data that epidemiologists track are births and deaths. In many countries, these aptly named **vital statistics** are recorded by the government. In the U.S., hospitals and health professionals are required to report both births and deaths, as well as many different diseases and conditions (see Notifiable Conditions below), and most state departments of public health house these documents, along with marriage and divorce records. Birth and death certificate forms filled out by the healthcare professional also include some information pertinent to epidemiology; such as demographics, information about the parents, pregnancy and birth for birth certificates, and cause of death (and sometimes factors related to the cause) for death certificates.

There are some important terms used in tracking these vital statistics. The first might be natality, or the birth rate. **Natality** refers to the number of live births in a given time period relative to the number of people in a particular population. Fertility rate refers to the number of live births per number of women in the population of childbearing age, which is typically considered 15-44. Pregnancy and birth is possible outside of that range, but much more rare (National Vital Statistics System, 2023a). Natality and fertility of a specific population or comparisons over time can provide information whether or not a population is growing, what resources might be needed (i.e. for maternal and infant care), and changes in family planning or contraception use trends.

Mortality refers to the death rate for a particular population, disease, or condition being studied. Of course death is the 100% predictable end of every human life, but when and how death occurs is influenced by a variety of factors - some of which can be changed. **Morbidity** refers to the disease or condition rate - typically expressed as incidence (new cases) and prevalence (current cases). Studying the morbidity and mortality rates of different diseases or conditions can inform where public health efforts need to focus the most. For example, if the population in a specific neighborhood has a higher rate of cancers, that might prompt an investigation of environmental exposures to cancer-causing toxins (carcinogens) in that area. Or if one racial demographic has higher mortality rates from a specific disease than the overall average, perhaps outreach, healthcare access, and screenings for this group may need to be improved in order to catch the disease earlier, and provide better treatment options. The goal of public health related to morbidity and mortality is to extend the years of healthy life for all people, and reduce or eliminate preventable causes of disease, disability, and death.

One of the biggest factors related to increasing risk of death from any cause is age. The older we get, the higher the risk becomes. Therefore, mortality rates for a particular population may not always be comparable to another population due to age differences. For example, if we compare mortality rates in Florida to those in Alaska, it might seem that Florida has a substantially higher mortality rate. However, Florida is also home to many people over the age of 65, which could skew their death rate to be higher, due to more deaths occurring in aging populations. In 2020, older adults made up over 21% of Florida's residents, and only 13% of Alaska's. Instead of using the "crude" or absolute mortality rate then, an **age-adjusted** mortality rate will more accurately reflect these outcomes between different populations (Seabert et al., 2021). Age-adjusted mortality rates attempt to control mathematically for these differences and allow for the comparison of mortality rates between different populations. The mathematical methods used to calculate age-adjusted rates are beyond the scope of this text, but it is important to understand what these terms mean when comparing vital statistics.

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6.4: Life Expectancy and Leading Causes of Death

One of the metrics used by epidemiologists to measure the overall health of a population is the average life expectancy. Life expectancy is simply how many years on average a person could expect to live at a given age. If a person was born in this year, how many years would it be expected that they would live? What if they are already 20 years old, or 45, or 65? This life expectancy changes over time depending on which diseases or conditions are the leading causes of death and what age group they tend to affect the most. We can compare life expectancy over decades and determine if we are moving toward longer average lifespans for the population of a specific country or region. We can also compare the life expectancy across different populations - such as gender, race, socioeconomic status, or geographical area etc. in order to identify health disparities that affect people of these different groups. This might help us identify the causes of those disparities, in order to come up with preventative measures that could extend the lifespan for everyone.

The most common diseases leading to death have changed over the last century. In the early 1900s the leading causes of death were infectious diseases like pneumonia, influenza, tuberculosis, and diarrheal diseases, with heart disease (a chronic disease) coming in at the 4th leading cause of death. Infectious diseases are spread between people and can cause death at any age, although the very young (under 5 years old) and older adults tend to be the most at risk. By 1940, this trend had shifted, putting heart disease and cancers at the top and infectious diseases further down - with pneumonia, influenza at #5 and tuberculosis at #7. In 2017, heart diseases, cancers, unintentional injuries (accidents), and chronic lower respiratory diseases were the top 4 leading causes of death. Chronic, noncommunicable diseases like heart disease, diabetes, cancers and COPD are not spread between people (you can't catch this type of disease like a cold), and they tend to progress over a long period of time - even several decades - which also means that increasing age is a risk factor. Another key feature of chronic diseases is that there are often lifestyle behaviors like nutrition, physical activity, and smoking and environmental factors like exposure to toxins that contribute to their development. Although both chronic diseases and infectious diseases have been leading causes of death over the last century, chronic diseases have certainly begun to outpace infectious diseases up until the COVID-19 pandemic (PPI, 2016).

Average life expectancy takes into account all deaths - those at young ages, middle ages and advanced ages. Chronic diseases will be more likely a cause of death at advanced ages, since these diseases take a long time to develop and cause harm. In the early 1900s, the average life expectancy was around 47 years, but that average was likely skewed due to the high infant and child mortality rates experienced from infectious diseases like tuberculosis and pneumonia. Advances in nutrition, urban sanitation, vaccine and antibiotic development from the 30s to the 60s significantly changed the life expectancy of children and infants, thus also pushing the average life expectancy upward (PPI, 2016).

In 2021, the average life expectancy for all U.S. citizens was 76.4 years, which is a decline from 2020 (77 years) (Arias et al., 2023) and 2019 (78.8) (Arias, Ph.D & Xu, M.D., 2022). The major event causing this shift in average life expectancy was the COVID-19 pandemic, which was a major cause or contributed to 385,676 deaths in 2020 and 463,276 deaths in 2021 (*NVSS - Provisional Death Counts for COVID-19*, 2023). This made COVID-19 the third leading cause of death for both of those years (*FastStats*, 2023).

In 2023, COVID-19 deaths dropped to the #10 leading cause of death. For many years heart disease and cancers have been the #1 and #2 leading causes of death for Americans. The list of top 10 causes of death as of 2023 is below, along with a chart in Figure 6.3 based on provisional mortality data from the NVSS.

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6.4.1: The top 10 leading causes of death for Americans in 2023

- Heart disease
- Cancers
- Unintentional injuries
- Stroke
- Chronic lower respiratory diseases
- Alzheimer disease
- Diabetes
- Kidney disease
- Chronic liver disease and cirrhosis
- COVID-19

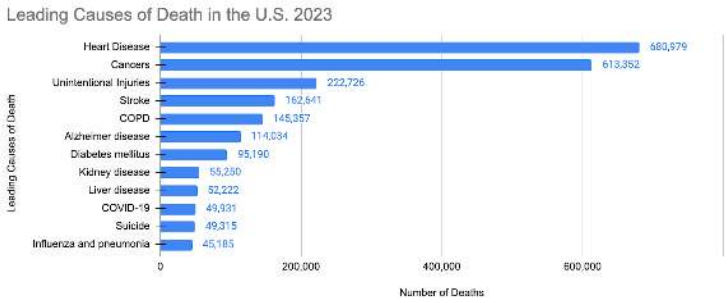


Figure 6.4.1.1: Leading Causes of Death in the U.S., 2023. Adapted from Centers for Disease Control and Prevention, National Center for Health Statistics. National Vital Statistics System, Provisional Mortality on CDC WONDER Online Database. Data are from the final Multiple Cause of Death Files, 2018-2022, and from provisional data for years 2023-2024, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/mcd-icd10-provisional.html on Aug 6, 2024.

Deaths at younger ages may be more concerning from a public health standpoint, since many of these deaths are below the average lifespan typically expected, and therefore they may be preventable. Those years lost from an early death include a loss of physical, emotional, and financial support to that individual's family, and friends. That persons passing leaves a hole in the social fabric of their community. And, although it may seem trite to mention, there is also a significant economic impact from early deaths. The **years of potential life lost** or YPLL is another calculation used by epidemiology to express the number of deaths at younger ages, and the impact that those younger deaths have on the population. This YPLL is the difference between the age of deaths and a "standard year" of death - which is often set somewhere between 65-75 years of age. For example using the higher number, a child's death at 5 years of age would have a YPLL of 70, whereas an older adult's death at age 65 would have a YPLL of 10. Deaths above the standard year are not counted. It's important to know the standard year used for this calculation, and why that particular number was chosen. This metric can be used for a specific disease, condition or a population. This calculation can be used to help focus public health efforts on preventing diseases with the greatest impact to younger populations (Seabert et al., 2021).

Sometimes the YPLL can also provide a more complete picture of the impact of a disease or condition than just the mortality rate alone. A great example of this is not a disease at all, but rather fatal accidents and violence - which tend to impact younger age groups the most heavily. Unintentional injuries (including car accidents and drug overdoses), homicide and suicide are leading causes of death for youths between 15-19 years of age (*FastStats*, 2023b). If we look at the data for unintentional injuries in 2021 overall, there were 224,935 deaths due to unintentional injuries. This equates to a crude (unadjusted) rate of 67.77 per 100,000 people, and an age-adjusted rate of 64.67 per 100,000. The age adjustment doesn't have a large effect on the mortality rate, likely due to the fact that unintentional injuries are a leading cause of death for younger age ranges - that is, there isn't an increasing risk of death with advancing age, like there may be with another cause of death like heart disease (which is a chronic disease, and therefore risk of death increases with age). The CDC calculated the number of years of potential life lost in 2021 due to unintentional injuries at 3,781,756 - which demonstrates the significant impact that this cause of death has on American society (*WISQARS Fatal and Nonfatal Injury Reports*, n.d.).

Still other metrics attempt to quantify the impact of chronic disease and disability on populations. Sometimes the term **healthy life expectancy** (HALE) is used to determine how many average years a person can expect to live before experiencing debilitating

effects of chronic disease. This number varies depending on the age we begin counting from, so often HALE at birth is used to determine a lifespan estimate and HALE60 - or healthy life expectancy at 60 years is used to describe the burden of disease and disability on our current aging population. For example, according to data from the World Health Organization, HALE60 in the U.S. in 2019 was 16.35 years - so someone at age 60 in 2019 could have expected to live on average another 16 or so years without disability. In the same year, Canada's HALE 60 was 18.99 years - demonstrating that Canada has a longer HALE60, and perhaps slightly lower burden of disease on their aging population (World Health Organization, 2023b).

Years lost to early death or chronic disease are also sometimes combined with years of life under which a person experiences life-altering disability. This metric is termed **disability adjusted life years** (DALYs), where one DALY equals a year of healthy life lost either to premature death or to disability. The World Health Organization has estimated the top diseases and conditions which are the highest sources of DALYs for countries around the world. In 2019, the leading causes of years lost to premature death and disability included (in order) (World Health Organization, 2023a):

- Ischemic heart disease
- Drug use disorders
- Chronic obstructive pulmonary disease
- Diabetes mellitus
- Neck and back pain
- Alzheimer disease and dementias
- Stroke
- Cancers of the lungs, trachea and bronchi
- Depressive disorders
- Self-harm

This list demonstrates that the leading causes of disability and premature death may not always be the same as the leading causes of death. Using these other metrics like YPLL and DALY allows for epidemiologists to get a fuller picture of not only how long a population is living, but how healthy those years are, and the causes of harm experienced.

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6.5: Incidence vs. Prevalence

When epidemiologists track diseases or conditions, there are two numbers that can express the current effect of the disease or condition on the population. **Incidence** refers to the number of new cases diagnosed during a specific time period. These cases are added to the total number of current cases for a specific disease. The total number of cases at a specific point in time or period of time is called **prevalence,** which counts anyone with a current diagnosed case of the disease. Of course, cases also exit this count when they are cured or deceased. That is why knowing the time component for both prevalence and incidence is very important.

A good way to understand the difference between incidence and prevalence is to imagine you're standing at a riverbank looking at a river. The river itself can represent time, because it is constantly flowing past you. You count the fish that you can see at that point in the river - this is the prevalence of fish at that point in the river. A few yards upstream, you notice a Fish and Wildlife officer dumping buckets of fish into the water. This is the incidence - the number of new fish entering the river. How many of the fish you counted originally had been there for a while? How many had just been dumped in? You wouldn't know whether the fish you just counted had just been added to the river or if they had lived there a long time already. You also don't know how many people are standing on the bank downriver from you with their lines in the water, catching those fish out of the river. If you're assessing a point-in-time prevalence, then all you can see are the fish that you are counting in the portion of the river right in front of you. See Fig. 6.5.1 for a diagram of this analogy.

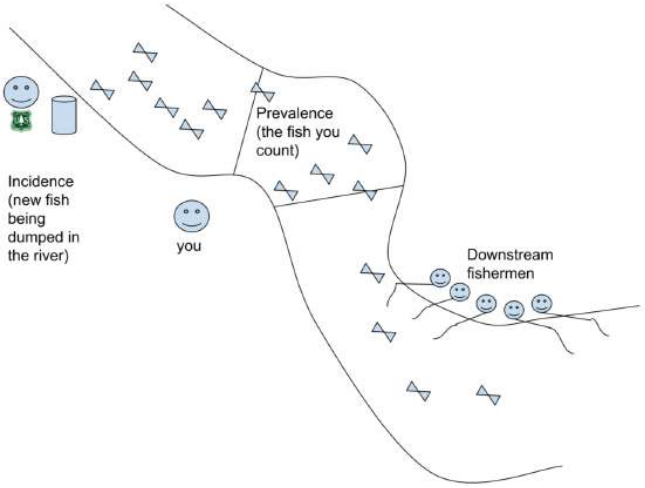


Figure 6.5.1: Analogy of incidence and prevalence as a river of fish.

Another way to think of prevalence is like a pool. Swimmers can enter the pool (get a diagnosis) or exit the pool (disease is cured or patient is deceased). The number that enter the pool in a given timeframe are considered the incidence of that disease. Those that are in the pool in a given timeframe constitute the prevalence. This prevalence is then highly influenced by the severity of the disease and how treatable it is - do patients live with this disease for a long period of time? Does the disease kill its victims quickly? Do we have medicines and treatments that extend the life of those diagnosed? See Fig. 6.5.2 for a visual diagram of this analogy.

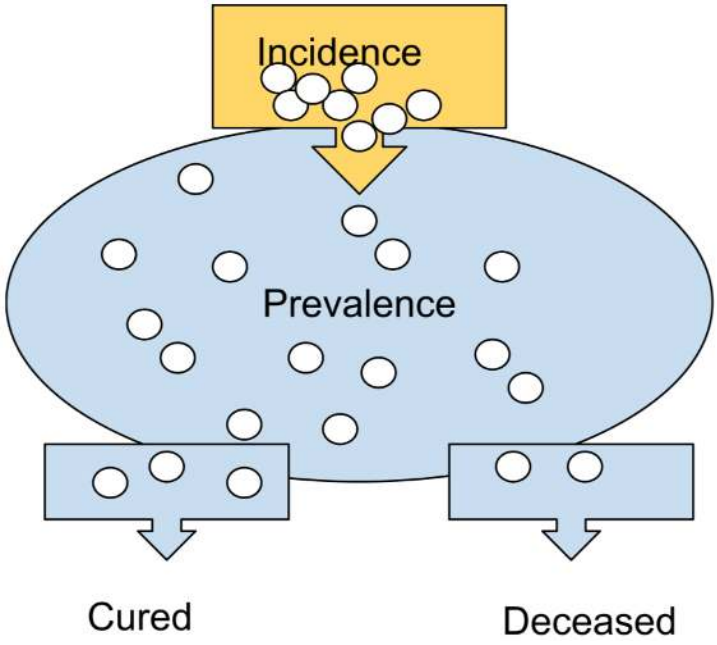


Figure 6.5.1: Analogy of incidence and prevalence as a pool with swimmers.

As an example, let's examine the incidence and prevalence of a chronic disease. In 2021, 1.2 million new cases of diabetes were diagnosed in the United States. Those 1.2 million are the *incidence* for the year 2021. The prevalence of diabetes was estimated at 38.1 million for the year 2021, including both diagnosed and assumed undiagnosed cases (*National Diabetes Statistics Report*, 2023). Diabetes is a chronic disease, in which the body's ability to utilize glucose (sugar) is decreased. This causes hyperglycemia (high blood sugar), which can be damaging to the nervous and cardiovascular systems, and could eventually cause kidney failure. Diabetes is also a risk factor for heart disease. So the prevalence "pool" may be reduced by some cases who are deceased within that year from various causes. Although there is no *cure* for diabetes, many people who have diabetes can manage it, or potentially reduce the severity of the disease with medicines and lifestyle behaviors like diet and exercise - thus essentially going into remission. There is the potential that some cases could exit the "pool" if their blood sugar is managed at below-diabetes levels, and the disease is prevented from progressing.

Knowing the prevalence of diabetes is helpful because we know how many people are currently living with the condition. These people may require treatment, medicine, and ongoing monitoring, and it's helpful to know how to dedicate resources. If the prevalence of a disease gets smaller over time, it can indicate different things. Perhaps fewer people are getting diagnosed with diabetes - so the incidence is decreasing. If the incidence is decreasing and that is causing a decrease in prevalence, then perhaps public health efforts to *prevent* diabetes are working, which would be a positive outcome. Or, another possibility is that less screening is taking place, and therefore more cases are simply going undiagnosed. But let's say that the prevalence is decreasing, but the incidence remains the same - or is perhaps higher than in years past. This could be for different reasons - perhaps more people are dying from diabetes, or it is becoming more difficult to treat. Or perhaps we are finding better medicines to reverse diabetes, but we are not able to prevent it. As this example demonstrates, knowing both the incidence and the prevalence helps an epidemiologist understand the disease better, but isn't enough information alone to identify problems or solutions for a particular disease.

Now let's look at the incidence and prevalence of an infectious disease with a much shorter time frame. Salmonellosis is caused by infection with the *salmonella* bacteria, often caused by eating contaminated foods like undercooked eggs or poultry. Most commonly this infection causes fever, diarrhea and stomach pain within several hours to a few days after exposure. The time between exposure to the pathogen (in this case, bacteria) and the symptoms is called the **incubation period**. Symptoms can last 4-7 days, and some people experience symptoms up to several weeks (*Questions and Answers*, 2023). The period of time when someone can transmit the disease to others is termed the **infectious period**. For this type of disease, knowing the prevalence on some random day of the year doesn't really do us much good. That's because people don't live with salmonellosis for a long time - they usually recover within days to weeks, although they may remain infectious for several months. The prevalence of people with salmonellosis on a Tuesday in March of 2023 doesn't tell us how long they have been sick, or help us identify where they got the infection. But knowing the incidence of salmonellosis over a period of time is very helpful. A rapid increase in the incidence over

the course of several days would indicate a potential outbreak - which would require immediate action to locate the source of contaminated food and prevent anyone else from eating it. It's also valuable to know if there is a year-over-year increasing incidence of salmonellosis, which may indicate that food safety regulations are not effective or being enforced.

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6.6: Surveillance

Surveillance may seem like an ominous term, but it is one of the most important roles of epidemiology. Disease surveillance is simply gathering data from different sources on the prevalence and incidence of different diseases and conditions. This allows health departments to get both a historical and current picture of the health status of the populations they serve. They can use surveillance to support decision making on funding particular research projects, allocating resources for hospitals or different community programs, or responding to outbreaks quickly. This data for metrics other than infectious diseases can also be used to determine if particular targets are being met - such as those set in the Healthy People initiatives.

How is surveillance conducted? Are health officers bugging phones and sitting in stakeouts like an old FBI movie? Disease surveillance originally began with boots-on-the-ground investigation, and in some places this is still the best method. However, new technologies and cutting-edge strategies help health departments keep tabs on the health of much larger populations.

There are two primary ways that health departments can conduct surveillance: active surveillance and passive surveillance. **Active surveillance** is a more traditional method of door-knocking and interviewing residents of a community, or perhaps conducting telephone interviews. This is how surveillance had to be done in the early years. John Snow famously visited houses in the Soho district of London. By interviewing residents in this area, he was able to record the number of cholera cases and deaths, and which houses were supplied by the two major water suppliers. This led him to the discovery that those houses fed water from one company (which collected its water from a particularly polluted area of the Thames river,) had significantly higher rates of the disease. Even though no one knew about the bacteria that causes cholera and how it is spread, there was still enough evidence collected by Snow to convince officials to remove the handle of the Broad Street pump - thereby removing the contaminated water source.

Active surveillance can be more accurate than passive surveillance in detecting each case that has developed over a period of time. It can also help with developing an understanding of community spread and potential sources of spread. However, active surveillance requiring door-knocking and interviews is rarely done in modern times due to the significant financial and personnel costs it requires. Instead, **passive surveillance** is relied on by health departments via reporting of certain diseases that doctors and laboratories come across in practice. For example, a doctor might see a patient complaining of symptoms which the doctor suspects are due to Hepatitis A. The doctor may ask for a stool sample and send that off to a laboratory to confirm results. The laboratory tests the sample and confirms that it is indeed a case of Hepatitis A and reports this case to the local health department, which in turn reports to the state health department and the CDC.

There are a few challenges with passive surveillance - one of them being the fact that not everyone goes to a doctor or clinic for symptoms that they have. Illnesses like influenza are often managed at home, so if a person feels like they have the flu, they won't go to the office and no official case is recorded or reported. Health departments have found other ways to monitor potential increases in influenza, such as gathering data from Google searches for flu-like symptoms - which tend to go up consistently before doctor visits and hospitalizations increase for influenza. A spike in symptom searches may indicate that the flu is spreading in the community among folks who will probably not visit the doctor for themselves, but may spread it to those who will experience more severe illness and end up in the hospital. One way that active surveillance was used most recently during the COVID-19 pandemic was through taking samples of wastewater (sewage) and testing it for the presence of the virus. This allowed for non-invasive testing and tracking for COVID-19, particularly when home-tests became available and fewer people were reporting illness (CDC, 2023). Thus, more modern data collection may allow health departments to utilize active surveillance in more cost-effective ways.

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6.7: Notifiable Diseases

The National Notifiable Disease Surveillance System (NDSS) is a division of the CDC and the hub for reporting and tracking data on specific diseases. If a disease or condition is on the Notifiable Diseases list, it must be reported to the NDSS, thus allowing the CDC to conduct ongoing passive surveillance of many diseases and conditions. Individual states may also have an independent list of reportable diseases as well. The National Notifiable Disease list is updated every year. See below for the list as of 2023 (National Notifiable Diseases Surveillance System (NNDSS) 2021):

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6.7.1: 2023 National Notifiable Conditions (Historical)

- Anthrax
- Arboviral diseases, neuroinvasive and non-neuroinvasive
  - California serogroup virus diseases
  - Chikungunya virus disease
  - Eastern equine encephalitis virus disease
  - Powassan virus disease
  - St. Louis encephalitis virus disease
  - West Nile virus disease
  - Western equine encephalitis virus disease
- Babesiosis
- Botulism
  - Botulism, foodborne
  - Botulism, infant
  - Botulism, other
  - Botulism, wound
- Brucellosis
- Campylobacteriosis
- Cancer
- Candida auris, clinical
- Candida auris, screening
- Carbapenemase-Producing Organisms (CPO)
- Carbapenemase-Producing Organisms, clinical
- Carbapenemase-Producing Organisms, screening
- Carbon monoxide poisoning
- Chancroid
- Chlamydia trachomatis infection
- Cholera
- Coccidioidomycosis
- Congenital syphilis
  - Syphilitic stillbirth
- Coronavirus Disease 2019 (COVID-19)
- Cryptosporidiosis
- Cyclosporiasis
- Dengue virus infections
  - Dengue
  - Dengue-like illness
  - Severe dengue
- Diphtheria
- Ehrlichiosis and anaplasmosis
  - Anaplasma phagocytophilum infection
  - Ehrlichia chaffeensis infection
  - Ehrlichia ewingii infection
  - Undetermined human ehrlichiosis/anaplasmosis
- Foodborne Disease Outbreak
- Giardiasis
- Gonorrhea
- Haemophilus influenzae, invasive disease
- Hansen's disease

- Hantavirus infection, non-Hantavirus pulmonary syndrome
- Hantavirus pulmonary syndrome
- Hemolytic uremic syndrome, post-diarrheal
- Hepatitis A, acute
- Hepatitis B, acute
- Hepatitis B, chronic
- Hepatitis B, perinatal infection
- Hepatitis C, acute
- Hepatitis C, chronic
- Hepatitis C, perinatal infection
- HIV infection (AIDS has been reclassified as HIV Stage III)
- Influenza-associated pediatric mortality
- Invasive pneumococcal disease
- Lead in Blood
- Legionellosis
- Leptospirosis
- Listeriosis
- Lyme disease
- Malaria
- Measles
- Melioidosis
- Meningococcal disease
- Mpox virus infection
- Mumps
- Novel influenza A virus infections
- Pertussis
- Pesticide-related illness and injury, acute
- Plague
- Poliomyelitis, paralytic
- Poliovirus infection, nonparalytic
- Psittacosis
- Q fever
  - Q fever, acute
  - Q fever, chronic
- Rabies, animal
- Rabies, human
- Rubella
- Rubella, congenital syndrome
- Salmonella Paratyphi infection (Salmonella enterica serotypes Paratyphi A, B [tartrate negative], and C [S. Paratyphi])
- Salmonella Typhi infection (Salmonella enterica serotype Typhi)
- Salmonellosis
- Severe acute respiratory syndrome-associated coronavirus disease
- Shiga toxin-producing Escherichia coli
- Shigellosis
- Silicosis
- Smallpox
- Spotted fever rickettsiosis
- Streptococcal toxic shock syndrome
- Syphilis
  - Syphilis, early non-primary non-secondary
  - Syphilis, primary
  - Syphilis, secondary

- Syphilis, unknown duration or late
- Tetanus
- Toxic shock syndrome (other than streptococcal)
- Trichinellosis
- Tuberculosis
- Tularemia
- Vancomycin-intermediate Staphylococcus aureus and Vancomycin-resistant Staphylococcus aureus
- Varicella
- Varicella deaths
- Vibriosis
- Viral hemorrhagic fever
  - Crimean-Congo hemorrhagic fever virus
  - Ebola virus
  - Lassa virus
  - Lujo virus
  - Marburg virus
  - New World arenavirus - Chapare virus
  - New World arenavirus – Guanarito virus
  - New World arenavirus – Junin virus
  - New World arenavirus – Machupo virus
  - New World arenavirus – Sabia virus
- Waterborne Disease Outbreak
- Yellow fever
- Zika virus disease and Zika virus infection
  - Zika virus disease, congenital
  - Zika virus disease, non-congenital
  - Zika virus infection, congenital
  - Zika virus infection, non-congenital

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6.7.2: Cases

Up until this point we might have assumed that the term “case” means that a person for sure has a particular disease. Ideally, this is true - for infectious diseases this means a case is identified by the presence of that pathogen via a lab test. However, if an outbreak occurs, doctors may not always have the time to confirm each case by sending off a biological sample to a lab. Or, as with the influenza example above, people may not visit a doctor’s office and report their symptoms, or perhaps will report their symptoms after the fact - perhaps if interviewed with active surveillance. Often the definition of a case must be outlined by a local or national health department, so that epidemiologists can track suspected, probable, and definite cases more accurately. The most definite cases are those confirmed by a laboratory test for an infectious pathogen or toxic agent. However, a cluster of symptoms may also qualify as a probable case. For example, *pertussis* (whooping cough) is a bacterial infection with the pathogen *Bordetella pertussis*. Clinical criteria include paroxysms of coughing - a type of violent, uncontrollable coughing that can cause trouble breathing or vomiting afterward, or the characteristic heaving inhale (whoop) associated with this illness. Even without a laboratory test confirming the presence of the *Bordetella pertussis* bacteria in a sample, a doctor may report a probable case of whooping cough based on those symptoms - particularly if there is evidence of contact with a known case - they know they got it from someone with a lab-confirmed case (National Notifiable Diseases Surveillance System (NNDSS), 2022). This helps public health professionals be able to track cases without having to wait for laboratory confirmation - especially if labs may be overwhelmed with a backlog of samples in an epidemic.

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6.8: Rates

It is helpful to know the absolute numbers of cases of a particular disease, especially to understand the need for healthcare resources. However, this number doesn't tell us how much the disease or condition affects the population. The case numbers should also be assessed relative to the population size. Health officials need to know whether a disease or illness is affecting a large or small portion of the population that could be affected. This helps epidemiologists determine how big the problem is, and sometimes helps to discover how transmissible a disease is or how certain risk factors may be emerging. Is this disease or condition quite common or rare? Is it increasing in its effect over time or in proportion to the growth of the population? Are there other factors also high in this population that could have an association to the condition? (See Chapter 5 for more information on ecological studies that look at this question). For these reasons, prevalence and/or incidence are often expressed as a rate, rather than an absolute number. Rates can be percentages, or per 10,000 people, or 100,000 people depending on the size of the population. Using rates can also provide more manageable numbers with which to calculate statistics.

For example, perhaps we know that there are 38.4 million people living with diabetes in the United States. Since the total population in the U.S. in 2021 was 331.9 million, 11.6% of the population had diabetes (*National Diabetes Statistics Report,* 2023). We could also express this as 384 cases per 100,000 people. Sometimes this format is easier to use when handling large numbers and trying to compare different populations. Now imagine that instead we were looking at the population of the UK which had 67.33 million people in 2021. Hypothetically, if the same absolute number of people in the UK had diabetes, that would make up 57% of their population instead of 11.6% - a much bigger problem! Instead, if we wanted to compare the effect of diabetes between the U.S. and the UK, we can use rates instead of absolute numbers. In reality, the UK estimates around 5 million people had diabetes in the year 2021 (JackW, 2023), which equates to 7.4% of their population, or 50 cases per 100,000 people. So not only does the UK have fewer people living with diabetes, they also have a lower rate of diabetes. See Table 6.8.1 for a tabulated comparison of these rates.

Table 6.8.1: Comparison of Diabetes Rates in the U.S. and UK 2021

Country	Population in 2021	Number of people living with diabetes in 2021	Percentage	Per 100,000
United States	331.9 million	38.4 million	11.6%	384
United Kingdom	67.33 million	5 million	7.4%	50

It's also important to make sure we are calculating a case rate from the appropriate population - the population at risk for developing the disease. Not all diseases and conditions affect all populations, so we do need to make sure we are calculating the percentage of folks who have the disease out of the folks who *could* have the disease or condition. This is also called the **attack rate** - essentially how many people that disease or condition attacks out of the population at risk. Sometimes the entire population is at risk, or could potentially be diagnosed, as in our earlier example of diabetes. But other times only a portion of the population may be at risk - for example, workers in a particular industry exposed to asbestos or silica dust who may be at risk for developing lung disease from that exposure. It would not be accurate to count workers in another industry when trying to determine rates of lung damage for workers exposed to those environmental toxins. A great example of the use of attack rates for outbreak investigation is with foodborne illnesses. Epidemiologists can calculate attack rates and use that information to discover the potential source or sources of the illness.

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6.9: Hypothetical Case Study- Foodborne Illness Outbreak



Figure 6.9.1: (Photo by Filip Andrejevic on Unsplash)

Attack rates are also used to help identify the source of an outbreak from a specific source, such as in a foodborne illness investigation. Let's pretend you are a public health officer investigating an outbreak of foodborne illness associated with a single meal (point source) at a U.S. Army basic training location. Several recruits experienced vomiting and diarrhea within a few hours of breakfast. Although samples have been sent to the lab for testing, you won't get the results for 3-5 days. In order to prevent further illness among the recruits, you can use epidemiological methods (like calculating attack rates) to determine which food item was likely the source of contamination. After interviewing all of the recruits, you come up with the following data on two suspected food items:

Breakfast food items: scrambled eggs and sausage.

Number of recruits who ate scrambled eggs and became ill: 186/400 attack rate = 46.5%

Number of recruits who ate sausage and became ill: 140/400 attack rate = 35%

Number of recruits who didn't eat scrambled eggs and became ill: 4/400 attack rate = 1%

Number of recruits who didn't eat sausage and became ill: 54/400 attack rate = 13.5%

Next, you'll calculate a new statistic: the risk ratio. This is the mathematical probability of becoming ill after eating each food vs. becoming ill after not eating each food. Your results are as follows:

Scrambled eggs risk ratio: 46.5/1 = 46.5

Sausage risk ratio: 35/13.5 =2.59

At this point you could draw a reasonable conclusion that the most likely source of the food poisoning was the scrambled eggs, since the risk ratio of becoming ill after eating scrambled eggs is 46.5, compared to the risk ratio of eating the sausage which was only 2.59. You would probably still do further investigation by taking a sample of the scrambled eggs and testing it for a microorganism, interviewing the chefs and cooking staff on their preparation methods, and finding out the source of the eggs used and perhaps testing that source as well. But you don't even need to know the pathogenic cause of the outbreak to advise the kitchen staff to discontinue serving the scrambled eggs until the exact cause is identified and removed.

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6.10: Outbreaks and Epidemics

The hypothetical case study above is an example of a point-source outbreak - or an outbreak caused by a single source. An **outbreak** is defined as a number of cases of a particular disease that is higher than what is normally expected (Houlihan & Whitworth, 2019). This definition can also be used for the term **epidemic** - an unusually large number of cases of a specific infection during a specific amount of time. The term outbreak is more often used to describe a local epidemic in a small geographic area - and is probably how we would categorize a foodborne illness that could be traced back to a single restaurant or meal as in the previous hypothetical example.

The use of the term epidemic can range from infectious diseases to behavioral issues or chronic conditions. For example, obesity was recognized as an epidemic in the U.S. in the late 1970's, as more and more people were reporting higher weight-to-height ratios above the cut-off body mass index (BMI) for obesity - which is 30kg/m2. This upward trend in obesity prevalence has continued over the years, so that the rates of obesity are still higher than would be expected prior to the 1980s. If we are interested in the body mass index of American adults, we cannot possibly ask every single U.S. citizen what their height and weight is. Instead, a random sample is taken and a survey is sent out to this population which is assumed to be representative of the whole U.S. population. Obesity rates are typically calculated from surveys like the National Health and Nutrition Examination Survey (NHANES), (see Chapter 5 on more about study designs and longitudinal surveys like NHANES). Let's say for example that 8,300 adults were surveyed, and 3,403 of them reported a BMI above 30. Those 3,403 adults make up 41% of the population surveyed, so the rate of obesity is inferred to be 41% for the entire population. The larger a randomized survey like this is, the more accurate it is to apply it to the entire population. Back in the years 1976-1980 the obesity rate was only 15% (Temple, 2022), (Bryan et al., 2021). This example is an oversimplification of the statistical analysis performed in studies like NHANES, which are far more nuanced and beyond the scope of this text. However, this example demonstrates the use of surveys and rates to define an epidemic.

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6.10.1: What Makes a Pandemic?

Before declaring an outbreak to be a pandemic, the World Health Organization (WHO) considers how widespread the disease is within a country, and how much it has spread around the world. The WHO divides the continents into 6 regions, and once an epidemic has increased within countries in the region and spread to at least one other country outside the region, the WHO may declare the outbreak to be a pandemic. Pandemics are typically contagious diseases with infection rates that skyrocket quickly - requiring a rapid, organized response. The Black Death, Spanish Flu and COVID-19 are all examples of pandemics (Columbia University Mailman School of Public Health, 2021).



Figure 6.10.1.1: (Copyright; Photo by Obi - @pixel8propix on Unsplash)

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6.10.2: Endemic Diseases

Some diseases reach a level of regularity or seasonality, meaning they stay at a particular level consistently or only increase and decrease in a predictable pattern. Essentially, these illnesses remain with us at a consistent background rate, or cycle with predictable peaks every year. For example, we may become accustomed to “cold and flu season” that typically peaks between December and February in the United States (CDC, 2022). Since the numbers of cases increase up to the peak and then decrease in a predictable pattern over the course of those months, we would call the common cold and flu “endemic” to the U.S. Other pathogens are endemic to specific areas of the world, like malaria. Since mosquitos are the vector which transmits malaria to humans, malaria is endemic in many tropical countries where mosquitoes abound. Many virologists predict that COVID-19 will become endemic if it has not already (Jared, 2023).

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6.11: Summary and Interview With an Epidemiologist

One of the important roles of public health is to communicate accurate and up-to-date health information to the public. Now more than ever, it is apparent how easily misinformation can spread quickly and change human behavior, eventually causing harm. This “infodemic” also promotes distrust in public health agencies and science in general. Well-conducted research and clear communication are essential tools in the battle against misinformation and supporting public health.

Watch the video below to learn more about what a career as an epidemiologist could look like!



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CHAPTER OVERVIEW

7: Major Diseases

Learning Objectives

- Outline strategies for prevention, detection and control of infectious and chronic disease.
- Demonstrate the use of basic epidemiological methods, such as the analysis of rates, and the definition of cases, population at risk, risk factors, incidence, prevalence, morbidity and mortality.

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7.9.2: Risk Factors/Protective Factors
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7.12: Chronic Lower Respiratory Diseases
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7.1: Introduction

The Biomedical Model asserts that diseases have a cause or causes based in human biology. Additionally, risk factors and protective factors may exist as well which increase or decrease a person's likelihood of developing a disease. This model is very useful in helping to identify, diagnose, and develop treatments for different diseases - whether they are transmissible between humans or not. The more we discover about these causes and factors, the more we can take steps to discover and treat diseases earlier, as well as take steps to prevent these diseases from occurring or progressing. In this chapter, we will go over different types of diseases, and some that are emerging or current concerns. We'll also discuss how public health is working to address these diseases with detection and prevention efforts.

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7.2: Communicable Diseases

It happens pretty regularly right around midterms and finals: you find yourself feeling a little tired and rundown, and then in a few days you have a full-blown head cold. **Infectious** or **communicable** diseases include familiar, yearly bugs like colds and the flu, and also much more serious illnesses like cholera or meningitis. Communicable diseases are called such because they can be “communicated” or transferred from one living being to another. They all have an infectious agent that causes the disease, which could be a virus, bacteria, fungus, or other pathogen. Typically infectious diseases cause acute illness - perhaps within a few hours to a few weeks from being exposed to the pathogen, a person will develop symptoms. However, some infectious diseases also have latent effects which cause damage to organ systems months or years later, or some may lie dormant in the human body and then cause a flare-up of symptoms when the immune system is weakened. In this section we will discuss how infectious diseases are transmitted, some classic and emerging infectious disease examples, and public health responses. It would be impossible to cover all pathogens and the diseases they cause in this chapter, so further reading is recommended on specific communicable diseases.

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7.2.1: The Chain of Infection

Recall in Chapter 6 how the epidemiologic triangle describes infectious diseases. Another model we can use to describe communicable disease spread is the chain of infection. See Fig. 7.2.1.1 below.

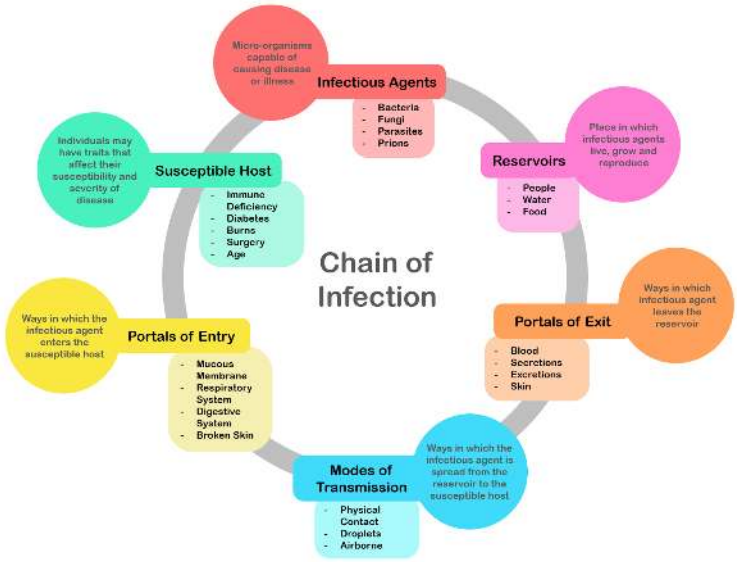


Figure 7.2.1.1: The Chain of Infection. (Copyright; Genieieiop, CC BY-SA 4.0, via Wikimedia Commons)

The chain of infection model describes each step in the transmission process, as well as those components of the epidemiological triangle (agent, host, environment). In order for a pathogen (agent) to be passed from one living organism to another, there must be a port of exit on the infected individual, a mode of transport, and a port of entry in a new susceptible individual. Hospitable environments are those that encourage this transmission, and potentially the growth of the pathogen outside of a host. Hygiene and workplace safety measures tend to focus on blocking routes of transmission and creating an inhospitable environment for pathogens (National Institute for Occupational Safety and Health, 2023).

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7.2.2: Routes of Transmission

Routes of transmission can be lumped into 5 basic categories. Different pathogens may be spread using one or more of the following methods:

- Direct transmission
  - Direct physical contact with an infected person including touching, kissing, or via bodily fluids (ex: bloodborne infection via blood transfusion or contact with an open wound)
  - Sexual intercourse, including vaginal, oral, and anal sex, or direct contact with external genitalia
  - Perinatal transmission in utero, or during a vaginal delivery
  - Airborne: inhalation of large droplets from a cough or sneeze that land in the mucous membranes of a susceptible person
- Indirect transmission
  - Fomite: touching utensils, household objects, or surfaces that have been touched by an infected person or animal
  - Fecal-oral: fecal contamination of fomites or hands, or contamination of food or water sources
  - Food-borne or Water-borne: ingestion of contaminated food or water
  - Airborne: tiny aerosols from speaking and breathing that linger in the surrounding air
  - Vector: transferred via the bite of an insect such as a mosquito or tick, from an infected person or animal carrier of the pathogen to a susceptible person (Seabert et al., 2021).

Let's use the common cold as an example of the chain of infection. Say that you have a coworker who feels a bit "under the weather". In actuality they are the reservoir or host for one of the viruses that causes the common cold (a coronavirus, adenovirus, or rhinovirus). You happen to be walking by them when they suddenly sneeze. The portal of exit is their nose and mouth, excellently demonstrated by the high-resolution photograph below. The mode of transport might be droplets that land in your nose (direct), or if some of those tiny particles dry they could be inhaled later (indirect). Regardless, your portal of entry is the mucosa lining of your nose and respiratory tract, where the virus gets into your respiratory system and begins to multiply. Particularly if you are under a lot of stress and your immune system is suppressed, you are likely to experience symptoms of a cold in the next few days.



Figure 7.2.2.1: This 2009 photograph captured a sneeze in progress, revealing the plume of salivary droplets as they are expelled in a large cone-shaped array from this man's open mouth, thereby, dramatically illustrating the reason one needs to cover his/her mouth when coughing, or sneezing, in order to protect others from germ exposure. (Copyright; *ames Gathany, 2009. Public Health Image Library, CDC*)

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7.2.3: Zoonoses

Zoonotic diseases (zoonoses) are those that can be shared between humans and animals. Any animal can potentially carry zoonoses, including pets, livestock, and wild animals. Some animals do not even get infected with the disease, but are simply carriers of the pathogen. Suburban sprawl and climate change are two more recent environmental factors that have forced humans and animals into closer environments. Many zoonotic diseases are also vector borne (transmitted by insect bites), and warmer climates can lengthen the breeding season for mosquitos and other insects (Burke & Weill, 2023). When a zoonotic pathogen finds its way from animals to humans this is called “spillover”. For example, HIV originally infected primates in the 1920s before the human outbreak several decades later (Ellwanger & Chies, 2021). It is estimated that 60% of known infectious diseases and 75% of emerging ones are zoonoses (*Zoonotic Diseases*, 2023).

Bats are reservoirs for many viruses that have the potential for spillover, the majority of which do not affect them. It is thought that they are probably the reservoir for the viruses that caused several recent epidemics such as SARS, MERS, and Ebola, as well as the COVID-19 pandemic (Burke & Weill, 2023). While direct or indirect contact with bats was a possible starting point for the COVID-19 pandemic, it has also been postulated that another animal such as a pangolin could have been an intermediary. Environments that allow a lot of direct and indirect contact between humans, live animals of different species, and meat - particularly if there are poor sanitary conditions - increase the risk of spillover events. Wet markets are culturally significant in China and other Asian countries, and it is suspected that human and animal interactions at a wet market in Wuhan, China were the origin of the COVID-19 pandemic (Ellwanger & Chies, 2021).

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7.2.4: Susceptible Hosts and Population Immunity

At the population level, we must assume that if a new communicable disease emerges, all individuals in the population are susceptible to it. For many diseases, those who are younger, older, and/or immunocompromised are at a higher risk of more severe disease. Barring any unique inherited immunity to a specific infection, the two major ways that humans develop immunity are through active immunity ("natural" exposure to the pathogen, and the subsequent immune response), or acquired immunity through vaccination. Both of these trigger an immune system response in each individual who experiences them. Some individuals experience more severe disease than others, and the most severe disease is experienced in natural exposure. In contrast, a third type of immunity is termed passive immunity, where antibodies are received from an external source. The most common examples of passive immunity are antibodies shared between a mother and fetus in utero, or via breastmilk - however some antibody treatments have also been developed for use in medicine.

Below is an oversimplified breakdown of the human immune system response.

- Humoral or innate immunity is the first line of defense. The immune system identifies the pathogen (aka antigen) and creates antibodies to "flag" this antigen and any cells that have been affected by it. White blood cells respond to destroy pathogens and infected cells. Fevers and inflammation are also used to activate chemical messengers and speed up metabolic processes that assist with the immune response. Some antibodies can linger even after the immune response has quieted down.
- Cell-mediated immunity refers to the "memory" of white blood cells (B and T cells) that allows the immune system to respond more quickly to future infections with the same antigen. This type of immunity lasts longer than the elevated levels of antibodies that occur immediately after an infection, or those provided by passive immunity.

Vaccines provide several benefits; both at the individual and population level. To the individual, a vaccine essentially primes the immune system response by triggering a much milder reaction to a dead or weakened (attenuated) virus. Multiple doses may be required to build up this immune response to levels that are protective against future infections. The individual's body may have both specific antibodies and B and T cells stored for many years that protect them from experiencing infection (CrashCourse, 2015, CDC, 2023e).

Some pathogens evolve and/or have several hundred variants - against which it is nearly impossible to create a single vaccine. The influenza virus and SARS-CoV2 are excellent examples of this virulent evolution. Even then, acquired immunity can lessen the severity of infection with a novel strain of the virus. Thus, vaccines can reduce and prevent hospitalizations and deaths from severe disease. For public health purposes, the ideal vaccine also decreases or eliminates infection and infectiousness, and thus prevents people from both contracting and transmitting the pathogen to others.

At the population level, vaccines increase the rate at which population immunity is developed, and decrease the cost in human lives to get there. If there are few or no humans in a community who are susceptible to a particular communicable disease (because they have developed immunity to it), the pathogen is likely going to die out due to a lack of hosts. This can cause the end of an epidemic, called **population immunity, community immunity,** or "herd immunity". The amount of time that it might take for this to occur naturally, along with the number of lives that would be lost, is untenable. (Jones & Helmreich, 2020). Instead, epidemiologists use the concept of population immunity to estimate the vaccination rates required in order to sufficiently protect populations from outbreaks. The more transmissible the pathogen is, the more people will need to be vaccinated to stop it. This calculation uses the estimated number of people a single infected person will likely transmit the disease to, or R0. Thus the vaccination rate would need to be 1-1/R0 in order for the population to develop immunity. If, for example, the average person infected with the flu shared it with 3 other people (R0=3), the vaccination rate would need to be at least 68% (1-⅓) in order to develop population immunity. If the average person who gets the measles infects 12-18 others, then the vaccination rate would have to be close to 100% in order to eradicate the spread (Fine et al., 2011, Guerra et al., 2017). Of course, in real life, imperfections in individual immune systems, global travel, and modern social life add much more complexity to these estimations and the possibility of population immunity. See Fig. 7.2.4.1 below.

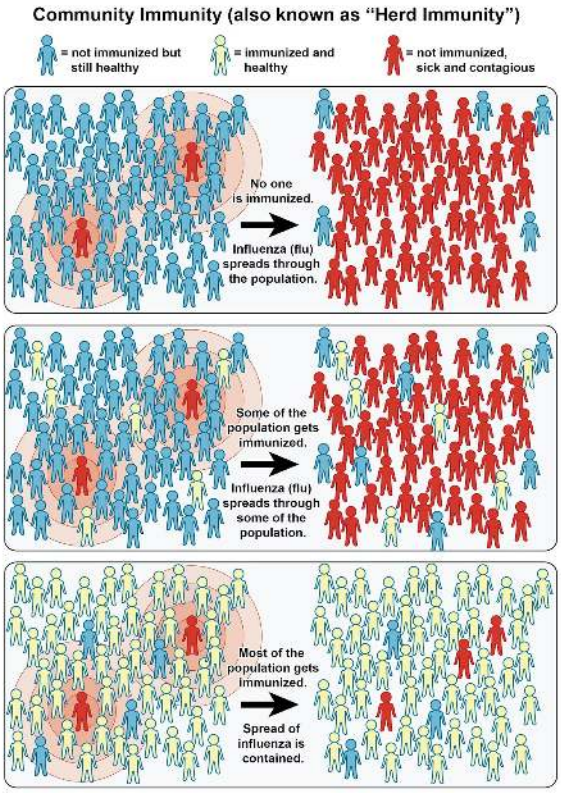


Figure 7.2.4.1: Community Immunity (aka herd immunity). (Copyright; CC0, The National Institute of Allergy and Infectious Diseases (NIAID))

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7.3: Types of Pathogens

Below are the categories of pathogens that we currently know about. Some are more well-known than others. It is important to remember that often the symptoms - and even disease processes - that we associate with infection are in fact our body's own immune response to the pathogen. However, knowing the type of pathogen that causes the disease is helpful at not only preventing its transmission but discovering treatment or prevention methods. For example, antibiotics are effective at treating bacterial upper-respiratory infections, but will not be effective against viral upper-respiratory infections.

- **Viruses:** Composed of either RNA or DNA packaged in a protein sheath, viruses invade host cells and cause the host cell's nucleus to reproduce the virus, often killing the host cell in the process (NHGRI, 2024). As the virus is reproduced within the host organism, it may "shed" the virus by releasing virus-laden mucus through coughing or sneezing. Viral shedding is essentially when the infected person is most infectious to others (ACHI, 2020).
- **Bacteria:** These are single-cell organisms that come in a variety of shapes, many of which are symbiotic to humans and animals (ex: gut microbiota). Some cause diseases by reproducing so rapidly that they invade healthy tissues, or by releasing toxins that kill off healthy cells (Drexler, 2010).
- **Fungi:** These are multicellular organisms that reproduce by creating spores that can be airborne or waterborne, including molds, yeasts, and mushrooms. Most fungi don't cause illness. When they do, fungal infections can affect the surface (skin) or internal organs (lungs or blood). Sometimes exposure to fungi can simply cause asthma or allergy symptoms (*About Fungal Diseases*, 2023).
- **Prions:** A relatively newly discovered pathogen, prions are only proteins that are abnormally folded. When this protein comes in contact with other proteins, it can change their structure, causing holes to form in tissue. Creutzfeldt-Jakob disease and "mad cow disease" are thought to be caused by prions.
- **Parasites:** These are single or multi-celled organisms that invade a host and use it to supply nutrients, often causing damage or disease to the host in the process. Although parasites are present in all countries around the globe, certain rural and impoverished areas have higher rates of parasitic infections called Neglected Tropical Diseases (NTDs - so named for their lack of public health attention) which affect a billion people worldwide.
  - **Worms:** (aka helminths). Worms attach themselves to the inner organs of the host that ingests them in order to gather nutrients. They often are ingested through contaminated food or water, and attach to the intestines, although they can spread to various parts of the body in their larval stage.
  - **Protozoa:** Single-cell organisms, these can live both in a host (parasitically) or outside of a host. Protozoa can be transmitted via vectors (such as a mosquito bite) or fecal-oral contamination of water or food, and cause diseases such as malaria, trichomoniasis, and giardia, among others. Malaria is a protozoa transmitted to humans by mosquito bites - and kills more than 400,000 people annually.
  - **Ectoparasites:** Typically including ticks, fleas, lice, and mites, an ectoparasite is any arthropod that burrows into the flesh and stays there for a period of time. They can also be vectors that transmit other pathogens through bites (CDC, 2024d).

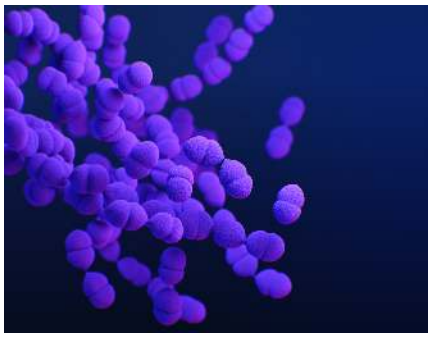


Figure 7.3.1: Medical illustration of drug-resistant, Streptococcus pneumoniae bacteria, presented in the Centers for Disease Control and Prevention (CDC) publication entitled, Antibiotic Resistance Threats in the United States, 2019 (AR Threats Report).. (Copyright; CC0 Meredith Newlove. CDC/ Antibiotic Resistance Coordination and Strategy Unit)

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7.4: How do we Eradicate Infectious Diseases?

To completely eradicate an infectious disease from the planet, the pathogen that causes that disease must be completely gone or unable to cause the disease in humans anymore. Although this is a possibility for many diseases, eradication has only happened once - with smallpox. Other diseases have been eliminated from some geographical areas (where there is no longer transmission of that disease), but haven't been completely eradicated. Often, poorer countries are burdened with highly preventable, curable, or treatable diseases that are no longer problematic in wealthier countries. And just because a disease has been eliminated or even eradicated, doesn't mean we don't still need to be prepared for the possibility of it re-emerging, particularly if it is a zoonotic or vector-borne disease (Roser et al., 2024).

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7.4.1: Smallpox and Polio

Smallpox was a devastating disease that used to kill 3/10 people it infected. Historians think it is at least 3000 years old, as some smallpox pustules have been found on ancient Egyptian mummies. Due to global travel and trade which happened between the 6th and 18th centuries, it spread around the world.

It was Edward Jenner's experiments with using cowpox to vaccinate against smallpox that began the idea of vaccination against disease and opened the door to the possibility of eradicating smallpox entirely. Even after better vaccines were developed, it still took nearly 2 centuries to get rid of smallpox around the world. The last known case of smallpox was in 1977, after the World Health Organization had begun the Intensified Eradication Program (1967). Although smallpox had already been eliminated in Northern Europe and North America in the decades prior, it took additional funding, personnel, and focused surveillance and vaccination efforts to reach eradication. Finally, in 1980, smallpox was declared officially eradicated. In order to decrease the risk of a potential laboratory accident, there are only two labs in the world approved to continue research on the variola virus - one at the CDC in Atlanta Georgia, and the other at the VECTOR Institute in Koltsovo, Russia (*History of Smallpox*, 2021).

Polio has seen a similar worldwide vaccination effort, particularly with the oral version of the vaccine which makes it easier to distribute without the need for healthcare providers to administer it. Two of the three wild polioviruses that cause the poliomyelitis disease have been eradicated, and one is still endemic in just two countries: Afghanistan and Pakistan (Roser et al., 2024). The Global Polio Eradication Initiative (GPEI) launched in 1988, and since then has decreased polio cases from 350,000 to just under 10 annually (CDC, 2023c).

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7.4.2: Measles, Mumps, and Rubella

There are hopes that measles, mumps, and rubella can also be eliminated or eradicated entirely, since humans are the only host for these viruses. The MMR combined vaccine is 78%-97% effective at preventing these infections depending on how many doses are administered (currently, the CDC recommends 2 doses for most). However, sometimes outbreaks can still occur - mostly among the unvaccinated, but sometimes even in highly vaccinated communities. These outbreaks will typically cause milder illness for those who are vaccinated (*Measles, Mumps, and Rubella (MMR) Vaccination*, 2023).

Although measles was declared eliminated (no longer endemic) in the U.S. since 2000 (*Measles Elimination in the U.S.*, 2023), there have still been several concerning outbreaks, and in the last few years a growing concern regarding misinformation and vaccine uptake (Santhanam, 2024). In the 2022-2023 school year, the average vaccination rates for kindergarteners in the U.S. were 93%, down 2 percentage points from 2019-2020. Vaccine exemptions also rose to 3% - mostly non-medical. This is concerning because if exemptions climb to 5% or greater, then population immunity is likely impossible and there is a much higher risk of outbreaks, and losing progress toward elimination (Seither et al., 2023). Perhaps since so few people in America experience these diseases anymore, the public has gained the perspective that there is no longer any need to vaccinate against them. The "Anti-Vax" movement which began with Wakefield's faulty research (see Chapter 5), saw growth during the COVID-19 pandemic, and has likely also been a cause of increasing exemption requests (Santhanam, 2024). See the figures below for a timeline of vaccine cases between 2000-2025 (Fig 7.3) and 1963-2023 (Fig 7.4).

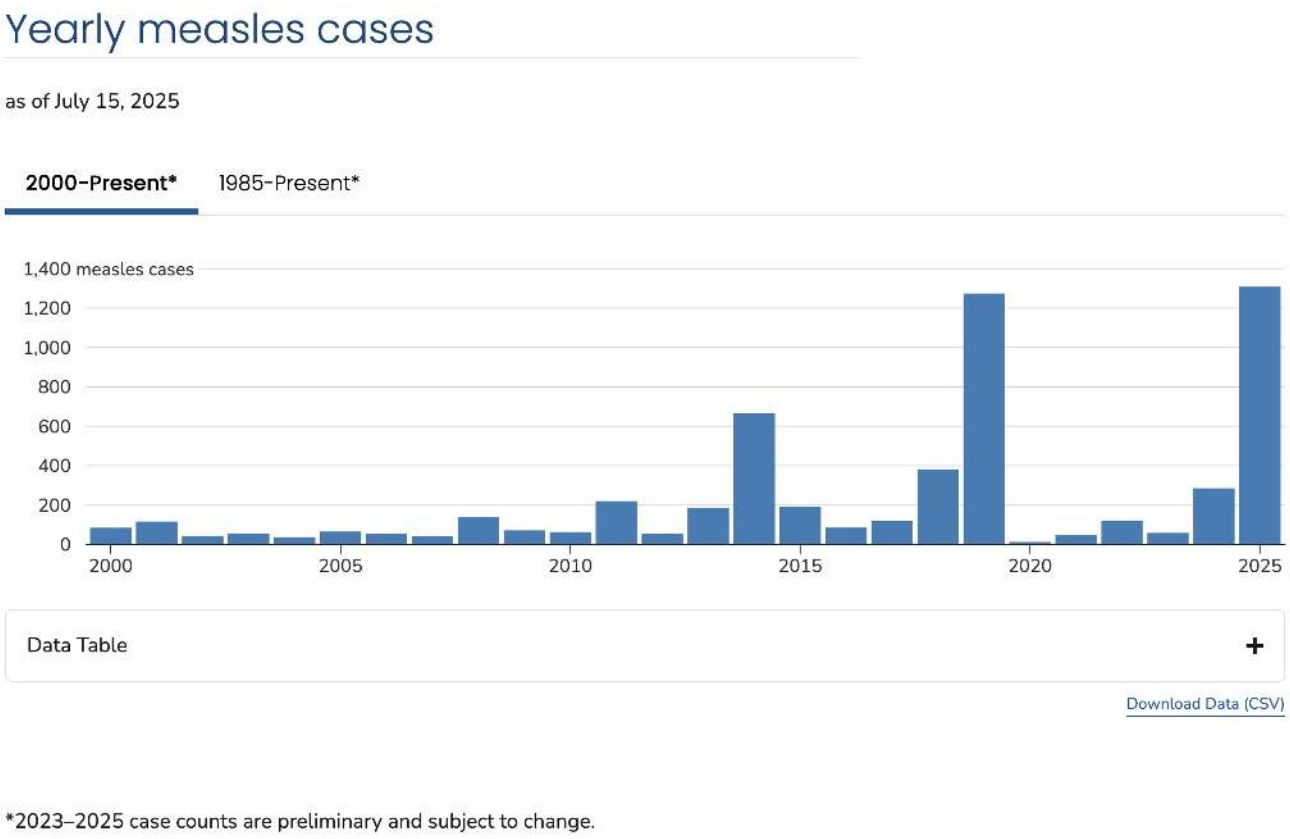


Figure 7.3 Yearly Measles Cases as of July 15, 2025. (CDC, 2025b)

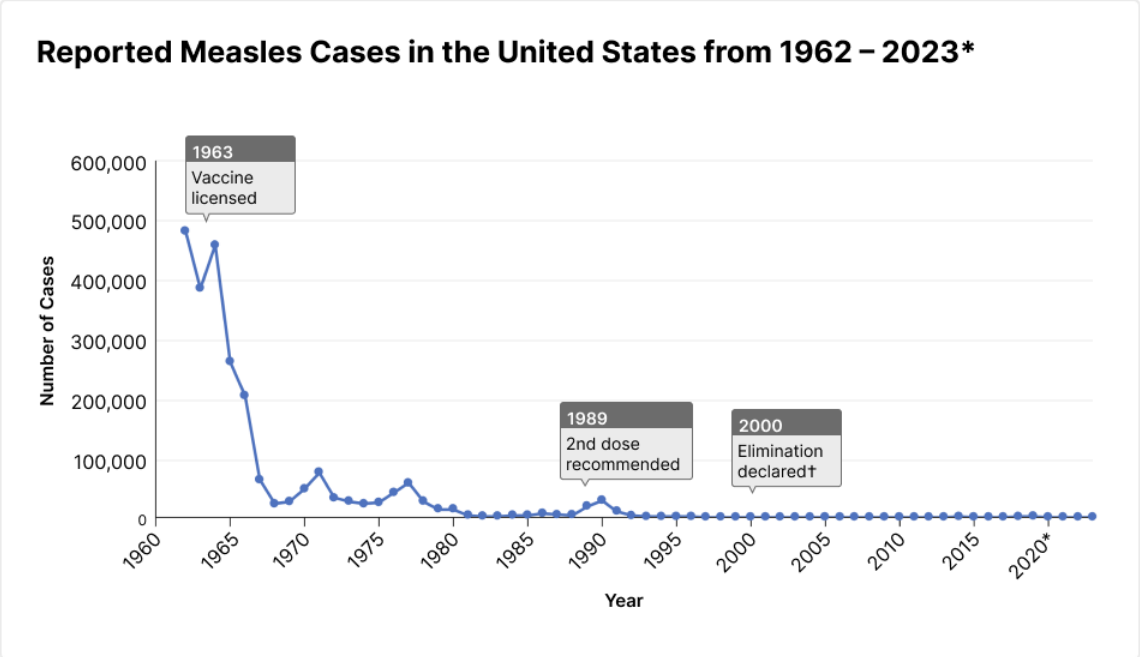


Figure 7.4. Reported Measles Cases in the United States from 1962-2023. *2023 data are preliminary and subject to change. †Elimination is defined as the absence of endemic measles transmission in a region for ≥ 12 months in the presence of a well-performing surveillance system (CDC, 2025b).

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7.5: Emerging and Re-emerging Infectious Diseases

Although we will still focus on eradicating those deadly diseases that we can, history has taught us to also be prepared for new infectious diseases to emerge - and sometimes new variants of old ones to re-emerge. **Emerging infectious diseases** are those that "have recently appeared within a population or those whose incidence or geographic range is rapidly increasing or threatens to increase in the near future."(*Emerging Infectious Diseases*, *Baylor College of Medicine*, n.d.) When certain diseases are on the decline and then the incidence starts increasing again, or perhaps a new disease is discovered from a known pathogen - these are referred to as **re-emerging diseases**.

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7.5.1: HIV/AIDS

In chapter 3 we covered a brief history of HIV/AIDS, which was first discovered in the U.S. the early 1980's, but had likely been a zoonotic disease transmitted to humans at least a century prior. Human immunodeficiency virus (HIV) attacks the body's immune system, particularly white blood cells that typically fight off infectious diseases: helper T cells (CD4+T), macrophages, and dendritic cells. This can lead to dangerously low levels of these cells, which disarms the cell-mediated immune response. If the disease progresses to the advanced stage, it can cause acquired immunodeficiency syndrome (AIDS), in which so-called opportunistic infections and cancers take hold. HIV is a uniquely devastating infection in this way: it attacks the body's defenses themselves, allowing other infections or cancers to easily overwhelm the person's weakened immune system. HIV is transmitted via direct contact with bodily fluids, whether from sex, sharing needles, infected blood transfusion, or perinatally and via breastmilk (Contributors to Wikimedia projects, 2024). Although some people get flu-like symptoms 2-4 weeks after infection with HIV, it may take between 9-11 years for HIV to progress to AIDS (untreated). Within that time frame, a person who does not know their HIV status may transmit it to many more people.(CDC, 2022a).

The most current estimated rates in the U.S. from 2022 are below.

- Incidence: 31,800 new cases (a 12% decrease from 2021).
- Prevalence: 1.2 million people currently living with HIV. The CDC estimates that 13% of HIV positive people are unaware of their status.
- Mortality: 19,310 deaths in people who were HIV positive, from any cause including COVID-19 (HIV.gov, 2025).

Significant medical advancements in testing, prevention and treatment have been made, including: antiretroviral therapy (ART) for those HIV positive, prophylactic medicines for pre-exposure (PrEP) and post-exposure (PEP) treatment. These medicines can decrease viral load to the point that not only is the virus undetectable, it is also not transmissible to a partner (HIV.gov, 2024). There is still a significant negative stigma associated with an HIV positive status, which deters many at-risk individuals from getting tested (CDC, 2022b). Self-tests that can be taken at home may help to reduce testing avoidance.

In 2021, President Biden's administration began the National HIV/AIDS Strategy (NHAS) 2022-2025 which set goals for reducing the number of new infections by 75% by 2025, and 90% by 2030. This plan coordinates national and local efforts, increases public health messaging on HIV, releases funding for testing and PrEP and PEP medications, and focuses on reducing disparities in HIV and addressing the associated social determinants of health (SDOH) (The White House, 2021). According to the 2023 Interim Report, estimated new infections had dropped by 12% between 2017-2023, and the number of people receiving PrEP treatment had increased significantly. Still, the report recognizes that racial, ethnic, and gender disparities still need to be addressed. Also of note in the report is that over half of those living with diagnosed HIV in the U.S. are over the age of 50 (The White House, 2023). However, several offices responsible for carrying out these efforts have been reduced or eliminated during the second President Trump administration in 2025. Although the new Administration for a Healthy America (AHA) office under HHS will include a division on HIV/AIDs, it remains to be seen how this reorganization will affect HIV incidence and access to prevention and treatment across the U.S. (Dawson & Kates, 2025).

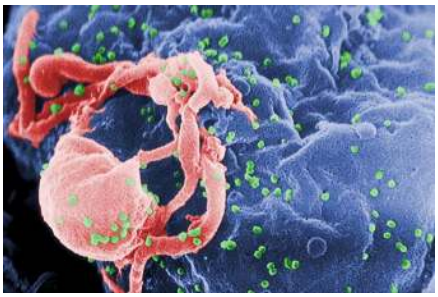


Figure 7.5.1.1: Scanning electron micrograph of HIV-1 budding (in green) from cultured lymphocyte. This image has been colored to highlight important features; see PHIL 1197 for original black and white view of this image. Multiple round bumps on cell surface represent sites of assembly and budding of virions. (Public Domain, C. Goldsmith Content Providers: CDC/ C. Goldsmith, P. Feorino, E. L. Palmer, W. R. McManus - This media comes from the Centers for Disease Control and Prevention's Public Health Image Library (PHIL), with identification number #10000.)

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7.5.2: Other Sexually Transmitted Infections (STIs)

The term sexually transmitted diseases (STD) implies that the STI has progressed into a symptomatic disease state. Many infections can be carried and passed to a partner without experiencing any symptoms - chlamydia, gonorrhea, herpes and HIV are examples of this (*CDC*, 2023b). Evidence-based public health measures include prevention, testing, and early or even prophylactic treatment of partners.

Sexually transmitted infections (STIs) have been on the rise once again in the U.S. In 2023 there were 2.4 million cases of gonorrhea, chlamydia, and syphilis reported, with signs that the recent epidemic of these STIs may be slowing. All of these diseases are bacterial infections, and can be treated with antibiotics. But letting them progress without treatment can cause permanent damage to reproductive organs (as with pelvic inflammatory disease caused by chlamydia and gonorrhea), and tertiary syphilis (which damages many organ systems and can cause blindness, paralysis, dementia, and strokes). Perhaps most concerning, congenital syphilis cases increased 183% over the past 5 years. Congenital syphilis is passed from an infected mother to a fetus and can cause blindness, intellectual disability, stillbirth and infant death. Despite the promising decline in new cases, STIs still disproportionately impact young adults, LGBTQ, and Non-Hispanic Black communities, which highlights the need for health equity in access to testing and treatment (CDC, 2024c).

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7.5.3: Viral Hepatitis

Viral hepatitis comes in several strains of the virus, the most common being A, B, and C. All three affect the liver, and can increase the risk of more serious illnesses like liver cancer. Hepatitis A is transmitted via fecal-oral contamination of surfaces, or utensils, or close personal contact with an infected person. Typically this version causes only an acute illness, but is easily spread without conscious sanitation measures. Hepatitis B and C are transmitted via direct or indirect contact with bodily fluids, including sexual intercourse, contaminated needles, and perinatal infection. Vaccines exist for Hepatitis A and B and are required for school children. There is no vaccine for Hepatitis C, but there are drugs that can cure it in about 95% of cases. These infections may cause acute symptoms like fever, vomiting, abdominal pain, and jaundice, but sometimes these symptoms appear weeks or even months after the initial exposure. Chronic hepatitis symptoms may not be present for years or decades (CDC, 2024a).

A recent report on viral hepatitis provides a summary of new cases reported in 2023 by most states indicates that the rates of hepatitis are declining. While local public health agencies, doctors, and laboratories are required to report cases, there are often cases that go unreported and undiagnosed. The data scientists at the CDC adjust for this underreporting by providing data for both reported cases and estimated acute infections (CDC, 2025a):

Hepatitis A: 1,648 reported cases, 3,300 estimated acute infections

Hepatitis B: 2,214 reported cases, 14,400 estimated acute infections

Hepatitis C: 4,966 reported cases, 69,000 estimated acute infections

The Division of Viral Hepatitis at the CDC has laid out aggressive goals for combating viral hepatitis in the next two years in order to address the climbing rates in the U.S. and move toward global elimination by 2030. The strategies involve increasing vaccinations, testing, and treatment, as well as prevention strategies and national surveillance. Of particular importance is to focus on disproportionately affected groups who might be unaware of their status and/or might otherwise not seek testing and treatment - such as people who inject drugs and those experiencing homelessness (CDC/NCHHSTP/Division of Viral, 2020).

Most cities and major metropolitan areas have public health clinics that provide free STI testing, particularly for the most commonly transmitted infectious diseases. These clinics also provide free condoms and vaccines, as well as testing for other infectious diseases and reproductive cancers, and some also provide HIV PrEP medication and contraceptives. They are an important resource for the communities they serve, and a key touchpoint for gathering surveillance data (*LA County Department of Public Health, n.d.*).

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7.5.4: Influenza Viruses

Of the 4 classifications of flu viruses (A, B, C, and D), only A and B tend to cause illness in humans, with a variety of these viruses causing the typical “seasonal flu” (World Health Organization: WHO, 2023). The subtypes of flu virus that circulate in a given community vary each year, and thus the flu vaccine efficacy also varies depending on the “popular” strains in that community and season. Even so, flu vaccines have been shown to be between 40-60% effective at reducing doctor visits, and also reduce severe illness, hospitalization, and admittance into the ICU for various age groups - especially children and older adults (*Vaccine Effectiveness: How Well Do Flu Vaccines Work?*, 2024).

Type A influenza viruses also include zoonotic strains that are known to have pandemic potential, including “swine flu” (H1N1) and “bird flu” or “avian flu” (H5N1). The swine flu is particularly deadly, causing a mortality rate close to 50%, whereas the avian flu was much less deadly but easily spread between humans. There is significant concern that a new influenza virus could emerge that employs both properties of virulence and severe disease, which could cause a deadly pandemic around the world (*Emerging Infectious Diseases*, *Baylor College of Medicine*, n.d.).

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7.5.5: Coronaviruses- MERS, SARS, and COVID-19

Coronaviruses are a group of viruses that can cause upper-respiratory infections like the common cold, with symptoms like fever, cough, runny nose, and a sore throat. They are called coronaviruses because of how they look under a microscope: spikes on the surface give the virus a crown-like appearance. In some cases, coronaviruses can lead to severe infections like pneumonia and certain strains can cause significant morbidity and mortality. Coronaviruses are also zoonotic infections, and have been found in bats, palm civets, and camels. In fact, zoonotic transmission to humans is how the more severe coronaviruses such as SARS and MERS are thought to have first emerged.

Severe Acute Respiratory Syndrome (SARS) was a coronavirus first discovered in 2002 in China and rapidly spread to several countries, causing over 8,000 cases and 800 deaths. Yet the public health response was swift; and even though this severe illness had spread to over two dozen countries, the outbreak was brought under control within the following year (*SARS and MERS*, n.d.).

Middle East Respiratory Syndrome (MERS) emerged in 2013 in the Middle East, and was thought to have been transmitted from camels, who probably got it from bats. Although this disease was less easily spread between humans than SARS, it caused more severe disease and the mortality rate appears to have been much higher - around 35% of cases cause death (SARS and MERS, n.d.). Between April 2012 and January 2024, there have been 2609 lab-confirmed MERS cases, and 939 deaths - and the majority of cases have occurred in Saudi Arabia (WHO Eastern Mediterranean Region, 2024).

SARS-CoV-2 is the virus that causes COVID-19 illness, and began the worldwide pandemic in December of 2019. What made this virus able to spread across the globe so rapidly was its virulence: unlike SARS and MERS before it, the virus could be transmitted to other humans even when the infected person showed no symptoms. Although it seemed as though the mortality rate of the disease was relatively low and decreased significantly over the next 2.5 years, the disease caused over 1 million deaths in the U.S. alone during that time simply due to the large numbers of people it affected (*SARS-CoV-2 and COVID-19*, n.d., CDC, 2024c).

The pandemic also had a huge impact on other biological and social determinants of health. Healthcare systems were overloaded, healthcare staff were at high risk of contracting the disease - especially with shortages of personal protective equipment (PPE). Fears of catching the virus kept people from seeking healthcare for other issues like managing chronic diseases (*SARS-CoV-2 and COVID-19*, n.d.). Businesses and schools were closed, and job losses created huge economic (and health insurance coverage) impacts which hit the lowest socioeconomic tiers the hardest.

Vaccines for COVID-19 were soon developed and clinical trials were fast tracked during 2020. By the end of 2020 and beginning of 2021, vaccines were given emergency use authorization (EUA) by the FDA. Three vaccines were used in the U.S. - the Moderna and Pfizer vaccines were mRNA vaccines, and the Johnson & Johnson vaccine utilized a vector. All three vaccines were unique in that they did not carry a killed or attenuated virus - rather they used different mechanisms to provide information to the human body to create the unique spike protein on the surface of the virus. The body's immune system could then recognize this spike protein and mount a defense against it. Although these vaccines were developed and tested in a far shorter time than expected, they built on research that had been going on for decades (National Institutes of Health, 2023).

The vaccines demonstrated high levels of safety and efficacy against the initial variants of SARS-CoV-2. As new variants emerged, it became clear that the vaccines were less likely to protect against infection completely, yet they still offered protection against severe disease, reduced hospitalizations, and even reduced viral load (which can potentially reduce transmission) (Oordt-Speets et al., 2023). It is estimated that vaccines prevented another 66 million infections and 2 million deaths (National Institutes of Health, 2023).

Vaccine hesitancy and misinformation also had an effect on vaccine uptake. Vaccine myths were perpetuated over social media and political venues, including proposals that the vaccines included microchips, made the vaccinated magnetic, affected fertility, or caused deadly heart problems in young males (CDC, 2023d, CDC, 2023e, CDC, 2023h). As of May 2023, over 81% of Americans had received at least one dose of the vaccine, and almost 70% had taken the recommended 2 doses. Subsequent booster uptake for new variants was significantly lower (CDC, 2023a).

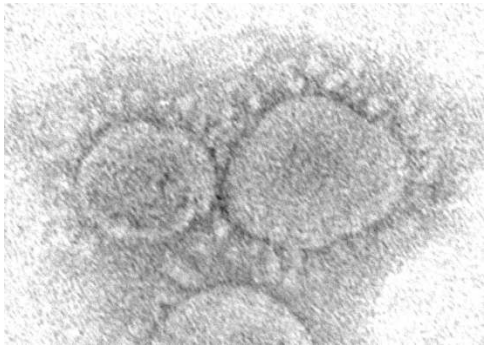


Figure 7.5.5.1: Electron microscopic image of a negatively stained particle of SARS-CoV-2, causative agent of COVID-19. Note the prominent spikes from which the coronavirus gets its name for “corona”, or “crown-like”. (Copyright; CC0, CDC/ Hannah A. Bullock and Azaibi Tamin)

Electron microscopic image of a negatively stained particle of SARS-CoV-2, causative agent of COVID-19. Note the prominent spikes from which the coronavirus gets its name for “corona”, or “crown-like”. CDC/ Hannah A. Bullock and Azaibi Tamin

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7.5.6: Monkeypox (Mpox)

Mpox or monkeypox is caused by a virus related to smallpox, and was named so because it was first discovered in small primates. Mpox can be transmitted via direct contact with an infected person (including sexual contact), as well as indirect contact by fomite (surfaces or objects touched by the infected person). There are two types of Mpox (called “clades”), one has a much lower case-fatality rate than the other (10% vs. <1%). In 2022 there was an outbreak of the latter strain of Mpox that traveled around the world and caused over 94,000 cases, many of which had not previously reported Mpox. Fortunately, a vaccine is available that has a 70% vaccine effectiveness measure, which means that vaccinated cases are 70% lower than unvaccinated cases (Mpox, 2024).

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7.6: Antimicrobial Resistance

Antimicrobial resistance refers to the adaptation of pathogens (microbes) to the current best treatments we have available for them. Antibiotic resistance can happen in bacteria, antifungal resistance in fungi, antiviral resistance for viruses, and antiparasitic resistance for parasites (worms) - although the most concerning examples are currently in bacteria and fungi. Resistance to drugs occurs when the microorganism has adapted to the way that the drug works to inactivate or kill the pathogen. Sometimes this occurs when other, healthy bacteria have also been killed off due to the treatment, allowing harmful bacteria to proliferate. These pathogens can then become extremely difficult or impossible to treat (CDC, 2022c).

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7.6.1: Clostridium difficile (C. diff)

One example of this imbalance in the microbiome occurs in people who have been using antibiotics to treat other infections. These antibiotics kill off the symbiotic, healthy bacteria that lives in the intestines, thus changing the gut microbiome. This allows the harmful bacteria *Clostridioides difficile* to multiply, causing symptoms like diarrhea, nausea, fever, and stomach pain. If this bacteria is not eliminated, and the gut microbiome recalibrated with healthy bacteria, it can be deadly. Because it is so difficult to treat, *C. diff* will often recur again in those who have had it previously, and is responsible for nearly half a million infections each year (CDC, 2023j).

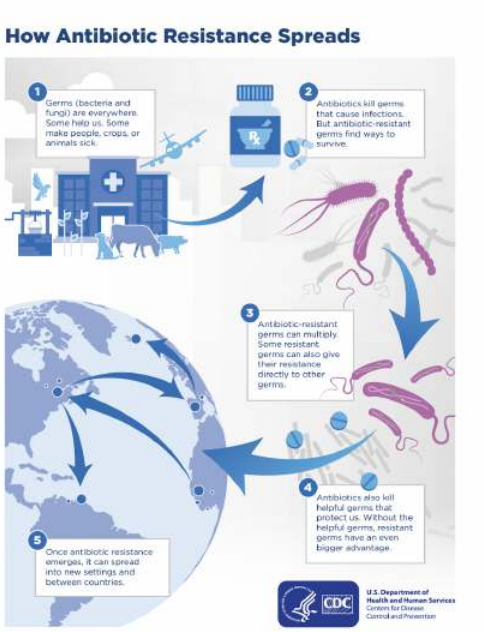


Figure 7.6.1.1: Infographic: How Antibiotic Resistance Spreads. (Copyright; CC0, CDC. Retrieved March 30th, 2024)

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7.6.2: Methicillin-Resistant Staphylococcus Aureus (MRSA)

Methicillin-Resistant Staphylococcus Aureus is a type of bacterial infection commonly referred to as “staph”. Although most staph bacteria are harmless, some can cause severe staph infections. Not all staph infections are resistant to treatment, but one particular strain of this bacteria (MRSA) has developed a resistance to the antibiotics commonly used to treat it. Healthcare settings are common sources of staph infections due to the depressed immunity of patients and the invasive procedures being done, which allows many opportunities for staph bacteria to be transmitted to susceptible people via surfaces or medical equipment. Community spread of staph infections, particularly MRSA, can happen in athletic facilities, in the military or childcare centers or schools as well - particularly in places where people do physical activity. Staph bacteria can only get through if there is a break in the skin, so keeping cuts and abrasions covered as well as cleaning surfaces and equipment are the best prevention strategies. MRSA most commonly causes infections in wounds or surgical sites, and in rare cases it can get into the bloodstream or lungs (causing pneumonia). In some cases this infection can cause sepsis - which is the body’s own amplified immune response to the infection, and can be deadly (CDC, 2019a).

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7.6.3: Drug-resistant Tuberculosis

Another very concerning example is that of drug-resistant tuberculosis (TB). The bacterium *Mycobacterium tuberculosis* causes disease most commonly in the lungs, although it can affect other organ systems. TB is spread through respiratory droplets, and develops slowly - only about 5-10% of those infected will actually develop the disease and become contagious - often due to a depressed immune system (often caused by HIV infection). Yet, the global disease burden is still high. It is estimated that 10 million cases of the disease happen every year worldwide, causing 1.5 million deaths (World Health Organization: WHO, 2019).

When the TB bacteria cause active disease, this can happen within 2 years or even decades after infection. Often other factors that depress the immune system are involved, such as co-infections (e.g. HIV), malnutrition, crowded housing, and lack of access to medical care. *Mycobacterium tuberculosis* has a thick, fatty surface that is difficult for the human immune system to break down, so white blood cells will typically envelope the bacteria instead - creating calcified “tubercles”. If the bacteria escapes these tubercles, then the bacteria can proliferate, causing active disease - mostly in the lungs but also in several other organ systems such as the central nervous system (CrashCourse, 2024).

Thanks to the development of antibiotics in the 1950s and 60s, we do have treatments and can cure this disease. Although TB has been eliminated from several countries and has the potential to be eradicated around the world, drug-resistant strains make this goal much more challenging. Certain factors increase the risk of drug-resistant TB, including:

- A full course of TB drug treatment is not completed, doses are missed or delayed
- High-quality drugs are not available
- The wrong drugs are prescribed (CDCTB, 2022)

In developing countries, other social determinants of health (SDOH) also influence these risk factors. For example, pharmaceutical companies are driven by profit incentives to develop and produce drugs, and since TB has been eliminated in many wealthy countries, there is less production of these drugs. Modern TB tests and drugs are (unnecessarily) expensive, and in order to ensure “compliance”, patients are often required to visit a clinic daily, or live in an inpatient facility for months. For someone already living in poverty, and with a severe illness, transportation and physical disability can be large barriers in getting treatment. Combine this with other SDOH such as access to nutrition, drinking water, and quality housing, and treating TB - especially drug-resistant TB - becomes much more challenging. Increases in the accessibility of testing, treatment, healthcare staff, and addressing barriers to treatment are all necessary if we want to eliminate TB (CrashCourse, 2024).

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7.7: Mosquito-borne Diseases- Malaria and Zika Virus

Mosquitos are the vectors that spread both Malaria (a protozoa) and the Zika virus as well as other diseases we will not cover here. Malaria can only be spread by mosquitos - it does not have a human-to-human route of transmission. Headache and chills are common symptoms, and sometimes malaria can progress into life-threatening illness. Fortunately, vector control measures, preventing mosquito bites, and taking certain prophylactic medicines can reduce the risk of infection. In 2021 a vaccine was developed for Malaria that shows promise at reducing the rates of severe, deadly malaria in children (World Health Organization: WHO, 2023b).

Zika also can be spread human-to-human via sexual contact and perinatally. Although most people infected with Zika virus will only have mild symptoms like a fever and rash, perhaps the most significant health impact occurs in the fetus of a pregnant person infected with Zika. A Zika virus infection during pregnancy can cause microcephaly in the fetus, an abnormally small head size and limited development of the brain and central nervous system. This can result in a variety of physical and severe mental disabilities at birth, and increase the risk of miscarriage or stillbirth (CDC, 2019b).

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7.8: Non-Communicable Chronic Diseases

There are other diseases and conditions that cannot be spread from one person (or animal) to another individual. These are called non-communicable diseases and include some of the leading causes of death for Americans: heart disease, cancers, diabetes, and chronic pulmonary diseases. Because these diseases often progress over long periods of time, they are also commonly referred to as chronic diseases. In fact, the beginning stages of many chronic diseases start as early as childhood, and are often highly influenced by lifestyle behaviors and environmental exposures. This also means that there is a lot of potential to reduce morbidity and mortality from these chronic diseases through effective public health programs. In this section we will discuss those four common chronic diseases and the risk factors associated with them, as well as public health responses.

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7.9: Cardiovascular Diseases (CVD)

The cardiovascular system includes the heart, blood vessels, and blood, so any diseases that affect these structures are collectively referred to as cardiovascular diseases (CVD). The most common type of CVD is coronary artery disease, which affects the blood vessels that supply the heart muscle itself (coronary arteries). However, hypertension, stroke, heart failure, and peripheral vascular disease are also included, and can often be co-morbidities (when multiple conditions are present at the same time).

Although CVD may have genetic and biological risk factors, they are highly influenced by lifestyle behaviors and environment. The most common types of cardiovascular diseases are chronic diseases, which can begin the disease process as early as childhood and progress over several decades. The disease process is characterized by changes in the arteries: atherosclerosis and arteriosclerosis.

Arteriosclerosis refers to the hardening and thickening of the arteries. Healthy arteries are elastic, and expand with each heartbeat that pumps a wave of blood flow through them. Chronic inflammation, smoking, diabetes and hypertension (high blood pressure), along with some genetic factors, can cause arteries to become calcified and/or develop fibrous tissue scars that decrease their elasticity. The arteries become stiffer and more resistant to blood flow, which in turn increases blood pressure and makes the heart have to work harder.

Atherosclerosis is a specific type of arteriosclerosis that occurs when fat deposits in the muscular walls of the arteries. These can start with fatty streaks and eventually turn into hard plaques. Arteries can get damaged from hypertension, smoking, and chronic inflammation. Low density lipoprotein (LDL cholesterol) is one way that fat is transported in the bloodstream, and tends to get “stuck” in these damaged areas in the arteries. The body will respond by creating a fibrous scar tissue over the top of the plaque - but over time the plaque can protrude into the artery, restricting blood flow.

Arteriosclerosis can progress over time to the point of causing other problems in the cardiovascular system. Blockages in the coronary arteries can decrease blood flow to the heart muscle (myocardium), called myocardial ischemia. This lack of blood flow can cause chest pain (angina pectoris), particularly when the body is under stress. Eventually this reduction in blood flow to the myocardium can cause those cells to stop contracting - which causes a heart attack or myocardial infarction. Or, if the blood vessels become weakened, they can bulge and/or burst, causing an aneurysm. These conditions can also occur in blood vessels that feed the brain tissue, causing a stroke or transient ischemic attack (mini-stroke).

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7.9.1: Current Rates in the U.S.

- Mortality:
  - Approximately 919,032 Americans died from CVD in 2023 - approximately ⅓ of the deaths recorded (CDC, 2025b).
  - Although CVD is the leading cause of death for all racial and ethnic groups, the highest percentages of deaths caused by CVD are found in Black Americans (22.6%) (CDC, 2025b).
- Morbidity:
  - It is estimated that 5% of American adults currently have coronary artery disease (CDC, 2025b).
  - Someone in the U.S. has a heart attack about every 40 seconds (CDC, 2025b).

The good news is that heart disease mortality has decreased since the 1970s, likely due to advances in medicine and other public health efforts to manage risk factors like smoking and high blood pressure. People are living longer after one or more heart attacks. Still, other types of heart disease like heart failure and arrhythmias are claiming more lives (King et al., 2025).

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7.9.2: Risk Factors/Protective Factors

The American Heart Association has compiled evidence-based metrics for cardiovascular health (CVH) into 8 different categories they call “Life’s Essential 8”. Ideal cardiovascular health includes:

- Nutrition: eating in a pattern close to the Dietary Approaches to Stop Hypertension (DASH) recommendations or a Mediterranean diet
- Physical Activity: achieving the CDC recommended minimum amount of physical activity for adults each week - 150 minutes of moderate physical activity, or 75 minutes of vigorous physical activity, or some combination. (The recommendations now also include two days of muscle strengthening activities).
- Smoking: avoiding exposure to tobacco smoke whether it be firsthand or secondhand.
- Sleep: getting at least 7 hours of sleep per night.
- Body weight: not being in the overweight or obese categories for body mass index (BMI).
- Blood lipids: keeping total cholesterol, LDL cholesterol and triglycerides low, while maintaining healthy levels of HDl cholesterol.
- Blood glucose: maintaining a healthy blood sugar level as measured by fasting blood glucose or A1C.
- Blood pressure: maintaining a healthy resting blood pressure reading of below 120/80 mmHg.

Conversely, smoking, obesity, sedentarism, poor nutrition, a consistent lack of sleep (and resulting elevated chronic stress), hypertension, diabetes and pre-diabetes, and high cholesterol are all risk factors for cardiovascular disease. Each of these health behaviors and factors is independently associated with an increased risk of cardiovascular disease, even though the behaviors and factors can be related. Several different types of research have shown that a low to moderate level of cardiovascular health as measured by these “Life’s Essential 8” contribute to 70% of CVD events, and maintaining high levels of CVH over time decreases lifetime risks of various cardiovascular diseases - perhaps even prolonging life by 4-5 years. A high level of CVH during pregnancy was also correlated with better cardiovascular health of the kids years later. The benefits of “Life’s Essential 8” are similar across all race and ethnicity demographics, yet it should also be recognized that the social determinants of health contribute to disparities in CVH measures and the likelihood of achieving these protective factors (Tsao et al., 2023).

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7.9.3: Public Health Response

Improving cardiovascular health by the “Life’s Essential 8” metrics is one of the objectives of Healthy People 2030, along with several other related objectives. Most of the objectives related to heart disease and stroke are at baseline levels or have little to no detectable change at this point in time. One of these objectives is to increase the control of high blood pressure in adults. According to the new standards for healthy blood pressure set in 2017, only 16.1% of people who have been diagnosed with hypertension have it under control. Addressing hypertension in Americans would not only have positive effects on CVH, but would also reduce the risk of other diseases and conditions like kidney diseases, pregnancy complications, and more (*Heart Disease and Stroke - Healthy People 2030*, n.d.).

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7.10: Diabetes

Diabetes mellitus refers to the body's inability to manage blood sugar (glucose), which results in chronically high blood glucose, or hyperglycemia. There are different types of diabetes depending on the origin and progression of the disease, however all types have something to do with the secretion or action of insulin.

In healthy conditions, the body has a consistent hormonal mechanism for managing blood sugar homeostasis (normal, resting levels). The pancreas produces two hormones: insulin and glucagon, with opposing functions. When a person eats a meal with any amount of carbohydrates, these are broken down in the digestive system to the simplest sugar: glucose, and then released into the bloodstream. This causes the blood glucose levels to rise, and in response, the pancreas releases insulin. Insulin signals to the body's cells to take up glucose, thus bringing the blood glucose levels back down to resting levels. All of the body's cells have receptors for insulin, and glucose can be taken up and used for energy, or stored as glycogen or within triglycerides (fat storage). Conversely, if blood glucose levels drop - such as with fasting or exercise - the pancreas will release glucagon, which signals to the liver to break down more of its stored glycogen and release it as glucose into the bloodstream.

Type I diabetes is classified as an autoimmune disorder, in which the body's immune system attacks and destroys the beta cells in the pancreas that produce insulin. Since the body is unable to produce adequate insulin (insulin insufficiency), hyperglycemia results and the body's cells are unable to use glucose for energy. This can result in symptoms like unintentional weight loss and low energy, and sometimes ketoacidosis - or the overproduction of ketones - which is a byproduct of the liver breaking down fat for energy and can cause weakness, vomiting, excessive thirst and urination (CDC, 2021). Type I diabetes is usually identified in children and adolescents, however some adults may be diagnosed with a latent form of type I diabetes as well. About 5-10% of people with diabetes have type I (ElSayed et al., 2022).

Type II diabetes is thought to progress from insulin resistance in the body's cells. Obesity is closely associated with insulin resistance, along with some genetic and immune factors that may be interrelated. Although there are likely several mechanisms in this relationship between obesity and diabetes, one of them seems to be that high levels of fat stored in adipose tissue tends to increase chronic levels of inflammation throughout the body, and this inflammation then decreases sensitivity to insulin. If the body's cells are resistant to the insulin being produced, the pancreas creates more - causing hyperinsulinemia. Eventually, the beta cells in the pancreas may also become damaged (perhaps also due to chronic inflammation), and insulin insufficiency may result (Rohm et al., 2022). Type II diabetes accounts for 90-95% of all diabetes cases (ElSayed et al., 2022). Pre-diabetes can be diagnosed as the early stages of this process, where blood glucose is slightly higher than normal, and can also be reversed with lifestyle interventions such as nutrition, exercise, and weight management.

Gestational diabetes is similar to type II diabetes in that it is characterized by insulin resistance - this time thought to be caused by pregnancy hormones. Obesity and a family history of type II diabetes certainly increase the risk of gestational diabetes. Most cases of gestational diabetes resolve after the pregnancy is over, however there may be an increased risk of developing type II diabetes in the future (ElSayed et al., 2022).

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7.10.1: Current Rates in the U.S.

- Prevalence: In 2021, it is estimated that 38.4 million Americans (11.6%) have diabetes, and almost 98 million (38%) had prediabetes (CDC, 2023j).
- Incidence: About 1.2 million people are diagnosed with diabetes each year.
- Diabetes was the 8th leading cause of death in 2021.
- Rates of diabetes in adults vary by race/ethnicity:
  - Alaska Native/American Indian (13.6%)
  - non-Hispanic Black (12.1%)
  - Hispanic (11.7%)
  - Asian (9.1%)
  - non-Hispanic White (6.9%) (American Diabetes Association, 2023).

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7.10.2: Risk Factors/Protective Factors

Risk factors for diabetes may include biological or disease factors outside of a person's control such as:

- Age (the risk of type II diabetes increases with age)
- Genetics (as in monogenic diabetes syndromes)
- Other diseases (cystic fibrosis, polycystic ovarian syndrome, pancreatitis)
- Treatments for other diseases (such as medicines for HIV) (ElSayed et al., 2022)

Particularly for type II diabetes however, there are several risk factors that are related to lifestyle behaviors:

- Obesity
- Poor nutrition (overconsumption of calories)
- Lack of physical activity

Conversely, protective factors against type II diabetes, and strategies used to reverse prediabetes include nutrition, exercise, and weight loss (if obesity is a factor). Exercise alone can increase insulin sensitivity both acutely and over the long term. When skeletal muscles contract, they have an "insulin-like effect" which draws glucose into the muscle cell, while becoming more sensitized to any existing insulin in the bloodstream. This allows them to take up glucose to use for the energy they need. Insulin sensitivity is increased for at least 16 hours after a workout, and if a person exercises regularly (and perhaps also decreases body fat) this can have lasting effects on their ability to manage blood sugar. Physical activity can also reduce the chronic inflammation associated with type II diabetes, and helps those with type I diabetes also manage the disease (Venkatasamy et al., 2013). For people who have obesity, losing just 5-7% of their body weight and getting 150 minutes of moderate physical activity per week reduces the risk of type II diabetes by 58%-71% (CDC, 2023b).

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7.10.3: Public Health Response

In 2010 the CDC created a National Diabetes Prevention Program (NDPP) to help address prediabetes and prevent type II diabetes. The NDPP utilizes public-private partnerships to provide access to lifestyle change programs for anyone diagnosed with prediabetes. Private companies and community organizations can become a Lifestyle Change Program Provider, and equip lifestyle coaches with toolkits and resources developed by the CDC. These lifestyle coaches can then work with folks who have been diagnosed with prediabetes to help them develop and maintain healthy nutrition, physical activity, and weight management behaviors. These programs can often qualify for cost coverage through federal (Medicare and Medicaid in some states) and/or employer-sponsored health insurance programs (CDC, 2016). Initial research comparing the DPP to a drug intervention (metformin) or placebo indicated that the lifestyle interventions of the DPP (targeting weight loss of about 5-7% of body weight for those with obesity) lowered the risk of developing type II diabetes by 58% compared to placebo, while the metformin group lowered their risk by 31% compared to placebo. Subsequent follow-ups 10 and 15 years later suggested a smaller, but still substantial reduction in risk (NIDDK, 2021). While more recent pharmaceuticals have been developed and shown even greater possibilities for preventing and treating type II diabetes, lifestyle interventions like supervised exercise are still important to help maintain weight loss and support healthy physiological function (Jensen et al., 2024).



Figure 7.10.3.1: This image depicts a man with diabetes in the background, listening to a community health worker, familiar with the necessary proactive approach one must implement in order to maintain control over the detrimental effects of this disease. The health worker was providing answers to questions posed by the patient regarding actions he would need to take, enabling him to lead a healthy, active life with diabetes. She was referencing a spiral bound manual created by the Centers for Disease Control and Prevention entitled, “Controle Su Diabetes”, which translated into English means, “Control Your Diabetes”. (Copyright; CC0, CDC/Amanda Mills)

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7.11: Cancers

Cancer refers to a type of disease characterized by the uncontrollable growth and spread of cells that serve no physiological function in the body. Healthy cells have a predictable number of divisions they can undergo to make new cells before they program their own death (cell apoptosis). Cancerous cells have genetic mutations and/or epigenetic changes that cause excessive reproduction and prevent their programmed destruction. These cells can form solid clumps, called neoplasms or tumors. Cancers as a group are often referred to as malignant neoplasms in epidemiology.

Tumors or neoplasms are clumps of cells that serve no physiological function, and can start invading nearby tissues or putting pressure on other bodily structures. **Benign** tumors are not cancerous - they are much slower-growing and don't tend to spread. However, benign tumors can still cause problems if they begin to put pressure on nearby physiological structures. **Malignant** tumors are cancerous: they grow more rapidly, grow their own network of blood vessels to bring them nutrients, and invade nearby connective tissues and lymph nodes. Cancerous cells also break free from the neoplasm and spread through the lymphatic system or bloodstream to other parts of the body - a process called **metastasis**. Some cancers have no solid tumors to begin with, but instead these malignant cells proliferate in the bloodstream or lymph system. Although cancers have these common characteristics, each cancer is a separate disease, named by the tissue and organ the cells originated in (*What Is Cancer?*, 2022). Different cancers have varied causes, risk factors, and treatments.

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7.11.1: Current Rates in the U.S.

- Morbidity:
  - Incidence: Over 2 million new cases of cancer will have been diagnosed in 2025.
  - Breast cancer in women has the highest number of new cases at over 316,000. Prostate cancer in men is not far behind, and lung and bronchus cancer comes in second for both sexes.
  - The lifetime probability of developing any cancer is nearly 40% (Siegel et al., 2025).
- Mortality:
  - In 2025, over 618,000 people will have died from cancer.
  - Lung/bronchial cancer is the deadliest type, causing over 20% of all cancer deaths. Breast cancer in women and prostate cancer in men cause the second most deaths, while pancreatic and colorectal cancer are not far behind for both sexes (Siegel et al., 2025).
  - Since the mid 1980's, cancer has caused a higher percentage of deaths for people under the age of 65 than heart disease (National Cancer Institute , n.d.).
  - Cancer death rates have dropped by 33% between 1991 and 2020, largely due to reductions in smoking, earlier detection, and medical advances in treatment (American Association for Cancer Research, 2023).

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7.11.2: Risk Factors/Protective Factors

Risk factors for cancers vary widely. Specific biological factors can put a person at risk for developing cancer, such as previous infections or treatment with specific drugs or radiation therapy, hormonal influences, and inherited genetic factors. Some of the most common biological factors include (but are not limited to):

- Specific genes (examples):
  - Inherited mutations on either BRCA1 and BRCA2 genes can increase the risk of breast cancer by up to 72% and the risk of ovarian cancer by up to 44% (National Cancer Institute, 2020). See Figure 7.3 below.
  - Mutation on the KRAS gene, which changes the proteins produced within the cell, causing it to grow uncontrollably (National Cancer Institute, 2022).
  - Lynch syndrome, which is when a mismatch repair is inherited on one or more specific genes that increases the risk of colorectal cancer by 40-70% (Imyanitov et al., 2023).

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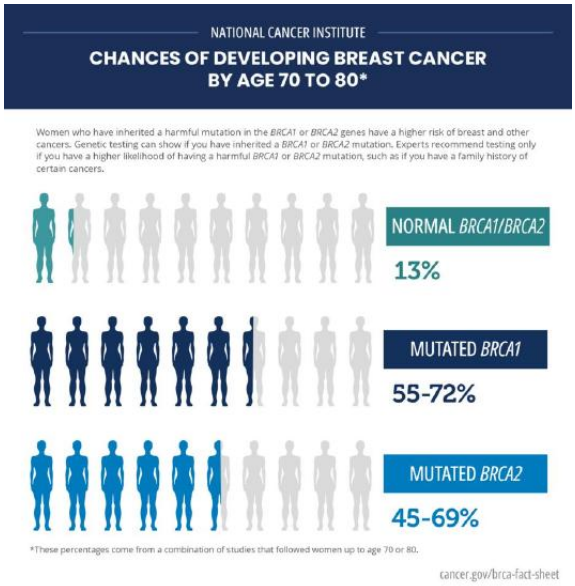


Figure 7.11.2.1: Chances of Developing Breast Cancer by Age 70 to 80. Specific inherited mutations in the BRCA1 and BRCA2 genes increase the risk of breast and ovarian cancers. . (Copyright; CC0, *National Cancer Institute, 2020*)

Several pathogens are also known to cause cancers. These include:

- Human Papillomavirus (HPV) is most known for its relation to cervical cancer, but it also increases the risk of cancers in both female and male reproductive systems, as well as head and neck cancers.
- *Helicibactor pylori is indicated in stomach cancers and non-Hodgkin Lymphoma.*
- Epstein-Barr virus increases the risk of Hodgkin and some non-Hodgkin Lymphomas, as well as nasopharyngeal cancer.
- Hepatitis B and C increase the risks for liver cancer and others (American Association for Cancer Research, 2023).

Epigenetic changes refer to alterations outside of DNA, which can cause changes to the way the cell functions, but may be reversible. Exposures to certain toxins can cause epigenetic changes which cause cancer (National Cancer Institute, 2022). Any

substance that can cause mutations in cellular DNA is called a mutagen, and any substance that is known to cause those mutations that lead to cancer is called a carcinogen. Carcinogens are usually studied in lab animals and then confirmed with epidemiological studies. The International Agency for Research on Cancer (IARC, a division of the WHO) maintains lists of possible, probable, and known carcinogenic substances or environmental exposures as research identifies them. Three levels of carcinogenicity are described in their regular publications (called Monographs), outlining the scientific evidence for each hazardous exposure:

1. Carcinogenic to humans

2a. Probably carcinogenic

2b. Possibly carcinogenic

3. Not classifiable as to its carcinogenicity in humans

Additionally, the CDC, NIH, and FDA collaborate on the National Toxicology Program (NTP) and release updated lists of known or reasonably anticipated carcinogens every few years. However, just because someone is exposed to a particular carcinogen does not guarantee that they will get cancer. Some carcinogens are hazardous even at low doses or for a short period of time, while others affect humans after repeated exposures of long durations (American Cancer Society, 2019).

Probably one of the most well known carcinogens is tobacco smoke. Smoking is a factor in nearly 20% of all cancer cases - including lung cancer and 17 others. Exposure to tobacco smoke increases the risk of kidney and bladder cancer, leukemia, female reproductive cancers, cancers of the head and neck, and cancers of the digestive tract. Nearly 30% of all cancer deaths can be attributed to tobacco products as well (American Association for Cancer Research, 2023). Environmental exposures to radiation (including UV radiation and skin cancer), toxic chemicals (such as asbestos and lead), or pollutants (such as particulate matter in the air we breathe) are also a significant risk. Many jobs have high levels of exposures to carcinogens. Firefighters, for example, are exposed to high levels of toxins from burning plastics and synthetic materials. These exposures can increase their risk of several different types of cancers over their lifetime (American Association for Cancer Research, 2023).

About 20% of all cancers are also related to just 4 lifestyle behaviors: alcohol consumption, nutrition, physical activity, and weight management. Obesity - particularly abdominal (visceral) obesity, is associated with chronic inflammation, prediabetes, and changes in sex hormones - all of which can increase the risk of cancer. Overweight and obesity are linked to 15 different types of cancer, and may be to blame for the rise in colorectal cancer seen in young people (under 50 years old) in the past decade (American Association for Cancer Research, 2023). For an infographic on obesity and cancer, see Fig. 7.11.2.2 below.

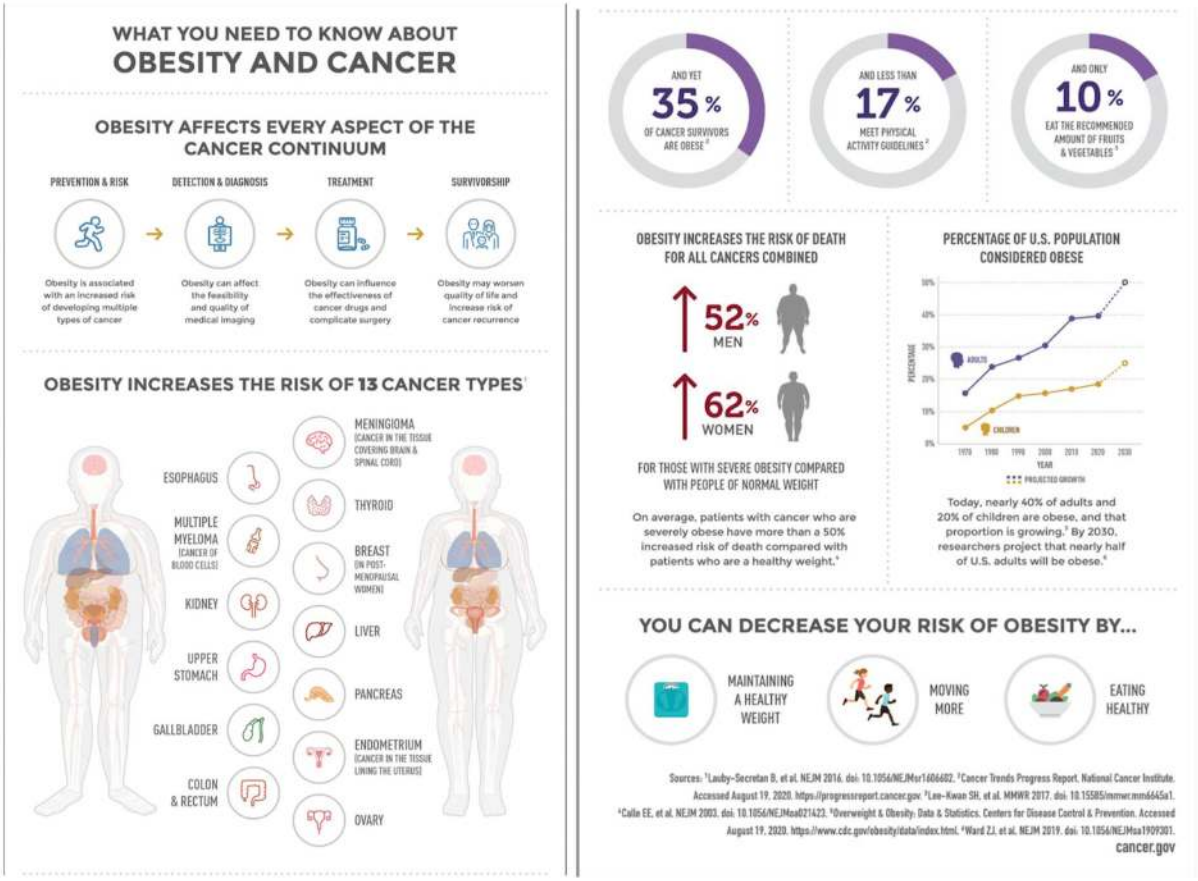


Figure 7.11.2.2: What You Need to Know About Obesity and Cancer. (Copyright; CC0, *National Cancer Institute*, *2020*)

Conversely, physical activity can decrease the risk of at least 9 cancers, with likely protection for more as well. It is estimated that over 46,000 cancer cases could be prevented if people engaged in the minimum physical activity guidelines of getting 150 minutes of moderate activity, plus 2 days of muscle strengthening exercises per week. Currently, less than ¼ of American adults meet this minimum (American Association for Cancer Research, 2023).

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7.11.3: Public Health Response

Public health efforts to reduce smoking may have had the most significant effect on cancer rates in the past decade. Between 2005 and 2021 smoking rates decreased from 20.9% to 11.9% of adults (CDC, 2023g). In 2012, the CDC launched the first federally funded anti-smoking campaign called *Tips from Former Smokers (Tips)*, which included stories from people suffering the effects of smoking-related diseases. Between 2012 and 2018, over 16 million people reported attempting to quit, and 1 million people did so successfully due to exposure to *Tips* messaging. It is estimated that this campaign helped prevent 129,000 early deaths (CDCTobaccoFree, 2024). The Office on Smoking and Health (OSH) is a division of the CDC which supports national and statewide tobacco use prevention through surveillance and promoting tobacco control programs and policies. And smoke-free policies have been demonstrated to have positive health outcomes - even acutely. In a county in Colorado, a smoke-free policy in 2006 was associated with a 23% drop in ambulance calls (CDC, 2021a). Perhaps one day, tobacco sales may be banned altogether. A recent bill in the U.K. was proposed to phase out smoking in the next generation. Smoking itself would not be criminalized, but the sale of tobacco products would be banned to anyone born after 2009. Similar legislation in New Zealand was just repealed in early 2024, so laws like this may face staunch resistance - at least initially (Reuters, 2024).

Other public health efforts have focused on increasing screening rates and vaccine uptake. Mailing self-collection sample kits for colon or cervical cancers, and using online resources like educational videos and telemedicine has been shown to increase screening rates for some of the most common cancers (American Association for Cancer Research, 2023). The HPV vaccine can prevent 80-90% of infections that cause cervical cancer, and many other cancers as well (National Cancer Institute, 2021). In 2021, 58% of 13-15 year olds had received the vaccine series (up from 48% in 20180), and the Healthy People initiative has set a target of 80% by 2030 (U.S. Department of Health and Human Services, n.d.). Some public health programs are working with pediatrician networks in order to increase doctor education, help overcome parent hesitancy, and use technology to remind both doctors and patients of the importance of HPV vaccines (Vernon et al., 2020).

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7.12: Chronic Lower Respiratory Diseases

Also referred to as chronic obstructive pulmonary diseases (COPD), this category includes emphysema, chronic bronchitis, and other chronic lower respiratory diseases (except asthma). Although this is currently the 6th leading cause of death for Americans behind heart disease, stroke, cancer, COVID-19 and accidents, it still is a significant group of diseases that contributes to both disability and mortality. These diseases affect the lungs and bronchi; causing inflammation, reducing elasticity and oxygen exchange within the air sacs (alveoli), and creating more mucus and phlegm. This causes coughing, wheezing, and trouble breathing - limiting the amount of activity that the person can do. COPD is progressive, meaning it gets worse over time (National Heart, Lung, and Blood Institute, 2023).

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7.12.1: Current Rates in the U.S.

Prevalence:

- In 2022, 4.6% of Americans were living with COPD, emphysema, or chronic bronchitis. This percentage has not changed significantly since 2019 (*FastStats*, 2024).
- The age-adjusted prevalence of COPD has hovered at around 6%, and has not changed significantly between 2011 to 2022 (*National Trends - Chronic Obstructive Pulmonary Disease (COPD)*, 2024).

Mortality:

- Over 142,000 people died from COPD (including asthma) in 2021, putting the mortality rate at 42.9 per 100,000 people (*FastStats*, 2024).

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7.12.2: Risk Factors/Protective Factors

The primary risk factor for COPD is cigarette smoking. Most people who develop COPD are current or former smokers (National Heart, Lung, and Blood Institute, 2023). However, a rare genetic condition called Alpha-1 antitrypsin (AAT) deficiency can cause asthma and COPD, and is a cause of about 5% of COPD cases (Brode et al., 2012). Other environmental or occupational exposures to secondhand smoke, air pollution, chemical fumes, or smoke from cooking can all damage the lungs. Most people who develop COPD are over the age of 40 (National Heart, Lung, and Blood Institute, 2023a).

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7.12.3: Public Health Response

The public health response to COPD is likely tied into other prevention efforts, such as anti-smoking campaigns. (See Cancer above).

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7.13: Summary

Summary

Major diseases often have a biological cause, or causes, that provide the opportunity for treatment and prevention. Communicable or infectious diseases are caused by microbial agents, and noncommunicable chronic diseases often have other genetic, environmental, and behavioral factors that contribute to their development. All diseases are affected by other factors like poverty and access to healthcare, that we collectively call the Social Determinants of Health (SDOH) - these will be covered next in chapter 8. Understanding the biological basis of diseases and their pathogenesis allows for the research and development of new vaccines, therapies, and treatments, and helps public health officials create coordinated, effective strategies for prevention.

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CHAPTER OVERVIEW

8: The Social Determinants of Health

Learning Objectives

- Analyze current public health issues and describe how they affect the health status of specific populations of age, gender, race and ethnicity, minority, education level, and socioeconomic status.
- Describe the interplay between the social determinants of health, including gestational endowment, social circumstances, environmental conditions, behavioral choices, and access to medical care, in determining individual and community health status, and local, state, national, and global health organization and policy.

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8.1: Introduction

Health is influenced by a myriad of factors, many of them beyond genes or biology. Factors such as income and wealth, housing quality, access to greenspace, access to healthcare, education, stressful environments, and more - are often lumped into a category we call the Social Determinants of Health (SDOH). The U.S Department of Health and Human Services provides a broad definition as:

Social determinants of health (SDOH) are the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks.

Variance in these environments and conditions that people are born into and live in cause stark differences in health outcomes. Life expectancy overall is influenced by zip code. Life expectancy at birth can vary by 10 years or more between different census tracts within the same county (NCHS, 2022). Indeed, as the Vice President of the California Endowment (a non-profit health equity advocacy group) Dr. Tony Iton states: “When it comes to health, your zip code matters more than your genetic code.” (Iton, 2021).

In this chapter we will cover health disparities and inequities, each of the different categories of SDOH, and how these determinants affect health outcomes. Although the focus of this chapter will be to cover the SDOH in the United States of America, it is important to remember that health inequities stemming from SDOH span across the globe between and within different nations and continents - each with unique and yet interdependent causes.

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8.2: Health Disparities and Inequities

Health disparities refer to differences in health outcomes (morbidity and mortality) between populations that are not based in genetics or individual biology. **Health inequities** are defined as an increased risk of poorer health correlated with race/ethnicity, gender, sexual orientation, socioeconomic status, health insurance status, rural/urban residence or (geographical location), and housing status (U.S. DHHS, HRSA, Office of Health Equity., 2020). Although the terms “disparities” and “inequities” are often used interchangeably (even in this text), it is the inequities in health opportunities that often lead to the disparities we see in health outcomes of different groups. In other words, we are recognizing that there are differences in how long we live and what diseases affect us (and how seriously sick we become) that have more to do with social, economic, political, and environmental factors than any genetic or biological influence. Why do people in one zip code live longer than those in another? Why is income or education level such a strong predictor of health? We should recall back to the philosophies of Virchow and Winslow (chapter 3) in recognizing that these social determinants of health are perhaps the strongest predictors of overall population health. “Health inequities refer to inequalities that are unfair, unjust, avoidable or unnecessary, and that can be reduced or remedied through policy action”(U.S. DHHS, HRSA, Office of Health Equity., 2020). Pursuing health equity - providing opportunities for all to attain their highest level of health - is a paramount role for public health (Healthy People 2030, n.d.).

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8.2.1: Race and Ethnicity - Definitions

The concept of different races within the species *homo sapiens* is a social construct; it has no basis in genetics or biology (Yudell et al., 2016). Races are categorized as characteristics of an external phenotype (such as skin color, eye color, hair type), and/or as a cultural identity or inheritance. A person's race may be a part of their own social identity, or could be applied to them by society, based on their appearance. Ethnicity is different from race in that it is more associated with a cultural heritage, language, religion, customs, shared history, or attachments to ancestral land (Seabert et al., 2021). Ethnicity is also socially constructed, and an ethnic identity may change over time with different generations. For example, a person with dark skin may be treated by other members of society as Black (racially). Assumptions and stereotypes may be made about them, microaggressions aimed at them and they may experience discrimination for being Black. The same person may also identify as ethnically Nigerian-American. Their parents or grandparents may have immigrated from Nigeria, they may adopt and express various customs and cultural expressions of both Nigerian and American culture - and perhaps a Nigerian-American subculture. Another individual with light skin may check the box for "White" or "Caucasian" on government documents, and may be ethnically Armenian. Each person's lived experience within society is influenced by all of their identities, whether the identity is ascribed to them by U.S. society, or owned and expressed by themselves.

How both race and ethnicity influence health outcomes via the social determinants of health has much more to do with racism, xenophobia, and ethnocentrism in American social, economic, and political structures than any influence from genetics, or cultural behaviors. (Genetic predispositions to specific health conditions that can be passed to offspring are covered briefly in chapter 9). Racial health disparities are not genetic predispositions to poor health. Ethnicities are poorly defined, complex, and fluid. Ethnicity in public health research often depends on self-identification with arbitrary classifications (such as "Hispanic" or "Asian"). Yet race and ethnicity are still used by the U.S. government in collecting census data, and still used in epidemiology - particularly to help identify health inequities that may be caused by systemic and structural racism, and Anglo/European-ethnocentrism (Bhopal, 1997).

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8.2.2: Racial and Ethnic Health Inequities

A recent report from the Office of Minority Health, an agency of the U.S. Department of Health and Human Services (DHHS), outlines how federal policies have caused and maintained structural disadvantages to obtaining long, healthy lives in minoritized communities. This report also uses the term *minoritized groups* rather than *minority or minorities* to further describe how structures and policies have affected populations, rather than these disparities being a result of numbers of a specific demographic in a population. (These terms will also be adopted in this text). The assertion is that racial and ethnic disparities in health and health outcomes are significantly caused or made worse by historical or existing governmental policies, and therefore a path toward health equity involves new federal policies and accountability (National Academies of Sciences, Engineering, and Medicine, 2023).

As discussed in Chapter 3 of this text, the United States' early history of Native American extermination, land seizure, kidnapping of native children and required assimilation has caused, and continues to perpetuate significant health repercussions for American Indians and Alaskan Natives (AIAN). Concurrently, the forced immigration and enslavement of Africans, subsequent Jim Crow laws, and even purposeful public health abuses (such as the Tuskegee Syphilis Study), have negatively affected the health of Black Americans for centuries. Additionally, federal policies relating to immigration and social services also play a role in health disparities, particularly those experienced by immigrants and asylum seekers, and their children. Although health disparities are also correlated with poverty and lack of education, those racial and ethnic inequities exist at all socioeconomic strata - indicating that the explanation lies beyond income or education alone. A section in the report summarizes just some of the health inequities in America:

There are higher rates of childhood asthma among low-income households, higher morbidity and mortality from chronic diseases among individuals with lower educational attainment, and higher exposure to air pollution among residents of disinvested communities—disproportionately individuals who are racially and ethnically minoritized. Moreover, the effects of the structural determinants of health on many health outcomes persist when accounting for income and education (National Academies of Sciences, Engineering, and Medicine., 2023).

According to an earlier DHHS Health Equity Report in 2019-2020, significant racial disparities in health and social determinants of health have persisted across the decades. Although measures like life expectancy and educational status have improved for all Americans, there are still differences in these and other measures between racial groups. Racially minoritized groups have twice or higher the poverty rates as non-Hispanic Whites do (U.S. Department of Health and Human Services, Health Resources and Services Administration, Office of Health Equity., 2020). According to the most recent report from the U.S. Census Bureau tracking poverty rates for the year 2022, the poverty rate for those identifying as non-Hispanic White or Asian was 8.6%, whereas it was 17.1% and 16.9% for those identifying as Black and Hispanic respectively, and 25% for American Indian and Alaskan Natives (Shrider & Creamer, 2023).

This disparity in poverty rates is also reflected in the increased likelihood of minoritized populations living in impoverished zip codes. Southeastern and Southwestern states tend to have the highest poverty rates, a trend which has remained consistent over time, and is consistent with higher unemployment rates in these areas. Neighborhoods that have been historically racially segregated as "non-White" have associations with lower life expectancy and higher rates of homicide, infant mortality, and all-cause mortality, as well as higher rates of mental distress, community violence, excessive drinking and smoking, and HIV prevalence (U.S. Department of Health and Human Services, Health Resources and Services Administration, Office of Health Equity., 2020). These neighborhoods often also have higher exposures to environmental toxins like air pollution and lead (Doctrow, 2022).

According to the KFF (formerly known as the Kaiser Family Foundation) health tracking polling, many disparities exist with how safe minoritized groups feel in their homes and neighborhoods, and how discrimination impacts everything from housing to healthcare. This foundation conducted a survey on racism, discrimination, and health in a representative sample of 6,000 Americans in 2023. Hispanic, Black, Asian and AIAN individuals are less likely to report feeling safe in their neighborhoods. About twice as many racially minoritized respondents reported a family member being victimized by violence as did White respondents. Also consistent with earlier surveys, minoritized groups are significantly more likely to have a family member who has experienced mistreatment from law enforcement (Artiga, 2023). "Nearly half of Black Americans say they have been afraid their life was in danger due to their racial background," (Reich, 2022). All of these disparities impact health on multiple levels across the lifespan; not the least of which is the heightened chronic stress due to discrimination, racism, and poverty.

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8.2.3: Systemic Racism

Systemic and structural racism cause disparities in access to goods, services, and opportunities using laws, policies, practices, or attitudes. Systemic racism is often hidden, and practices or social values are accepted as the norm without questioning whether racism had any influence on their creation. Below are two examples of how systemic and structural racism continue to impact racially minoritized communities and cause health inequities.

Systemic racism has influenced neighborhoods through redlining: a practice of segregating Black Americans into urban neighborhoods and denying them residential loans. Black neighborhoods were considered financial “risks” by banks and lenders. Newly-built housing tracts often came with contracts requiring that anyone who purchased one of the new houses could not sell it later on to folks from other races or ethnicities - thus keeping suburban communities segregated. Even when the Fair Housing Act of 1968 opened up FHA loans for Black Americans legally, the practice of discrimination continued on within financial institutions. At the same time, home prices continued to increase in the suburbs, which continued to keep loans out of reach for many (Rose, 2023). A majority of those communities that were redlined almost a century ago are still low income, minoritized neighborhoods. Since home ownership is one of the primary mechanisms of building wealth for the middle class, this had a generational effect on racial wealth disparities (Reich, 2019).

Structural racism also influences access to education and economic advancement via funding for public schools. Public schools are funded primarily by state taxes and local property taxes, with much smaller portions from federal funds or community fundraising. This means that if home values are lower in a particular neighborhood, their school district gets less money compared to a school district with higher home values. In those states that have approved them, voucher programs also redirect tax dollars from public schools into private, charter schools - cutting into public school budgets even further. Schools in lower income neighborhoods tend to have more trouble attracting and maintaining teachers, and they may spend more of their limited resources on safety measures and behavioral interventions rather than enhancing learning programs (Reich, 2023). In school, young Black men are more likely to receive harsher punishments, and schools are more likely to call the police when disciplining them - thus increasing the risk of incarceration and eroding trust (P. A. Braveman et al., 2022). In these ways and many others, both current and historic policies continue to create structures and systems that provide fewer opportunities for wealth and impact long-term health outcomes in racially minoritized neighborhoods.

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8.3: Social Determinants of Health (SDOH)

According to Healthy People 2030, the social determinants of health (SDOH) are “the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks” (*Social Determinants of Health - Healthy People 2030*, n.d.). These social determinants of health can be grouped into 5 major categories: economic stability, educational access and quality, healthcare access and quality, neighborhood and built environment, and social and community context (see Figure 8.1 below). It is important to remember that these categories are interrelated; each one has effects on the others.

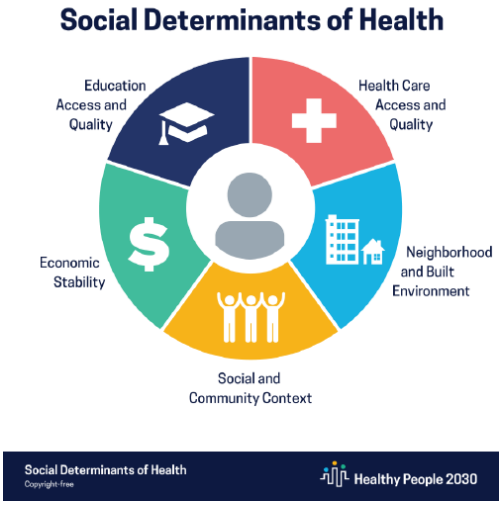


Figure 8.3.1: Healthy People 2030, U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (Retrieved 11/30/2023 from https://health.gov/healthypeople/objectives-and-data/social-determinants-healthe)

Inequities exist in each of these categories, which can have significant effects on health outcomes - both immediately and later in life. Recognizing these social determinants of health is imperative for successful public health programs. Understanding the SDOH can help public health practitioners discover influences of health behaviors, barriers and motivators to change within a community, and help them design truly effective health promotion programs and advocate for health policies that improve health equity.

Let’s take a look at an example of a health behavior and health outcome that could be addressed by community health interventions: cigarette smoking and its link to lung cancer. If the health intervention only focuses on the behavior of smoking, there may be other factors that influence a person’s likelihood to pick up smoking that get ignored; including economic, education, policy, and environmental influences. Poorer communities are more likely to have higher rates of cigarette smoking (Hiscock et al., 2011). Those with lower levels of educational attainment tend to earn lower wages, increasing their chronic stress levels, which may also lead to the adoption of health-risk behaviors, all while having less access to smoking-cessation support. If smoking is also permitted in stores, restaurants, and public places, other people will be exposed to second-hand smoke and young people will see cigarette smoking behavior modeled for them. Let’s say a public health practitioner identified high smoking rates in this example community and immediately proposed an anti-smoking advertisement campaign utilizing shock tactics (like billboards with images of tar-covered lungs). Not only might the campaign not be successful at decreasing cigarette smoking, ultimately it may even cause more resistance to public health advice within that community, as individuals perceive these billboards as “preachy” or attempting to constrict personal freedoms. Although the public health project may have sound medical rationale, it didn’t take into account these other factors that influence behavior just as much as personal choice. See Figs. 8.3.2 and 8.3.3 below for current smoking rates reported by U.S. adults in 2021, by both education level and household income.

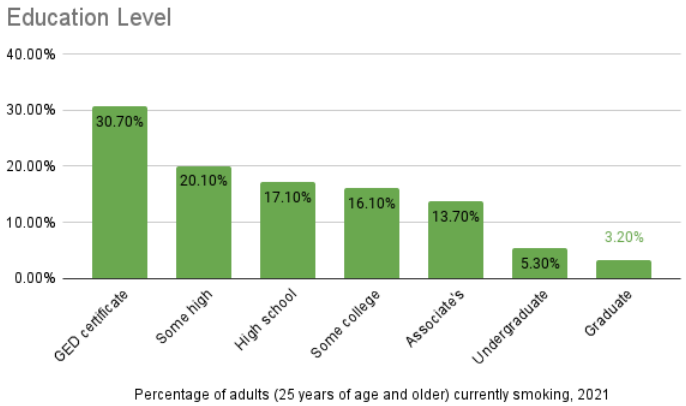


Figure 8.3.2: Current cigarette smoking rates for adults age 25 and older by education level, in 2021. Data are from the National Health Interview Survey. (Cornelius ME, Loretan CG, Jamal A, et al. Tobacco Product Use Among Adults – United States, 2021. MMWR Morb Mortal Wkly Rep 2023;72:475–483. DOI: http://dx.doi.org/10.15585/mmwr.mm7218a1.)

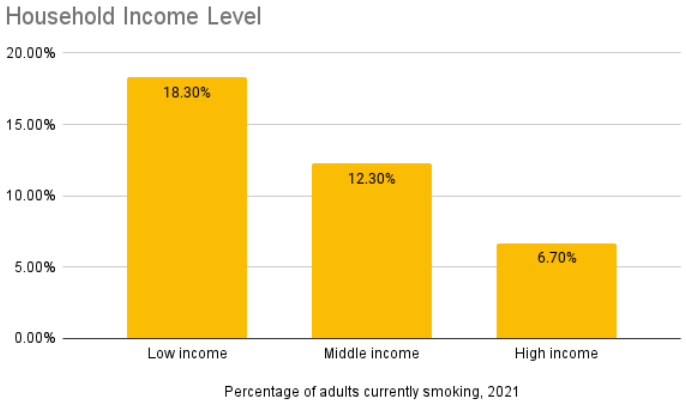


Figure 8.3.3: Current cigarette smoking rates for adults by income level, in 2021. Data are from the National Health Interview Survey. (Copyright; Cornelius ME, Loretan CG, Jamal A, et al. Tobacco Product Use Among Adults – United States, 2021. MMWR Morb Mortal Wkly Rep 2023;72:475–483. DOI: http://dx.doi.org/10.15585/mmwr.mm7218a1.)

In the sections that follow, we'll dig deeper into each of the 5 social determinants of health to learn more about inequities within each category, and how these disparities impact health outcomes for individuals and communities.

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8.4: Economic Stability

Economic stability refers to the ability to afford things like housing, food, and health insurance, and the social structures and built environments that come along with wealth. Economic stability can certainly be assessed with income levels, but income alone may not provide a complete picture. Other metrics like home ownership (which can be a surrogate for wealth), or self-reported stress about food or housing are also important ways to measure the effects of money on health. Population economic stability is certainly affected by macroeconomic and political factors such as inflation, unemployment rates, and the minimum wage. Individual changes in socioeconomic status such as job gain or loss, property ownership or loss, and even marriage or divorce can also be factors that impact health outcomes.

Poverty is a significant factor in many different health outcomes. Poverty in America is defined as an income at or below a certain standard set by the U.S. federal government, which changes over time due to inflation. In 2022, the poverty level for an individual annual income was set at $14,880, or $29,950 for a family of 4. This is up from $12,880 and $26,500 respectively just a year prior in 2021 (U. S. C. Bureau, 2023b). Over 37 million Americans currently live at or below the poverty rate by this official poverty measure, which in 2022 was 11.5% (as seen in Figure 8.2 below). Notably, these income limits do not change in different areas to reflect the geographic variance in the cost of living. So it may require an income significantly higher than the poverty rate to be able to afford housing and food in a larger metropolitan area where these things can be more expensive. Additionally, some folks who receive government assistance may not be factored into the official poverty measure, so a supplemental poverty measure (SPM) is also used as a metric to account for these factors. The SPM for 2022 was 12.4%, and although the official poverty measure did not change between 2021-2022, the SPM increased by 4.6% over that year (Shrider & Creamer, 2023). See Figure 8.4 below.

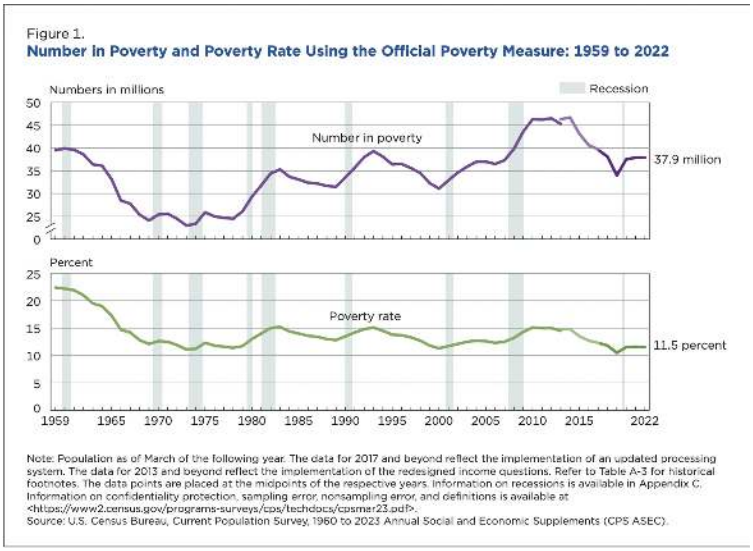


Figure 8.4.1: Emily A. Shrider and John Creamer, U.S. Census Bureau, Current Population Reports, P60-280, Poverty in the United States: 2022. (CC0; U.S. Government Publishing Office, Washington, DC, September 2023)

Many of those living in poverty are children. Childhood poverty is calculated using the SPM which takes into account people receiving social assistance like the Supplemental Nutrition Assistance Program (SNAP). There are also racial differences with poverty for children, with the highest poverty rates in Hispanic and Black children, and the lowest poverty rates in non-Hispanic White children. In 2020 and 2021, social assistance programs were expanded in response to the pandemic, which included SNAP and the Child Tax Credit (CTC). The latter specifically reduced childhood poverty significantly (in all groups) - lifting 5.3 million people out of poverty, including 2.9 million children (U. S. C. Bureau, 2022). In 2021 childhood poverty hit a historic low at 5.4%, but then climbed back up to 12.8% in 2022. The expiration of the expanded CTC benefits is at least partially to blame for this relapse in poverty (Parrott, 2023). Food and housing insecurity negatively impact childhood health in several ways; including poor nutrition, a lack of physical activity, behavioral and academic problems in school, and higher risk of health problems like obesity and type II diabetes (U.S. Department of Health and Human Services, Health Resources and Services Administration, Office of Health Equity., 2020).

Whether you have a lived experience of poverty or can imagine it, wondering if you'll be able to pay rent, utilities, buy food, and medicine can be mentally and emotionally debilitating. Worrying about housing costs can cause severe psychological distress, and

is associated with poorer self-reported health. Even risks of chronic diseases like heart disease, high blood pressure, and diabetes are associated with higher stress around housing affordability. Additionally, home ownership is often a proxy for wealth, so renters are more likely to experience this kind of stress than homeowners. The majority of renters who live in government-subsidized housing are women (⅔), and often these renters are single or divorced, and experience much higher distress levels than those who own a home. (U.S. Department of Health and Human Services, Health Resources and Services Administration, Office of Health Equity., 2020).

Obesity rates, diabetes rates, and sedentary rates increase inversely with wealth (American Diabetes Association). Wealthy people are more likely to engage in healthy behaviors like exercise and less likely to engage in unhealthy behaviors like smoking. Wealth in terms of home ownership also increases the social cohesion of a neighborhood, with those who own homes reporting more trust in their neighborhood. This social cohesion also results in more engagement in voluntary organizations and local activities (religious centers, sports, community activities, etc.). In fact, parents living in wealthier neighborhoods are far more likely to report social support of their community in watching out for each other's children and helping each other out. People who own their home are also likely to live there for longer than if they were renting (U.S. Department of Health and Human Services, Health Resources and Services Administration, Office of Health Equity., 2020). Wealth and home ownership are thus strong factors in health and well-being outcomes for individuals and communities.

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8.4.1: Employment

Although we will discuss how work environments influence health more broadly in another chapter, it's important to note that employment status has a significant effect on economic stability. Both unemployment and under-employment impact a person's ability to pay their bills and their sense of security in meeting their basic needs. Underemployment includes intermittent unemployment, poverty wages, or being unable to find a job that matches or appropriately compensates the person's education level and skill set. Part-time employment can also fall into this category, as many workers who would like to work full-time must take several part-time jobs instead. And, do these jobs pay a "living" wage - that is, can someone work the equivalent of full-time, or 40 hours per week, and afford rent and food based on their area's typical prices? If not, a person may have to work overtime, juggle multiple jobs, live with several family members or roommates, and/or accept substandard living conditions (see Housing Instability and Quality below). Many low-wage jobs are also high-stress, which has an impact on mental health and a correlation with substance abuse (*Employment - Healthy People 2030*, n.d.).



Figure 8.4.1.1: Employment Infographic from Healthy People 2030

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8.4.2: Housing Instability

A lack of sufficient and quality housing affects health in both large cities and rural areas. Perhaps the first problem we think about with a lack of housing is homelessness, or a state of being unhoused. Although images of tent encampments on sidewalks are often what is portrayed on the news media to describe the “homelessness crisis”, the unhoused population includes more people than those visibly living on the street. Folks who have no permanent residence may be living out of their car, in hotel rooms, or “couch surfing” and staying with friends or family temporarily. They may also be living in temporary subsidized housing or staying in shelters overnight. Housing status can be dynamic and change rapidly over time, so it can be difficult for public health officials to get a true count of housing needs in a particular area. For example, the Los Angeles Homeless Services Authority (LAHSA) conducts a point-in-time count of unhoused individuals over 3 days, twice per year, which includes those in shelters, transitional housing, and hospitals, as well as a visual count conducted by volunteers across the city (Greater Los Angeles Homeless Count, 2024). This may still undercount some individuals who lack permanent housing, or are housing insecure - which can also mean being at risk for losing housing within the next couple of weeks. Housing instability is obviously a complicated problem.

Both a lack of permanent housing and housing insecurity can cause significant physical and mental stress. Those without housing are at higher risk of being assaulted, are likely to go hungry and have food insecurity, and lack access to basic hygiene facilities - which increases risks of infectious disease and malnutrition. The psychological stress of housing insecurity can be debilitating; anxiety, depression, and substance abuse are common. Yet American society adds to these hardships by stigmatizing and dismissing those who are unhoused as “lazy” or “drug addicts” (Bhattar, 2021). Local governments often take steps to remove homelessness from the sight of other residents, many times without actually providing sufficient housing for those affected. Some attempts to convert or build temporary housing facilities are met with strong opposition from local residents due to this stigma (Canadian Observatory on Homelessness, 2021). Hostile architecture like bars in public benches, or pylons under bridges are built to make it impossible for people to find shelter in those locations. Some local governments make camping on the street illegal, increasing the likelihood of hostile police interactions and incarceration for the unhoused. Assaults by private individuals and police officers on the homeless have been documented (Bhattar, 2021).

Individuals experiencing a lack of housing are not a monolith, yet homelessness does tend to affect marginalized groups at higher rates. Some are suffering from mental illness and addiction. Veterans suffering with post-traumatic stress disorder (PTSD) often lack housing and may have other disabilities as well. There are also those who have one or more jobs and their wages are insufficient to support them. Other individuals have been kicked out of a family home, or left abusive relationships. LGBTQ+ youth can be at a high risk of homelessness, and victims of domestic abuse often face homelessness while leaving an unsafe relationship. A lack of affordable housing in many areas of the U.S. exacerbates these problems (Bhattar, 2021). College students are also often among those lacking housing. For example, a CA State Assembly report found that 5% of UC students, 10% of CSU students, and 20% of community college students in CA reported experiencing some form of housing insecurity - often from a lack of affordable housing close to the campus they are attending (Burke, 2022). Lacking those basic necessities can have a significant impact on the academic performance of those students.

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8.4.3: Housing Quality

Substandard housing is also a public health issue. The U.S. Department of Housing and Urban Development (HUD) considers substandard housing to be any permanent residence lacking hot and cold water, sink, toilet, or shower, and kitchen facilities like a stove, refrigerator, and sink with running water. Living in a place without any of these utilities can affect personal hygiene, the ability to cook fresh and healthy meals, and ultimately increases the risk of both infectious and chronic diseases. A recent report estimates that substandard housing affects over 1.5 million people living in cities and over 368,000 people living in rural areas. American Indian and Alaskan Natives have the highest rates of lacking appropriate plumbing and kitchen utilities, followed closely by rural communities and people with disabilities (Swendener et al., 2023).

Even if housing has adequate plumbing and kitchen facilities, there may be other issues that impact health such as rodent or insect infestation, mold, lack of heating or cooling, or exposure to household toxins like lead or formaldehyde. Even low levels of lead exposure can have significant effects on neurodevelopment in children. Dilapidated structures pose higher risks for injuries for children, older adults, and people with disabilities (*Quality of Housing - Healthy People 2030*, n.d.). A lack of disposable income can make it difficult to pay for home repairs, and landlords can sometimes shift responsibilities to tenants - particularly in competitive rent markets. One report found that even prior to the COVID-19 pandemic, nearly 15% of rental homes either needed substantial repairs, had rodent infestations, or lacked some resource (like heating or water), and these homes were more likely to be rented to the poorest - and most rent-burdened families (U.S. Government Accountability Office, 2020).

Other issues around housing include struggling to pay rent or a mortgage, spending more than 30-50% of income on housing, overcrowding, and having to move frequently (*Housing Instability - Healthy People 2030*, n.d.). Housing is considered “affordable” when it costs 30% or less of the household income (Braveman et al., 2011). Children who have to move more than 3 times in one year have much poorer health and are also less likely to have health insurance. Overcrowding increases the risks of infectious disease transmission and can also impact mental health. The COVID-19 pandemic only highlighted the impact of overcrowding and poor ventilation in living spaces. All of these factors can impact both physical and psychological health of individuals and the social cohesion of a community. Over their lifespans, people living in areas of poverty or experiencing homelessness have significantly worse health outcomes (*Housing Instability - Healthy People 2030*, n.d.).

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8.4.4: Food Insecurity

Food insecurity describes not only experiencing the physical pain of hunger, but also not knowing when or where the next meal will be, and/or a reduction in the quality and desirability of food. In fact, the USDA describes two levels of food insecurity as being low food security and very low food security depending on whether or not a person has limited access to only quality or both quality and *amount* of food (*Food Insecurity - Healthy People 2030*, n.d.). Food insecurity is also associated with obesity, diabetes, and other chronic diseases that are often caused by overconsumption of calories. This is sometimes referred to as the food insecurity paradox. Although to date research has not identified a clear reason for this, one of the proposed mechanisms focuses on food cost vs. quality. For example, a person may have adequate access to total calories (or too many calories), yet those calories may be provided by highly processed foods with very little nutritional value. They may not be able to purchase fresh fruits and vegetables, meat, fish, eggs and dairy products, and/or their meals might mostly consist mostly of canned, frozen or prepackaged foods, or meals from vending machines, fast-food restaurants, and convenience stores. These cheaper, more convenient food products also tend to be higher in fat, sugar, salt, and calories. Thus, although in developing countries food insecurity is associated with dangerously low body weight, in wealthier countries like the U.S. food insecurity is associated with obesity - particularly in women (Carvajal-Aldaz et al., 2022). In terms of other health effects, certainly worrying about the next meal or being able to afford food impacts a person's stress level and their mental health as well (*Food Insecurity - Healthy People 2030*, n.d.).

In 2022, food insecurity affected 12.8% of households, which is a significant increase since 2021, when food insecurity was at 10.2%. Rates of food insecurity were the highest - and increased the most between 2021 and 2022 - for single mothers with children under 18 (*USDA ERS*, 2023). See Figure 8.6 below.

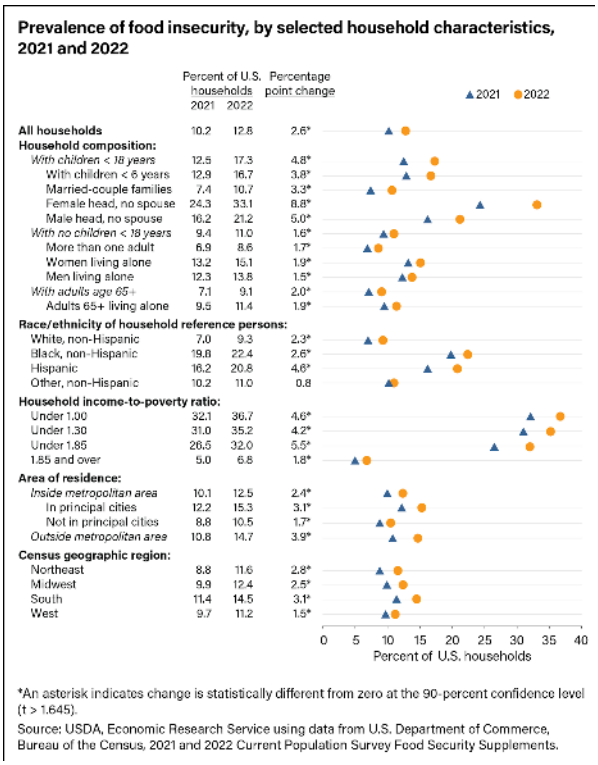


Figure 8.4.4.1: Prevalence of Food Insecurity by Selected Household Characteristics, 2021 and 2022. Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of the Census, 2021 and 2022 Current Population Survey Food Security Supplements.

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8.4.5: Hungry College Students

The trope of the “starving student” may actually be closer to reality than many realize. As the cost of tuition, books, and living expenses in many college towns increases, many students are also finding themselves housing or food insecure. The cost of college is estimated to be 1200% higher than it was in 1980 (Bhutada, 2021). See Fig. 8.4.5.1 below.

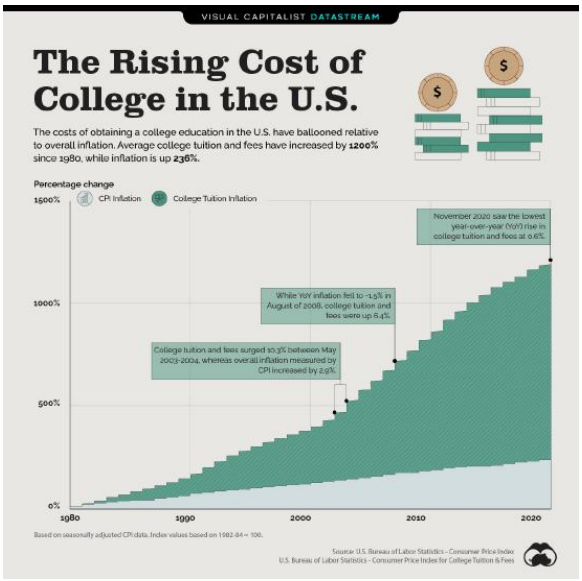


Figure 8.4.5.1: Bhutada, G. (2021, February 3). *The rising cost of college in the U.S.* Visual Capitalist.

Fig. 8.7 Bhutada, G. (2021, February 3). *The rising cost of college in the U.S.* Visual Capitalist. https://www.visualcapitalist.com/ris...ollege-in-u-s/

Food insecurity among college students as a public health issue is clouded by many different factors, including student debt, poverty stigma, and a tendency among college students to opt for cheaper, convenient, and less healthy foods even when on university meal plans. Despite these and other confounders, the data still highlights significant food insecurity among both private and public university students, with higher rates found at Historically Black Colleges and Universities (HBCUs) and community colleges. Students from lower income households, first-generation college students, and those non-traditionally aged and those with disabilities report higher rates than the overall average. As many students attend college to improve their earning potential and/or escape generational poverty, experiencing food insecurity can hamper their academic progress and negatively impact their health (Hagedorn-Hatfield et al., 2022).

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8.5: Educational Access and Quality

On the whole, higher levels of education are linked with better paying jobs *and* better health over the lifespan. Graduating from college decreases the risk of future unemployment (and thus many of the health factors that come with economic instability), and college graduates report better health than those who only complete high school. College education is more often required for white-collar jobs, which tend to pay better wages and are more likely to provide health insurance benefits. This also means college graduates may be able to afford better quality housing, and have more access to healthy dietary patterns and leisure-time physical activity. Unhealthy behaviors like smoking and drinking excessively are lower in more educated populations (*Enrollment in Higher Education - Healthy People 2030*, n.d.).

Education levels of parents are also correlated with the health of the rest of the family. Childhood obesity is negatively correlated with the education level of the head of the household (HHS reports). If parents have higher education, children are less likely to experience adverse childhood experiences (ACEs). These types of experiences can include trauma from physical or sexual abuse, neglect, witnessing a family member use drugs or have mental health problems - including attempting or committing suicide - or having a family member become incarcerated. They can also include witnessing violence in the home or community, becoming homeless, or experiencing stress from housing and food insecurity (U.S. Department of Health and Human Services, Health Resources and Services Administration, Office of Health Equity., 2020).

As mentioned earlier, racial disparities in health and life expectancy persist across educational strata. However, one increasingly common cause of death primarily affects white, non-college educated, middle-aged men, who live in mostly rural areas and small towns. Correlated with the decline in blue-collar job opportunities in middle America, so-called “deaths of despair” have increased over the last decade. These include deaths from suicide, drug (mostly opioid) overdoses, and liver disease, all associated with physical and psychological pain (Scutchfield & Keck, 2017). This is a tragic example of a combination of social determinants of health converging: unemployment, poverty, and a lack of access to healthcare (mental health care in particular), all contributing to higher rates of depression and substance abuse.

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8.5.1: Early Childhood Development and Education

The experience in the first 5 years of a child's life have significant repercussions for the rest of their lives. Although much emphasis is placed on ages birth to 5, recent evidence also includes maternal health prior to conception and during pregnancy as impacting future health. Exposures of the mother to toxins, infections, or stress can all impact fetal physical and neural development - altering risks for future health outcomes, even chronic diseases and mental health issues (Center on the Developing Child at Harvard University, 2010).

Adverse childhood events (ACEs) include physical, sexual, and psychological abuse, child neglect, family dysfunction, incarceration or death of a family member, exposure to violence in the home or neighborhood, and poverty - including housing and food insecurity. Traumatic life events cause stress to children that can have immediate effects on their physiological and psychological development, and lifelong effects on their health. Adverse childhood events are linked to everything from mental health issues and substance abuse later in life, to increased risks of chronic diseases like cardiovascular disease and cancers, and can negatively affect economic and academic opportunities as well (Merrick et al., 2019). The adoption of health-risk behaviors and lack of engagement in health-promoting behaviors may be a mediating factor, as people with multiple ACEs often have maladaptive coping behaviors for future life stressors. Some evidence also points to the possibility that early life stressors also influence health outcomes independently from health behaviors, suggesting that ACEs can cause epigenetic changes (the way genes are expressed) that affect the immune, cardiovascular, and neurological systems during development, which in turn increases chronic disease risk (Soares et al., 2021). According to a cross-sectional study administered by the CDC in 2019, almost 16% of adults reported experiencing 4 or more ACEs. The authors estimated that if ACEs were prevented, this could reduce the rates of negative health outcomes such as depression by up to 44%, heart disease by up to 12%, and smoking and heavy alcohol use by up to 33% and 24% respectively (Merrick et al., 2019).

In contrast, early childhood education can have a substantial positive impact on future academic success, health behaviors and outcomes. High quality preschool, kindergarten, and elementary education is associated with lower rates of health-risk behaviors like smoking and binge drinking later on in life, as well as lower rates of risk factors for heart disease like obesity, high blood pressure, and high cholesterol at age 30 (*Early Childhood Development and Education - Healthy People 2030*, n.d.). High quality preschools and early childhood home visitation programs are also associated with a reduced risk of child abuse and neglect, and thus could help prevent ACEs and improve health outcomes in several ways (Merrick et al., 2019). See Fig. 8.5.1.1 below.

Access to high quality childcare can be a significant limiting factor for families. Due to the COVID-19 pandemic, many childcare providers were forced to take fewer children and enforce strict public health measures, or ended up closing their doors. Health concerns, loss of employment, and remote work prompted many parents to keep children at home, and as many schools were also closed, families struggled to balance childcare and employment from home. According to the U.S. Census Bureau, 35% of those with children under 5, and 54% of parents with children 5-11 years old indicated they had no type of childcare during the pandemic. One in 5 parents relied on family members for childcare. The closure of childcare facilities also caused many women to leave the workforce and become full-time caregivers; a trend which hit low-income families the hardest (U. C. Bureau, 2023c). In the years that followed, the childcare industry has progressively recovered, but as of 2022 had not yet reached pre-pandemic levels of employment (Crouse et al., 2023). As other industries also recovered and demanded a workforce, the demand for childcare also went up, and in turn the rising cost of childcare has begun to outpace wage growth and inflation in other sectors. Childcare workers have traditionally been one of the lowest paying jobs, and that trend continues despite some increases in hourly pay (*Child Care Prices, Inflation, and the End of Federal Pandemic-Era Aid in Five Charts - Equitable Growth*, 2023). All of these factors can create a crisis for families: if parents cannot find or afford high-quality childcare, they may be limited to one income - or for single parents they may be forced into riskier solutions (i.e. low-quality childcare), or out of the labor force altogether. From a population standpoint, a lack of affordable childcare creates a ripple effect on other social determinants of health such as economic stability, housing and food insecurity, and social cohesion.



Figure 8.5.1.1: Early Childhood Development and Education Infographic from Healthy People 2030.

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8.5.2: High School Graduation and Enrollment in Higher Education

Graduating high school is often used as a key metric since it is associated with better economic opportunities. Most jobs - even entry level, minimum wage jobs - require at least a high school diploma or equivalent. Dropping out of high school is associated with other social determinants of health such as poverty and unemployment, but also health outcomes such as higher risk for chronic disease. Teens who have gotten pregnant during high school are more likely to drop out, as are students who have less support for their education from parents. A perception of safety and caring in the classroom is also important. Students are more likely to complete high school when they feel like their teachers are invested, and don't apply unfair punishment or discipline within the classroom (*High School Graduation - Healthy People 2030*, n.d.).

In recent years, high school completion rates have improved, however disparities still exist. For example, in the 2019-2020 academic year, the graduation rate was 87%, which is the highest it was in 8 years. Asian/Pacific Islander and White student graduation rates (93% and 90%) were still the highest compared to Hispanic (83%) Black (81%) and American Indian/Alaska Native (75%) (*COE*, 2023). And these racial disparities continue into college enrollment. According to the Bureau of Labor Statistics (BLS) in October of 2022, 62% of 16-24 year olds who had graduated high school the year prior were enrolled in college. This percentage was not a significant change from the 2 years prior, but prior to the pandemic in 2019 the college enrollment percentage was just above 66%. Women are also significantly more likely to go to college, with 66% of young women and only 57% of young men enrolling. Enrollment rates in 2022 were highest for Asians (72%), slightly lower for Blacks (64%) and Whites (62%) and lowest for Hispanics (58%) (*College Enrollment and Work Activity of Recent High School and College Graduates Summary*, 2023).

Higher education can have many benefits for both income and health across the lifespan. Although there are always a small percentage of those with a high school diploma that make more money than bachelor's degree holders, and a small percentage of bachelor's degree holders that make more than graduate degree holders, the general trend for the majority of the population favors college educated individuals getting higher earnings with each level of degree (associates to doctorate/professional degrees) (*The College Payoff: More Education Doesn't Always Mean More Earnings*, 2021). Higher paying jobs are often less dangerous, can lead to growing wealth, better housing, and often come with more reliable access to health insurance and better retirement potential. College graduates are also less likely to engage in harmful health behaviors like excessive drinking, and more likely than their non-college educated peers to adopt positive health behaviors like exercising and getting routine health screenings (*Enrollment in Higher Education - Healthy People 2030*, n.d.)

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8.5.3: Language, Literacy, and Health Literacy

Language can be a barrier to accessing healthcare and having good communication with a healthcare provider. Even if translators are present, patients with limited English proficiency may not understand diagnoses, prognoses, medications, or other health information. Quality of care may be lower, particularly if caregivers lack cultural understanding, and patients may be hesitant to ask questions or share their symptoms (*Language and Literacy - Healthy People 2030*, n.d.). Sometimes interpreters are required by law to translate exactly what is said, and they may not be able to add to the communication in order to clarify or educate patients. At the same time, the healthcare providers may not be able to assess the patient's understanding. Healthcare providers can develop cultural competencies for the communities they work with, and community health workers can work to advocate for patients and connect community members with resources (The Healthy Project, 2024).

Literacy includes many different forms of understanding and communication. Oral literacy describes the ability to listen, understand, and communicate verbally, whereas print literacy refers to reading and writing skills and numeracy refers to competency using numbers. These types of literacy skills are also important for health literacy, which is the ability to find, understand and use health-related information and services (*Language and Literacy - Healthy People 2030*, n.d.). For example, if a patient is diagnosed with type II diabetes, they need to be able to find information on what the disease is, how it progresses and affects their risk of other diseases, and what they can do to monitor and manage their blood glucose. This may include verbal explanations from their doctor, written instructions on how to take their medicine or use a glucose monitor, and numbers that they have to track in order to make sure they manage their glucose levels throughout the day. If a person struggles with any form of literacy - or has low health literacy, this can affect their ability to not only get healthcare, but also communicate with a provider, follow medication instructions, and even notice important health symptoms that might indicate an emergency.

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8.6: Healthcare Access and Quality

When people can get preventative care and screenings, diagnoses, and treatment for health conditions in a timely manner, their health outcomes are substantially better. Access to healthcare includes health insurance, affordability of care, location of doctor's offices, urgent care facilities, and hospitals, along with access to transportation to get there, and even the availability of appointments with physicians and specialists. Costs and supplies of medical devices and medicines are also an important part of this access. Many barriers to getting healthcare are undeniably intertwined with the American healthcare system itself.

The U.S. outspends other similarly wealthy nations on per-person healthcare costs, and yet has the lowest life expectancy compared to these other countries (Reich, 2022). On average, U.S. life expectancy is 3.9 years below the average of other countries in the OECD (Organisation for Economic Co-operation and Development) such as Japan, Australia, Germany, Finland, Costa Rica and several others. The United States spent over $12,500 per person on healthcare in 2022; over twice the OECD average of other countries (in U.S. dollars) which was around $5000 per person (Sabine, 2023). Part of the reason for this is because America has a greater range of diagnostic tools and specialized procedures, however, it is unlikely that greater quality is the primary driver of higher healthcare spending. The highest excess expenditures of healthcare are from administrative costs (about 30%) and prescription drug costs (10%). Although American doctors and nurses get paid more on average than other OECD countries, this accounts for only about 15% (combined) of the excess expenditure on healthcare. The U.S. also tends to spend less on public health and more on medical care than other comparable countries, which could further explain why spending more doesn't necessarily correlate with a healthier, longer-living population (Turner et al., 2023).

Health insurance policies are often offered as part of the compensation paid to employees along with their wages by large companies. Pursuant to the Employees who work part-time, are self-employed, or contract-based often have to purchase their own health insurance. Government funded health insurance like Medicare (for those 65+) Medicaid (for those in poverty, pregnant or with disabilities), and CHIP (Children's Health Insurance Program - for children of low-income families), provide coverage for those people who might otherwise not be able to get health insurance through an employer. Additionally, through the ACA, government subsidies help reduce the cost of health insurance for those individuals who don't qualify for other programs but for whom health insurance premiums would be cost prohibitive.

Just having health insurance alone does not necessarily make it affordable. Even if the healthcare plan is offered by an employer, it may still cost a monthly premium for the employee, especially if the plan covers other family members. Additionally, many health insurance plans have deductibles or annual out-of-pocket maximums that must be met before the insurance company begins to pay, or even co-insurance - which requires that the individual and the insurance company split the costs of doctors visits, prescriptions or procedures (see also chapter 14). Healthcare premiums and deductibles have continued to rise over the past 3 decades, often at a rate faster than inflation and employee wages (KFF, 2023). Perhaps as a result of this, employer-provided health insurance is declining (Reich, 2022). Employers can opt for cheaper plans with higher deductibles and out of pocket limits, deduct premiums out of employee paychecks, or even opt for creating more part-time and contract positions instead of full-time positions. A recent Kaiser Family Foundation (KFF) survey found that medical debt reached $220 billion by the end of 2021 - even though 90% of Americans were covered by health insurance. Within that total, the majority of people with medical debt owed more than $10,000. This debt can come from co-insurance, deductibles, or from being denied insurance coverage for certain procedures or getting care from out-of-network providers. Medical debt can discourage people from seeking further healthcare - thus contributing to worsening health over time (Rakshit et al., 2024). See Fig. 8.6.1 below.

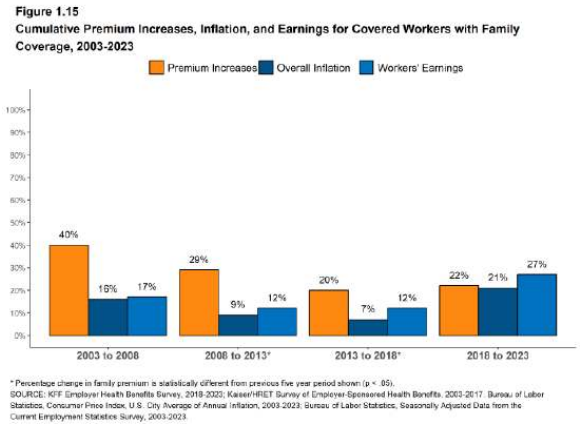


Figure 8.6.1: Cumulative Premium Increases, Inflation, and Earnings for Covered Workers with Family Coverage, 2003-2023. KFF. (2023, October 18). Section 1: Cost of health insurance - 10240. 2023 Employer Health Benefits Survey; KFF

Health insurance coverage is only one barrier to getting timely healthcare. Another barrier is physically getting to the doctor. While there are shortages of primary care physicians in both urban and rural areas of the U.S., rural areas tend to have the highest rates of healthcare worker shortages (Rural Health Information Hub, 2024). Additionally, many hospitals in rural America have closed down altogether (*Rural Hospital Closures*, 2020), which means that residents will have to travel even further for some types of care. Conversely, long wait times for urgent care facilities and overcrowding of emergency rooms can decrease access to healthcare in more populated areas. A lack of transportation can be a barrier to accessing care, especially for those with disabilities or limited mobility. All of these barriers can lead to delayed care and diagnoses, which means that many people may not know they have a disease or get treatment for it until it has progressed to a worsened state (*Access to Health Services - Healthy People 2030*, n.d.). See Fig. 8.6.2 below.



Figure 8.6.2: Access to Health Services Infographic from Healthy People 2030.

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8.7: Neighborhood and Built Environment

The neighborhood that you live in can have a significant impact on several dimensions of your health. Built environments refer to the places that humans create to live, work and play in - the homes, schools, stores, and community centers that create neighborhoods and cities.

Consider your own neighborhood where you currently live. Are there grocery stores within a convenient distance that offer affordable healthy foods like fresh produce, grains, and protein sources? Does your neighborhood have trees, greenspaces, and parks for adults and children to walk and play in? Are the public schools well-funded, safe, and supporting academic success for their students? Are the streets safe for people to walk and bike? Are residents protected from environmental hazards like lead, pollution, and water contaminants in their homes? Are crime rates in the community low? Do people who live there feel connected to their neighbors and supported by their community? Are there many hubs for community engagement across all ages: like community centers, sports and recreation clubs, and religious and philanthropic organizations? The answers to these questions define this category of the social determinants of health.

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8.7.1: Nutritional Access

As covered earlier in this chapter, food insecurity is associated with long term health consequences such as obesity and a higher risk of chronic diseases. This may be because food insecurity does not only include potentially skipping meals or not getting enough to eat, it also includes being forced to opt for cheaper, less-healthy food items. Access to healthy nutrition includes both the availability of healthy foods and their cost.

In order for a person to engage in healthy behaviors, they first must have an environment that allows for those behaviors. Perhaps nowhere is this more obvious than with health-supporting nutrition. According to the USDA, a healthy dietary pattern includes fruits and vegetables, grains (particularly whole grains), low-fat and fat-free dairy products, protein foods (including meat, eggs, and plant-based protein sources), and oils. Eating patterns that include these types of foods are associated with lower rates of chronic diseases including heart disease, diabetes, and some cancers. Epidemiological evidence points to higher rates of obesity and diabetes in neighborhoods with fewer fresh produce sources and more fast-food restaurants. Children who attend schools with a plethora of fast-food chains within ½ a mile tend to eat fewer fruits and vegetables, drink more soda, and are more likely to be obese than those who attended schools without fast-food nearby. Low-income and racially minoritized communities tend to also have fewer grocery stores in their neighborhoods, and have to travel farther to purchase fresh produce (*Access to Foods That Support Healthy Dietary Patterns - Healthy People 2030*, n.d.). This has led to the theory of "food deserts"; geographic locations around the U.S. where healthy food options are scarce, or residents have to travel long distances to reach a grocery store. These are not limited to urban areas either - ironically, people living in rural farmlands may also have to travel long distances to obtain a variety of fresh produce and protein foods. Rural food insecurity rates are similar to the high rates in inner cities (*Rural Hunger and Access to Healthy Food Overview*, 2024). Additionally, "food swamps" refer to areas replete with fast-food restaurants. Some studies indicate that living in a food swamp influences obesity rates even more so than food deserts. A neighborhood can be both a "food desert" and a "food swamp" at the same time (L. D. Burke & Weill, 2023). See Fig. 8.7.1.1 below.



Figure 8.7.1.1: Access to Foods that Support Healthy Dietary Patterns Infographic from Healthy People 2030.

Food prices tend to rise with general inflation, but can also outpace inflation particularly for specific food items. According to the USDA, the Consumer Price Index for foods increased dramatically in 2022 at around 10%, above the overall average increase in prices for other goods, and the largest increase in several decades (*Consumer Price Index: 2022 in Review : The Economics Daily: U.S. Bureau of Labor Statistics*, n.d.). This price increase was less during the following year, yet the costs of healthier foods have long been higher than the prices of less healthy, fast-foods or highly processed foods. Furthermore, people who live in low-income communities may pay higher prices for limited fresh produce options at convenience stores than those who live in more affluent communities with more large grocery stores (*Access to Foods That Support Healthy Dietary Patterns - Healthy People 2030*, n.d.).

Fast food options and pre-packaged foods are also convenient for people who may not have time to prepare or cook whole foods purchased from a grocery store. The time-cost of healthy food becomes increasingly important to those who work multiple jobs, have long commute times, are caregivers, and/or those who have a disability.

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8.7.2: Crime and Violence

People who witness or who are victims of crime and violence - particularly where they live - are at risk for a host of health issues. Certainly there is a risk of injury or death from violence itself, but also for stress and post-traumatic stress disorder (PTSD). Other health issues related to stress are also higher risk, like hypertension, stroke, asthma, and mental health disorders. Crime can include property crimes such as break-ins, robberies, and vandalism. Violence encompasses physical assault, child or intimate partner abuse, elder abuse, and gun violence - including homicides and suicides. The long-term impact of violence on children was also discussed earlier with ACE's, but anyone of any age can have adverse health effects from witnessing or even hearing about violence (*Crime and Violence - Healthy People 2030*, n.d.).

Firearm injuries and deaths are a significant public health problem in the United States, and disproportionately impact certain populations. Over 85% of gun death or injury victims are men. Gun homicide rates are highest among teens and young adults, and especially Black, Hispanic or AI/AN young people (*Fast Facts: Firearm Violence and Injury Prevention*, 2023). In recent years, firearm deaths (including accidents, homicides, and suicides) became the leading cause of death for children between 1-17 years old - even outpacing car accidents and childhood cancers. Accounting for 20% of the deaths of children in America in 2021, this far outpaced other wealthy nations like Canada, several countries in Europe, and Japan (*Child and Teen Firearm Mortality in the U.S. and Peer Countries*, 2023).

There are structural conditions that place minoritized and impoverished communities at higher risk for crime and violence, and others that offer protective benefits to more affluent neighborhoods. For example, higher income inequality and lower economic opportunities are associated with a higher risk of violence when comparing different neighborhoods. Families who have to move often because of housing instability have less time to create social ties with the neighborhood, thus decreasing social capital and social cohesion (see this topic below). Although there may be more crime in many minoritized neighborhoods, there is also less trust in the criminal justice system: these neighborhoods are often overpoliced and experience more police misconduct, including police brutality. Police violence is a leading cause of death for young Black men (P. A. Braveman et al., 2022). The lifetime risk of being killed by police is highest for Black men, followed by American Indian/Alaskan Native men, and Latinos (Edwards et al., 2019). Distrust in the police is commonly precipitated by police misconduct and over-policing in minoritized communities, which may also contribute to increased violence (Armstead et al., 2019).

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8.7.3: Environmental Conditions

Although environmental health deserves its own chapter, it's important to recognize the unjust influence that environmental factors have on particular neighborhoods and communities. Historically, we have many examples of environmental hazards like drinking water contaminated with lead, hazardous waste disposal, and high levels of pollution in neighborhoods with majority black, hispanic, and/or indigenous populations, or high levels of poverty. To make matters worse, there are just as many stories detailing the obstruction of investigations, delays in notifying residents and providing safe alternatives, or refusals to hold accountable those responsible for environmental disasters. Advocating for healthy and safe neighborhoods for all is a priority of the environmental justice movement.

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8.7.4: Water Quality

In general, residential tap water is safe to drink in the U.S. This is primarily because of the Safe Drinking Water Act (SDWA) first signed into law in 1974 and then amended in the 80s and 90s, which empowered the Environmental Protection Agency (EPA) to set standards for over 90 hazardous contaminants (*Drinking Water Standards and Regulations*, 2022). The EPA oversees local and municipal agencies, which are often tasked with regular testing of their own water supplies, and enforcing those standards. Problems with clean water are closely related to the management of sewage, industrial and farming waste, and storm runoff that brings oil and other pollutants into the water from busy streets. Drinking water sources in cities often originate in more rural areas, from large rivers and lakes or from underground aquifers. Agricultural runoff or industrial waste often makes its way into the surface water sources - sometimes at amounts that cannot be treated effectively. Similarly, groundwater aquifers can be contaminated by leakage from landfills, mines, or fracking (a technique used to mine for natural gas). Private wells are not under the oversight of local authorities or the EPA, and can also be subject to contamination by the same sources. Thus, water quality issues can affect both urban and rural areas. Unfortunately, contamination often happens in low-income areas that have limited resources, and the culprit is often only discovered after residents get sick. Compared to wealthier areas, the responses to contaminated water crises in poor communities have been bungled at best, and at worst - negligent or intentionally slowed.

Perhaps one of the most well-known examples of environmental justice failures is the Flint, Michigan water crisis that began in April of 2014. The city of Flint was home to a predominantly Black population, and 41% of its residents lived below the poverty line. Control of the city's finances had recently been taken over by the state due to financial problems. In order to save money, the decision was made to change the source of residents' drinking water from Detroit's Water and Sewage system to the Flint river. Very soon, complaints arose about the tap water being discolored, smelling and tasting bad, sickening and killing plants and pets, and causing rashes and hair loss in humans. It was discovered that the Flint river water (which was acidic, and not treated correctly) was corroding the old, lead pipes in Flint's public water supply. Even when the water source was switched back to Detroit's system a month later, the damage to the pipes had been done, and harmful lead contamination still affected thousands of people in the city. In October of 2015 the county finally declared a state of emergency, and the governor of Michigan declared a state of emergency almost 4 months later. Finally, bottled water, testing kids and filters were delivered to Flint's people. In the meantime, 90 people had fallen ill with Legionnaires disease, 12 people had died from it, and 30,000 children had been exposed to toxic levels of lead. Whether from exposure to lead and other toxins, post-traumatic stress from the incident or a combination of these factors, standardized testing scores plummeted, and the number of children in special education classes doubled over the next 3 years. But the story of Flint, MI is not new. Similar water contamination crises have happened recently in Newark NJ, Benton Harbor MI, and Jackson MS - all in predominantly Black and Hispanic communities (L. D. Burke & Weill, 2023, Schneider, 2020).

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8.7.5: Air Quality

Air pollution also tends to be higher and is associated with higher rates of childhood asthma in poorer communities. Due to historic redlining practices and discriminatory residential zoning, communities of color are more likely to be near air pollution sources like factories or hazardous waste sites (*Environmental Conditions - Healthy People 2030*, n.d.). City design and lack of investment in poorer urban communities means they tend to have higher automobile traffic and fewer trees planted - both of which affect air quality and ambient temperature. See Fig. 8.7.5.1 below for more sources of air pollution.

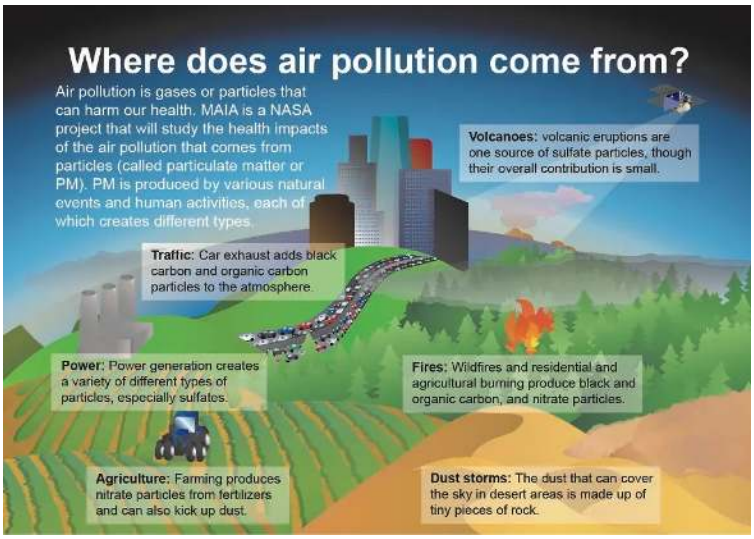


Figure 8.7.5.1: Sources of air pollution infographic. (Copyright; Alan Buis,NASA's Jet Propulsion Laboratory, CC BY-SA 4.0, via Wikimedia Commons)

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8.7.6: Waste Management and Other Environmental Hazards

Finally, a big question for many cities and towns is what to do with the garbage generated by residents and industries. Up until 50 years ago, waste was still being dumped into open-trash heaps, oceans, lakes, and rivers, or incinerated - which releases toxic chemicals into the air (one of the sources of air pollution, above). After several environmental protection laws were passed in the 70's, most trash disposal converted to sanitary landfills. These landfills are lined with plastic, with vents created for the hazardous gasses that disintegrating trash produces (Schneider, 2020). Land that is less populated and cheaper tends to be the target for landfill sites. Yet, many of these landfills are also near poor, rural, and minoritized communities. Perhaps this is because many of these communities are assumed to be less likely to protest, or perhaps because these areas are promised job opportunities and community investment (L. D. Burke & Weill, 2023).

There is ample evidence that living near environmental hazards such as nuclear power plants, hazardous waste sites, cropland where pesticides are heavily used, and areas with high air and noise pollution (such as major highways and freeways), have negative impacts on the health of children and adults. These include a higher risk of low birth weight, preterm births and some congenital health defects for infants, childhood cancers, and asthma, pulmonary diseases, renal disease, and diabetes among others. Environmental risks such as these also disproportionately impact poor and minoritized groups (Brender et al., 2011, *Environmental Conditions - Healthy People 2030*, n.d.)

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8.8: Social and Community Context

The social and community context in which people live includes many different factors that don't necessarily fall into (but are influenced by) the other categories. Social factors that improve health outcomes center around how connected people feel to each other and how much they feel that they can contribute to and change their communities for the better. Actions like civic participation - which can range from membership in sports and recreation clubs to voting and volunteerism - help people feel both connected to their communities and empowered to make changes that benefit everyone. Conversely, high levels of incarceration of the community members disrupts the social fabric and can also decrease trust in local government and emergency services. Discrimination is also a social factor - whether systemic or interpersonal - that leads to breakdowns in community connectedness and trust. And all of these factors influence the health outcomes of individuals, their families, friends, neighbors, and community at large.

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8.8.1: Civic Participation

Although the idea of “civic participation” often evokes the idea of involvement in voting, politics and governance, this is not the entirety of what it encompasses. Being involved in one’s community can take on many forms, whether it’s membership in a faith-based organization, sports or hobby clubs, volunteering or advocacy groups. Civic participation includes any activities that have benefits for the group members or society as a whole. These types of activities are not only beneficial to individual health, they are also used as a health outcome measure - and are therefore evidence of a healthy community.

Participation in recreational and volunteer activities is associated with increased physical activity, which makes sense particularly if the activities are related to sports, dance, fitness, or community gardening. Volunteerism can also increase physical activity as many opportunities to help those in need or to improve the built environment require some movement. Lifting boxes to distribute food at a food pantry, repairing a community center or painting a mural all require some physical activity. But these actions also benefit mental/emotional and social health. And typically people who engage in them report higher levels of overall well-being (*Civic Participation - Healthy People 2030*, n.d.). See Fig. 8.8.1.1 below.

Voting is associated with improved levels of self-reported health as well. Perhaps it is the case that those individuals who are healthy are more likely to be involved in local and national politics, and those with poorer health may feel less connected and disempowered. Or perhaps taking actions that you perceive will benefit yourself and/or your community tends to improve your mental and emotional health. Belonging to a group also decreases loneliness, which has implications for mental and emotional health, and builds social capital. Social capital is like an investment; if you invest your time into your community, you can expect social support in times of trouble as well (*Civic Participation - Healthy People 2030*, n.d.).

Disenfranchisement (depriving people of the right to vote) works to harm health via several mechanisms. Modern forms of disenfranchisement include voter suppression, voter intimidation, and gerrymandering, which all work to decrease the power of an individual’s vote, and decrease the power of specific communities to vote for representatives who will champion their needs (P. A. Braveman et al., 2022). This can lead to less public investment in minoritized neighborhoods, fewer parks and greenspaces built or maintained, and less funding set aside for community services and programs. Policymakers may also be more willing to allow businesses that produce toxic byproducts into the community, or to zone land for projects that have health hazards - particularly if they doubt these actions will have an effect on their political career.



Figure 8.8.1.1:Civic Participation Infographic from Healthy People 2030

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8.8.2: Discrimination

Discrimination is any difference in the way a person is treated that is unfair, unjust, and causes harm. Discrimination can be structural or systemic (see Systemic Racism, above) or individual and interpersonal. Laws, regulations, policies, practices, and even unspoken rules in how individuals are treated can create structural and systemic discrimination. Interpersonal discrimination refers to poor treatment of one individual by another based on personal characteristics, whether or not there was an intent to cause harm. It might be a difference in the way a doctor talks to a specific patient, or the way a group of people is served at a restaurant. It could mean getting repeatedly passed up for promotions at work, or a difference in the appraised value of a house depending on who is living there. Discrimination is based on personal, inherent characteristics like race, ethnicity, sex, gender, sexuality, age, religion, or disability. The term **intersectionality** recognizes that a person may face discrimination based on multiple facets of their identity. For example, a Black woman may experience discrimination differently than a Black man, and a transgender person who has a disability may experience discrimination differently than a cisgender person with a disability.

Structural discrimination influences health outcomes through other social determinants of health. For example, when a location for a landfill is chosen near a town with a majority Black and Hispanic population, or when sidewalks are not maintained and people using wheelchairs are forced into the street, or when fewer trees are planted in lower-income neighborhoods, depriving them of shade and natural air purification - all of these structures and policies create unjust environments and contribute to health inequities. Systemic discrimination can also include attitudes and beliefs that have been so ingrained in a practice or culture that it might not be obvious that they are there. For instance, some algorithms used in medicine make assumptions about racial differences in biology and genetics, or ascribe higher risk factors for specific surgeries and treatments to patients of color. These algorithms may put Black and Hispanic people at risk for getting denied treatment for no valid medical reason (Vyas et al., 2020). Alternatively, some medical devices have been found to be inaccurate for people of color because they have only been validated on white patients. As a case in point: pulse oximeters were found to be overestimating blood oxygen in Non-Hispanic Black COVID-19 patients, which delayed their care (Sudat et al., 2022).

Interpersonal discrimination can also become a systemic problem when people are repeatedly treated differently due to inherent characteristics, especially by those working in positions of power or authority. Prime examples of systemic, interpersonal discrimination can also be found in healthcare. Healthcare providers may have explicit bias (when they are aware of their biases), or implicit biases (unconscious beliefs and attitudes). Particularly when healthcare providers are rushed or stressed, these biases come out in interactions with patients, resulting in poorer communication and even differing treatment recommendations (Hall et al., 2015). For example, Black patients are less likely to be referred for cardiovascular treatments, receive less pain medication, and have poorer maternal health outcomes. LGBTQ+ individuals may defer or avoid seeking treatment due to fears of discrimination. Negative interactions with healthcare providers decrease trust in medical care and increase the stress response in patients, which in turn affects overall mental and physical health (Apodaca et al., 2022).

All types of discrimination cause higher stress and worse health for those affected by it. And the stress experienced from discrimination, unfair treatment, and unjust systems can have a cumulative effect over time. This long term effect of discriminatory stress to health is part of the “weathering hypothesis” first proposed by Dr. Arlene T. Geronimous to describe disparities in fertility and maternal health of African American women. Subsequent research has linked the cumulative “allostatic load” of stress over the lifetime - including social stressors like discrimination - to brain aging and mental health (Contributors to Wikimedia projects, 2024).

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8.8.3: Incarceration

Almost 2 million people are incarcerated in all of the state and federal prisons, jails, juvenile detention, and immigration detention centers in the United States (Sawyer & Wagner, 2023). At this point in time, Americans are incarcerated at a higher rate than anywhere else in the world. Since the 1990's, rates of incarceration have increased exponentially, and only began to decline slightly in the last decade (see Figure 8.14 below). Yet, very little evidence supports the use of incarceration for improved public safety, and in fact, research suggests that incarceration has a substantial impact on the health of those impacted by the justice system, as well as their families and communities (*Incarceration - Healthy People 2030*, n.d.).

Many people are jailed before they have been convicted of a crime due to the bail system. The average amount of bail is $10,000, which many of those arrested cannot afford - and thus they await their day in court in pretrial detention. Additionally, almost 1 in 5 people incarcerated are there because of some violation of their parole - often a technicality (Sawyer & Wagner, 2023). Incarceration disproportionately affects people of color: 38% of the incarcerated population are Black Americans, and 21% are Hispanic - at much higher rates than the demographics of the general population (Wang et al., 2022).

Those living in prison or jail are more likely to be in poorer mental and physical health; including having higher rates of mental illness, substance use disorders, high blood pressure, asthma, cancer, and infectious diseases (*Incarceration - Healthy People 2030*, n.d.). And prisons are not great places to get treatment for mental health, addiction, or physical ailments either. Very few offer treatment programs for addiction, and suicide is one of the leading causes of death in prison. Even after release, formerly-incarcerated people often suffer from poor mental health and PTSD, on top of employment and other socioeconomic hurdles (Sawyer & Wagner, 2023).

The families and communities of those incarcerated are severely impacted as well. Nearly 113 million Americans have had an immediate family member spend at least 1 night in jail (*Every Second*, n.d.). Children of incarcerated parents are more likely to have adverse childhood experiences - including having witnessed violence - and are more likely to live in poverty. Behavioral issues and learning challenges are also common, and these kids are at a higher risk of entering the system themselves (*Incarceration - Healthy People 2030*, n.d.). In fact, many of those incarcerated are victims of violence or abuse themselves - which demonstrates the vicious cycle described by the adage: "hurt people hurt people". Higher fines and harsher sentences only seem to make this cycle worse and more difficult for impacted communities. High incarceration rates in a community only serve to disrupt social cohesion and decrease trust in government systems.

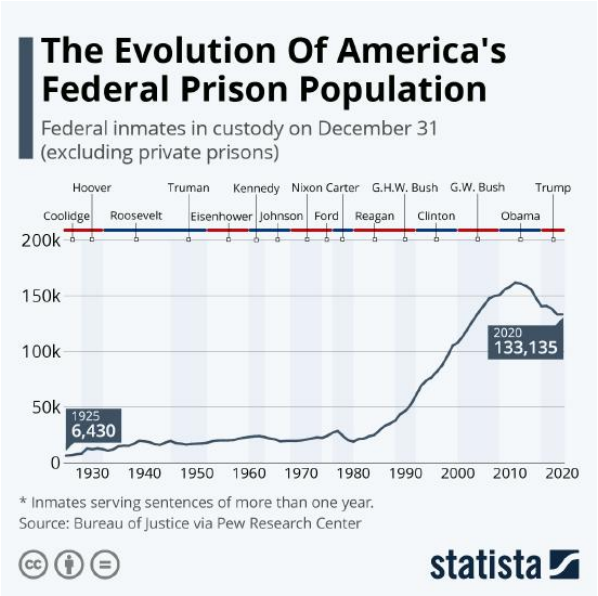


Figure 8.8.3.1: The Evolution of America's Federal Prison Population. This chart shows the number of federal inmates in custody excluding private prisons. (Copyright; Niall McCarthy. CC-BY-SA-4.0 https://www.statista.com/chart/24289/federal-inmates-in-custody/)

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8.8.4: Social Cohesion

In general, the sense of solidarity that a community has, how “tight-knit” it is, and how strongly the members feel they can support and rely on each other, all have positive impacts on health. The idea that neighbors and community members can be trusted to take actions for the common good, and can be relied on in times of need, are characteristics of social cohesion. Social cohesion also encompasses social capital (which includes connecting community members with resources), and social networks - which are multiple sources of support, whether emotional or physical. To whom will you turn if your car breaks down and you need a ride? If you knew of a good job opening, who would you share it with? Where would you go if your home was subject to a natural disaster? When community members share mutual trust and respect, they are able to work together to better their lives. This collective efficacy is associated with lower rates of neighborhood violence, and better access to things like healthcare, health-supporting foods and physical activity options. Health-related behaviors - whether positive like physical activity, or negative like smoking - also tend to be influenced by social networks (*Social Cohesion - Healthy People 2030*, n.d.).

On the flipside of social cohesion, loneliness and isolation are significant drivers of poor health. In adults over the age of 50, loneliness increases the risk of dementia, heart disease, stroke, depression, anxiety, and death from all causes. Those that are at higher risk for isolation include minoritized populations, immigrants (particularly first-generation), and LGBTQ folks. Stigma and discrimination prevent the development of trust and strong social-support networks, which in turn isolates people in the community (*Loneliness and Social Isolation Linked to Serious Health Conditions*, 2022). Although most of the research on loneliness addresses older adulthood, it can also significantly impact young adults. Self-reported loneliness increased during the COVID-19 pandemic - particularly among young adults and low-income households - and has gradually tapered off since (Witters, 2023).

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8.9: Social Cohesion

Summary

It is apparent now more than ever that the health of every person depends on their community - where they are born, live, work, learn, play, and gather. These social determinants of health are perhaps stronger for many health outcomes than even biological or genetic factors. Stark disparities in these social determinants of health continue to unjustly impact minoritized communities in the U.S.. In order to improve the health of citizens in this country, we must work towards improving health equity in all communities across the nation.

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CHAPTER OVERVIEW

9: Maternal, Infant, and Child Health Concerns

Learning Objectives

- Analyze current public health issues and describe how they affect the health status of specific populations of age, gender, race and ethnicity, minority, education level, and socioeconomic status.
- Identify the components of the Whole School, Whole Community, Whole Child (WSCC) model designed to improve learning and health in our nation's schools.

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9.1: Introduction

While the prevention of both infectious and chronic diseases is certainly a primary focus of public health, there are a myriad of community health concerns that affect population health across the lifespan. Individuals and communities have varying needs to support health through different stages of life. This chapter will cover major public health concerns for maternal, reproductive and infant health, and health through childhood. In another chapter we will continue with adolescence, across adulthood, and into the "golden" years of old age. Here we will also examine the Whole School, Whole Community, Whole Child (WSCC) model; a holistic framework for public health interventions focused on childhood health. This multicomponent approach can have a profound impact on the schools themselves, along with the families and communities as a whole. Once again, our focus will remain on community health issues in the United States (U.S.), yet we may occasionally compare data with other nations around the world.

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9.2: Maternal and Infant Health

Many elements impacting an individual's health may be at play prior to their birth. This includes the health of biological parents prior to conception, genetic material combined at conception, maternal and fetal health during pregnancy, and the events of labor and delivery. Genetic components and the condition of gametes (sperm and ovum) affect the probability of conception and successful implantation in the uterus, as well as the potential for miscarriage. Environmental factors during pregnancy also have an effect on fetal development and future health; everything from the availability of nutrients, to exposure to toxins, and even levels of maternal stress can increase or decrease the risk of congenital defects or future diseases. Additionally, a variety of factors have an impact on both physical and mental health of the pregnant person during and after pregnancy.

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9.2.1: Maternal Mortality

At the time of this writing, maternal mortality rates in the U.S. have recently received a lot of media attention. According to the CDC, maternal mortality rates rose significantly between 2019 (20.1 deaths per 100,000 live births) and 2021 (32.9 deaths per 100,000 live births). Using data from death certificates collected by the National Vital Statistics System (NVSS), the CDC's most recent report states that 754 women died of maternal related causes in 2019, 861 died in 2020, and 1205 in 2021. Mortality rates are higher with increased age: the rate for women 40 and over was 6.8 times greater than the rate for women under 25 years of age. Additionally, these mortality rates demonstrate clear racial disparities: the rates for non-Hispanic Black women were 2.6 times the rates for non-Hispanic White women (Hoyert, 2023). Although the absolute number of maternal deaths may be small in comparison to overall deaths in women, the fact that these rates are increasing, combined with stark racial disparities, indicates the need for improvements in prenatal and maternal healthcare.

A recent study published in the American Journal of Obstetrics and Gynecology questions whether this dramatic increase in maternal mortality rates was potentially caused by a change in surveillance methods. Could this spike in death rates be factual, or could it be influenced by how maternal deaths are defined, and how physicians record them on the death certificate? The researchers also questioned whether the increase in maternal deaths was due to an increase in deaths associated with pregnancy or the medical management of pregnancy, or whether other causes of death to women who have been pregnant at the time of death (or within the last year) were also included in the reporting - and thus skewed the data. When analyzing for specific causes of death, the rates of pregnancy and delivery-related mortality were essentially the same between 2018 and 2021. However, the research still confirmed that non-Hispanic Black women experience significantly higher mortality rates from pregnancy and delivery-related complications (Joseph et al., 2024). This research highlights the importance of care and attention to detail in epidemiological surveillance and in reporting health outcomes to the public.

If maternal mortality rates in the U.S. have remained stable over the last several years, they are still comparable or slightly higher than other countries with similar economic profiles and medical technology (OECD, 2023). Although medical advances have been made over the last century that have brought these rates down, there are still far too many deaths related to pregnancy and birth around the world. In low income countries the maternal mortality ratio (MMR - which is the number of maternal deaths per live births), can be as high as 430/100,00 live births. In high income countries the MMR is as low as 13/100,000 live births. Another way of comparing this is to consider the lifetime risk of a person who can become pregnant. The lifetime risk of a woman dying from pregnancy or birth-related complications is 1 in 49, compared to 1 in 5300 in high income countries (WHO, 2024b). Much of this risk has to do with access to healthcare- including a lack of skilled healthcare providers. Other risks include poverty, lack of education, and harmful gender norms and inequalities, as well as environmental issues that disrupt infrastructure and lead to other problems such as malnutrition or infection. The most common reasons for maternal deaths around the world are preventable, and include:

- severe bleeding (mostly bleeding after childbirth);
- infections (usually after childbirth);
- high blood pressure during pregnancy (pre-eclampsia and eclampsia);
- complications from delivery; and
- unsafe abortion (WHO, 2024b).

In the United States, a report published by the CDC states that 80% of maternal deaths are preventable. Causes include mental health conditions (including suicide and overdose/poisonings related to substance abuse), severe bleeding, infections, and other cardiovascular-related issues including pre-eclampsia and eclampsia (CDC, 2022c). Postpartum depression (PPD) is the most recognized mental health issue, and is generally considered to be depressive symptoms (feeling sad, down, irritable) within 4 weeks of delivery. However, research suggests that depression and anxiety are frequently experienced during pregnancy and within the first year of giving birth. According to recent research, PPD affects about 13% of American women after giving birth, and this rate can be significantly higher for teen mothers (between 53-61%). Other risk factors for PPD include a lack of social support, poverty, traumatic birth experiences, multiple births (such as twins or triplets), domestic violence, intimate partnership problems, as well as a prior or family history of depression and anxiety (NICHD, 2020). See Fig. 9.2.1.1 below for MMR by state 2018-2022.

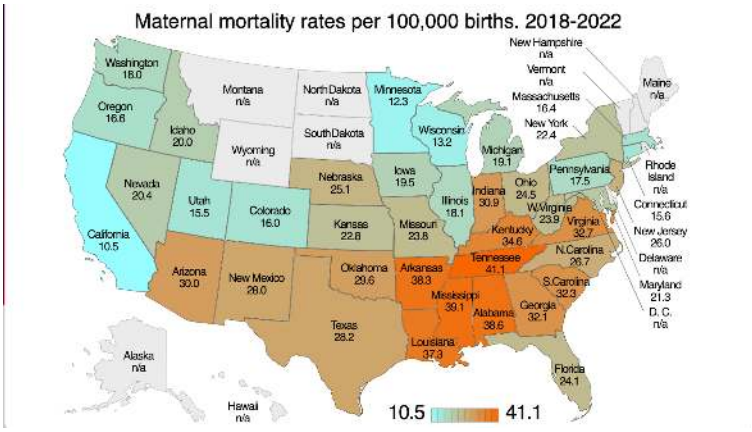


Figure 9.2.1.1: Maternal mortality rates per 100,000 births by state. US map derived from data published by the US Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS), and National Vital Statistics System (NVSS). (Copyright; Timeshifter from template. Wikimedia Commons. CC-BY-SA-4.0)

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9.2.2: Infant Health and Mortality

Infant mortality is defined as the death of an infant between the day they are born and 1 year old (NICHD, 2021). The most recent report from the National Center for Health Statistics (NCHS) shows an increase of 3% in the U.S. infant mortality rate between 2021 (19,928) and 2022 (20,538). Rates for infant mortality are typically expressed as the number of deaths per 1,000 live births. Racial disparities are also found with infant mortality rates, with the lowest rates in 2022 for infants of Asian (3.60) and White (4.52) and Hispanic mothers (4.88), followed by rates for infants of Native Hawaiian or Other Pacific Islander (8.50), American Indian/Alaskan Native (9.06), and Black mothers (10.86). The top five causes of death in infants are:

- congenital malformations
- premature birth and low birth weight
- sudden infant death syndrome (SIDS)
- unintentional injuries (accidents)
- maternal complications of pregnancy (Ely & Driscoll, 2023).

Exposure to toxins in the environment during fetal development can cause birth defects and potentially infant death. These toxins are referred to as **teratogens**. While some teratogens are well known, others have lesser known effects and are difficult to study due to the ethics of performing such research on pregnant people. Known teratogens include:

- Smoking, which can cause low birth weight,
- Alcohol consumption, which is linked to both physical and mental disabilities collectively called Fetal Alcohol Spectrum Disorders,
- Other drugs such as cocaine and heroin, which are associated with withdrawal symptoms after birth, and can cause impaired fetal growth, increase the risk of preterm birth and low birth weight, and are linked to learning disabilities and behavioral problems (Seabert et al., 2021),
- Radiation, which is associated with an increased risk for miscarriage, growth restriction, birth defects (including impaired brain function and malformations), as well as cancers (CDC, 2023c).

One of the most delicate systems during fetal development is the central nervous system (brain and spinal cord), which during the embryonic stage is called the “neural tube”. Supplementing with folic acid before and during pregnancy has been found to significantly reduce the risk of neural tube defects. The most common types of these birth defects are anencephaly and spina bifida. **Anencephaly** is an incomplete formation of the brain and skull, and typically causes death shortly after birth. **Spina Bifida** is a malformation of the spine which can cause paralysis or other physical disabilities. Anyone who can get pregnant or is intending to get pregnant is recommended to take prenatal supplements containing at least 400 micrograms of folic acid daily to prevent neural tube defects(CDC, 2022b). Two pivotal studies in the early 1990’s demonstrated a reduced neural tube defect risk of 72% or greater with folic acid supplementation, which prompted the FDA to require the addition of folic acid to enriched cereal products by the end of that decade. Adding folic acid to food sources increases health equity for those who may not be able to afford supplementation (Crider et al., 2022).

Infectious diseases such as syphilis and rubella can also have profound effects on a developing fetus. Congenital syphilis is passed through the placenta and can cause blindness and mental disabilities. Fortunately, syphilis is treatable with the antibiotic penicillin, even during pregnancy. Rubella is a virus which causes mild childhood illness but can cause deafness in a fetus if the mother contracts it during pregnancy. Rubella vaccines are typically part of childhood immunization schedules, and can prevent future deafness in offspring (Schneider, 2020). Lastly, toxoplasmosis is caused by a parasite that can be transmitted via eating undercooked, contaminated meat, or from indirect exposure to infected animals - particularly cats, through their feces. Although there might not be any symptoms present at birth, infants can develop severe brain and eye damage from congenital infection later on (CDC, 2022e). Zika virus is transmitted via mosquito bites, and although in adults it usually causes mild symptoms, infections during pregnancy can cause birth defects in about 5% of cases. Fetal transmission of Zika virus is associated with microcephaly - severely small infant head size at birth - and subsequent physical and mental disabilities such as difficulty feeding, seizures, and musculoskeletal issues (CDC, 2024i).



Figure 9.2.2.1: Focus group of pregnant women in Puerto Rico discussing how to improve Zika communications materials. (Maureen Fonseca-Ford, CDC/ CDC Connects, 2016)

This image was captured during the 2016, Zika outbreak in Puerto Rico, by CDC staffer, Maureen Fonseca-Ford, who described the scene as follows, “While on deployment to Puerto Rico for the Zika response in May 2016, I led a focus group on the island of Vieques, where an unlikely group of low income, low literacy, young pregnant women, were some of the participants. They gave us some of the richest feedback, for improving the Zika communication materials in Puerto Rico. We have been working with the CDC Division of Vector-Borne Diseases (DVBD), and US-Mexico Unit (USMU), on creating effective, field tested materials, and this experience was one of the first times in CDC’s outbreak history, where behavioral science has been included at the outset of the response. This was a joint effort with Puerto Rico’s Department of Public Health.”

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9.3: Genes

In addition to our parents' genes passing on inherited traits such as eye or hair color, we may also inherit unique health profiles. Genes can be associated with both protective health factors and disease risk factors. Some of these may not even be expressed physiologically until environmental forces - called **epigenetics** - change how the gene is expressed in the body. A few chronic conditions have a single, known, genetic link. Sickle-cell anemia and thalassemia are two such diseases, which are both caused by a mutation on chromosome 11. Interestingly enough, the same mutation that causes sickle-cell anemia may also have a protective effect against malaria infection (Contributors to Wikimedia projects, 2024). Many chronic diseases are thought to have genetic links, from mental illness to cancers or high cholesterol - whether a single gene or multiple genes are involved. For example, the BRCA1 and BRCA2 genes are linked to a high risk of reproductive cancers and breast cancer. In rare cases, obesity can be linked to the variation of a specific gene, called **monogenic** obesity. More commonly though, obesity, cancers, and other chronic diseases that run in families are a combination of multiple factors; including genetics, biology, environment, and behaviors (CDC, 2018).

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9.3.1: Genetic Disorders and the Ethics of Prenatal Testing

Genetic errors are relatively common in the process of conception, and are thought to be the cause of about 50% of known miscarriages (ACOG Committee on Practice Bulletins—Gynecology, 2021). Even if a fertilized egg implants successfully in the uterine wall and continues to grow, genetic mutations can cause a variety of problems. Since each embryo inherits half of their 46 chromosomes (DNA) from each parent, certain diseases can be inherited from only one parent if the genetic disorder is **dominant** - the parent will pass that trait on to approximately half of their offspring. Some examples include Huntington's disease (a brain disease), and certain types of dwarfism (achondroplasia) and gigantism (Marfan syndrome). **Recessive** genes are associated with some diseases that will affect a child if both parents carry them, and if both of those recessive genes are passed on (Schneider, 2020). See Fig. 9.3.1.1 below for the "Punnett Square" diagram illustrating recessive genes.

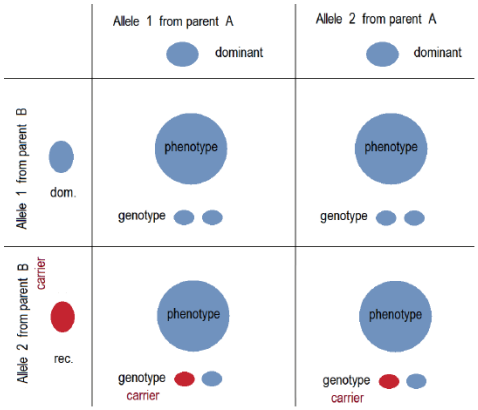


Figure 9.3.1.1: Autosomal recessive inheritance. Punnett square: If the other parent does not have the recessive genetic disposition, it does not appear in the children, but 50% of them become carriers. (Copyright; Sciencia58, CC0, via Wikimedia Commons, 2019)

Examples of diseases associated with recessive genes include:

- Tay-Sachs disease: a neurological disorder, most common in people with Ashkenazi Jewish ancestry;
- Sickle-cell anemia: causes red blood cells to be shaped like a crescent and decreases oxygen transportation, most common in people with African or African American ancestry;
- Cystic fibrosis: a disease of the lungs causing excessive mucus production and damage to lung tissue, most common in people with northern European ancestry;
- Thalassemia: which causes a lack of hemoglobin in the blood, decreasing oxygen transport capacity, affects those with Mediterranean, Middle Eastern, Asian, and African ancestry, (CDC, 2020, National Health Service, 2021, Schneider, 2020).

Still other genetic disorders are linked to the X chromosome or female sex chromosome. These diseases primarily affect genetic males who have XY chromosomes, since the affected X tends to be recessive (whereas in a genetic female with two X chromosomes, the recessive gene would not be expressed) (Schneider, 2020). For example, Duchenne muscular dystrophy is an X-linked disorder that leads to muscular degeneration, weakness, and eventually paralysis. It is not more common in any racial or ethnic populations, but much more common in genetic males than females (Muscular Dystrophy Association, 2017).

Some genetic disorders are not necessarily inherited but occur due to a genetic mishap in either the sperm, egg, or both prior to conception. The human gametes (egg and sperm) each contain one half of 23 pairs of chromosomes, and the resulting zygote (fertilized egg) will have 46 chromosomes, or 23 pairs. A **trisomy** occurs when there are 3 copies of one of the chromosomes, perhaps from the egg or the sperm carrying both chromosomes in a pair, instead of one. The most common expressions are trisomy 13 (Patau syndrome), trisomy 18 (Edwards syndrome) and trisomy 21 (Down syndrome). Infants born with trisomy 13 or 18 rarely survive past one year old, due to resulting malformations of the brain, heart, lungs, and kidneys (Stanford Medicine Children's Health, n.d.). Down syndrome causes a spectrum of physical, mental, and developmental challenges, and can increase the risk of congenital heart defects, hearing loss, and sleep apnea. However, most people with Down syndrome can live long and healthy lives with the appropriate support (CDC, 2024d). A **monosomy** occurs when there is a chromosome missing from a pair. Turner syndrome is caused by a partial or complete deletion of the second X chromosome in a genetic female. This syndrome causes suppressed physical growth, and possibly future reproductive and other health issues (Boston Children's Hospital, n.d.).

Prenatal testing can identify potential genetic disorders in the first or second trimester. Prenatal screening is done during the first trimester, and involves a blood test that checks fetal DNA matter found in the mother's bloodstream for genetic mutations like

trisomies or monosomies. Nuchal translucency screening (NTS) is an ultrasound that measures the thickness of the neck of the fetus, as more fluid buildup can indicate an increased risk of trisomies. An anatomical ultrasound scan is also typically done around week 20 of pregnancy to measure fetal growth and screen for malformations of the head, internal organs, or limbs (ACOG, 2023b). Diagnostic tests cannot typically be done until the second trimester, and include taking samples from the amniotic fluid (amniocentesis) or placenta (chorionic villus sampling). While screening tests are highly accurate at predicting the risk for specific genetic disorders or malformations, diagnostic tests are usually used to confirm the presence of a disorder. Taking into account other risk factors like the parents' family history or genetic risks, and maternal age (pregnancy at over age 35 tends to increase certain risks), physicians may recommend less-invasive prenatal screening first, and then diagnostic testing if the screens indicate an increased risk (Johns Hopkins Medicine, 2021).

Genetic testing of parents prior to pregnancy and prenatal screening or diagnostics during pregnancy can help inform parents' decision making and family planning. Some parents may decide to not have children or adopt children if they are genetic carriers for certain syndromes. Considering a diagnosis where an infant would likely suffer and have a short life expectancy after birth, some parents may opt to terminate a pregnancy. Sometimes when a diagnosis is discovered and the pregnancy is continued, parents can make preparations for services and support for both themselves and an infant with a disability. Still other parents may prefer to not know a diagnosis until birth, as it would not change their plans. Regardless of parents' healthcare decisions, it is important that parents have access to accurate information regarding screening, diagnostic tests, and the potential impacts (ACOG, 2023b, Schneider, 2020).

Genetic screening also comes with ethical questions from a population perspective. Although substantial suffering and death from cruel diseases could potentially be prevented with genetic screening, emerging gene therapies, early medical intervention, and/or family planning, there is also the real risk of racism and ableism affecting genetic medicine. Historically, eugenics and racialized medicine have been used to justify atrocities: the Holocaust in Nazi Germany, forced sterilization of Black women and immigrants in the U.S., and other attempts at ethnic cleansing and harming or killing those with disabilities around the world. Even when genetic screening and counseling is done ethically, there is a risk of genetic information influencing a person's social life, their potential for employment, and thus also their ability to get health insurance coverage. Genetic testing and prenatal screening therefore should always be voluntary and confidential, include education and counseling, and include tests that are of high quality and evidence-based (Schneider, 2020).

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9.4: Reproductive Healthcare and Family Planning

Reproductive healthcare includes regular screenings and testing for sexually transmitted infections (STIs), reproductive cancers, and treatment of reproductive disorders such as infertility, pelvic inflammatory diseases, endometriosis, polycystic ovarian syndrome, and others. Reproductive healthcare also includes counseling and education to help those who want to become pregnant, as well as those who wish to prevent pregnancy. Many families rely on Title X funded clinics (discussed in Chapter 14) for access to reproductive care and contraception. Family planning allows for individuals and couples to make important decisions on when to have children, to ensure they are healthy enough to have children, and to determine the spacing between children if they wish to have more than one child. It is important to note that hormonal contraceptives are also used for purposes beyond preventing pregnancy - they can be used to treat reproductive disorders like dysmenorrhea (painful periods), hormonal imbalances, and even acne (ACOG, 2023a).

Planning for pregnancy and parenthood helps to ensure appropriate resources and support systems are in place, and the health of the whole family is taken into consideration. This process may include considerations to improve fertility in the parents, preventing exposure to teratogens, ensuring adequate nutrition (including folic acid supplementation), and supporting the physical and mental health of the entire family. It can also include planning for parental leave from work, financial commitments (such as physician visits, labor and delivery, daycare, school, etc.), and studying parenting styles. Yet, nearly half of pregnancies in the U.S. are unintended, and have an increased risk of exposure to teratogens, delayed prenatal care (or lack thereof), and risk factors from other social determinants of health (Seabert et al., 2021).

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9.4.1: Teen Pregnancy

While older maternal age increases the risk for certain genetic disorders, very young maternal ages carry other physical and social risk factors. Teenage pregnancies and births are at high risk for health complications and a lack of social and financial support. Babies born to teen mothers are at higher risks for low birth weight, premature delivery, and infant mortality. Teen mothers are more likely to drop out of high school, and have to rely on public assistance for financial support (Seabert et al., 2021). Fortunately, the rates of teen pregnancies and births in the U.S. have been declining. In 2020, the birth rate for teens between 15-19 years of age was 15.4 per 1,000 population, down 75% from the highest level in 1991 of 61.8 per 1,000 population (OASH: Office of Population Affairs, n.d.). According to a report from the CDC, between 2012 and 2021 there was a 53% decline in the teen birth rate, a 50% decline in the abortion rate among adolescents under age 15, and a 41% decline in the abortion rate among adolescents 15-19 years old (Kortsmit et al., 2023). Declines in teen pregnancies over the last two decades are credited to delays in sexual intercourse initiation, and increased use of contraception among teens - both of which are reflective of effective public health efforts (OASH: Office of Population Affairs, n.d., Seabert et al., 2021). A continued focus on comprehensive sexual health education, plus increasing access to contraceptives and reproductive healthcare are all important strategies to help individuals and couples prevent unintended pregnancies and delay having children until they are physically, mentally, and financially ready.

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9.4.2: Termination of a Pregnancy

The termination of a pregnancy is often referred to as a miscarriage (or pregnancy loss) if it is spontaneous, and an abortion if it is caused by medical intervention. However, this differentiation fails to accurately describe the complexities of pregnancy termination. Sometimes an abortion (medical intervention) is necessary for a "missed" or incomplete miscarriage, in order to expel any remaining tissue which could cause infection. It is estimated that about 10-20% of *known* pregnancies end in miscarriage, however the total number is likely much higher as many miscarriages happen before the pregnancy is discovered (Mayo Clinic, 2023).

The CDC requests data on the number, type, gestational age, and demographics of abortion procedures each year from 50 states, the District of Columbia, and New York City. The most recent data (presented below) is from 2021, when 48 of these areas reported numbers - excluding California, Maryland, New Hampshire, and New Jersey (Kortsmit et al., 2023):

- Over 625,000 abortions were performed in 2021.
- When compared to the population of women in those reporting areas between the ages of 15-44, the rate was 11.6 per 1,000 women.
- When compared to the number of live births reported, the rate was 204 abortions per 1,000 live births.
- There was a 5% increase in abortions compared with the year prior (2020).
- Since 2012, there has been an 8% decrease in the number of abortions performed.
- For the 41 areas reporting gestational age at time of abortion in 2021:
- 80.8% of abortions occurred at $\leq$ 9 weeks of gestation
- 93.5% of abortions occurred at $\leq$ 13 weeks of gestation
- 5.7% of abortions occurred between 14-21 weeks of gestation
- 0.9% of abortions occurred after 21 weeks.

The decision to terminate a pregnancy with medical intervention is influenced by a variety of factors. Research suggests that the most common reasons given for choosing abortion have to do with economic factors (including job stability or finishing schooling), ability to care for other children, partner support or concerns about partner relationships, and concern for future children. These reasons haven't really changed over the last few decades (Finer et al., 2005). For abortions that occur in the second trimester or later, several factors cited for delaying the procedure include: not knowing a pregnancy existed, a lack of access to abortion care or travel requirements, or the cost of an abortion. Later abortions are also often associated with the discovery of lethal fetal abnormalities as well as the development of maternal health risks (Gomez et al., 2024).

After the U.S. Supreme Court overturned *Roe v. Wade* in June of 2022 with the *Dobbs v. Jackson Women's Health Organization* ruling, many states brought back old laws or enacted new ones to ban abortions. As of 2024, 14 states in the U.S. have total abortion bans. Some states have enacted bans with exceptions for rape, incest, and the life or health of the pregnant person, but often these exceptions also have legal processes and requirements that are difficult to interpret - which may delay the process to a point at which the abortion would no longer be permitted anyway (*State Bans on Abortion throughout Pregnancy*, 2024). Several states, including California, have voted to enshrine abortion rights in their state constitutions, while still banning abortion after the age of viability - meaning that abortion is permitted up until the point at which a fetus potentially could survive outside of the uterus. Although "viability" is not a medical designation, this is typically considered around 24-26 weeks of gestation and was the original limit of *Roe v. Wade*. Survivability of infants born at this gestational age is highly dependent on a variety of factors including the amount of medical intervention needed, as well as advances in medical technology (Guttmacher Institute, 2024, Gomez et al., 2024).

The World Health Organization states that ensuring access to safe, legal abortion care supports gender equality and the health and well-being of women and girls around the world (WHO, 2024c). One study assessed rates of unintended pregnancies and abortions around the world, comparing countries where it is legal to places where it is restricted. Researchers found that between 1990-2019, the number of unintended pregnancies globally has declined, yet the percentage of unintended pregnancies ending in abortion has increased. When comparing regions around the world with legal restrictions on abortions (from countries with outright bans to those with some exceptions), the abortion rates were no different than in countries where it was legal and accessible (Bearak et al., 2020). Restricting access to abortion does not actually reduce the number of abortions, it only increases the number of unsafe abortions, which come with much higher rates of maternal morbidity and mortality. While deaths from safely-performed abortions are less than 1 in 100,000, mortality rates from unsafe abortions are much higher, around 200/100,000 Legalization of abortion is not only associated with lower health risks, there may be other social benefits as well: when pregnancies and births are wanted,

children and society benefit from better parental investments in their care and education. Further, the WHO asserts that restrictions to abortion care contribute to emotional distress, social stigma, financial hardships, and risks constituting human rights violations against women and girls (WHO, 2024c).

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9.5: Examples of Effective Programs for Maternal and Infant Health

Postpartum home visitations by nurses can help to reduce incidences of child maltreatment, and improve postpartum psychosocial outcomes. Nurses in one study provided 1-3 home visits after the birth of a baby, to provide support and resources for parental and infant health, managing infant crying, and connecting parents with other community support they might need. The nurses also screened for potential problems like family violence or substance abuse, and provided referrals for further interventions if needed (Dodge et al., 2019).

Sudden Infant Death Syndrome (SIDS) is the sudden death of an infant before the age of 1 - typically occurs in their sleep - and cannot otherwise be explained. Most of these deaths happen in cribs, and although specific causes are often unknown, several risk and protective factors have been identified. Eliminating smoking from the home, placing a baby to sleep on their backs, and removing any blankets, toys, or other objects from the crib have been shown to be effective protective measures against SIDS. In fact, since the beginning of the “Back to Sleep” campaign in 1994 (now called “Safe to Sleep), SIDS rates have dropped from 130.3 to 38.4 per 100,000 live births (between 1990-2020) (CDC, 2024e, U.S. Department of Health and Human Services, n.d.).

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9.6: Childhood Health

Childhood is a pivotal time for growth and development. Most of us can remember experiences during childhood that shaped who we are as adults. Many of the health beliefs and behaviors that we have as adults were first introduced during those early years, and often conditions that begin during childhood (like obesity) tend to persist into adulthood.

Childhood can be characterized in different developmental stages, but is generally considered to be after infancy (above 1 year old) and prior to puberty and the teen years. The term “child” might be considered in some research to be only between 1-9 years (Seabert et al., 2021), or separated between toddlerhood (2-5) years and elementary school ages (6-11). By other definitions it includes everyone up to 14 years old, since after this age is typically considered adolescence. In this section, we’ll go over the leading health issues for American children between the ages of 1-14. We’ll also examine one of the simplest and perhaps most comprehensive ways to improve childhood health: through the public school system.

As of 2022, the National Center for Health Statistics reports that 1.5% of children under 4 and 2.2% of children between the ages of 5-11 are in fair or poor health. Additionally, 8% of elementary school-aged children missed 11+ days of the school year due to an illness, injury, or disability (CDC/National Center for Health Statistics, 2024b). Although it might seem like this indicates that the majority of children in the U.S. are healthy, there are also significant health risks that affect this country’s children more than those of other similar economically developed countries.

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9.6.1: Leading Causes of Morbidity and Mortality

In 2022, 4,156 U.S. children under 4 (28.0 per 100,000 population), and 6,239 children between 5-14 (15.3 per 100,000 population) lost their lives. The leading causes of death for children are not chronic lifestyle-related diseases or infectious diseases - although both of these are still health concerns for children. Importantly, the leading cause of death for children is unintentional injuries (accidents), which can often be prevented with safety technology, regulations, and behaviors. Below are the top 3 leading causes of death for children in different age groups in 2022 (CDC/National Center for Health Statistics, 2024b):

- 1-4 years of age
  - Accidents (unintentional injuries)
  - Congenital malformations, deformations and chromosomal abnormalities
  - Assault (homicide)
- 5-9 years of age
  - Accidents (unintentional injuries)
  - Cancer
  - Congenital malformations, deformations and chromosomal abnormalities
- 10-14 years of age
  - Accidents (unintentional injuries)
  - Intentional self-harm (suicide)
  - Cancer

Accidents (unintentional injuries), include car accidents, drowning, falls, fires or burns, accidental poisoning, and suffocation. Toddlers have the highest risks for drowning. Car accidents are the highest risk of mortality for all children, and are often related to the inappropriate use or lack of seatbelts or car seats (Seabert et al., 2021). A very concerning trend is that of firearm injuries and deaths. If we combine causes of death for children and adolescents, there were more firearm related deaths in 2022 than car accident deaths. Firearm deaths include both firearm accidents (such as children playing with a firearm, or accidental discharge), assault or homicide with a firearm, and suicide. From 2019 to 2022 the number of firearm deaths for those under 18 increased by 46%, demonstrating this growing problem. And firearm deaths disproportionately affect Black children and adolescents at nearly 6 times the rate of other races/ethnicities, and American/Indian Alaskan Native children and adolescents at 3 times the rate of other races/ethnicities. Death rates from firearms are also 4 times higher in boys than in girls. The highest risk of gun death for young people of all ages comes from assault, followed by suicide for adolescents, and accidental gun deaths for children (Panchal, 2024). Violence is a significant public health problem, particularly for children and youth.

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9.6.2: Health Concerns for Children

Children are dependent on parents, guardians, teachers, and caregivers to provide safe environments that meet their physical and emotional needs, allowing them to grow and mature. This includes not only providing for physiological needs such as food, water, clothing, and sleep, but also emotional stability, comfort, physical safety, and intellectual stimulation, along with developmentally appropriate education. Certainly no parents or caregivers are “perfect”, and there are a wide array of parenting styles which can promote healthy growth and behaviors. The most important thing is to protect children from adverse childhood experiences (ACEs), which can have a substantial impact on their current and future health and well-being, as well as that of future generations.

Child maltreatment includes neglect and abuse of any form (physical, sexual, psychological). Failing to provide children with food, water, clothing, medicine, and supervision are considered child neglect. Emotional and verbal neglect and abuse often go unnoticed, yet can cause significant psychological damage to children. All of these forms of maltreatment qualify as adverse childhood experiences (ACEs) and have both acute and long term impacts on children. Maltreatment can be committed by parents or caregivers, or another person supervising the child such as a teacher or clergy member. Beyond the immediate potential harm from bruises, cuts, burns, or broken bones, children who have experienced ACEs tend to have maladaptive coping mechanisms, harmful behaviors towards others (such as bullying), and engage in more health-risk behaviors such as drug use, dangerous driving, and risky sexual behavior. They are at higher risk for health problems like sexually-transmitted infections, cancers, obesity, and early death from all causes. Adults who have experienced neglect and abuse during childhood can have post-traumatic stress disorder, attention and learning difficulties, and it can affect their academic and employment/economic prospects. They may also be more likely to commit acts of abuse or neglect on their own children. Nationally, it is estimated that at least 1 in 7 children experience abuse or neglect in the past year (CDC, 2024b, Seabert et al., 2021).

Children should also get routine vaccinations in order to prevent deadly infectious diseases. Thanks to programs like Vaccines for Children providing free immunizations to poor, uninsured and underinsured children, the availability of vaccines is quite high in the U.S. However, misinformation in recent years has caused some parents to avoid or delay vaccination, thus decreasing population immunity and increasing the risk of outbreaks - even in vaccinated children (Seabert et al., 2021). See chapters 3, 5, and 7 of this text for more on vaccines and vaccine hesitancy.

Childhood obesity is also a growing problem. While the rates of childhood obesity are certainly lower than adult obesity, nearly 1 out of every 5 children in the U.S. has obesity. Obesity in children and adolescents is determined by comparing body mass index (BMI) to normative values (referencing them to other children/teens) for their age and gender. A child or teen with a BMI above the 95th percentile is considered to have obesity. Due to the nonlinear pattern of growth during childhood and adolescence, it is typical that children will go through phases where they have more or less body fat on them - and this may be essential for growth spurts. However, too much body fat increases the risk for obesity and chronic diseases during adulthood, and impacts the quality of life of children. Kids with obesity may not be comfortable participating in physical activity, they are at a higher risk for asthma, sleep apnea and bone and joint problems, they may face stigma at school, and their mental and emotional health can suffer (CDC, 2024c).

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9.7: The Whole School, Whole Community, Whole Child Model

Public schools have the perfect opportunity to improve the health of the communities they serve. They can become a hub for engagement with families, employees, and other community members. Many of the lifestyle behaviors that adults engage in are habits and norms formed during childhood. So schools may be an optimal setting to reinforce health behaviors such as personal hygiene (for example brushing teeth and handwashing), physical activity, healthy nutrition, and interpersonal skills (such as conflict resolution). Nearly all of the social determinants of health are interconnected with public schools and their programs:

- educational access and quality (including comprehensive health and physical education),
- healthcare access and quality (e.g. school based health centers, school nurses, health insurance for employees, and employee wellness programs),
- neighborhood and built environment (by providing safe physical environments for learning, as well as becoming a community center for other community activities),
- social and community context (with family and community engagement, schools can improve social cohesion and civic participation),
- economic stability (by assisting families in need with school meal programs, and improving future economic stability via student academic success).

Given the far-reaching influence of public education on the social determinants of health, it may seem obvious that public schools are an important setting for public health efforts. However, in order for health promotion in public schools to be truly effective, it needs to be holistic, including policies, procedures, and people from all aspects of the school community. The Whole School, Whole Community, Whole Child (WSCC) school health promotion model provides a comprehensive framework to implement holistic public health interventions at the local level. See Figure 9.1 below for a diagram of this model.



Figure 9.7.1: Whole School, Whole Community, Whole Child model: A collaborative approach to learning and health. Centers for Disease Control and Prevention. (Retrieved from: https://www.cdc.gov/healthyschools/wscc/index.htm)

The WSCC model places the child at the center of the framework, as the children served are the focus of public school education. In the first circle, the model prioritizes a learning environment where students are safe, engaged, supported, challenged and healthy. In order to support both the learning process and overall health of the child, it is recognized that policy, process, and practice will need to be coordinated around these goals. To that end, the WSCC model includes 10 components, surrounded in the outer circle by the community itself. These components are:

1. Physical education and physical activity.
2. Nutrition environment and services.
3. Health education.
4. Social and emotional climate.
5. Physical environment.
6. Health services.
7. Counseling, psychological and social services.

8. Employee wellness.
9. Community involvement.
10. Family engagement.

The WSCC model "recognizes that schools and communities have a shared responsibility for the health and education of children and youth", and that "The relationship between the school and the community affects the entire community, not just the students attending the school", (Lewallen et al., 2015). The families of children attending the school, the employees who work at the school, and the community members who engage with the school all contribute to and benefit from healthy schools.

The WSCC model is not an intervention itself, but rather the framework that can be used by schools and communities to implement changes at their schools which address the needs of their students, families, employees, and communities. Meeting such broad goals requires the support of school administration at minimum, typically along with a well-organized school health advisory council, and perhaps even a school health coordinator (or a current employee with the appropriate training and educational background who can take on that role). The buy-in of the school administration, staff, and parent groups is ultimately necessary to create meaningful school health policies and implement health-related programming and messaging (Seabert et al., 2021). Below we will examine each of these 10 components in greater detail.

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9.8: Physical Education and Physical Activity

According to evidence-based guidelines from the U.S. Department of Health and Human Services (HHS) and the CDC, children between the ages of 6-17 should be getting at least 60 minutes of moderate to vigorous physical activity each day. This can include age-appropriate activities such as sports, dance, exercise, and unstructured play. Any type of physical activity that is aerobic in nature, or promotes muscle or bone strengthening can be beneficial for both physical health and for cognitive skills like memory and focus (HHS, 2018). Childhood is also the best time to learn and develop motor skills such as running, skipping, jumping, throwing, catching, and balancing - foundational skills that increase the likelihood of participation in organized sports, dance, and exercise later in life. Although young children do tend to participate in physically active unstructured play “naturally”, the development of motor skills also requires instruction and practice, emphasizing the additional need for structured physical education during childhood. In fact, the combination of both structured physical education and opportunities for unstructured play allows for children to practice skills and improve their health and fitness (Moon et al., 2024). See Fig. 9.8.1 for more benefits of physical activity during childhood.



Figure 9.8.1: Benefits of School-Based Physical Activity. (Copyright; CC0 CDC.gov https://www.cdc.gov/healthyschools/physicalactivity/school_pa_benefits.htme)

Physical activity also does not take away from academic time - in fact, it can play a supportive role. There is ample evidence at this point in time that physical activity can acutely improve the learning experience. Integrating physical activity into classroom lessons or creating activity breaks throughout the school day has been shown to improve students’ focus and educational outcomes (Lansky, 2022). Although there isn’t enough data to suggest that physical activity levels directly improve grades in high school, there is definitely a correlation between physical activity, less sedentary time, and higher grades earned (*Youth Risk Behavior Surveillance System (YRBSS)*, 2023). The research on whether physical activity interventions improve academic performance is mixed, but mostly indicates a positive or neutral effect (Rasberry et al., 2011).

Current data suggest that less than a quarter (24%) of U.S. children and youth achieve the recommended minimum amount of daily physical activity. Just over 50% of U.S. high school students get daily physical activity and about the same percentage report attending physical education classes in an average week (CDC, 2022a). Total physical activity tends to decrease as children get older, with the sharpest declines happening in middle school. Girls tend to be less active than boys and experience a sharper decline as they enter higher grades (Pate et al., 2022). Perhaps this is due to increasing academic demands, whether or not students participate in organized sports, or even social and cultural pressures that cause a decrease in unstructured play. In the most recent Youth Risk Behavior Survey (YRBS) data from 2021, the percentage of high school students playing on at least one sports team dropped below 50% for the first time since 1999 - likely influenced by precautionary measures taken during the COVID-19 pandemic (*Youth Risk Behavior Surveillance System (YRBSS)*, 2023).

Schools can provide opportunities for students to learn and practice physical skills, and engage in physical activity during the school day, and also before and after school hours. A comprehensive school physical activity program (CSAP) includes the community, staff, and families in promoting physical activity throughout the day. Installing safe playground equipment and

maintaining school grounds and gymnasiums can encourage physical activity during recess. Physical education curriculum should teach students skills for lifelong physical activity, as well as supporting age-appropriate motor development, emotional intelligence, ethical behaviors in competition (aka “sportsmanship”), and self-efficacy. This requires a trained, certified physical education teacher. Partnerships with community resources (afterschool programs, sports clubs etc.) and keeping school yards and playgrounds open for the community can provide opportunities for physical activity outside of school hours. Safe sidewalks, paths, and street crossings can support active transport to and from school. Finally, emphasizing the importance of physical activity for children can also spill over into the rest of the community - whether via employee wellness programs or family activity events (CDC Healthy Schools, 2021, Seabert et al. 2021).

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9.9: Nutrition Environment and Services

Similar to physical activity, healthy eating patterns are also learned behaviors which have a huge impact on health both during childhood and adolescence and in the future. Although nutritional needs vary between individuals and across the lifespan, the Dietary Guidelines for Americans 2020-2025 recommends that children and adolescents eat a variety of fruits, vegetables, whole grains, and proteins, and drink water or 100% fruit juice while limiting sugar-sweetened beverages. According to the Health Eating Index (HEI-2015) nutritional patterns for American children are poor to begin with, and then tend to decline further over adolescence. Of particular concern is the lack of fruits, vegetables, dairy products, and whole grains in the typical-kid diet (although consumption of refined grains is high), as well as low protein intake for teenage girls. Overall, the greatest dietary concerns for children and youth come from a high consumption of sugar-sweetened beverages, and the lack of nutrient-dense plants and protein sources. Particularly during adolescence - a time of rapid growth and physical maturation - this dietary pattern can lead to malnutrition and nutrient deficiencies (USDA and HHS, 2020).

It's hard for kids to learn in class when they are hungry. One of the strongest associations between nutritional behaviors and getting higher grades is eating breakfast (CDC, 2021). Yet according to the most recent YRBS reports (2021), 22% of high school students reported not eating breakfast, and only 25% ate breakfast all 7 days of the previous week (*Youth Risk Behavior Surveillance System (YRBSS)*, 2023). In the 2022-2023 school year, over 14 million children received a free or reduced price breakfast, and twice as many (over 28 million) participated in free or reduced price lunch programs. Compared to the school year prior, this was a decrease of 1.2 million breakfasts and 1.8 million lunches. Due to pandemic-era funding in 2021-2022, federal waivers had supported free breakfast and lunch programs for any student without any means testing (for example, ensuring that their families met low income requirements). Schools had also found creative ways to ensure students got breakfast: by allowing them to eat in the classroom, or serving a late breakfast after the first class of the day. The elimination of federal waivers and "going back to normal" school policies in the 2022-2023 school year have been indicated as causes of reducing the number of students being served school meals. Eight states - including California - instead implemented Healthy Meals for All legislation to keep access to breakfast and lunch free for all students (Hayes & FitzSimons, 2024). These meals tend to be healthier than what students might otherwise eat, since school breakfast and lunch programs have to follow specific standards for nutrition, including providing fruits, vegetables, and whole grains.Students who participate in the school breakfast program tend to miss fewer days of school and do better on tests (CDC, 2022d).

Taking a WSCC approach includes more than just the food in the cafeteria. Children and adolescents can learn about healthy nutrition from health education classes, messaging (posters, labels, marketing etc.) in the school cafeteria, and modeling by staff. All of the competing food on the school campus (vending machines, etc.) should follow similar health standards to the breakfast and lunch programs. Schools can promote drinking water instead of sugar-sweetened beverages by ensuring that drinking fountains are accessible and operational, and allowing water bottles in the classroom (see also Fig 9.3). Direct education on healthy eating patterns alone is probably unlikely to affect behavior change alone, especially since most schoolchildren get 8 hours or less each year. Instead, the WSCC approach encompasses everything from making nutritious food available, providing adequate time to sit down and eat, normalizing healthy eating patterns, and reinforcing positive messaging throughout the school day, as well as implementing special programs like Farm to School programs or school gardens (CDC, 2023a). See Fig. 9.3 below for the CDC's diagram of the Components of the School Nutrition Environment and Services.



Figure 9.9.1: Components of the School Nutrition Environment and Services. CDC. (2023). (*School nutrition environment*. CDC. https://www.cdc.gov/healthyschools/nutrition/schoolnutrition.htm)

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9.10: Health Education

Health education is more than just about providing facts to students regarding health behaviors. Increasing factual knowledge about health behaviors alone has not been shown to contribute to behavioral change. Instead, a comprehensive health education curriculum teaches students how to think about health promoting and health risk behaviors, the social and psychological factors that influence each of them, and then provides opportunities for students to practice and develop skills to navigate their own health decisions. In order to adopt healthy behaviors and avoid health-risk behaviors, attitudes, beliefs, and norms around these behaviors must also be addressed. Students will also not adopt individual health behaviors if they lack self-efficacy (the belief that they can change a behavior). This type of health education requires adequate time for discussion and practicing skills, and needs to be repeated throughout the academic experience - it cannot be encapsulated in a single stand-alone lesson (CDC, 2019).

Currently, health education is not required or offered across all grade levels in highschools across the U.S. However, the research on innovative health education interventions demonstrates that well-planned, skills-based, and integrated lessons can improve knowledge, attitudes, and perceptions around healthy eating and physical activity. Examples studied included integrating health lessons into general curriculum (including physical activity breaks), hands-on learning experiences like taste-tests and cooking lessons, games, mindfulness activities, and farm-to-school units. Several interventions have also reported improvements in healthy eating patterns and physical activity among students. In adolescents, establishing these behaviors in high school can predict their continuance into adulthood (Lee et al., 2023). It is clear from the literature that comprehensive health education can be effective using a WSCC approach, particularly when it is also individualized for the needs and cultural context of the school community.

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9.11: Social and Emotional Climate

The social and emotional climate refers to the relationships between students, staff, administration, and family, that significantly influences the learning environment. Many schools have placed more emphasis on social-emotional learning (SEL), especially since the COVID-19 pandemic. A positive social and emotional climate supports learning, and the mental and physical health of students. Multiple factors are involved with creating a positive climate: including perceptions of safety, how the school addresses and prevents bullying, the skills students learn to deal with mental and emotional health (such as mindfulness practices) and the trust and rapport that teachers and administrators have with the students, their families, and the community. Combined with the physical environment (see below), a positive social and emotional climate can reduce absenteeism and behavioral issues for students, and improve job satisfaction for employees (CDC Healthy Schools, 2021, Hawkins et al., 2023).



Figure 9.11.1: Hanging by his arms from an overhead ladder swing, this happy young boy was photographed, during his outdoor physical education class session, which was taking place at one of the many metropolitan Atlanta, Georgia primary schools. Behind him, some of his classmates were about to take on this challenge. This was, but one of the many playground stations offered, providing school children with a wide array of choices, which would allow them to exercise all aspects of their growing bodies. (Copyright; CC0, *Amanda Mills/CDC, 2014*)

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9.12: Physical Environment

Providing a safe learning environment for students includes maintaining the physical structures that make up the school, as well as having emergency procedures and safety protocols in place. Any buildings with broken windows, non-functional heating or cooling systems, plumbing or drainage issues, leaks, pest problems, mold or mildew in the walls or ceilings, or toxic building materials - including asbestos and lead - can drastically harm students' health and their ability to learn.

Going above and beyond the basic physical safety and operation of buildings to consider how design affects mood and behavior is important for schools. For example, outdoor green spaces and colorfully painted playgrounds can encourage physical activity during recess. Access to greenspace and nature can also decrease teasing and bullying behaviors, and increase social-emotional well-being. Physical changes to the cafeteria space can also encourage healthy eating; such as the order in which foods are served, the attractiveness, variety, and convenience of fruits and vegetables (i.e. pre-sliced, fresh fruit). Changes to the physical space don't have to be huge to make a difference, and should be individualized to the needs and desires of the students and employees (Hawkins et al., 2023).

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9.13: Health Services

School nurses respond to emergencies, acute health needs, manage chronic health conditions, and provide referrals and support for primary care for both students and often staff as well. School nurses are also an integral part of the health team in that they can help identify physical hazards, provide individual and small group counseling and education for health issues, and support school-wide community health measures such as preventing the spread of infectious diseases. They may also play a role in ensuring quality health education curriculum, monitoring the availability of healthy foods (through the cafeteria, vending machines, etc.), and working with psychological counselors and social workers to support students' social and emotional well-being (National Association of School Nurses, 2017). The role of the school nurse is so integral to the WSCC model, that were it not for the heavy workload assigned to school nurses they would be an obvious choice to lead a school health advisory council (Seabert et al. 2021).

Since the 1960's, schools have been recognized as a potential hub to offer increased access to healthcare in the communities that they serve. School-based health centers (SBHC) expand on the services offered by the school nurse to provide physical, mental, vision, and dental health services within the school setting. Schools that serve low-income communities, those with many uninsured or underinsured students, and those with limited access to healthcare (rural or urban), benefit highly from SBHCs. An SBHC may include pediatricians, physician's assistants, nurse practitioners, dentists, mental health and substance abuse counselors and other healthcare providers. Some may even become Federally Qualified Health Centers and expand their services to student families, employees, and the community at large. Since most SBHCs are located on school property, they can make doctor's appointments easier for parents and kids to get to. SBHCs can help address inequities in healthcare access and improve health outcomes for students experiencing poverty, adverse childhood experiences, and those at higher risk for health-risk behaviors. There is evidence that SBHCs are financially sustainable with a variety of grant funding sources, and can improve physical health outcomes, as well as the potential for positively influencing mental health outcomes and educational attainment. Although the role of SBHCs in sexual and reproductive health is controversial for some, they can also help to prevent teen pregnancies and STIs, as well as providing prenatal care for teens who do become pregnant (Arenson et al., 2019).

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9.14: Counseling, Psychological, and Social Services

School counselors, psychologists, and social workers can play a pivotal role in addressing the needs of individual students and their families, as well as supporting the social-emotional climate of the school as a whole. They can help identify areas of improvement for the school, and support SEL with specific lessons or elective classes, or by guiding student clubs. Family engagement can be included with workshops outside of school hours (CDC Healthy Schools, 2021). It is becoming increasingly apparent that adolescents can benefit from stress management skill development. Interventions that use yoga, mindfulness, and emotional regulation techniques can help students manage stress, and improve their mental health as well as academic performance. And employees can benefit from yoga and mindfulness interventions as well (Hawkins et al., 2023).

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9.15: Employee Wellness

The teaching profession is one of the most stressful; with many teachers reporting low wages, a lack of administrative support, risks to their safety, the ever changing and high demands of the job, and a lack of autonomy (Pitt Barnes & Lang, 2023). Teachers also experience socio-political pressures from politicians, media, and parents. They may be blamed for behavioral problems and declines in academic performance or college preparation. More recently, states have begun enacting restrictions on topics that teachers can discuss in classrooms, including gender and race - policies which are having a chilling effect on teachers even in non-restricted states (Woo et al., 2024). With early retirements and teacher burnout likely exacerbated by the COVID-19 pandemic, thousands of educators have left the profession in recent years. In many states, recent increases in teacher salaries and teacher preparation support (including student loan forgiveness programs), is helping to reduce shortages and bring the number of teachers back up or even higher than pre-pandemic levels (U.S. Department of Education, n.d.). However, problems with teacher retention were present long before the pandemic.

Offering a wellness program for employees can benefit all staff, as well as the students who attend the school. Healthy behaviors are modeled by everyone from the classroom teachers to bus drivers, cafeteria employees, administrators, office staff, and custodial employees. Positive employee morale influences the social-emotional climate of the school, and healthier employees can support student learning and adoption of health behaviors (CDC Healthy Schools, 2021).

As of this writing, the WSCC research on employee wellness particular to school employees has been sparse, and more is certainly needed. The few interventions in schools, as well as workplace wellness programs in other industries have shown mixed results for employee physical activity and nutrition behaviors, as well as stress reduction and mental health. Multi-component approaches with adequate, long-term funding may be the most beneficial. The provision of a wellness program for school employees should also be used in conjunction with addressing other needs, such as improving organizational support, increasing salaries, and offering adequate health insurance and sick leave policies. These can benefit the whole school, and all of the employees - including teachers (Pitt Barnes & Lang, 2023).

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9.16: Community Involvement

Along with engaging families (below), connecting with community partners can be an invaluable resource for WSCC efforts. Community partnerships can include other non-profits, after school programs, sports and recreation clubs, businesses, and universities. For example - schools can connect families to health resources - including social service agencies and health clinics - within the community by hosting health fairs, providing coupons to health-related businesses, or utilizing restaurants with healthy menus for fundraising opportunities. Universities often have educator-training programs, public health, nutrition, or kinesiology departments with students and faculty looking for internship and research opportunities. Taking advantage of these partnerships allows for students and communities to mutually benefit while reducing costs to the school district (Michael et al., 2023). Connecting to community resources can also increase civic engagement and social cohesion - two important social determinants of health (CDC Healthy Schools, 2021).

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9.17: Family Engagement

While children and adolescents may spend 7 hours of the school day at school during the academic year, the remainder of their lives is spent with their families and their community. Incorporating the family into efforts to improve knowledge, attitudes, and perceptions around health behaviors, can reinforce and normalize them. Healthy behaviors may then also “spill over” into the community as well, inspiring family members and friends to engage in physical activity, adopt healthy eating patterns, and engage in positive social-emotional health practices.

In order to foster family engagement, administrators and teachers need to make it a priority. Strategies might include communicating with families on health education lessons being taught and physical activity or nutrition behavior outcomes. Schools can also invite families to participate in decision-making by using surveys, focus groups, and community meetings, or including parents and students on the health advisory council to assist with WSCC planning and to determine the best ways to help reinforce efforts outside of school time. There aren’t yet best-practices established for family engagement that are proven to cause behavior changes alone, since many of these are part of a multi-component WSCC study (Michael et al., 2023). However, it is clear that families and schools need to work together in order to support the learning and health of students from childhood through adolescence (CDC Healthy Schools, 2021).

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9.18: Example of WSCC Partnerships- Bradley University

Bradley University is a small, private university in Peoria, Illinois, which includes a variety of degree programs through their College of Education and Health Sciences. The university partners with eight local schools serving high-need student populations, to provide internship and volunteer opportunities for Bradley graduate and undergraduate students working on WSCC projects at the schools. These projects include short or one-time events such as refurbishing a school courtyard, or providing blood pressure screenings and flu-shots at a “Grandparent’s Day” clinic. Longer-term projects include pre-service teachers (student-teachers) integrating health curriculum into reading and writing lessons, immediately followed by PE instruction using fitness stations in the classroom. Ongoing projects included a student nurses’ “Teddy Bear Clinic” for kindergarteners and first graders, menu reviews by nutrition faculty, collaborations with local YMCA after school programs, delivery of anti-bullying curriculum, and other health-promoting programs. Each project addressed different aspects of the WSCC model, and provided valuable experiences for Bradley University students while tapping into the college as a resource for the schools. Over time, these partnerships create a sustainable framework for implementing WSCC goals for surrounding schools (Drake et al., 2018).

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9.19: Summary

Summary

While public health certainly has its hands full just focusing on communicable and non-communicable diseases alone, it would be futile to ignore the many other community health concerns that affect populations across the lifespan. In this chapter we covered some of the more pressing concerns at different stages of life; from maternal and infant health, to childhood. We examined an example of a comprehensive approach to health in childhood with the Whole School, Whole Community, Whole Child (WSCC) model, which has the potential to positively impact more than just children in schools, but families, school employees, and entire communities as well. The WSCC model provides an example of using an evidence-based framework to address community health concerns in a holistic way. Communities can provide environments (like schools, parks, and healthcare facilities) and encourage behaviors (like physical activity and healthy nutrition) that will improve health and quality of life for all - and across every life stage.

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CHAPTER OVERVIEW

10: Adolescent, Adult, and Elder Health Concerns

Learning Objectives

- Analyze current public health issues and describe how they affect the health status of specific populations of age, gender, race and ethnicity, minority, education level, and socioeconomic status.
- Describe the Dual Diagnosis/Co-Occurring Disorders approach to treating people who suffer from both an addiction and a psychiatric disorder.

10.1: Introduction
10.2: Unintentional Injuries
10.3: Violence
10.3.1: Gun Violence
10.4: Mental Health
10.5: Drug Abuse, Addiction, and Co-Occurring Disorders
10.6: Tobacco Use
10.7: Obesity
10.8: Nutrition
10.9: Physical Activity and Fitness
10.10: Elder Health
10.10.1: Falls and Fractures
10.10.2: Dementia and Alzheimer's Disease
10.11: Summary
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10.1: Introduction

Although many of the major health issues that affect children also affect adolescents and adults, there are several different challenges that populations face as they progress from the teen years and into adulthood. As we have covered infectious and chronic diseases in other chapters, here we will focus on psychological and behavioral factors that impact health. Mental health (a term often used interchangeably with psychological or emotional health) is increasingly being recognized as a significant factor in overall health and well-being. As children become more independent from their caregivers, the use and abuse of substances and other health-risk behaviors become more pertinent. American young adults suffer from mental health and substance use issues, as well as violence and unintended injuries, both of which are a significant source of morbidity and mortality. On the flipside, health-promoting behaviors such as healthy nutrition and physical activity play an important role in well-being and longevity. And although the consequences of poor nutrition and a sedentary lifestyle may begin to harm health in childhood and adolescence, the risks and impact associated with obesity and poor fitness tend to increase as we age. So while the term “behavioral health” typically refers to mental health services in medical practice, we will examine all of these topics as related to health-behaviors, and the impact that they have on adolescent and adult populations.

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10.2: Unintentional Injuries

The leading cause of death for Americans between 1 year of age and 44 years of age is unintentional injuries, or accidents. This rather broad category includes accidental poisoning and drug overdoses, automobile accidents, and unintentional falls. Of these, accidental poisoning (including drug overdoses) caused the highest number of deaths, killing 112,728 Americans in 2022. (CDC - Injury Prevention and Control, 2024, CDC - National Center for Health Statistics, 2022).

Susceptibility to different types of injuries varies by age. While drowning poses the largest threat to those under 4, older children and teens have higher rates of injuries from motor vehicle accidents and gun-related accidents. Drug overdoses are a higher risk for young, middle aged, and older adults, while falls tend to be the highest risk for those over 75 (Seabert et al., 2021). For all ages, hazardous behaviors and environments play a role in the risk of harm.

Motor vehicle crashes continue to be a significant cause of death and injury across the lifespan. In spite of lockdowns and stay-at-home orders during the Covid-19 pandemic years, data suggests that Americans were driving more recklessly - motor vehicle accident deaths spiked in 2020 and didn't begin to decline until 2022. Even though there were fewer cars on the road, it is likely that reckless driving, driving under the influence of drugs or alcohol, and not wearing seatbelts contributed to an increase in accidents and deaths (U.S. Government Accountability Office, 2022). Perhaps because there were fewer cars on the road, this enabled higher speeds and more dangerous driving. There are also likely psychological and socioeconomic factors that may have influenced driving behaviors as well. In terms of injury prevention, a lot of headway has been made in designing safer vehicles and roads. Yet the use of technology in vehicles has been mixed: while texting and taking phone calls (even hands-free phone calls) are distracting to drivers, the development of automatic safety features promises to help drivers prevent accidents altogether (NHTSA, n.d.). Historically, epidemiology and public health efforts have played a significant role in reducing deaths and injuries. Refer to Chapter 6 for a summary of the Haddon Matrix and its application in preventing motor vehicle accidents and injuries.

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10.3: Violence

While violence may be considered by some to be a criminal justice or policing issue alone, it is also a public health issue because it affects the lives and health of the public. Violence, including self-inflicted harm, contributes to some of the leading causes of death for young people. Suicides are now the second leading cause of death for those between the ages of 1 and 44, while homicides have been in the top 5 since the 1980s (CDC - Injury Prevention and Control, 2024).

Violent behavior is influenced by a variety of factors. Personal factors include psychological trauma, particularly that which is experienced during developmental stages in childhood. Children who experience ACE's and high levels of family stress may have heightened "fight or flight" responses as adults, and may not have learned cooperative coping mechanisms to deal with interpersonal conflict - such as empathy and problem solving. Community factors include many of the social determinants of health; such as job opportunities, social cohesion, and witnessing violence as children. Overall, violence seems to create more violence; victims of abuse are at an increased risk for later victimization or becoming violent themselves. Yet, there are also known protective factors that can help prevent violence. Stable, caring relationships from friends and family, connections to mental health and drug abuse recovery services, and the development of non-violent coping skills, can all support preventing the many different forms of violence (Wilkins et al., 2014).

Violence encompasses a spectrum of physical and psychological harm. Often we think of violence as only damaging a person's physical body, yet even threats and verbal abuse are harmful to a person's mental and emotional health. Below is a list of harmful behaviors and types of violence, but it is not an exhaustive list.

- Stalking, cyberstalking, controlling behaviors, verbal or written threats, "doxing"
- Verbal abuse, including yelling/screaming, calling names, demeaning, bullying and cyberbullying
- Child maltreatment, including physical, sexual, and emotional abuse or neglect of a minor
- Elder maltreatment, including physical, sexual, emotional, and financial abuse of an older adult
- Physical assault, including battery, or road rage
- Sexual assault, including groping, rape, and intimate partner violence (IPV)
- Suicide and attempted suicide
- Homicide and attempted homicide
- School violence, youth gang violence, and violence related to organized crime
- Robbery and arson (*Violent Crime*, 2011).

The prevalence of violent crimes varies by location and year. The Federal Bureau of Investigation (FBI) publishes information on national crime rates reported by participating law enforcement agencies each year, however it should be remembered that these are only the crimes reported to law enforcement agencies (property crimes like larceny/theft, motor vehicle theft, and burglary are not considered violent crimes by the FBI definition). The most commonly underreported crimes are sexual assault and rape - in fact some estimates indicate that the majority (over 60%) of sexual assaults are not reported (National Sexual Violence Resource Center, 2015). See Fig. 10.3.1 below for the crime rates published by the FBI in *Crime in the Nation, 2022*:

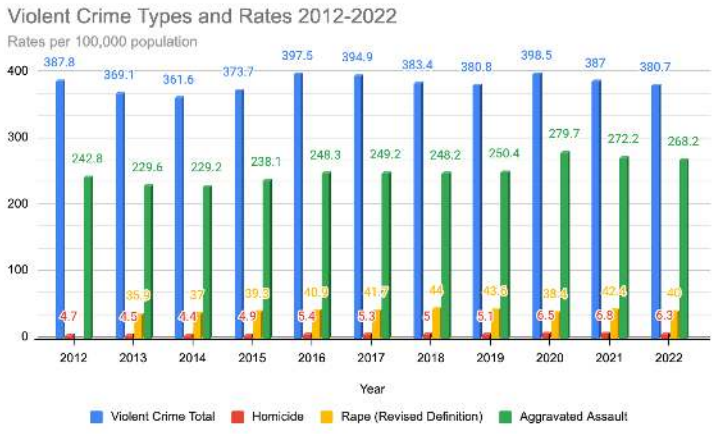


Figure 10.3.1: Violent Crime Rates and Types 2012-2022. Adapted from Federal Bureau of Investigation (2024). Note: due to a change in definition of rape (the removal of the term "forcible") in 2013, data from 2012 are not available. (*Federal Bureau of Investigation Crime Data Explorer*. https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/explorer/crime/crime-trend)

The most recent update provided by the FBI's Uniform Crime Reporting Program at the time of this writing demonstrates a 15.2% decline in violent crime between the first quarters (January through March) of 2023 and 2024. Murder and rape declined the most by 26.4% and 25.7% respectively, and aggravated assault decreased by 12.5% (FBI National Press Office, 2024).

Data on the prevalence of violent deaths from the CDC are slightly different, and place the homicide rate for 2022 at 7.5 per 100,000 population, for a total of 24,849 deaths that year. The CDC also reports that gun homicides accounted for 19,651 of those deaths (CDC/National Center for Health Statistics, 2024a). The suicide death rate is nearly double that of homicides. According to the CDC, 49,476 people lost their lives to suicide in 2022, which is 14.8 per 100,000 population (CDC/National Center for Health Statistics, 2024b).

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10.3.1: Gun Violence

Gun violence is of particular concern to public health, as both intentional violence and unintentional injuries and deaths involving guns remains a significant health threat to the U.S. population. Over the last decade, both deaths and injuries from firearms have been climbing, and peaked in 2020 with over 21,000 deaths and 40,000 injuries due to firearms. The number of mass shootings (those involving 4 or more victims besides the shooter) have steadily increased year over year from 272 in 2014 to 656 in 2023 (Gun Violence Archive, 2024). According to the CDC, the number of firearm deaths (including those that are accidental or intentional) in 2022 was higher than motor vehicle accident deaths (48,204 vs. 44,534) (CDC/National Center for Health Statistics, 2024d). The highest proportion of gun deaths continues to be from suicides. Gun deaths in the U.S. are much higher than in some other wealthy countries like Canada, Australia, and Germany, yet are significantly lower than the rates found in several South American countries (Geiger, 2023).

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10.4: Mental Health

Mental health is a broad category that covers over 200 potential illnesses of varying severity. The mental health spectrum includes emotional, psychological, and social well-being. Mental health is influenced by genetics, biological factors like diseases or injuries, neurochemistry (chemical messengers in the brain), as well as environmental factors such as stress, adverse childhood experiences (like abuse, neglect, etc.), trauma, isolation and loneliness, and the use of drugs and alcohol. Life changes significantly impact mental health - particularly significant changes such as the death of a loved one, the end of a relationship, the birth of a child, a change in living situation, and physiological changes that occur across the lifespan such as maturation and aging. When certain symptoms of psychological distress or problematic thinking are severe or long lasting, they may be diagnosed as a mental illness. The CDC reports that over 20% of U.S. adults currently live with a mental illness, and over 20% of youth between the ages of 13-18 have experienced a debilitating mental health issue. The most serious mental illnesses include bipolar disorder, schizophrenia, and major depression, affecting about 1 in 25 adults (CDC/National Center for Injury Prevention and Control, 2024).

Mental illnesses or mental disorders cannot be diagnosed with blood tests or X-rays. Instead, these disorders are diagnosed by a cluster of symptoms - usually by a licensed psychologist or psychiatrist (the difference being only the latter type of doctor provides any prescriptions for psychiatric medications). As research continues to expand our knowledge of mental health disorders, these diagnoses are updated into a manual used by mental health professionals. The *Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition* (DSM-5) is the most recent iteration, published by the American Psychiatric Association. This manual includes symptoms and diagnoses for different types of psychological disorders, including:

- Neurodevelopmental disorders - such as autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD)
- Schizophrenia spectrum and other psychoses
- Bipolar disorders (also known as manic-depression)
- Anxiety disorders - such as generalized anxiety disorder (GAD), panic disorders, and specific phobias
- Obsessive-compulsive disorders - such as OCD, hoarding, body dysmorphic disorder
- Depressive disorders - such as major depression, dysthymic disorder, premenstrual dysphoric disorder
- Trauma and stress-related disorders - such as post-traumatic stress disorder (PTSD) or acute stress disorder
- Eating disorders - such as anorexia nervosa, bulimia nervosa, and binge-eating disorder
- Neurocognitive disorders - such as Alzheimer's disease or cognitive impairment
- Personality disorders - such as narcissistic, antisocial, paranoid, or borderline personality disorder
- Sexual dysfunctions
- Substance-related disorders - such as addiction to alcohol, cannabis, pills, or gambling
- Other disorders such as dissociative, somatic, and impulse-control disorders (Seabert et al., 2021).

Mental disorders can occur together, and the interpretation of symptoms (and therefore diagnosis) is complicated. Accurate diagnosis and treatment is also dependent on the cultural competency of the provider to differentiate between behavioral differences that are due to socio-cultural factors vs. those caused by a mental disorder (Seabert et al., 2021). Historically, the DSM has been revised in favor of emerging evidence-based criteria in diagnostics, and to reflect the evolving understanding of socio-cultural influences on the interpretation of mental health. For example, up until the 1980s (when it was removed), homosexuality - or a reference to "sexual orientation disturbance" - was present in the DSM. And prior to the 1980s, PTSD, bipolar disorder, and acute stress disorders were not included. In the DSM-5, the term "hysteria" was replaced with "somatic symptom disorder", and Asperger's was removed as an independent diagnosis and instead included within the Autism spectrum (Surís et al., 2016). Further advances in the medical understanding of mental health and diagnostic procedures for psychiatric disorders will likely prompt continued evolution of this manual, as well as psychiatric and psychological practices.

Even for those without a diagnosed mental illness, mental and emotional health are highly influenced by stress. Each year the American Psychological Association (APA) conducts a survey on Stress in America to get a snapshot of the amount of stress Americans are experiencing and the most common stressors (sources of stress). The data for 2023 indicate increased stress in America due to recovery from the COVID-19 pandemic, as well as global conflict, inflation, racism and racial injustice, and climate disasters (such as drought, wildfires, floods, and severe storms). Collective traumatic stress from the pandemic may be impacting the psychological and physical health of individuals and communities in the U.S., where COVID-19 has claimed the lives of over 1 million people, caused huge job losses and economic impacts, and strained social cohesion. According to this latest analysis, self-reported mental illness diagnoses have increased from 32% of adults in 2019 to 37% of adults in 2023 (though 81% of those surveyed reported their own mental health as good or better). Those reporting a stress level of 8/10 or higher rose from

19% in 2019 to 24% in 2023. The increase was especially pronounced for those aged 35-44 (American Psychological Association, 2023).

Mental health issues are particularly concerning for adolescents. Over half of all mental illness cases will start showing symptoms by age 14, and 75% of them develop symptoms before 24 ((CDC/National Center for Injury Prevention and Control, 2024). The top 3 leading causes of death for adolescents are unintentional injuries (accidents), homicides, and suicides (Elflein, 2024), all of which may have poor mental health as a factor. Young people with poor mental health are also more likely to engage in risky behaviors such as unprotected sex and drug use. The Youth Risk Behavior Surveillance Survey in 2021 reported that persistent feelings of sadness and hopelessness (symptoms of depression) affected 42% of high school students, and this rate was significantly higher for female students and LGBTQ+ youth. Overall, rates of poor mental health for high schoolers had increased since 2011 (CDC/DASH, 2023).

College students are also struggling with increasing rates of mental health issues, particularly during the recovery from the COVID-19 pandemic. According to one study, in 2020-2021, over 60% of college students met the criteria for a mental health disorder - a 50% increase from 2013 (Lipson et al., 2022). High levels of stress are often reported by college students, as well as depression, anxiety, panic attacks, and substance abuse problems. In fact, college may be where many students first begin experiencing symptoms of mental disorders, and/or begin using stimulants or prescription substances to get high or help with studying. Having a supportive network of family and friends as well as access to mental health services on campus may help to help students find balance and prevent them from dropping out early. Common barriers to getting help include social stigma of seeking help for mental health, as well as cost and access to counselors (Johnson et al., 2023).

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10.5: Drug Abuse, Addiction, and Co-Occurring Disorders

Drugs can include any substance that is psychoactive or mind/mood altering. This would include nicotine (found in tobacco products), caffeine, alcohol, marijuana, and all other illicit (illegal) drugs along with any psychoactive pharmaceutical medicines. Abuse of a substance is defined as either using an excessive amount of a recreational substance, or using a prescription medication for a purpose other than it was intended for (for example, taking someone else's ADHD pills in order to stay up late and study for a test). Sometimes people develop a **substance use disorder (SUD)**, which according to the APA definition, is a "cluster of physiological, behavioral, and cognitive symptoms associated with the continued use of substances despite substance-related problems, distress, and/or impairment, such as impaired control and risky use" (APA, 2008). There is likely a continuum of symptoms ranging from recreational use, to binging, to daily use, which may become an addiction. **Addiction** is differentiated from other use disorders as being in a state of dependence - psychological and often physiological dependence - on a substance (like alcohol, methamphetamines, or prescription painkillers), or a behavior (such as gambling, shopping, sex, or exercise) (APA, 2008).

According to the 2022 National Survey on Drug Use and Health, over 168 million people, or 59.8% of the population over the age of 12 used some sort of drug in the year prior. Their survey categorized a drug as including alcohol, tobacco, vaping, and illicit drugs (including marijuana, and prescription drug abuse). The majority of that use came from alcohol consumption: 48.7% (or 137.4 million people) drank alcohol, whereas only 18.1% used tobacco products, 16.5% used an illicit drug, and 8.3% vaped nicotine. Alcohol consumption becomes particularly concerning based on the dose. **Binge drinking** is defined as having 4 or more drinks for a woman or 5 or more drinks for a man on the same occasion. **Heavy alcohol use** is this type of drinking behavior on 5 or more separate occasions in the past month (SAMHSA, 2023). See Fig. 10.5.1 below for more on alcohol consumption.

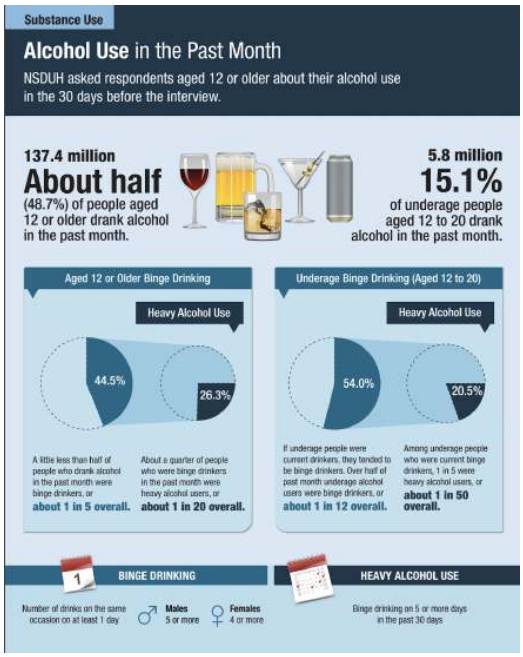


Figure 10.5.1: Alcohol Use in the Past Month. Substance Abuse and Mental Health Services Administration. (2023). *Results from the 2022 National Survey on Drug Use and Health: A companion infographic (SAMHSA Publication No. PEP23-07-01-007).* (Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/report/2022-nsduh-infographic)

The same report notes that marijuana is the most commonly used illicit drug, and in several states it has become legal for medicinal and/or recreational use, but typically only for those over the age of 21. About 22% of people over the age of 12 have used marijuana in the past year, and almost a quarter of those between the ages of 12-20 reported using it (SAMHSA, 2023). Use at young ages has been associated with declines in cognitive functioning and academic performance, as well as amplified behavioral issues. Teens who use marijuana seem to be at a higher risk of developing an addiction to marijuana or other substances later in life. Additionally, marijuana use is associated with poorer mental health: teens experiencing depression or suicidal thoughts may be more likely to use marijuana as a coping mechanism, but marijuana use also increases symptoms of depression and suicidality (Sultan et al., 2023). On a positive note, according to the YRBSS, the use of alcohol, marijuana, and any illicit drugs among high school students has declined since 2011 (CDC/DASH, 2023).

Although presumably in possession of more developed brains than their highschool selves, college students are not immune to SUDs. Many college students have the perception that using stimulants will improve their academic performance, although science provides evidence to the contrary. The misuse of prescription amphetamines (a type of stimulant used to treat ADHD) is particularly common among college students, who may use it to help them study, or along with other drugs like marijuana or alcohol (Butler et al., 2021).

Whether from prescription medications to treat pain, or street drugs (like heroin), opioids are particularly addictive and carry a high potential for drug overdoses due to the fact that they depress (slow down) the function of the central nervous system (CNS). According to the SAMHSA report, 8.9 million Americans or 3.2% misused prescription opioids, and only 991,000 misused fentanyl - including illegally manufactured fentanyl. This might be a significant underestimation however, since illegally manufactured fentanyl is often present in other drugs like heroin and cocaine without the user's knowledge (SAMHSA, 2023). In 2022, the drug overdose death rate was 32.6 per 100,000 population, an increase from 8.2 per 100,000 population just two decades prior. Although there was no significant change between 2021 and 2022, the last few years have seen an increase in drug overdoses from fentanyl and stimulants (like cocaine and methamphetamines). Drug overdose deaths affect men at over twice the rate of women (Spencer et al., 2023).

Substance use disorders (SUD) and mental illness are often co-occurring disorders. People often use alcohol or drugs to alleviate symptoms of anxiety, depression, sadness, or thoughts of suicide. About half of those living with a serious mental illness (such as major depression or bipolar disorder, among others) also had an SUD - yet only 70% of these folks with co-occurring disorders actually received treatment for it. Mental illness can lead to the desire for self-medicating or using drugs to reduce negative side-effects from psychiatric medication. The link between SUD and mental illness is complex, and often treatment models and providers are separated. Additionally, nicotine dependence and tobacco use problems are commonly overlooked in mental health treatment and addiction recovery (Abrams, 2024). See Fig. 10.5.2 below.

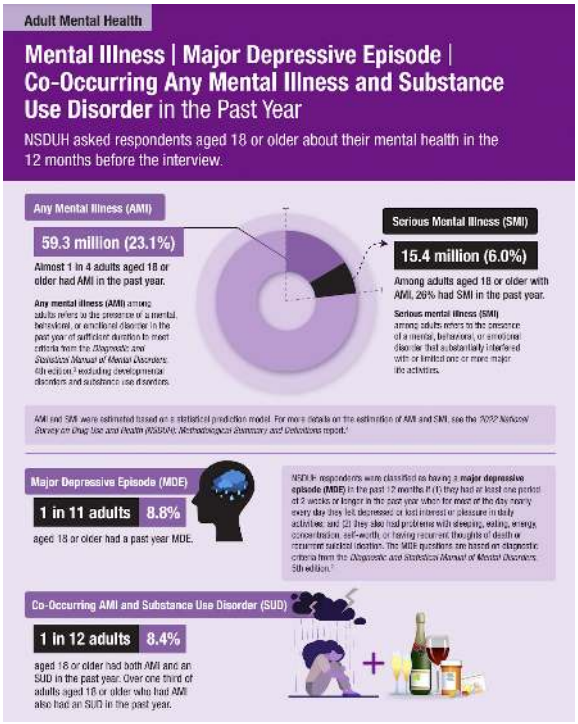


Figure 10.5.2: Co-Occuring Disorders. Substance Abuse and Mental Health Services Administration. (2023). *Results from the 2022 National Survey on Drug Use and Health: A companion infographic (SAMHSA Publication No. PEP23-07-01-007)* (Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/report/2022-nsduh-infographic)

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10.6: Tobacco Use

Probably one of the most recognizable public health movements has been the fight against the use of tobacco products. Since the first Surgeon General's report on the harmful effects of smoking in 1964, the public perception and acceptance of smoking has strongly soured. The rate of current cigarette smokers in the U.S. in 2021 was estimated to be 11.5% (28.3 million Americans), demonstrating this downward trend over time: from an estimated 42% of Americans who smoked in 1965, and even 25.3% in 1990 (CDCTobaccoFree, 2023b, National Center for Health Statistics, 2021). For teens, there has been a significant decline in cigarette smoking since the 1990s - in 1997, 24.6% of high school seniors reported smoking daily (Pampel & Aguilar, 2007), whereas in 2023 current use was at about 6.6% for middle schoolers and 12.6% for high schoolers. Among those kids who currently smoke though, e-cigarettes are the most common product used. Smoking during the teen years is particularly concerning due to the addictive nature of nicotine. Nearly 90% of adult smokers began smoking before age 18 (CDCTobaccoFree, 2023c).

Who are these holdout smokers? Men tend to smoke more than women, while smoking rates are lowest for Asian and Hispanic groups compared to non-Hispanic White and non-Hispanic Black populations. Perhaps most telling is the correlation of tobacco use and education or income levels. The highest smoking rates are found for folks with a GED (30.7%) or no high school diploma (20.1%), and progressively decline with higher educational attainment - only 3.2% of those with a graduate degree smoke. Similarly, smoking rates decline along lines of income, with highest rates for low income (18.3%) versus middle income (12.3%) and high income (6.7%) (CDCTobaccoFree, 2023b). Perhaps there are factors associated with socioeconomic status and education level which influence a person's likelihood of smoking, and the ease with which they can quit. Stress, social norms, and access to smoking cessation support are all influenced by these other social determinants.

The burden of tobacco products on society cannot be overstated. Smoking is the top leading preventable cause of death, and is considered responsible for over 480,000 deaths each year. Smoking increases the risk of cardiovascular disease, stroke, diabetes, cancers (particularly lung cancer - but also others), asthma, chronic obstructive pulmonary disease (COPD), and more. In 2018 it is estimated that smoking cost the U.S. over $600 billion, including both healthcare costs and lost productivity (CDCTobaccoFree, 2023b). Yet, the tobacco industry still spends billions of dollars to advertise their products. Targeted marketing is often aimed at women and specific racial/ethnic communities. And in spite of decades of restrictive legislation on this advertising to protect children, these advertisements still have an effect on youth perceptions of smoking (CDCTobaccoFree, 2023a).

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10.7: Obesity

The obesity epidemic is the probably most modern public health concern. Body fat is not an inert blob. In fact, adipose tissue (fat storage cells), are metabolically active, pumping out hormones and cytokines (chemical messengers) associated with everything from satiety (that feeling of fullness) to inflammation (Foreman, 2020). Excess stored fat on the body is associated with the leading causes of death, including CVD, stroke, diabetes, several cancers, pancreatic, gallbladder, and kidney diseases, and breathing problems like sleep apnea and asthma. Carrying excess weight throughout life can impede physical activity, and when people do move it causes more stress to joints - which are then more likely to develop osteoarthritis (inflammation and breakdown of cartilage). Although infectious diseases are caused by pathogens, people with excess body fat can often experience more severe illness from infections. Social stigma around obesity can impede career, academic, and social function, and these factors combined with obesity can lead to poor mental health (NIDDK, 2023). Of particular concern is visceral, or central adiposity, which is the fat that accumulates around the internal organs in the abdomen and is more strongly associated with chronic health risks due to its metabolic activity. Central adiposity is a more common weight distribution pattern in men and postmenopausal women, putting them at higher risks for cardio-metabolic diseases like diabetes, hypertension, and cardiovascular disease (Juppi et al., 2022).

It would be optimal to estimate body fat accurately with tools like a dual energy X-ray absorptiometry scan (DEXA scan) or even bioelectrical impedance analyzer (BIA), but these are often costly machines. The DEXA requires trained personnel to operate, and results from the BIA can be influenced by other physiological factors (like hydration status), so specific procedures must be followed to ensure accuracy. Therefore, these tools are not typically used to estimate fat mass to body weight ratios, or body fat percentage (BF%), for large populations. Instead, epidemiologists have long used a controversial calculation of weight-to-height ratio instead, called body mass index (BMI). There are several reasons that BMI is considered less accurate than BF%, one of them being that BMI will be higher in those individuals with more muscle mass or bone density, and there may be genetic variance in body density that is not accounted for by BMI. For example, Asian populations tend to have lower rates of obesity as classified by currently accepted cutoffs (see below), and yet have higher rates of central adiposity (fat around the internal organs in the abdomen) and higher levels of obesity-related disease factors at lower BMIs (Li et al., 2023). Even with these complications, BMI is easy to calculate using self-reported weight and height, and so large epidemiological surveys still employ this measurement to indicate health-related weight status for populations.

BMI is calculated using either of the equations below:

BMI = weight (kg) / height (m)^2 BMI = weight (lbs) / [height (in)]^2 x 703

Using BMI levels as criterion values for weight status provides the following classifications:

- Underweight = BMI <18.5
- Normal weight = BMI 18.5-24.9
- Overweight = BMI 25-29.9
- Obesity = BMI 30+
- Severe or “morbid” obesity = BMI 40+

Although we have been calling obesity an epidemic for what seems like a long time, it is still a growing problem. According to the CDC, the prevalence of adult obesity was 30.5% in 1999-2000, and had increased to 41.9% in 2017 - March of 2020 (at the beginning of the COVID-19 pandemic response). Severe obesity increased from 4.7% to 9.2% in the same timeframe. In terms of healthcare, obesity costs over $1,861 excess 2019 dollars per person, and severe obesity over $3000 per year. Obesity also disproportionately impacts people of color, with the highest rates of obesity in Non-Hispanic Black populations (49.9%), and Hispanic (45.6%) populations. Interestingly, those populations who had a high school diploma and some college had the highest rates of obesity (46.4%) compared to those without a high school diploma (40.1%) and those with a college degree or higher (34.2%). As we might expect, obesity rates do increase with age up to the 40-59 year old range, then decline slightly for those over 60 years of age (CDC, 2024c). Some researchers project that the rates of obesity in U.S. adults will reach almost 50% by 2030, and half of that will be severe obesity (Ward et al., 2019).

Obesity is not only a problem in America either. According to the WHO, obesity rates have doubled worldwide since 1990: with nearly 1 in 8 adults, and 8% of children between the ages of 5-19 living with obesity in 2022. In medium and low income countries in particular, obesity co-exists with malnutrition. Food insecurity may include not having enough food to eat or only having access to low quality food sources, often high in sugar and fat, which are associated with the development of obesity. Thus, undernutrition and obesity may both be affecting impoverished areas around the globe (World Health Organization: WHO, 2024a).

In a higher-income country like the U.S., obesity has increased in both low and high socio-economic strata. However, poverty is still considered a driver of obesity, as well as other factors associated with poverty such as stress and “obesogenic” environments. The link between obesity and socio-economic status may be bi-directional. Having obesity may limit economic success via weight stigma in the workplace, while conversely, living in a wealthier neighborhood with plenty of greenspace and opportunities for physical activity, as well as access to high-quality healthy food sources (more supermarkets, fewer convenience stores), is associated with having a lower BMI (Anekwe et al., 2020).

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10.8: Nutrition

If obesity rates are high in the U.S., we might safely assume that nutritional status is poor on average as well. Since 1980, the USDA has published nutritional guidance in the *Dietary Guidelines for Americans* with updates every 5 years to align recommendations with current nutrition science (USDA and HHS, 2020). The purpose of these guidelines is to promote health and prevent disease in the U.S. population, not to prescribe specific diets for each individual. In the 1990s, the USDA adopted the "Food Pyramid" to provide a visualization of daily servings for different food groups. In 2011 this was revised to *Choose My Plate* which created a much easier visual representation of the guidelines in the form of a plate (Raikar, 2023). The most recent guidelines also place emphasis on ethnic and cultural variations in dietary patterns and how the guidelines can be applied in enjoyable and affordable ways (USDA and HHS, 2020). Below are the overarching guidelines in the most recent iteration (2020-2025):

1. Follow a healthy dietary pattern at every life stage.
2. Customize and enjoy nutrient-dense food and beverage choices to reflect personal preferences, cultural traditions, and budgetary considerations.
3. Focus on meeting food group needs with nutrient-dense foods and beverages, and stay within calorie limits. Food groups include:
    a. Vegetables of all types - dark green; red and orange; beans, peas, and lentils; starchy; and other vegetables
    b. Fruits - especially whole fruits
    c. Dairy, including fat-free or low-fat milk, yogurt, and cheese, and/or lactose-free versions and fortified soy beverages and yogurt as alternatives
    d. Protein foods, including lean meats, poultry, and eggs; seafood; beans, peas, and lentils; and nuts, seeds, and soy products
    e. Oils, including vegetable oils and oils in food, such as seafood and nuts.
4. Limit foods and beverages higher in added sugars, saturated fat, and sodium, and limit alcoholic beverages (USDA and HHS, 2020).

The ChooseMyPlate model visually represents relative portion sizes for each major food group. See Figure 10.4 below.



Figure 10.8.1: Start Simple with MyPlate. USDA, 2020. Adapted from: https://myplate-prod.azureedge.us/sites/default/files/2021-01/DGA_2020-2025_StartSimple_withMyPlate_English_color.pdf

Researchers and epidemiologists utilize a scoring system to compare current eating habits of Americans with the dietary guidelines. This score is called the Health Eating Index (HEI) and is reflective of diet quality not quantity (or number of calories consumed). Between 2005-2006 and 2015-2016, HEI scores taken from NHANES data have averaged around 56-60/100. This reflects a persistence in typical eating patterns remaining far below the dietary guidelines in terms of quality (USDA and HHS, 2020). In terms of quantity, we are certainly eating more. United Nations publications indicate that total calorie consumption is up worldwide in the past two decades, increasing by 9% between 2021 and 2022 to an average of 2960 kcals per day. In Europe and North

America, the average was 3,540 kcal per day (United Nations News, 2022). Data from the USDA suggest that average daily consumption per capita in the 1970's was just over 2,000 kcal. Although dietary fads come and go, Americans are certainly consuming more grains, fats than we used to (DeSilver, 2016), and the consumption of sugar-sweetened beverages is up in the U.S. and worldwide (Lara-Castor et al., 2023).



Figure 10.8.2: (Photo by David from Freerange Stock)

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10.9: Physical Activity and Fitness

Both maintaining consistent physical activity and having a high level of physical fitness are protective against the chronic diseases which are the primary causes of death. Physical activity refers to the total amount of movement you get throughout the day. Fitness is referring to the conditioning of your body: the capacity of your heart, lungs, and muscles to perform high intensity work. The two are indelibly intertwined of course, since it takes a minimum level of fitness to be physically active, and those who have a high level of fitness tend to do more physical activity. Yet what is interesting is that each is independently protective against cardiovascular disease, diabetes, and some cancers - regardless of body weight, or age, or sex (which are usually also risk factors). In other words, being active and fit is important for health in every body (Foreman, 2020).

The CDC recommends that adults get a minimum of 150 minutes of moderate physical activity or 75 minutes of vigorous physical activity (or some combination of both) per week, including muscle strengthening exercises on at least 2 days of the week. But that's just the bare minimum. Doubling that amount - 300 minutes of moderate or 150 minutes of vigorous physical activity - can provide substantially greater health benefits. In this way, physical activity and exercise have a dose-response relationship with better health: some is good, and more is better. Children and adolescents are encouraged to do at least 60 minutes per day of moderate to vigorous physical activity, some of which should include muscle and bone strengthening exercises on at least 3 days per week (U.S. Department of Health and Human Services, 2018). There isn't anything magical that happens between the ages of 17 and 18 that immediately decreases the need for physical activity - shifting from the recommendations for children and teens to those of adults. However, it should be noted that as kids grow they may shift from unstructured play to organized sports and/or exercise. Perhaps the changes in recommendations are more a reflection of societal demands (education, work, etc.) that change *how* we engage with physical activity (van Sluijs et al., 2021). Of course, there is also an upper limit where frequent, high intensity exercise provides no further benefits for health and longevity - or could even be dangerous. But this excessive amount is typically only the stuff of avid endurance athletes, or a concern when a sedentary person drastically increases their PE all of a sudden (Foreman, 2020).

Most Americans certainly do not get enough physical activity. In 2018, only 54% of adults reported achieving the CDC recommended minimum for minutes of physical activity per week, only 27.6% performed at least 2 days per week of muscle strengthening exercises, and only 24% got both (DNPAO, NCCDPHP, CDC, 2024). According to data from the Behavioral Risk Factor Surveillance System (BRFSS) over the years 2017-2020, over 25% of adults reported getting NO physical activity outside of their work (CDC, 2024d). Adolescence is a time where physical activity tends to decline - we go from energetic, playful children to much more sedentary teens and young adults. This decline in physical activity is sharper for teen girls than boys, likely due in part to the drop off of PE requirements during the last two years of high school combined with gender-skewed participation in organized sports. Nearly 80% of adolescents across the globe do not get enough physical activity, and in high income countries like the U.S., these trends also disproportionately affect teens in lower socioeconomic tiers (van Sluijs et al., 2021).

"Fitness" is traditionally classified as cardiorespiratory fitness (CRF), as measured by a maximal, submaximal, or field test. These tests either directly or indirectly measure the maximum capacity of the human body to use oxygen for physical work, so they essentially measure aerobic (endurance) capacity. Of course there are other measures of fitness including muscular strength, endurance, flexibility, and balance - all of which also have been shown to have protective health benefits. The majority of the research over the last several decades however has been done on CRF and its inverse association with chronic diseases, and particularly risk factors for cardiovascular disease. Poor CRF is considered a stronger risk factor for all-cause mortality than obesity, hypertension, smoking, high cholesterol, or diabetes (Foreman, 2020). And improving CRF and physical activity levels decreases risks for all-cause mortality *regardless of weight status.* So for folks who have excess body fat, if they also have a moderate to high level of fitness, they are in better health than those with normal weight and low fitness levels (Gaesser & Angadi, 2021).

Getting an accurate picture of the average CRF in Americans is tricky though. While some studies have been able to collect accurate measurements on large groups of people, the less fit are often left out of these measurements because performing a validated CRF treadmill test on them is too risky. Thus, several studies that attempt to take cross-sectional measurements of CRF tend to recruit people who are already physically active or fit, and their subjects tend to be predominantly white, with relatively high incomes and educational attainment. Even with these limitations to the research, it is still apparent that on average, CRF declines with age, and higher CRF is associated with more leisure-time physical activity and lower body mass. CRF also tends to be disproportionately lower in women of color than other demographic groups (Wang et al., 2010).

Physical activity has other benefits besides chronic disease prevention, including supporting mental health. Being active can reduce both acute (immediate) and long-term symptoms of depression and anxiety. Adolescents who are active on at least 5 days per week

and those who play sports tend to have a lower risk for depressive symptoms. By contrast, using a computer - a very sedentary behavior - for more than 3 hours per night increases risks for depression (C. H. Wang & Peiper, 2022). Physical activity can support quality, efficient sleep, which also supports mental and emotional health. When it comes to brain gains, most of the evidence for the acute and long-term cognitive benefits of physical activity has been found in children, yet there is growing evidence for the association of CRF with academic achievement in young adulthood (Åberg et al., 2009). Lifelong physical activity is certainly protective against dementia and improving cognition in older adulthood (U.S. Department of Health and Human Services, 2018). In fact, physical activity and exercise combat most of the markers of aging - including muscle loss (sarcopenia), bone loss (osteoporosis), and reductions in physical functioning. There's likely no other behavior quite as powerful for longevity and quality of life as being physically active (Foreman, 2020).

The other side of the physical activity coin is time spent not moving - or sedentary time. Research from 2019 suggests that American adults may spend an average of 9.5 hours per day sedentary (Matthews et al., 2021). A follow up in 2022 suggested that the COVID-19 pandemic didn't really change time spent sedentary for most people. Although some folks started working from home and saving time on their commute, that only seemed to translate to more leisure physical activity time for men, not so much for women. Much of that saved commute time was simply spent in sedentary leisure activities. Families with children who had to complete remote schooling tended to decrease their physical activity throughout that time (Matthews et al., 2022). Recent research suggests that long bouts of sedentary time and/or the accumulation of prolonged sedentary hours is leading to chronic diseases and conditions, including CVD, diabetes, some cancers, muscle weakness, low back pain, depression, and more (Foreman, 2020). Even those adults who reach the recommended minimum physical activity may not be able to undo all of the health hazards of sitting for the rest of the day. Per a meta-analysis of sedentary studies and risk of all-cause mortality, it takes about 60-75 minutes of hard exercise to offset the risks of sitting for more than 8 hours each day (Ekelund et al., 2016). In other words, not only do people need to move more for their health, they also need to sit less.

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10.10: Elder Health

Certain health issues become more and more important to us as we age. As discussed earlier, older adults are at a higher risk of falls, and most Americans have one or more chronic conditions by age 65 (Boersma et al., 2020). With the advancing age of the Baby Boomer generation, some predictions estimate that the number of adults over 80 will more than double by the year 2050, and the majority of those over the age of 50 will be living with at least one chronic condition (Ansah & Chiu, 2023). Yet there is controversy about whether chronic conditions should just be expected as a function of aging and the "natural" breakdown of the human body, or whether other factors like environment and behaviors can be leveraged to achieve better health and longevity for aging populations. Since we covered chronic diseases elsewhere, we will focus on two other pressing concerns for older adults: the risk of falls, and dementia - including Alzheimer's disease.

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10.10.1: Falls and Fractures

A fall to the ground might seem like a minor thing - after all, children fall down and get up multiple times a day. Yet as an adult, and particularly an older adult, falls can become a much greater risk for a severe injury. And falls are quite common as we get older: over 25% of adults over the age of 65 fall each year, yet less than 50% of those that fall tell a doctor about it. Emergency departments see over 3 million falls annually, and 1 million older adults are hospitalized from one. Falls can cause bone fractures (often in the hip or wrist) and traumatic brain injuries (TBI) (CDC, 2024b). All told, falls are the leading cause of injury-related deaths for older adults.

The risk for falls increases due to a few aging-related factors, many of which can be prevented. As we get older we tend to lose muscle mass, which if it is severe enough is called sarcopenia. With this loss of muscle comes a loss of strength, balance, and motor control - all of which can increase the risk of falling. But even though some declines in strength and balance are to be expected with age, sarcopenia is much more common in those with low physical activity and a sedentary lifestyle (HHS/OASH Office on Women's Health, 2023). A lot of muscular strength and muscle mass can be maintained with strength training. Practicing Tai Chi has also been extensively studied as an effective fall-prevention strategy, specifically for improving balance and coordination (Chen et al., 2023).

Similarly, bone mass declines with aging, particularly the center "spongy" bone in our long bones. If bone loss is severe enough, it can eventually lead to osteoporosis, which significantly increases the fracture risk if a fall does occur. People with smaller frames tend to be at a higher risk of osteoporosis, as are women after menopause. The drastic decrease in estrogen experienced during menopause is associated with a steeper decline in bone mass. While physical activity, especially strength training and impact exercise (like running and jumping) can certainly increase bone mass in children and adolescents, it is becoming clear that exercise only delays the decline in older age. In other words, it is much harder (or perhaps impossible) to increase bone mass in our later years, but we can definitely hang on to more of what we built in our youth (Foreman, 2020).

Other risk factors for falls include having a chronic condition such as hypertension which can affect balance and cause dizziness, particularly when standing up from a seated or lying position, or being on medication that can affect balance. Lower acuity in sight or hearing can also cause trips and falls, as can cognitive impairments. It is extremely important to maintain an environment that supports an older person's functional capacity, with floors clear of clutter, ramps or few level changes, and railings to provide support (CDC, 2024c).

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10.10.2: Dementia and Alzheimer's Disease

Dementia is a rather broad category of any type of cognitive decline with age that begins to affect a person's memory, their capacity to function in daily life, and eventually their ability to take care of themselves (CDC, 2024a). Probably the most significant and familiar type of dementia is Alzheimer's disease, which is characterized by troubles with memory, language, and thinking. It is thought to be caused by the buildup and changes of specific proteins in the brain, which cause damage to neurons. This damage results in chronic inflammation and potentially even shrinkage of brain tissue. Alzheimer's disease is progressive and eventually deadly, killing more people than breast cancer and prostate cancer combined (Alzheimer's Association, 2024b).

It is estimated that almost 7 million Americans currently live with Alzheimer's disease, and by 2050 that number could be as high as 13 million (Alzheimer's Association, 2024b). Age is the most common risk factor: it affects approximately 10.9% of people over the age of 65, and 33.4% of those over 85. Specific genes have been identified in the process of developing Alzheimer's disease - one of them being the APOE-e4 gene that helps create a protein for transporting cholesterol in the blood. Protective factors include maintaining cardiovascular health with nutrition and exercise, as well as fostering social connections and intellectual stimulation. Education may also be protective by helping develop a "cognitive reserve" in mid-life, thus delaying symptoms, or it may also be associated with other healthy behaviors (such as not smoking and exercise) or a corelary with socioeconomic status and other social determinants of health (Alzheimer's Association, 2024a). Physical activity and exercise in a variety of forms has been shown to have a very powerful protective effect on the brain. It can both prevent and delay symptoms of Alzheimer's or dementia of any type (Foreman, 2020).

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10.11: Summary

Summary

Adolescents, adults, and older adults make up the majority of the U.S. (and the world's) population. While there are some differences in what people need to be healthy at different ages, many of our primary health concerns continue across the lifespan. The prevalence of mental illness, substance abuse disorders, and violence are growing public health concerns, influenced strongly by biological, environmental, and the social determinants of health. Unintentional injuries are particularly concerning as they often affect young people the most - thus costing the most in years of potential life lost (YPLL). But the public health outlook for adults is not all bleak. Healthy behaviors such as proper nutrition and physical activity can improve both physical and mental health and well-being for anyone, at any age. Creating environments and supporting community efforts to encourage healthy behaviors may also help to discourage health-risk behaviors at the same time, and support the pursuit of long, healthy lives for all.

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CHAPTER OVERVIEW

11: Environmental Health

Learning Objectives

- Describe the inter-relationship between human beings and their environment and public health initiatives and policies to protect the planet.

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11.1: Introduction

Environmental health includes both the human impact on the earth, as well as the health effects of different environmental exposures (chemicals, gasses, radiation, etc.) on humans. According to the World Health Organization (WHO):

Healthier environments could prevent almost one quarter of the global burden of disease….Clean air, stable climate, adequate water, sanitation and hygiene, safe use of chemicals, protection from radiation, healthy and safe workplaces, sound agricultural practices, health-supportive cities and built environments, and a preserved nature are all prerequisites for good health (WHO, 2020).

Environmental factors contribute to leading causes of morbidity and mortality around the world, causing nearly 1 in 4 human deaths globally in 2016 (WHO, n.d.). Recognizing that human health is interconnected to the health of animals as well as the entire ecosystem in which we live, the One Health framework has been developed to promote an interdisciplinary approach to environmental health. Taking this holistic approach can help to reduce zoonotic disease transmission, improve access to food and clean water, and mitigate and adapt to the effects of climate change (WHO, 2022).

Any ecosystem has a maximum capacity, called the “carrying capacity” for sustaining the life of a particular organism. If this capacity is reached and exceeded, there will not be enough resources to sustain the further growth of that species, and the population will decline to below the carrying capacity (Frumkin, 2016). On planet Earth this includes both the potential “using up” of Earth’s natural resources, as well as our contributions to climate change which have an effect on ecosystems themselves. Climate change may cause some areas of the planet to become uninhabitable by humans in the (near) future. Many regions are already experiencing the cascading effects to human health caused by climate change. In this chapter, we will explore the health effects of climate change, as well as some common environmental toxins and pollutants, environmental regulations, and public health responses to environmental health concerns.

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11.2: Climate Change

One of the most pressing concerns in environmental health is the effects of climate change on the planet, and human and animal populations. **Climate change** refers to the shifts in climate over time in various regions across the globe. Many of these shifts are due to **global warming**, or the observable increase in average temperature of the earth. The term “global warming” sometimes causes confusion because people think it means all temperatures will be higher throughout the year. Instead, it’s better to think of global warming as the driver of climate change, because the increasing average global temperature is causing shifts to different regional climates across the globe - including more severe storms, droughts, and permanent changes to ecosystems.

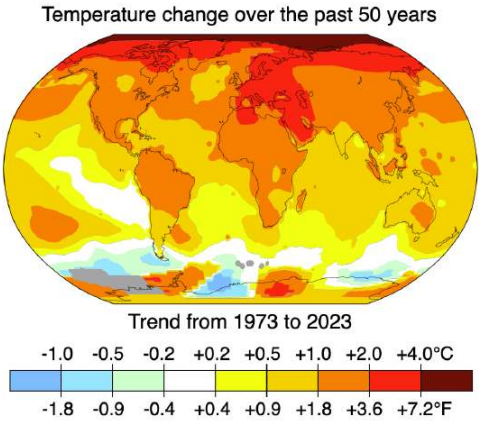


Figure 11.2.1: Change in Average Temperature With Fahrenheit. (Copyright; CC0, NASA’s Scientific Visualization Studio, Key and Title by uploader

How do we know that the earth is warming? Evidence from ice cores collected from Greenland and Antarctica, plus ambient temperature data collected since 1958 demonstrate that although the earth has gone through cycles of warming and ice ages, human activity since the industrial revolution has caused much more warming in the last 150 years than occurred in the ~800,000 years prior. Images from space show ice sheets and glaciers melting and shrinking, dumping fresh water into the ocean. And since the middle of the last century, scientists have tracked a 2 °F increase in the average temperature of the planet, with the most significant increase happening in the last 4 decades (NASA, 2024).



Figure 11.2.2: Melting Canadian glacier. (Katherine Lean, CDC/ CDC Connects, 2017.)

This glacier located along the Icefields Parkway, near Banff National Park, Canada, is melting, showcasing the effect global climate change is having on the environment. The glaciers in this area have been studied since the 1950s, making them some of the longest scientifically observed glaciers in the world. Photo Credit:

This most recent and rapid global warming is considered to be **anthropogenic** (caused by human activity), not something that would typically happen from natural sources alone. Anthropogenic factors include the release of **Greenhouse Gasses (GHG)**. These GHGs include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O),and are released into the atmosphere from the burning of fossil fuels for energy, as well as from modern agricultural practices. Trees actually remove CO_2 from the atmosphere and store it in their trunks - so forests become “carbon sinks”. Deforestation therefore also contributes to global warming by cutting into carbon sinks - thus decreasing the amount of CO_2 collected (Burke & Weill, 2023). These GHGs left floating in the atmosphere trap heat from the sun and reflect it back down to the earth, causing an increase in the average temperature - much like a greenhouse uses glass walls to trap heat from the sun and keep the interior warmer for plants. Since the 1970s, the release of GHGs has increased much faster than in years prior, with the largest spike happening after the turn of the 21st century (Frumkin, 2016). Part of this is due to global population growth, which certainly contributes to the demand for energy production and thus the burning of fossil fuels to make it. However, the largest contributors to GHG tend to be the wealthiest countries, and per-capita GHG emissions are higher for more economically developed countries than for less economically developed countries. So it’s not just that more people require more energy, it’s also the behaviors and demands of wealthy societies that are driving GHG emissions. Still, as a few countries like Germany and the Netherlands have demonstrated, quality of life can be maintained while reducing GHG emissions through the use of technology and renewable energy sources (Ritchie & Roser, 2020). See figures 11.2.3 and 11.2.4 below.

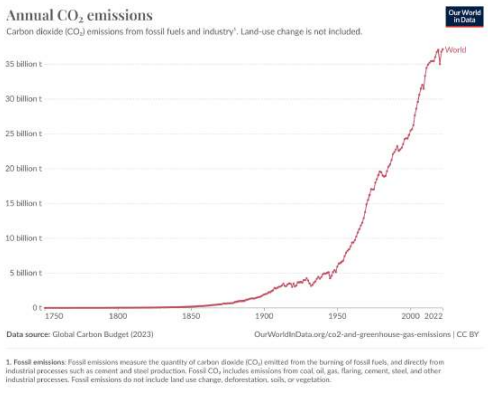


Figure 11.2.3: Annual CO_2 emissions from fossil fuels and industry. (Copyright; CC-BY Our World in Data)

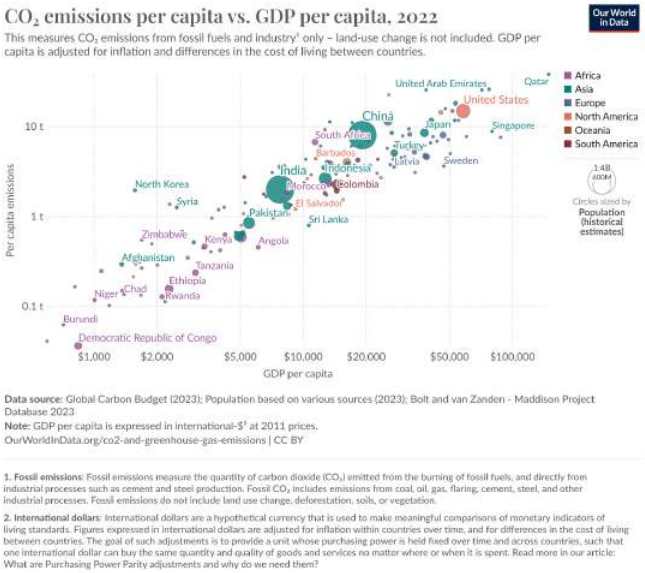


Figure 11.2.4: CO_2 emissions per capita vs. gross domestic product (GDP) per capita. (Copyright; CC-BY Our World in Data)

Increasing the Earth’s average surface temperature has several consequences. When the ocean warms even just a little, it expands. As ice sheets and glaciers on land melt, they also contribute to rising sea levels. (Melting icebergs don’t contribute to increased sea levels, as their volume is already accounted for - like ice cubes in a glass of water). Increases in ocean temperature can cause the “bleaching” of coral reefs, essentially killing them and the marine life that rely on them for food and shelter (NOAA, 2023). On

land, the higher temperatures cause more evaporation of water from plants and soil, leading to droughts. Warming air can also hold onto more water vapor, which can also cause more extreme weather - like severe rainstorms, hurricanes, and flooding (Frumkin, 2016). As warm air travels toward the poles, it shifts the cold air from the polar vortex (low pressure air at the north and south poles) which can cause severe winter storms - like the unexpected snowstorms experienced in Texas in 2021 which caused massive failures in the power grid (Burke & Weill, 2023). While some rain is needed for vegetation growth, very wet springs followed by dry summers cause all that vegetation to dry out. In 2021 during the summer, dry timber and windy conditions led to mega wildfires in the Sierra Nevada mountains (Sierra Nevada Conservancy, 2022). Droughts can not only dry out plants, but also make the soil less permeable, causing flooding when substantial rains do fall, and allowing precious rainwater to wash away into the ocean instead of sinking into groundwater aquifers (Fry & Reyes-Velarde, 2019). And if heavy rains follow a wildfire, they can cause mudslides that change terrain and threaten homes and roads (Burke & Weill, 2023). .

Climate change might include changes in temperature, rain or snowfall, drought, or wind that influence the overall climate for that region. **Climate** is a term used to describe *average* weather patterns. Southern California for example has a mostly mediterranean (arid or semi-arid) climate around the coastal cities and Los Angeles, gradually shifting to a desert climate in the Mojave desert and inland regions. Los Angeles has pretty mild temperature changes over the seasons, with some rainfall in the winter, and dry, sunny summers. The desert areas get much less rain of course, and have more temperature extremes, getting hotter in the summer and colder in the winter. **Weather** is made up of the temperature, atmospheric pressure, precipitation, wind, and humidity at any given time and can change rapidly. Certain weather patterns may be predictable for a particular climate, but the two are not the same by definition. Over time, if the climate changes in a specific area, there may be more extreme weather patterns, and there will be changes in the overall ecology of that region - which may positively or negatively influence its ability to support life of the plants and animals who live there (Burke & Weill, 2023).

In our California example, the average temperature in the Los Angeles (LA) region has already increased since the middle of the 20th century, and is expected to be 4-5 °F warmer by the middle of the century. This increase in temperature is causing more of the snowpack to melt from the nearby mountains, and more of the water sources across the state to evaporate. The combination of warm, dry summers and substantial rainstorms in the winter will cause more vegetation to grow in the spring and become dry, wildfire fuel in the summer. Subsequent rains will increase the risk of mudslides and soil erosion. Along the coast, higher sea levels will threaten coastal communities, which, along with mudslides can cause severe danger to lives and homes (California Climate Adaptation Strategy, 2024). Central California has a mediterranean climate similar to LA, which is conducive to growing fruit and nut orchards and crops that require rain in the winter and warm sun in the summer. If the entire climate in central CA becomes more desert-like, it will severely impact the state's large agricultural economy. For example, almond orchards in CA produce 80% of the world's almonds - but these trees require many years to mature and need water year round (Chea, 2021).

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11.3: The Health Effects of Climate Change

As global warming causes a cascade of climate changes and weather pattern disruptions, these too cause changes to the ecological systems in which we live, which in turn affect human health. Besides the dangers of extreme weather events, which can be deadly on their own, climate change will affect both physical and human health in many ways. According to the most recent (5th) National Climate Assessment from the U.S. Global Change Research Program:

Health risks from a changing climate include higher rates of heat-related morbidity and mortality; increases in the geographic range of some infectious diseases; greater exposure to poor air quality; increases in some adverse pregnancy outcomes; higher rates of pulmonary, neurological, and cardiovascular diseases; and worsening mental health (USGCRP, 2023b)

And these risks to health are not equal across America or across the globe. Social determinants of health also influence which populations will be at higher risk for experiencing the health effects of climate change, with the most severe impacts being felt by communities and countries with less wealth, fewer resources, less education, and those historically marginalized by the rest of society. Even within relatively wealthy countries, the populations most at risk include the elderly, unhoused, children, pregnant people, and those with chronic conditions and disabilities (USGCRP, 2023b).

While warmer temperatures in some areas actually increase the capacity to grow food, they can harm crops and farmers in other regions, and disrupt the food supply chain. The northern regions in Siberia (Russia) and Canada are now warm enough to grow crops that would not have survived before (like soy and wheat), but South Asia, South America, and Africa will experience significant losses to dietary staples (wheat, corn, etc.). Warmer weather also encourages the growth of pests, fungi, and other plant diseases, causing more crop losses (Frumkin, 2016). Warmer ocean temperatures threaten fish and shellfish, which are important sources of protein for many Indigenous communities (USGCRP, 2023b). And although CO_2 can be removed from the air by certain trees and plants, it can also change the nutrient content in some food sources like rice and soybeans. Meanwhile, weeds, allergy-producing plants (like ragweed), and poisonous plants (like poison ivy) thrive in the heat and higher CO_2 (Frumkin, 2016). Food insecurity is already high in many of the same places experiencing negative agricultural effects of climate change.

Foodborne, waterborne, and vector borne pathogens are likely to increase with climate change via several pathways. Many bacteria and fungi thrive in warm, humid climates, and many vectors (like mosquitos) breed in standing water. Water sources can be contaminated with runoff from heavy rains and flooding, and can contribute to food contamination via irrigation and washing of plants. Water shortages may also prompt people to turn to other sources of water like nearby lakes and streams, which are more likely to be contaminated with runoff and/or pathogens. And higher temperatures also promote harmful algal blooms (colonies of algae), both in freshwater (lakes) and saltwater (oceans), which can be harmful to humans and other marine organisms. Vectors like mosquitoes and ticks have spread further as other regions warm, bringing with them diseases like malaria, West Nile virus, dengue fever, and chikungunya. Even fungal diseases like Valley Fever are expected to spread north with drought conditions (Frumkin, 2016, USGCRP, 2023).

Many regions are experiencing higher-than average temperatures, and more frequent heat waves, or extreme heat events (EHE). In the summer of 2023, Phoenix experienced a record 31-day streak of temperatures over 110 ℉ (The Associated Press, 2023). While the American Southwest is not stranger to hot summers, other regions also experienced severe heat waves for which they have little history or preparation. In 2021, the Northwestern states and Canada (typically a cooler, “oceanic” climate) experienced a “heat dome” which caused high temperatures over the summer (Zhang et al., 2023). Similar heatwaves have hit Australia, China, Japan, and Europe (Zachariah et al., 2023), and can be particularly dangerous in regions that aren’t typically prepared for hot summers with air conditioning in buildings and public transportation. EHEs can cause acute heat-related illnesses (HRIs) such as heat exhaustion, dehydration, and heat stroke, and they also increase risks for cardiovascular events and kidney problems in those with chronic diseases like diabetes, as well as health complications for infants and pregnant people.

People most at risk for HRIs are older folks, young children, and pregnant people, as well as those who take certain medications, those who lack housing or air conditioning, and those who work outside. Social determinants of health also impact disparities in HRIs. If folks lack the money to pay for high electric bills, they may not run their air conditioning during the summer months. And poorer, urban communities may actually experience hotter conditions than wealthier suburban neighborhoods. A lack of tree cover/greenspace and more cement can create “urban heat islands” up to 4 ℉ hotter, and less likely to cool down at night. But plants that provide shade and absorb CO_2 need irrigation, which is why wealthier neighborhoods tend to have more of them (Dialesandro et al., 2021, USGCRP, 2023b). See Figure 11.3 below for region-specific climate change effects in the U.S.

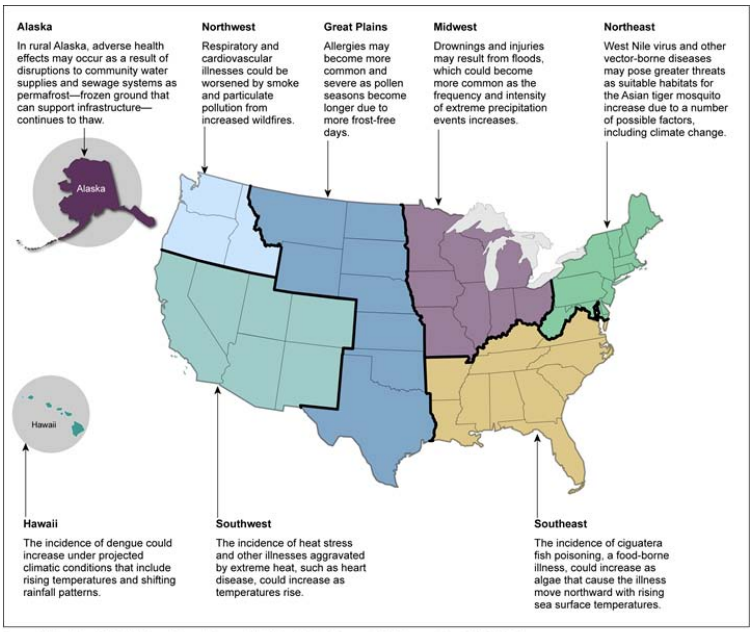


Figure 11.3.1: Examples of Potential Health Impacts from Climate Change in the United States, by Region. U.S. Government Accountability Office from Washington, DC, United States. (Public domain, via Wikimedia Commons. November 10, 2015)

Figure 11.3 Examples of Potential Health Impacts from Climate Change in the United States, by Region. U.S. Government Accountability Office from Washington, DC, United States, Public domain, via Wikimedia Commons. November 10, 2015.

Climate change affects mental health in several ways. People may lose everything in a natural disaster like a hurricane, wildfire, or flood. They may lose friends and family members, pets, photographs, homes and vehicles, and entire communities. They might lose their jobs and livelihoods to a natural disaster, or a change in climate - particularly in agricultural economies. Experiencing environmental trauma can have a severe and long-lasting impact on mental health, often causing post-traumatic stress disorder (PTSD) and heightened anxiety for many years (USGCRP, 2023). Historically minoritized communities and those who have fewer resources to begin with are often those the most harmed. For example in 2005, Hurricane Katrina devastated parts of New Orleans. The areas hardest hit were home to majority Black residents due to historical redlining practices which had segregated homeownership to certain parts of the city. These neighborhoods were below sea level, and so experienced the worst flooding (Burke & Weill, 2023). And the recovery has been just as difficult - nearly 175,000 Black New Orleans residents were displaced, and 75,000 have still not returned almost 2 decades later. Housing costs increased, flood insurance became expensive, and the federal program designed to fund rebuilding efforts ended up being sued for shortchanging poorer recipients and trying to collect overpayments (SPLC, 2023).

What happened after Hurricane Katrina is perhaps a microcosm of the displacement of communities due to climate change. Severe weather and natural disasters may destroy neighborhoods, towns, and even cities, forcing inhabitants to move elsewhere. Likewise, heatwaves and droughts may make agriculture unsustainable in certain regions, forcing people to migrate. Indigenous peoples already experience disparate impacts which threaten traditional ways of life, as well as the destruction of culturally and spiritually significant landscapes (USGCRP, 2023b). These and other socioeconomic impacts threaten civil and international conflict, and will likely disrupt global economies - all of which will have cascading effects on human health. See Fig. 11.3.2 below for a diagram outlining these health effects of climate change.

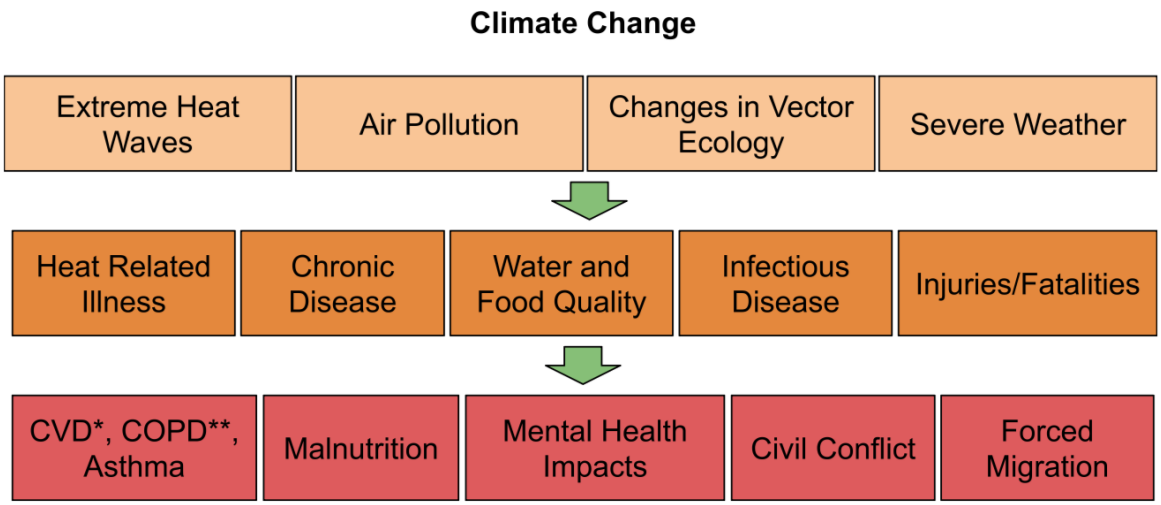


Figure 11.3.2: Health Effects of Climate Change. *Cardiovascular Disease (CVD). **Chronic Obstructive Pulmonary Disease (COPD).

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11.4: Climate Change Policy

In December of 2015, 196 countries signed the Paris Agreement - a legally binding international treaty to address climate change. This treaty mandates that signatory countries set their own goals to reduce their impact on climate change, while recognizing that low-income countries may need extra funding and support in order to join in climate mitigation efforts to reduce their GHG emissions, as well to adapt to the adverse effects of climate change they are already experiencing. The long-term target of the Paris Agreement is to keep the increase in Earth's average temperature (compared to pre-industrial levels) well below 2 ℃, while pursuing the target of at or below 1.5 ℃ - since warming below 2 ℃ will still cause substantial climate change impacts like droughts, floods, and extreme storms. The agreement includes nationally determined contributions (NDCs) by each country; commitments to take economy-wide steps to lower GHG emissions (UNFCCC, 2015). As of the early 2020's warming is already at 1.2 ℃, yet if all of the long-term targets for GHG emissions the Paris Agreement were implemented in full and on time, it is possible that warming could be kept at or below that dire 2 ℃ mark by 2100 - but unlikely that warming could be kept under 1.5 ℃. To reach this more aggressive goal, signatory countries would have to move up their net zero emissions targets, cut CO_2 emissions by 45% and other GHG emissions substantially by the year 2030, and support other countries in doing so as well (especially low-income countries) (Meinshausen et al., 2022). Unfortunately, the United States is behind on its NDC of lowering GHG emissions by 50-52% below 2005 levels by 2030, despite positive projections assumed from implementing the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA) signed into law by President Joseph Biden. In order to close the gap, the Environmental Protection Agency (EPA) could use the Clean Air Act (see below) to set more aggressive standards for lowering pollution across industries, and the federal government could expand funding for forestry and agricultural incentives to promote mitigation and sequestration (removal of GHGs) (Clean Air Task Force, 2023).

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11.4.1: The Paris Agreement

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11.4.2: Climate Change Policy in California

In the state of California (CA), “The 100 Percent Clean Energy Act of 2018,” Senate Bill 100 (SB 100, De León) requires all electricity generation to be produced by zero-carbon sources by 2045, and at least 60% of the state’s electricity should be generated via renewable resources by 2030. Renewable energy resources include solar, wind, geothermal, bioenergy, fuel cells, and existing hydroelectric and nuclear power plants (no new nuclear power plants are to be built). According to the initial multi-agency assessment report, CA will need to triple its current electricity capacity to meet demands, and triple its solar and wind build rate. Battery storage build rates need to increase by nearly 8 times the current rate. These and other considerations to maintain a “flexible” grid will cost nearly $4.6 billion dollars by 2045. Yet, the report is positive that the goal of 100% renewable energy for electricity customers and state agencies is doable by the target year (Gill, Gutierrez, & Weeks, 2021). At the same time, the Clean Air Resources Board also enacted a rule to require all new cars and light trucks sold in CA must be fully electric or plug-in hybrids by 2035. Projections estimate that this will cut GHG emissions from motor vehicles in half by 2040, and substantially reduce cardiopulmonary deaths, emergency room visits, and asthma attacks related to smog for CA residents (CARB, 2022).

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11.5: Clean Air

While air pollution is certainly a contributor to climate change via GHGs, it also harms human health in other ways. Air pollution is generated both by natural (biogenic) and human (anthropogenic) sources. Wildfires and volcanoes can spew particulate matter into the air, while vehicle emissions and industrial pollutants produce smog and other gasses. Some air pollutants also undergo chemical reactions when exposed to sunlight which create harmful ground level ozone. Wind currents and water vapor can carry pollutants miles away from their original source. The WHO asserts that both ambient (outdoor) and indoor air pollution contribute to over 7 million deaths around the world each year (WHO, 2019).

The Clean Air Act of 1970 regulates air pollution by empowering the Environmental Protection Agency (EPA) to set and enforce air quality standards. There are six pollutants for which the EPA sets National Ambient Air Quality Standards (NAAQS) for, which are called **criteria pollutants.** These include carbon monoxide, sulfur dioxide, nitrogen oxide, particulate matter, ozone, and lead. In 1990 the Clean Air Act was amended to include another category of **hazardous air pollutants**, such as volatile organic compounds (VOCs), pesticides, herbicides, and radionuclides (Frumkin, 2016). The Agency for Toxic Substances and Disease Registry (ATSDR), an agency of the U.S. Department of Health and Human Services, responds to potential toxic emergencies, assists local public health departments, conducts research, and maintains a registry with toxicological profiles of the health effects of natural and man-made hazardous substances that affect our soil, water, and air (ATSDR, 2024).

Primary air pollution is released straight from its source. For example, carbon monoxide is released from motor vehicle exhaust and the combustion of fossil fuels in power plants. It is also released in smoke from forest fires, and is present in environmental (or "second-hand") tobacco smoke. When other compounds like nitrogen oxides and sulfur dioxide are exposed to sunlight, they can undergo chemical reactions that create ozone and particulate matter. These subsequent pollutants are called **secondary** air pollution. Thus, air quality is often worse on warm, sunny, summer days than on colder, winter days (Frumkin, 2016, Seabert et al., 2021).



Figure 11.4.2.1: Smoke cloud from the Mosquito Fire in California, September 2022. Cal Fire. (Public domain, via Wikimedia Commons)

Ozone is both beneficial and hazardous to human health depending on where it exists. In the stratosphere (upper layer of Earth's atmosphere), ozone blocks harmful UV rays from the sun and protects humans, plants, and animals below - preventing things like skin cancer and cataracts. Compounds called chlorofluorocarbons (CFCs) were used extensively in the mid-20th century to make aerosol propellants, for refrigerators, and in building materials, but these and other pollutants were found to be depleting the ozone layer. Fortunately, in 1987, the Montreal Protocol was signed and countries began phasing out production of ozone depleting substances. Scientists predict that it will be completely repaired by the middle of the 21st century (EPA, 2023). Ground level ozone (in the troposphere) on the other hand, is quite harmful to humans, plants and animals. It can damage the heart and lungs and lead to a variety of chronic diseases (USGCRP, 2023a). Ozone can also be worse in the summer months as a layer of warm air called an inversion layer will trap pollution closer to ground level instead of letting it disperse upward into the stratosphere (Seabert et al., 2021).

Particulate matter is made up of very fine particles of dust, soot, and other solids or liquids of varying sizes. When breathing through the nose, larger particles are typically caught in the nose and upper respiratory system, trapped in mucus and expelled in coughs and sneezes. However, fine particulate matter, or PM2.5 (particulate matter smaller than 2.5 micrometers) can get inhaled much deeper into the lungs and cause damage to lung tissue, as well as increasing the risks of cardiovascular and neurological issues (USGCRP, 2023a). Particulate matter comes from dust, smoke, industrial pollution, vehicle emissions, pollen, and even sea-

spray (Frumkin, 2016). We often see particulate matter in the air as smog or brownish haze, hovering over a city-scape on a sunny day.

Air pollution disparately affects minoritized communities including people of color and those of lower socioeconomic status, both in urban and rural areas. This can often be connected to policies and practices such as redlining, as well as industrial zoning. Exhaust from diesel trucks and industrial facilities can be much higher in urban areas, whereas rural areas may be more exposed to pollution from agricultural practices - such as dust and pesticides from crops, or emissions from concentrated animal feeding operations (aka “factory farms). Power plants also release air pollution as well as GHGs. Air quality is made worse by climate change, particularly during heat waves, which may create more secondary air pollution (USGCRP, 2023a).

While the EPA monitors and regulates ambient air pollution, it does not have the same oversight of indoor air pollution. Indoor air pollution can come from building materials, insulation, environmental tobacco smoke, and burning wood, coal, kerosene and even natural gas for cooking or warmth. Mold, mildew, pet dander and dust can also cause respiratory problems. Household cleaning products can release VOCs, which can be particularly harmful to the respiratory system if certain compounds are mixed and then inhaled. Improperly vented combustion for cooking or heating releases carbon monoxide, nitrogen oxides, and particulate matter into the household air. Radon is a radioactive gas that is released from uranium-rich rocks, and can seep into cracks in a home’s foundation and cause lung cancer. Switching to cleaner fuel sources for cooking (such as electricity), removing sources of pollution (such as environmental tobacco smoke), using appropriate ventilation when using cleaners or solvents, and using central ventilation and air conditioning (HVAC) filters or portable air filters are all ways to reduce indoor air pollutants. Additionally, any home improvement projects done on old houses should first be tested for asbestos and lead - as these were commonly used in building materials in the 20th century (EPA, 2014). According to the WHO, 2.3 billion people around the world still use solid fuel for cooking (such as wood, charcoal, and dung), exposing mostly women and children to high levels of air pollution and increasing the risk of respiratory and cardiovascular diseases, cancers, and some infectious diseases as well. In low and middle-income countries, efforts can be made to move toward cleaner fuel sources, such as natural gas and electricity, which would improve air quality, reduce GHGs, and improve health equity (WHO, 2023).



Figure 11.4.2.2: Woman feeding a cast iron wood stove. (Public Domain, CDC/ Dawn Arlotta, 2009.)

This home’s interior, though beautiful, houses a potential hazard on many levels, therefore, special care need be taken in order to safely operate this wood-burning stove, for not only does it generate a terrific amount of heat, it does so using flame, rather than electricity, which is much more difficult to control. This woman was about to place what appears to be a piece of treated lumber (which can also release harmful pollutants) into the stove as fuel.

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11.6: Clean Water

Humans cannot survive without water. Nearly all cities and towns have been built around sources of freshwater for drinking and agricultural uses. While our “blue planet” may be covered in water, the majority of it is too salty to be used for these purposes. In fact, only about 1% of the water on earth is both freshwater and accessible to humans via the water cycle (aka hydrological cycle). Water from melting snowpack and rain flows through rivers and streams to lakes and oceans and sinks into underground aquifers. From lakes and oceans it is evaporated into the atmosphere as water vapor. Eventually once this water vapor condenses into clouds and gets heavy enough, it is returned to the ground via precipitation (rain, snow, etc.) Freshwater is accessible to humans from two sources. **Surface water** includes any water source open to the air: lakes, rivers, streams, ponds, etc. The other source is **groundwater** which comes from underground aquifers, wells, and springs. Groundwater has long been considered more ideal for human use since it has been filtered through soil and rock, and will thus require less treatment. Surface water is often full of dirt, microbes, and pollutants which requires an extensive filtration and disinfection process in order to be drinkable (Frumkin, 2016).

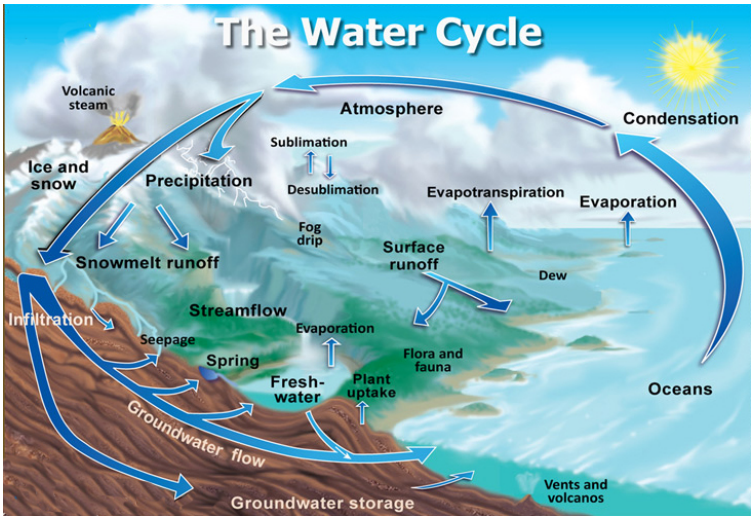


Figure 11.6.1: Water Cycle Summary.. (Copyright; John Evans and Howard Periman, USGS, Public domain, via Wikimedia Commons)

Drinking water can get contaminated by pollutants, chemicals, or biological contaminants from a variety of sources. **Point source** contamination occurs when there is a single source or multiple identifiable sources - such as a specific pipe dumping industrial chemicals into a stream, or several septic tanks leaching fecal matter into groundwater. **Nonpoint source** contamination occurs from an array of different sources - such as pesticides from agricultural runoff, or when rainwater picks up gasoline and oil on roadways. There are many different types of contaminants; they may be organic or inorganic chemicals, biological contaminants (such as bacteria, viruses, or protozoa), and even pharmaceuticals - which can lead to antibiotic resistance (see chapter on infectious diseases). Drinking water must therefore be properly filtered, disinfected, transported (via well-maintained pipes), and regularly tested in order to prevent toxic exposures or waterborne illnesses in humans and animals (Frumkin, 2016).

Particularly in developing countries around the world, many infectious diseases and toxic exposures can be prevented with improved access to water, sanitation, and hygiene practices. Combined, these are called **WASH.** The WHO estimates that despite major progress in the last 30 years, diseases caused by unsafe WASH still account for over 1.4 million deaths (in 2019), the majority of those related to diarrheal diseases - which affect hundreds of thousands of young children each year (WHO, 2023a). Sanitation and the proper treatment and disposal of wastewater also significantly impact exposure to pathogens. While wastewater can be an important source of water recycling (such as greywater from sinks and showers), many countries may lack sewage facilities, and open defecation is still practiced in many low-income countries, particularly in rural areas. Overall, inadequate sanitation accounted for the highest percentage of diarrheal disease deaths (38%). Yet sanitation is closely related to safe drinking water, which accounted for 35% of diarrheal disease deaths (WHO, 2023a). Open defecation or inadequate disposal of fecal matter can easily contaminate surface water, which may be collected downstream for drinking and agricultural uses. Proper handwashing behaviors (i.e. using soap, washing after potential fecal contact or before preparing food), are also extremely effective at reducing pathogen transmission. Both the resources - soap and water - and the education (knowing why it is important) are necessary to change behaviors. Yet even in high income countries these behaviors are not universally practiced (WHO, 2023a).

Although improving WASH is of particular importance in low and middle income countries, there are many potential sources of contamination in high income countries as well. In the U.S. there are two laws that primarily govern safe water sources: the Clean Water Act (CWA, 1972), and the Safe Drinking Water Act (SDWA, 1974, amended in 1986 and 1996). The CWA empowers the EPA to regulate surface water for fishing and recreation, as well as wastewater management - requiring industries and municipalities to pre-treat any wastewater before it enters into waterways. This law also prevents oil spills that could affect inland water and tasks the EPA with responding to those that do happen. The SDWA governs the treatment and delivery of drinking water to municipalities; protecting surface and groundwater sources of drinking water, as well as enforcing health standards for all public drinking water systems (Frumkin, 2016, and EPA, 2013). Even with these protections in place, water contamination still occurs, and tends to most often impact historically marginalized communities.

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11.6.1: Flint Water Crisis

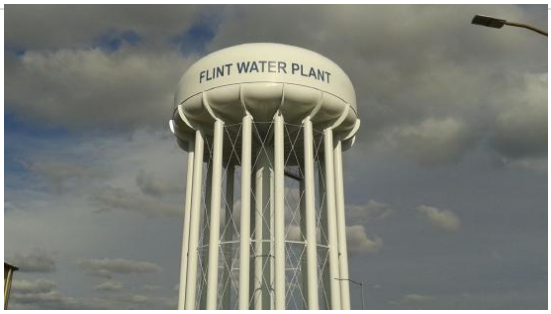


Figure 11.6.1.1: Water tower at the water treatment plant in Flint, Michigan. (Unknown, United States Environmental Protection Agency, Public domain, via Wikimedia Commons. April 11th, 2016.)

The story of the Flint Michigan water crisis is one of a human-made public health catastrophe that could have been avoided at several junctions. Flint, Michigan is a majority Black city. In 2014, 40% of the residents there lived in poverty (Murembya, & Guthrie, 2016). Flint was having a financial crisis, and an emergency manager was appointed by Michigan's governor. One of the ways proposed to save money was to switch Flint's water source: from the Detroit Water and Sewerage Department (DWSD) to the Karegnondi Water Authority (KWA), which was building pipeline from Lake Huron - where Flint, Detroit and other towns already sourced their drinking water. Upon hearing of this plan, the DWSD terminated its contract with Flint effective 2014, but the KWA pipeline wouldn't be ready until 2016 (Dixon, n.d., Kennedy, 2016). Until the pipeline was completed however, they needed an alternative water source for the city of Flint. For this, they turned to the Flint River, which had been the city's water source up until the 1960's (Kennedy, 2016).

Instead of treating the water or testing to ensure that the water would not corrode the city's aging pipe system, city officials took a "wait and see" approach. Barely a month after the switch, residents in Flint began to complain about their tap water's color and odor. Some people developed rashes or hair loss by showering or bathing in it (Runwal, 2024). By August, officials had detected E. coli bacteria, which prompted them to increase the chlorine levels and issue boil advisories to residents. Meanwhile, an outbreak of Legionnaire's disease, caused by the bacteria *Legionella pneumophila*, *was* correlated to the water source switch and improper chlorination (Zahran et al., 2018), causing the deaths of at least 12 people (Runwal, 2024). By January of 2015, other compounds (by products of disinfection which are carcinogenic) had also been found in the water - this violated the SDWA and forced the city to take some action (Kennedy, 2016).

In February, high levels of lead were found in the water of a resident's home. While the EPA issued an internal memo expressing concerns about lead contamination, the city officials in the Michigan's Department of Environmental Quality (MDEQ) downplayed the reports and insisted that Flint's water was safe. Meanwhile, researchers from Virginia Tech University were finding dangerously high lead levels in the water supply and blood levels in children (Kennedy, 2016). Lead is a neurotoxin which is especially harmful for children: it can cause learning disabilities, behavioral problems, as well as affecting growth and potentially causing anemia or in some kids - seizures. If ingested by pregnant women it can harm the growth of the fetus and lead to premature birth. And in adults, exposure to lead is associated with cardiovascular, kidney, and reproductive problems (EPA, 2016). In September of 2015, the city finally issued a lead warning to the city, and in October a state of emergency was declared and Flint switched back to the Detroit water supply (Kennedy, 2016). But the hazards were not over.

The pipes that brought water to the city were old, and made of lead and galvanized iron. Since the Flint river already had higher levels of chloride, this began to corrode the pipes, and the chlorine added to reduce the *E. coli* bacteria corroded the pipes even more. By the time the water was switched back to the Lake Huron source, it was too late - in April of 2016 the water was declared still unsafe to drink by Virginia Tech researchers (Kennedy, 2016). Many Flint residents have continued to drink bottled water as the pipes are slowly replaced throughout the city - even though the free bottled water program ended in 2018 (Runwal, 2024). Many of the city and public health officials were criminally indicted for not following proper procedures and covering up reports of contamination, and even Governor Rick Snyder had charges related to his apparent inaction for 17 months during the water crisis. Yet many of these cases were thrown out on technicalities by the Michigan State Supreme Court, leaving Flint's residents doubting anyone will be held accountable (White, 2022). The state of Michigan was ordered to pay out $600 million in a settlement to Flint's residents - a portion of which will also cover legal fees (White, 2021).

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11.6.2: Case Study- The Jackson Water Crisis



Figure 11.6.2.1: A Mississippi National Guard soldier takes water to a person's car at the Mississippi State Fairgrounds in Jackson, Mississippi, Sept. 1, 2022. Nearly 600 Mississippi National Guardsmen were set up across seven sites through Jackson for people to collect bottled water and non-potable water from water buffalo trucks during the water crisis. (Copyright; Staff Sgt. Connie Jones, U.S. Army National Guard, CC BY 2.0, via Wikimedia Commons.)

The residents of Jackson, Mississippi are no strangers to boil-water advisories. The city has dealt with infrastructure problems for years; massive leaks, *E. coli* and lead concerns, and a lack of funding and staffing to maintain its aging water and sanitation facilities (Pettus, 2022). A cold snap in 2021, and heavy winter storms in 2022 caused pipes to burst and shut off water supplies to thousands (Adams, 2023). When heavy rains caused the nearby river to overflow in the summer of 2022, one of the city's two water treatment facilities was compromised (Breslow, 2022). Since low water pressure allows bacteria and other contaminants to seep in through cracks in the aging pipes, residents were under yet another boil-water advisory, and bottled water was distributed (Pettus, 2022).

Jackson's chronic water crisis demonstrates the complex interplay of social determinants of health, environmental health, public health policies, and politics. To begin with, 80% of the 150,000 residents in Jackson, Mississippi are Black, and a quarter of them (25%) are at or below the poverty threshold (Pettus, 2022). Mississippi has a long history of racism and white supremacy, with Jackson at the center of the Freedom Riders protest, when civil rights activists were arrested for riding segregated public transportation from DC (Contributors to Wikimedia projects, 2024). Jim Crow laws, housing discrimination and underinvestment in communities of color have disproportionately exposed Black populations to environmental hazards (USGCRP, 2023c). After the integration of schools in the 1960s, white families moved out of Jackson *en masse* over the next several decades - so called "white flight" to the surrounding suburbs (Wiggins & Morrow, 2022). For these and other reasons, tax income to the city has declined, and Jackson has long had problems with finding money to fix its infrastructure (Pettus, 2022), some of which is over 100 years old (SPLC, 2023). Jackson's history of discrimination and underinvestment are compounded by emerging environmental factors. Climate change is contributing to more rainfall and severe storms - including hurricanes and more severe flooding in the southeast U.S. region (USGCRP, 2023c). While an EPA investigation into the recent water crisis concluded that state agencies did not racially discriminate against Jackson's residents in distributing federal funds for infrastructure updates (Muhammad & Judin, 2024), it is clear that a combination of systemic and historic racism, poverty, policies, and climate change are contributing to the struggles Jackson is facing in providing clean water to its residents.

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11.7: Food and Drug Safety

Long before the CWA and SDWA, the U.S. government recognized the need to regulate food and drug safety. The United States Department of Agriculture (USDA) was established by President Abraham Lincoln in 1862. In 1906 the Pure Food and Drugs Act was passed, requiring accurate labeling of food, drug, cosmetic and liquor products. The same year, the Federal Meat Inspection Act required that meat was processed in sanitary facilities - tasking the USDA with inspecting and enforcing these requirements. In 1938, congress passed the Federal Food, Drug and Cosmetic Act, which gave the newly rebranded Food and Drug Administration (FDA) the responsibility of establishing food safety standards (USDA, 2018). Today, the USDA is responsible for meat and dairy products, the EPA governs pesticides and fertilizers, and the FDA takes care of the remaining food products, drugs, and cosmetics.

Food borne disease outbreaks are defined as 2 or more cases of a similar illness that results from eating a particular food. Foodborne illnesses are typically caused by pathogens like bacteria, viruses, or other parasites that have gotten into the food source - often due to water or equipment contamination, unsafe cooking or serving practices (like failing to cook food thoroughly or leaving at room temperature for too long), or behaviors (such as failure of staff to wash hands). Pasteurization of dairy products is highly protective against bacterial outbreaks in dairy, and the sale of “raw” milk is illegal for this reason (Seabert et al., 2021). Although rare, there is also the possibility for intentional poisoning or bioterrorism, as happened in 1984 when a religious cult in Oregon intentionally contaminated a local city’s salad bars and water supply with *Salmonella* bacteria (Oh, 2017). Local and state public health agencies are typically responsible for investigating foodborne illness outbreaks, but they work closely with the USDA and FDA inspectors (Seabert et al., 2021). While Hollywood has perpetuated an image of the ill-tempered health inspector threatening to close down a beloved restaurant, these public servants actually protect the public from a plethora of potentially deadly disease outbreaks.

Pesticides are any materials used to kill, repel, or change the behavior of a pest that could potentially harm humans. This includes herbicides (which kill unwanted plants, or weeds), insecticides (which kill insects), fungicides (which kill fungi), rodenticides (which kill rodents), and even antimicrobials (which kill bacteria and viruses) (Frumkin, 2016). Technically, a pest is any animal, insect, or plant that poses a threat to humans - everything from the mosquitos that transmit malaria, to cockroaches in a kitchen, to rats in subway stations, or dandelion weeds in a front lawn. Pesticides must often be used with other tactics (like barriers for example) in order to prevent resistance developing in the target pest.

Pesticides can be either synthetic (man-made), or naturally-derived. Some synthetic pesticides have been found to have acute and chronic neurotoxic effects, and tend to linger in the environment (like DDT, which was banned in 1972) (EPA, 1972). Just because a pesticide is naturally-derived does not make it safe - arsenic and nicotine sulfate are naturally derived but are very toxic. In agricultural practice, the USDA regulates pesticides which can be used for conventional and organic agriculture. While conventional growers can use synthetic or natural pesticides, organic producers must only use products from a list published by the Organic Materials Review Institute (OMRI), which are mostly natural in origin, with a few exceptions (Andrews & Rose, 2018).

Most exposure to pesticides falls into two categories: residential and occupational. Residential exposure occurs when pesticides are used to prevent insects, rodents, or weeds around the home or yard. These can cause accidental poisoning (particularly in children), and are sometimes used in intentional poisoning (suicide/homicide) attempts. Occupational risk is highest for agricultural workers who administer the pesticide, and thus have more concentrated exposure. They may also expose family members if the pesticide lingers on clothing or materials brought home (Frumkin, 2016). As with any substance, the dose makes the poison, so amount and duration of exposure are important variables in identifying the toxicity of a substance. The EPA has categories of pesticides based on their toxicity levels with the following labels:

- Caution = relatively low toxicity.
- Warning = moderate toxicity.
- Danger = high toxicity (Frumkin, 2016, Andrews & Rose, 2018).

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11.8: Waste Management

Modern humans create much more waste than our animal counterparts and even our human predecessors. According to the EPA, the average American produces nearly 5lbs of trash per day, the majority of which is paper and food waste. Compare that with 1960 - when the average was only 2.68lbs of trash per person, per day (EPA, 2023a). Obviously the amount of garbage the U.S. is producing has increased substantially over the last 70 years. This waste is usually categorized as one of the following: municipal solid waste, special waste, or hazardous waste, with certain considerations for the disposal of each (Frumkin, 2016). But once it is removed from household or industrial trash bins, it doesn't just disappear. What do we do with it? Do we store it somewhere? Recover it and use it to make other products? Pay another country to take it? And what is the effect of all of this refuse on the environment and the planet as a whole?



Figure 11.8.1: Trash Day - Arlington, Massachusetts, USA. Left to right: recycling, compost, trash, yard waste. (Copyright; Daderot, CC0, via Wikimedia Commons, June 2023.)

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11.8.1: Types of Trash

Garbage is categorized as municipal solid waste (MSW), special waste, or hazardous waste according to specific characteristics. MSW includes nearly all household trash: paper, plastic, glass, aluminum, food scraps, textiles (old clothing etc.), yard trimmings, and wood (Frumkin, 2016). But this trash generated by homes, businesses and schools actually accounts for only about 2-5% of the total amount of waste products produced in the U.S. (Seabert et al., 2021). Special waste accounts for almost anything that isn't the typical household waste but also doesn't fall into the hazardous waste category. This includes:

- Medical waste: medical devices, syringes, sharps, blood-soaked bandages, gloves, gowns - anything that comes in contact with blood or bodily fluids. This must be disposed of separately to general MSW in order to protect workers from contracting infectious diseases. Typically this waste is incinerated before being disposed of along with MSW (Frumkin, 2016).
- Construction debris: any building materials (other than asbestos), such as drywall, wood, metal, tile, cement etc. are typically disposed of at special construction waste sites or along with MSW. Asbestos has to be carefully removed and disposed of in order to prevent inhalation which can cause cancers and other lung diseases such as mesothelioma (EPA, 2013a).
- Mining waste: which can be liquids or fine, ground up rocks called "tailings", which can contain heavy metals and byproducts from mining such as sulfuric acid or cyanide. If mining waste storage dams break they can wreak havoc and cause damage to the local environment, or release toxic substances into rivers and lakes (*Tailings*, 2017).
- Agricultural waste: solid animal waste or runoff from farms may include pesticides, pathogens, or antibiotics (which may encourage antibiotic resistant microbes) (Frumkin, 2016). Growing and processing grains, legumes, fruit and vegetable products also generates plant waste, which could be useful for biofuels or compost (Sadh et al., 2018).
- Radioactive waste: may include the nuclear fuel and waste products or clothing and protective gear that has come in contact with it. While the U.S. struggles to find a permanent solution for disposing of nuclear waste (high-level radioactive waste), the less dangerous, low-level reactive waste is typically disposed of in special landfills (Frumkin, 2016).
- Sewage sludge: is typically separated from wastewater as part of the treatment process, and chemically treated to remove pathogens. These solids are either put in landfills or used in agriculture as fertilizer (Frumkin, 2016).
- eWaste (electronic waste): includes computers, phones, printers, televisions, gaming devices, or anything with electronic components that are non working or obsolete. These may still contain valuable materials that can be extracted and recycled, but if disposed of improperly can leach heavy metals into the environment (Seabert et al., 2021).

The best solution for waste is simply not to make it in the first place. For example, offices can convert to modern technology and use electronic communications and documents (such as email and electronic signatures) to reduce paper waste production. Food production companies can utilize less plastic packaging. Companies that ship products can combine shipments and reduce unnecessary paper and cardboard use. Reducing the production of waste would be the best option, followed by recycling or recovering "waste" to be reused for other purposes. For example, old tires can be broken down into crumb rubber and used to make playground equipment, truck bed liners, and other products that benefit from the elasticity of the rubber (Frumkin, 2016). Some waste can be used to generate energy through combustion, or the conversion of food waste into compost or animal feed. If nothing more can be used from the waste or if it is too hazardous to keep around, then treatment and proper disposal are the only other options (EPA, 2018). See Fig. \(\PageIndex{1}\ below for a diagram of the waste management hierarchy.

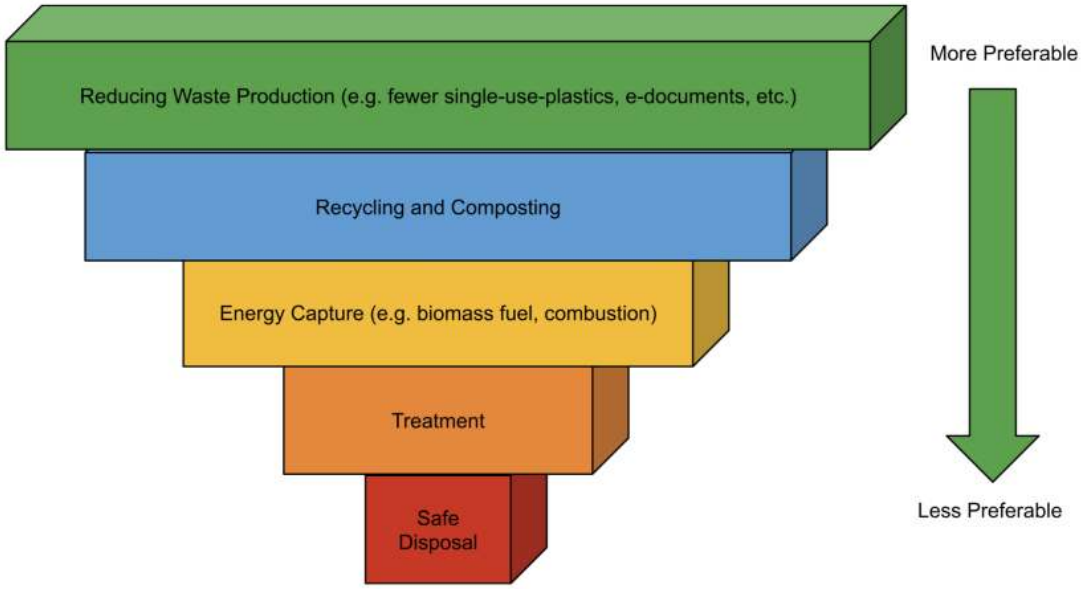


Figure 11.8.1.1: Waste Management Hierarchy. Adapted from https://www.epa.gov/trinationalanalysis/waste-management.

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11.8.2: Recycling and Composting

In 2018, the United States generated 292.4 million tons of MSW, and recycled or composted 94 million tons of it - amounting to about 32.1% of the total. While some other methods were also used to recover energy or create animal feed, over ½ of all waste still ended up in a landfill. While this may not seem like progress, the amount of MSW discarded in landfills has remained relatively constant since 1990 - in spite of population growth - while other methods like recycling and composting have grown (EPA, 2023a). While metals (like steel and aluminum), glass and paper products (including cardboard), are relatively easy to recycle, plastics are much less commonly recycled. Approximately 9% of the world's plastic containers, bottles, bags and other materials are recycled; 50% end up in landfills, another 20% are mismanaged (burned or dumped, potentially ending up in lakes and rivers), and 0.5% end up in the ocean (Ritchie et al., 2023). See Fig. 11.8.2.1 below.

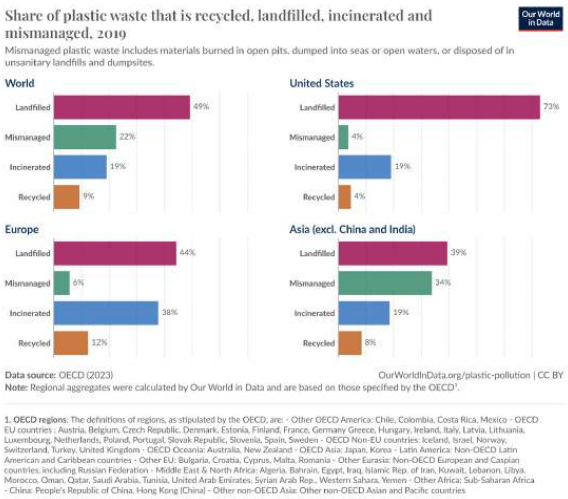


Figure1 11.8.2.1: Plastic Pollution.. (Copyright; CC-BY OurWorldInData.org/plastic-pollution)

Plastic pollution is particularly hazardous because of the characteristics of plastic that make it so desirable. Plastic is durable, and doesn't break down easily. It may take a plastic water bottle floating in the ocean nearly 450 years to decompose (Harris, 2023), broken down by UV rays into smaller and smaller pieces called microplastics. The **Great Pacific Garbage Patch** is really a misnomer because it's not an island or "patch" of trash floating in the Pacific Ocean: much of the plastic pollution is microplastics, swirling around the ocean currents like a plastic soup (Evers, 2024). These microplastics can get into our food and water sources, be ingested by birds and fish, and make their way up the food chain into human tissues. Microplastics have been found in the human gastrointestinal tract and in placental tissue (Ragusa et al., 2021). We may even be breathing in microplastics in the air, which can get into lungs and eventually the bloodstream. Exposure to microplastics and the chemicals that make them could have profound effects on human health, particularly in the immune system response to plastic toxins, chronic inflammation, and a myriad of other subsequent health problems (Prata et al., 2020). The best way to manage plastic waste is not to rely on recycling, but to produce less of it in the first place.

Composting is another way to manage biodegradable waste such as food waste. In the U.S., it is estimated that 30-40% of the food supply ends up as waste - much of that at the retail or consumer level (USDA, n.d.). Food waste may include inedible food scraps such as eggshells or fruit rinds, but it also includes food that could have been consumed but perhaps was spoiled or uneaten. Not only does the food wasted cost energy to grow and transport, it also produces methane gas while decomposing in a landfill - contributing to GHG production and climate change. Food waste can be reduced at the retail and consumer levels by only producing and purchasing what is needed, donating leftover food and preventing spoilage. Composting is also a much better use of food waste, as it produces usable fertilizer for agricultural and landscaping purposes (EPA, 2015). While backyard composting can support a home garden, industrial or large-scale composting has much greater potential for managing food waste, yard waste, sludge and other agricultural or industrial wastes. Bacteria and fungi feed off of the waste products, creating heat which destroys undesirable microbes and weed seeds, and turns the solids into excellent fertilizer for plants. When those raw materials are chipped up into smaller pieces, combined in appropriate ratios, and well-aerated, the composting process can be completed more quickly and produce high-quality soil amendment (Sherman, 2020). As of 2022, California requires that organics be disposed of separately to recyclables and MSW in order to be composted or used to generate biofuel (CalRecycle, 2024).

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11.8.3: Sanitary Landfills and Combustion

Much of the trash we produce ends up in landfills, which are essentially encapsulated and buried under layers of dirt. In order to protect groundwater and surface water from potentially toxic **leachate** - liquids that accrue from the decomposition of waste - the sanitary landfill needs to be lined with plastic and have adequate drainage. The leachate may be collected and treated before it too is stored. Additionally, decomposition of waste produces gasses and heat - which can cause emissions or even catch fire if not properly vented. Sometimes the methane produced by a landfill can be collected, treated, and used for energy. After waste is dumped into the landfill, it needs to be covered with soil in order to prevent pests (rodents, birds, or insects) from getting into it or the wind from blowing it out of the landfill (Frumkin, 2016). It may seem obvious that landfills are limited by capacity and location: no one wants to live near a landfill, and what should be done once the landfill is full?

Combustion of waste is another option. Although open incineration of trash was often practiced in backyards up until the mid 20th century, this practice creates high levels of pollution - particulate matter and GHGs - that pose a risk to the community and planet. The Clean Air Act of 1970 essentially put an end to this practice in the U.S., although it is still common in other developing countries. Incinerators in the U.S. can be used to produce energy and get rid of waste, but they must have expensive technology to reduce air pollution. The resulting ash can also become problematic to dispose of (Frumkin, 2016, Seabert et al., 2021).

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11.8.4: Hazardous Waste, RCRA and CERCLA

Hazardous waste is typically industrially-produced waste that is ignitable, corrosive, reactive, or toxic; meeting specific criteria established by the EPA. Two key federal laws regulate hazardous waste: the Resource Conservation and Recovery Act (RCRA, 1976) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 1980), also known as the "Superfund". The first, RCRA, gave the EPA authority for regulating both hazardous and solid waste management, including setting standards for sanitary landfills. It requires tracking of hazardous materials from "cradle to grave", or from production, to transportation, use, and eventually disposal and treatment (Frumkin, 2016). The most common method for disposing of hazardous waste is underground injection, where hazardous waste is deposited into deep wells in the ground. Care must be taken, however, that groundwater aquifers are protected (Seabert et al., 2021). The second law, CERCLA, set up a fund to address already existing hazardous waste sites that had been abandoned, and created the ATSDR (see Clean Air, above). To create this fund, taxes are levied on the industries most commonly responsible which produce petroleum and other toxic chemicals. If the polluter can be found, they are held responsible for paying for the cleanup, but if not, then the superfund does. The EPA has identified over 300,000 waste sites, but only about 2,000 of them were deemed hazardous enough to go on the National Priority List (NPL) and be targeted for cleanup (Frumkin, 2016, Seabert et al., 2021). As of June, 2024, the current list has 1340 sites, 457 deleted sites (where cleanup and remediation has been completed), and 39 proposed sites to be added to the NPL (EPA, 2024).

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11.9: Summary

Summary

Humans are part of the ecosystems in which we live, and have developed immense power over harnessing the capacity of those ecosystems to support modern life. Yet, we are still at the mercy of the environment, and the impact of the air we breathe, the water we drink, and the food we eat on our health. The earth is not an indestructible home or infinite resource, and its ability to support life is highly dependent on the effect that humans have on it. Our health is intricately connected to the health of the soil, air, water, plants, microbes, insects, and animals with whom we share this planet. It behooves us then to consider the environmental impacts of every action we take - to preserve our ecosystems and support the health of all living things across the globe.

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CHAPTER OVERVIEW

12: Occupational Health

Learning Objectives

- Identify common practices that contribute to intentional and unintentional workplace injuries and public health policies that would reduce their occurrences.

12.1: Introduction
12.2: Occupational Health Policy
12.2.1: Who is Most Vulnerable?
12.2.2: Child Labor Laws
12.3: Workplace Injuries and Illnesses
12.3.1: Workplace Violence
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12.1: Introduction

Besides the home, many Americans spend the majority of their time at a workplace. This makes the workplace a common source of exposure to hazards that can cause illness or injury. When workers get sick, injured, or die from work-related hazards, their families, communities and taxpayers pay the brunt of the costs - from medical bills to lost productivity (Frumkin, 2016). Occupational health refers to a branch of public health that focuses on preventing workplace-related injuries and illnesses, and overall protecting the workforce and keeping working people healthy. This includes healthcare administration and worker's compensation for work-related morbidity and mortality, as well as governmental policies setting restrictions on exposure to environmental toxins, safety guidelines and procedures, and worker's rights. As of 2024, there are around 168 million Americans between the ages of 15-64 participating in the labor force, about 60% of the civilian population (BLS, 2024). The remaining 98 million Americans are often part of the unpaid workforce - providing caregiving to children, older adults, or those with disabilities, or perhaps living with a disability themselves. While occupational health focuses mostly on those employed, it should be recognized that the health of workers also directly affects the health of their families and communities.

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12.2: Occupational Health Policy

Occupational health hazards have been recognized since antiquity, but it wasn't until the industrial revolution that there was widespread awareness of the need to regulate workplaces. Initially these efforts were based on sanitation, cleanliness, and reducing worker injuries - which were common in many factories (Seabert et al., 2021). After decades of industrial tragedies including deaths nearly every other day in steel mills, a plethora of coal mine accidents, the Triangle Shirtwaist factory fire, the Hawk's Nest Tunnel disaster, and others, worker's unions and environmentalists worked together to lobby congress for worker's protections in the 1960's (Frumkin, 2016). The Occupational Safety and Health Act (OSH Act) has only been around for just over 50 years, as it was signed into law by President Richard Nixon in 1970. It began by setting standards for worker exposure to specific environmental hazards, such as asbestos, lead, and cotton dust. Since then more standards have been established to protect workers from injuries, bloodborne pathogens, and other environmental toxins (OSHA, n.d. -b). The OSH Act also established the Occupational Safety and Health Administration (OSHA) to set and enforce these standards, and the National Institute for Occupational Safety and Health (NIOSH) to conduct research and make recommendations for these health standards (Seabert et al., 2021). Because of these laws and oversight agencies, it is widely accepted that employers are responsible for providing "safe workplaces, free of recognized serious hazards" (Frumkin, 2016).

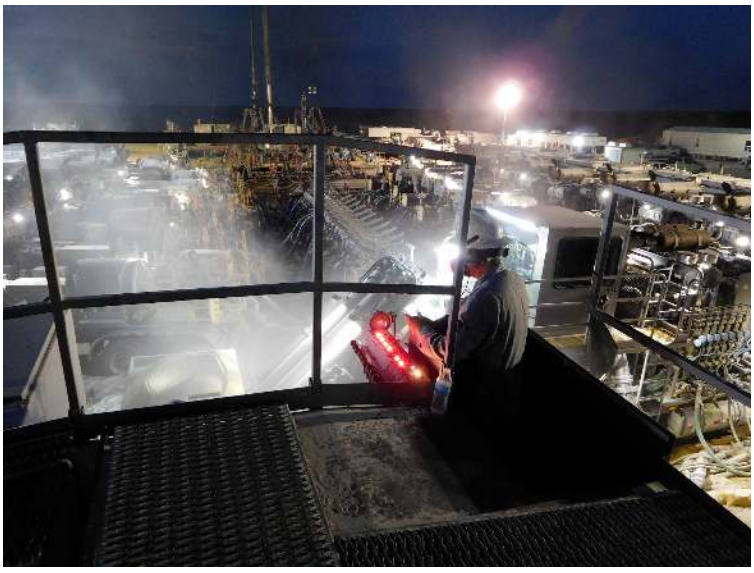


Figure 12.2.1: Hydraulic fracking operation at night. (CDC/ Theresa Roebuck, 2016)

"This 2016 image depicted the process of hydraulic fracturing, or fracking, a 24/7 activity, and showed how the need for occupational health and safety never stops. NIOSH researchers from the Western States Division, and the Division of Applied Research and Technology, were the first to systematically document hazardous exposures to workers at fracking sites, including exposures to respirable crystalline silica (RCS), diesel particulate matter, and volatile organic compounds. This sand mover operator was monitoring the sand level in the blender tub, framed in the bottom left handrail. His half-face cartridge respirator may not have been providing a high enough assigned protection factor to protect him from the elevated concentration of RCS, to which he was exposed. This photograph was taken in Encinal, Texas, during a test of a NIOSH-developed engineering control, known as the NIOSH mini-baghouse retrofit assembly, installed to reduce RCS emissions."

Prior to the industrial revolution, common law principles held the worker at fault for any injuries they received while on the job, and some employers went so far as to require "death contracts" as an acknowledgement of the employee of the potential dangers - and perhaps deadliness - of their work. In the late 19th century, Prussia was the first country to create worker's liability and insurance laws in an effort to maintain the loyalty of the working class while squashing Marxist and socialist political movements. Other European countries and the U.S. followed suit, although it took until 1948 for the last state to enact worker's compensation laws. While these laws did provide for monetary compensation in the form of employer-funded insurance policies, they also protected the companies from the threat of lawsuits (Guyton, 1999). Currently, each state in the U.S. has its own worker's compensation system, rules, and regulations, which may cover or exclude certain injuries or illnesses (Frumkin, 2016). Notably, in many states, agricultural employers are exempt from the requirements to provide workers' compensation, even though agricultural work is some of the most dangerous. Fourteen states (including California) do require workers' compensation for agricultural businesses, and enforce penalties for non-compliance (Mikolajczyk, 2022).

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12.2.1: Who is Most Vulnerable?

Historically, African American workers were given the most hazardous jobs, and thus had higher risks of occupational injury and illness. More recently this vulnerability has shifted to immigrant workers, many of whom may be undocumented and may therefore be less likely to raise concerns about safety conditions in the workplace. They are also less likely to be represented by a union, which could advocate on their behalf for better wages and working conditions (Frumkin, 2016). Another growing vulnerable group are the participants in the so-called “gig economy” (Maryville University, 2023). Temporary workers, contract employees, and self-employed workers also face a lack of job security and other benefits that full-time employees have. Even when worker’s compensation is available, immigrant workers and those with low-wage jobs are less likely to file claims, perhaps because of the complicated process (Frumkin, 2016).

Unions have historically been, and continue to be powerful advocates of worker’s protections. While occupational fatalities have declined from about 38 per day in 1970 to only 15 per day in 2022, OSHA is a relatively small agency and employs one compliance officer for every 70,000 workers in the U.S. (OSHA, n.d.-a). A report published in 2021 found that unionized construction worksites are far safer than non-unionized sites - they have substantially fewer OSHA violations. Unions also advocate for higher wages and benefits, and provide “whistleblower” protections for workers to speak out about safety hazards without fear of retaliation from the employer (Manzo IV et al., 2021).

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12.2.2: Child Labor Laws

After the emancipation of slaves and the emergence of the industrial revolution at the turn of the 20th century, children had become a common source of low-wage or unpaid labor in the U.S.. In 1910, about 18% of American children between the ages of 10-15 were employed in some way (Schuman, 2017b). Families had long had their own children working on farms, but now more children worked as couriers, selling newspapers as “newsies” in large cities, or special jobs in cotton mills in the south and coal mines in the north. As soon as a child had the size and skill enough to work, they became an economic benefit to the family. Thus, children of low-income parents were the most often employed, and it was believed that this benefitted them by reducing idleness, or keeping them out of trouble (Schuman, 2017a). After several tragic accidents, many states passed age limits for employment, and set limits on the number of hours children could work. Initial child labor laws were primarily aimed at educational requirements rather than safety. Yet many of these restrictions were resisted by the parents and children themselves. It wasn’t until 1938 that the Fair Labor Standards Act was passed, which made 16 years the age limit for employment, and 18 the limit for employment in certain hazardous jobs. This law also established the first federal minimum wage and limited the workweek to 44 hours (Schuman, 2017b). Notably, child labor law violations have increased over the last several years. Both meatpacking plants and auto manufacturers have been found to be hiring immigrant children between 13 and 17 years old and exposing them to hazardous jobs and chemicals. Several states have also recently proposed rollbacks to child labor laws, pushed by industry. Several of these recent bills would extend working hours for teens, lower age limits, and allow younger teens to work in more hazardous conditions. Yet research shows that not only are teens at higher risk of getting injured in the workplace, but also that long work hours and lack of sleep harms health and academic performance, as well as affecting their future economic opportunities (Sherer & Mast, 2023).



Figure 12.2.2.1: "Glassworks. Midnight. Location: Indiana." From a series of photographs of child labor at glass and bottle factories in the United States by Lewis W. Hine, for the National Child Labor Committee, New York. (Lewis Wickes Hine. Restored by Michel Vuijlsteke, Public domain, via Wikimedia Commons.)

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12.3: Workplace Injuries and Illnesses

Workplace injuries include both relatively minor injuries like cuts or bruises, and major injuries like amputations, fractures, loss of an eye, or severe burns and acute poisoning. Non-fatal injuries are most commonly slips, trips, and falls, or contact with equipment (CDC/NIOSH, 2022). Motor vehicle accidents are the most common source of fatal workplace injuries, but deaths from violence and unintentional overdoses have also increased over the last several years (BLS, 2023). In 2022, workplace injuries and deaths in the U.S. had a price tag of 167 billion dollars; including the lost productivity, medical expenses, and administrative costs. Compared to the number of people in the workforce, that's just over $1000 per worker. There were also 108 million days of work lost to injuries that happened in 2022 or in years prior (National Safety Council, 2024a).

Workplace illnesses are often more difficult to connect to workplace exposures since symptoms can often take many years to develop. These include skin diseases, loss of hearing from industry noise, or cancers developed from exposure to environmental toxins used in industrial processes. Workplace-related respiratory conditions include (among others) silicosis - which is developed from inhaling silica dust commonly from grinding or sanding rocks or cement, coal worker's pneumoconiosis - aka black lung disease, and asbestosis - caused by inhaling asbestos fibers (Seabert et al., 2021). Those working outdoors such as farmers, construction workers, and firefighters are also at higher risk for heat-related illness such as heat stroke and heat exhaustion - particularly in the summer months (Riley et al., 2018).

In 2022, the BLS reported 5,486 fatal work injuries, an increase of 5.7% from 2021. The BLS also reported 2.8 million nonfatal work-related injuries and illnesses in private industry, up 7.5% from 2021. Including government jobs as well, the rate of nonfatal injury and illness was 3% of all workers for 2022 (BLS, 2023a). The highest rates of nonfatal work-related injuries and illnesses were found in transportation and warehousing, as well as agriculture, forestry, fishing and hunting. The highest total numbers of nonfatal injuries and illnesses were recorded for the healthcare and social assistance sector however, likely due to the high number of workers employed in those occupations. See Fig. 12.3.1 below.

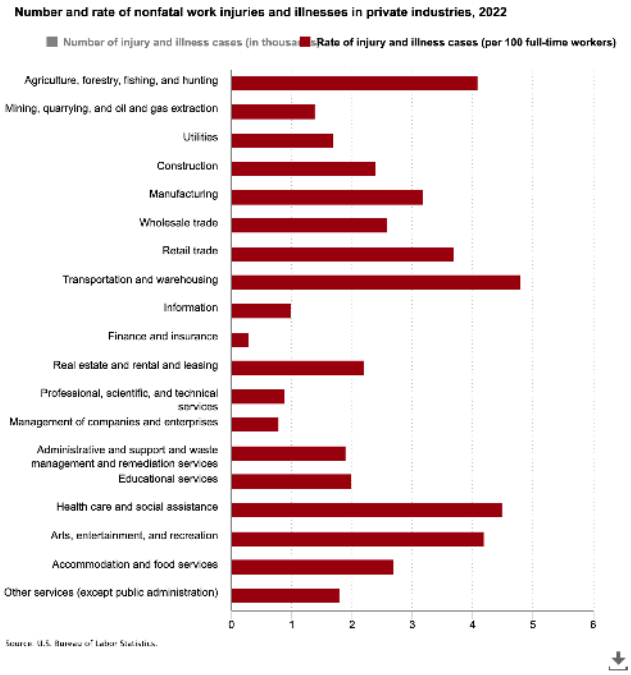


Figure 12.3.1: Rate of nonfatal injuries and illnesses (per 100 full-time workers), by private industries, 2022.(CC0, U.S. Bureau of Labor Statistics.)

According to the BLS, the fatal injury rate in 2022 was 3.7 per 100,000 full-time equivalent (FTE) workers. However, this rate was higher for African American or Black workers (4.2 per 100,000 FTE workers) and Hispanic or Latino workers (4.6 per 100,000 FTE workers). Those between the ages of 55-64 have the highest number of fatalities (BLS, 2023b). These demographic differences may indicate disparities in exposures to hazards, or perhaps a lack of protections in certain sectors of industry.

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12.3.1: Workplace Violence

There were 849 fatalities in 2022 due to violence or injuries inflicted by people or animals in the workplace, with 524 deaths due to homicide (BLS, 2023b). According to NIOSH, over 80% of workplace homicide victims were men. For non-fatal injuries in the workplace, 73% of victims are women, and 76% of victims work in healthcare and social assistance (CDC, 2024). Violence is the fifth leading cause of workplace-related fatalities. The National Institute for Occupational Safety and Health (NIOSH) identifies 4 categories of workplace violence: criminal intent, customer/client, worker-on-worker, and personal relationships - the last of which women are most often the victims (National Safety Council, 2024b). Healthcare occupations have seen increasing rates of violence over the last several years, but still only account for 4% of workplace homicides. Workers at psychiatric and substance abuse hospitals have the highest rates of non-fatal injuries intentionally inflicted by another person (BLS, 2020).

During the COVID-19 pandemic, public health workers experienced heightened public hostility - perhaps due in large part to pandemic-related work stoppages, regulations, and business closures. Threats and verbal abuse are perhaps more common than physical violence, but can have significant impacts on a public health worker's mental health. Responding to a public health emergency already increases stress on these professionals, and combined with work-related non-physical violence can have a substantial impact on mental health and well-being - potentially leading to anxiety, depression, burnout, and leaving the public health sector altogether. The mental health needs of frontline workers should be recognized, and the appropriate support and protections put in place (Tiesman et al., 2023).

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12.3.2: Statistics are People

We must remember that behind every statistic are the people that these injuries and illnesses happened to. Lives are lost, or permanently changed. The ability to work, earn a living, or even physically move and perform activities of daily living (ADLs) is disrupted by non-fatal injuries and illnesses in the workplace. When people get hurt or sick enough from their job that they can no longer work, they end up with a permanent disability that often forces them to spend much more time and money getting treatment, and substantially affects their socioeconomic status and quality of life. Perhaps the biggest tragedy is that many of these incidents can be prevented with proper safety and health policies and procedures in place. When young workers are injured or killed on the job it is particularly tragic; a young life was cut short, or a young person must live with a disability for the rest of their lives.

The OSHA website has several such stories of preventable workplace injuries and deaths to young people. Teenagers working in a grain silo were caught and pulled into the grain, suffocating them - they were not wearing protective harnesses at the time. A young construction worker was cleaning a cement mixer, and got pulled in by the paddles, while a nearby coworker didn't know how to shut it off. A teen performing routine pH testing on a swimming pool was electrocuted by the machinery and the wet concrete. Falls are the most common cause of injury and death on construction sites, and people often lose fingers or limbs when operating heavy machinery (OSHA, n.d.-b). While these are likely meant as cautionary tales, they also serve to personalize these incidents and give a voice to the victim. Workers are people, whose health and safety matters more than just the dollar amount of the worker's compensation claim.

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12.3.3: Globalization

An increasingly global economy means that many products are manufactured in multiple countries and regions around the world. Companies pursuing lower costs and higher profits will take advantage of this system, and procure the raw materials or parts of a product from countries with lower labor costs, and fewer worker protections (Frumkin, 2016). The International Labour Organization (ILO) estimates that over 160 million children are victims of child labor as of 2020; working in conditions that are unsafe, working hours that are too long, and/or work that interferes with their education (ILO, 2024b). The ILO has set standards for "decent work" including the abolition of forced labor, minimum age requirements, occupational safety and health standards, as well as gender equality and the right to organize. However, the ILO has no power to enforce these standards, and instead relies on commitments and partnerships with various countries to drive change (ILO, 2024a). The United Nations Sustainable Development Goal #8 strives to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" (U.N. Department of Economic and Social Affairs, 2023).



Figure 12.3.3.1: "Hazardous child labour, mines and quarry - Young boys carrying bricks on their head. They work for a brickyard employing children at the entrance of Antsirabe, Madagascar." (Copyright; © ILO/M.CROZET, CC BY-SA 4.0, via Wikimedia Commons.)

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12.4: Employee Wellness Programs

A full-time employee spends about a third of their day on the job, five days a week (CDC, 2021). While technological advances can be at least partially credited for making jobs safer, they have also made work more sedentary. Over 80% of modern jobs are mostly sedentary, which combined with other factors such as mental stress and the availability of high calorie foods has contributed to the rise in noncommunicable diseases such as obesity, diabetes, and cardiovascular disease (CVD). This has prompted calls to update the OSH Act to include lifestyle factors such as a lack of physical activity and access to healthy foods in the workplace as health hazards (Duffy et al., 2021). Workplaces represent a significant opportunity to promote healthy behaviors for a good portion of a worker's day. And maintaining a healthy workforce benefits the company through improved morale and productivity, fewer sick days, and potentially reduced healthcare costs and worker's compensation claims (CDC, 2021).

According to a study done by the Rand Corporation in 2013, wellness programs were offered by about 50% of U.S. employers, and larger companies were more likely to offer comprehensive wellness programs. These programs often include health screening or health risk assessments, as well as interventions such as fitness, nutrition, smoking cessation, health education, and stress-management programs (Mattke et al., 2013). The Affordable Care Act included grants to help small businesses begin offering wellness programs (Shi & Singh, 2017). Over the last decade these programs have grown in popularity. As of 2021, 58% of small companies and 83% of large companies offered some sort of wellness program to their employees (Vankar, 2022). Corporate wellness as a global industry was valued at $53 billion in 2022, and is expected to grow over 4% annually through 2030, in spite of a short decline during the COVID-19 pandemic (Grand View Research, 2022).

Research regarding the efficacy of workplace wellness programs is still mixed, and depends highly on the type of program delivered and the metrics used to measure success of the program (Horn et al., 2020). Employee wellness programs might be as limited as offering a discount on gym memberships, or annual health screenings for blood pressure, cholesterol, and blood glucose, or they might be as comprehensive as offering on-site health education classes, fitness classes, stress management sessions, and support groups or behavioral coaching. Some companies may use the physical work environment to promote physical activity by providing standing or walking desks, or providing healthy meals in cafeterias and healthy snacks in vending machines. Still others create policies and stimulate a work culture of health; employees may have more flexible work hours or locations, managers might conduct "walking meetings" or the company might host competitions encouraging employees to get more daily steps or lose weight (Mattke et al., 2013, Horn et al., 2020). Because of the wide variety of programs offered at different companies, and varying levels of employee engagement (not all employees may participate, and often those already focused on their health do), it can be difficult to determine the best practices for worksite wellness programs in general. However, a few reviews suggest that well-designed and implemented workplace wellness programs have the potential to:

- Increase productivity (Marin-Farrona et al., 2023),
- Decrease absenteeism (Marin-Farrona et al., 2023),
- Improve cardiorespiratory fitness, muscular fitness, and decrease musculoskeletal symptoms (fatigue, postural control, etc.) (Marin-Farrona et al., 2023)
- Improve health metrics such as body mass index (BMI) (Mattke et al., 2013, Peñalvo et al., 2021), body composition blood pressure, blood cholesterol (Marin-Farrona et al., 2023, Peñalvo et al., 2021), and blood glucose (Peñalvo et al., 2021),
- Increase the amount of physical activity that employees perform throughout the week (Mattke et al., 2013, Marin-Farrona et al., 2023),
- Improve some nutritional habits, such as eating more fruits and vegetables and less fat (Peñalvo et al., 2021),
- Reduce smoking behaviors (Mattke et al., 2013),
- Improve employee's perceptions of their own health (Marin-Farrona et al., 2023),
- Reduce work-related stress (Marin-Farrona et al., 2023),
- Reduce healthcare costs and provide a monetary return on investment to the employer in some studies (Astrella, 2017, Baicker et al., 2010, Lerner et al., 2013, Mattke et al., 2013).

It is possible that the full benefits of workplace wellness programs will not be realized for several decades. The noncommunicable diseases that most wellness programs aim to prevent are also chronic - they take several decades to develop. The lifestyle behaviors that improve health and prevent diseases may then need to be consistently practiced for many years in order to achieve the goal of disease prevention and healthcare cost savings (Astrella, 2017).



Figure 12.4.1: An employee wellness program at a community college in California includes a daily step count challenge. (Copyright; Glendale Community College, 2023.)

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12.5: Summary

Summary

Employers have a responsibility to provide safe and healthy working conditions for their employees. Workers spend a good portion of their day at the job, and may have much higher exposures to health hazards at work than the general public does. When injuries and illnesses do happen, it has a huge impact on the worker, their families, and their community. Thus, protecting the workforce from unnecessary hazards is a high priority for public health, and promoting health at the workplace could have benefits for the company and community at large.

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CHAPTER OVERVIEW

13: Community Organizing and Health Promotion Programming

Learning Objectives

- Define important fundamental concepts in community/public health.
- Outline the process of community organizing and health promotion programming.

13.1: Introduction
13.2: Behavioral Change Theories and Models
13.3: Theory of Planned Behavior
13.4: Health Belief Model
13.5: Social Cognitive Theory
13.6: Self-Determination Theory
13.7: Transtheoretical Model (Stages of Change)
13.8: The Social-Ecological Model
13.9: Community Intervention Models
13.10: Health Promotion Program Planning
13.10.1: Generalized Model
13.10.2: Needs Assessment
13.10.3: Goals, Objectives, and Activities
13.10.4: Implementation
13.10.5: Evaluation
13.11: Mobilizing Action through Planning and Partnerships (MAPP)
13.12: PRECEDE-PROCEED Model
13.13: Case Studies
13.14: Case Study 1- 3Wins Fitness
13.15: Case Study 2- Our Choice/Nuestra Opción- The Imperial County, California, Childhood Obesity Research Demonstration Study (CA-CORD)
13.16: Summary
13.17: References

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13.1: Introduction

The U.S. spends more on healthcare than many other countries (OECD, 2023), and spends far more on healthcare than on public health (Pilar et al., 2020). Yet several of the leading causes of death are strongly influenced by lifestyle behaviors. This has led several researchers to quantify the *actual* causes of death in terms of behaviors and environmental factors. Prior to the COVID-19 pandemic, actual causes of death in 2017 were identified as the following list, with the percentage of total deaths associated in parenthesis. Note that these percentages will not add up to 100% because there are other causes of death not on this list, and many diseases have multiple causes.

- Poor nutrition (19%)
- Tobacco use (18%)
- Toxic agents (7%)
- Microbial agents (4%)
- Illicit drug use (4%)
- Alcohol use (3%)
- Physical inactivity (3%)
- Firearms (1%)
- Motor vehicles (1%)
- Sexual behavior (1%) (Pilar et al., 2020).

A recent study looked at trends in self-reported healthy behaviors between 1999-2000 and 2017-2020 using data from the National Health and Nutrition Examination Survey (NHANES). Results indicate that over the last few decades, more Americans are avoiding smoking tobacco (57.7%), being physically active at least 150 minutes per week (69.1%), and eating a healthy diet (24.5%). However, we are still gaining weight: those reporting a healthy weight status decreased from 33.1% to 24.6%, and our alcohol consumption has remained about the same. Those who reported 4 or more healthy lifestyle behaviors increased slightly from 15.7% to 20.3%. This study also showed consistent disparities in race and ethnicity, education level, and income level, suggesting that social determinants of health (SDOH) are still powerfully associated with healthy behaviors (Li et al., 2023).

It makes sense then that many community health interventions target changing lifestyle behaviors in a population in order to prevent a disease or injury from occurring in the first place (i.e. primary prevention). In order to effectively change human behavior on a large scale, we need to first understand what makes humans behave the way they do. In this chapter, we will go over a few (not all) of the behavioral change models used in public health practice, as well as community intervention models, and program planning models. At the end of this chapter we will discuss two examples of community interventions targeting physical activity and childhood obesity.



Figure 13.1.1: Woman eating french fries. (Photo by Pexels from freerangestock.com.)

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13.2: Behavioral Change Theories and Models

Why do people engage in some health behaviors and not others? One of the earliest models describing behavior is classical conditioning, as demonstrated by Ivan Pavlov's experiments with dogs. In these experiments, Pavlov noticed that the dogs would salivate when hearing noises associated with feeding time. He then began to ring a bell before feeding them, and eventually they associated the bell with food and would salivate at the sound of the bell. Classical conditioning has been used as a model to treat cravings, phobias, or even bedwetting (Rehman et al., 2023). Subsequent behavioral researchers like B.F. Skinner proposed a stimulus response model that is based on the behavior's subsequent result - either reinforcement or punishment (McKenzie et al., 2017). These reinforcements or punishments may be artificially imposed by ourselves or authority figures such as parents, employers, or government, or they may be natural consequences of behaviors. For example, if a person discovers that they are in a better mood after they exercise, they are more likely to continue the exercise behavior because they expect the happy feelings to follow. Alternatively, if they associate exercise with debilitating muscle soreness, they are likely to avoid it!

Is human behavior really this simple though? Perhaps on the surface, for an individual person who is trying to change their own behavior or prompt a child's (or perhaps a dog's) behaviors, these models can be useful. However, they tend to ignore the rest of that individual's life and lived experience; including the complexities of intrapersonal factors (such as beliefs and attitudes), interpersonal factors (such as cultural and social norms, and support systems), and environmental factors (such as economics, their physical environment, and politics). Other models of behavior expand into these different areas.

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13.3: Theory of Planned Behavior

The Theory of Planned Behavior (TPB) was built by Icek Ajzen on a prior theory (Theory of Reasoned Action, first proposed by Martin Fishbein and Ajzen), which describes how an individual might intend to make a behavioral change. This intention is essentially the decision made by the person to "do the thing" right before they do it - intention immediately precedes the behavior. The TPB model involves 3 factors that influence intention: behavioral beliefs, subjective norms, and perceived behavioral control. Behavioral beliefs are those ideas that we hold internally about the behavior; like whether or not it is effective at giving us the desired outcome (McKenzie et al., 2017). As a hypothetical example, if someone believes that exercise is an effective way to improve their health, they are more likely to start a fitness program. Conversely, if they believe that exercise is ineffective, too hard, takes too much time, not worth the effort etc., they probably won't. These beliefs may be founded in scientific evidence, personal experience, or something else entirely, but they are highly influential on someone's readiness to change a behavior.

The second component of the TPB is the subjective norms of that person's social circle. These social norms may influence the beliefs that the person has about the behavior, and vice versa (McKenzie et al., 2017). These social norms can also be "positive peer pressure" to engage in healthy behaviors. Using our previous example, if most of a person's family and friend circle are regular exercisers or involved in sports, they will think of physical activity as the "norm". Evidence suggests that children and teens are far more physically active when parents are supportive. This support might include role modeling an active lifestyle, taking them to sporting practices and games, verbally encouraging them, or even just active play (Su et al., 2022).

Lastly, in order for a person to change a behavior they need to have "perceived behavioral control". That is, they need to have the belief that they *can* change that behavior, they have what it takes. This may include actual behavioral control - meaning the skills, resources, and environment needed to change the behavior - but even if the actual control is there, if the person doesn't believe they have control over their behavior they are not likely to change it (McKenzie et al., 2017). This concept is very similar to self-efficacy, presented in other models of behavioral change (below). If our hypothetical person believes that exercise improves health, and those around them exercise also, but they don't believe they'll ever be able to stick with a fitness program themselves, this alone may prevent them from exercising. See Fig. 13.3.1 for a diagram of the TPB.

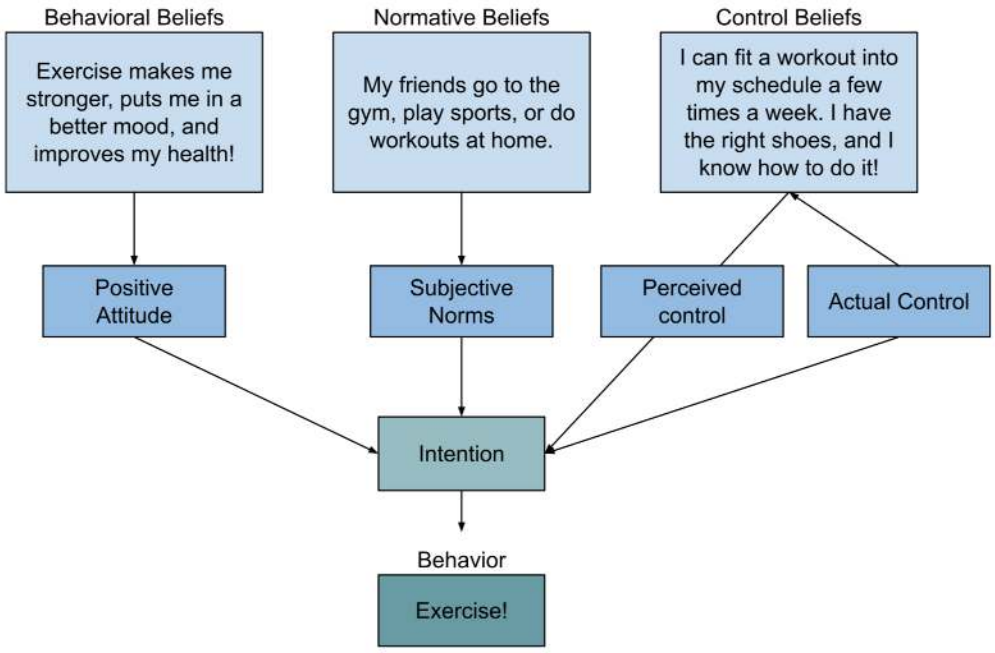


Figure 13.3.1: Diagram of the Theory of Planned Behavior.

The TPB has been successfully utilized in several experimental and quasi-experimental studies aiming to improve nutrition, increase physical activity, change traffic safety behaviors (like seat belt wearing in cars or helmet wearing while riding a bicycle), increase safe-sex behaviors, reduce alcohol and drug use, and even improve behaviors at work (like ergonomics and stress reduction). Practitioners can use techniques like providing information, persuasion, skill development, planning, social encouragement, goal setting, motivation, self-monitoring, modeling, and others to help people change their behavioral, normative, and control beliefs - thus increasing their intention to change. Some strategies work better to help a person increase their

motivation, which leads to intention. Other strategies might work better after the person has expressed an intention to change; they have the motivation already and now just need the tools (actual control) to reach their goals (Steinmetz et al., 2016).

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13.4: Health Belief Model

The Health Belief Model (HBM) was actually proposed by researchers working for the U.S. Public Health Service in the 1950s, who were attempting to explain why some people might not opt for health screenings (such as a tuberculosis test) or vaccinations (such as those for polio), especially if these were offered at little to no cost (Rosenstock, 1974). This model asserts that in order for a person to take action, they must have certain beliefs, including:

- That the consequences of not taking action are severe,
- That the person themselves is susceptible,
- And that the perceived benefits outweigh the perceived costs of taking action.

There also need to be cues in the environment that prompt the person to take action. Subsequent applications of the HBM to more complex behaviors highlighted the importance of including self-efficacy in this process as well (McKenzie et al., 2017). Self-efficacy is the belief that a person has about their own abilities to take a specific action. Thus, a lack of self-efficacy could be considered a substantial perceived barrier in this model (McKenzie et al., 2017). See Fig. 13.4.1 below for a diagram of the HBM.

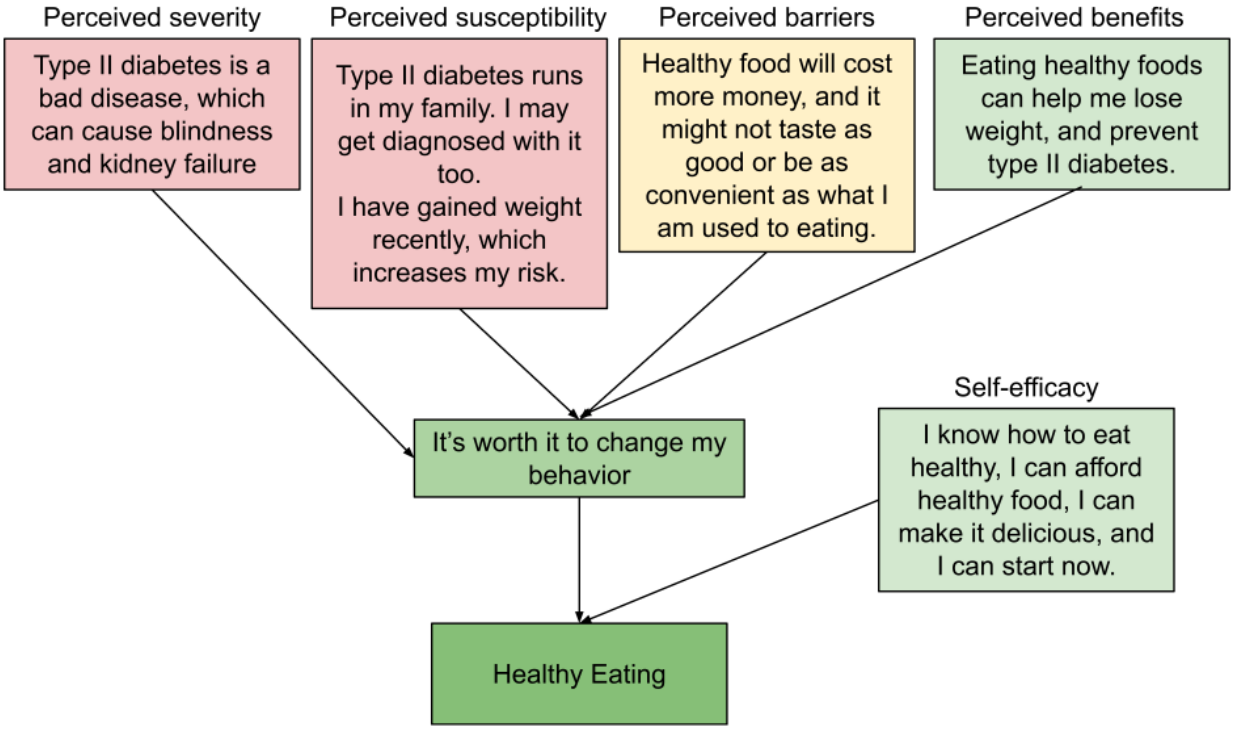


Figure 13.4.1: Example of the Health Belief Model applied to the behavior of healthy eating to prevent type II diabetes.

Both the TPB and the HBM are intrapersonal models, meaning they focus mostly on what the individual thinks, believes, and decides about the behavior themselves. The TPB certainly recognizes the influence of social norms, and the HBM perhaps implicitly includes some environmental aspects into the perceived barriers and benefits, yet these models may not fully explain how a person develops beliefs or self-efficacy. The next model attempts to do just that.

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13.5: Social Cognitive Theory

Social cognitive theory (SCT) was developed by Albert Bandura in the 1980s, and built upon an earlier theory of his about societal learning. Learning is an important component of SCT, characterized by reinforcement of a particular behavior. Bandura provided the SCT as a loose framework, where each component had a bidirectional influence: it influenced the other factors and was influenced by them. Personal factors include the person's own experiences, thoughts and feelings, which are highly influenced by their environment, and also influence the behaviors they engage in. Their environment includes the people in their social circles who may both model behaviors and provide reinforcement for those behaviors - but the individual also has influence on that circle. Finally, the behaviors themselves and the experiences from engaging in the behaviors will have an effect on the environment and the person's thoughts and feelings (LaMorte, 2022).

Included in this theory are several concepts which tie these factors together: behavioral capability, self-efficacy, expectancies, and reinforcements. The first is **behavioral capability**, which refers to the knowledge and skills that individuals must possess in order to adopt a new behavior. **Self-efficacy** is the personal belief that the person has this knowledge and skill, and can effectively engage in the behavior. For example, if someone wants to start a healthy dietary pattern, they must first know what a healthy diet is, and secondly how to prepare these foods (behavioral capability). They must also believe that this dietary change is possible for them (self-efficacy). Something that contributes to developing both behavioral capability and self-efficacy is observational learning; which just means that people learn from watching others. If a child observes their parents preparing fruit for a snack, they are more likely to copy them. And observational learning works for adults too - if a person sees their neighbors taking walks every day, they might be more likely to do so themselves. **Expectancies** are the value that the person places on the anticipated outcome of the behavior. For example, if a person values healthy eating over enjoying the taste of a food, they are more likely to eat health-promoting foods - whether they taste good or not. Finally, **reinforcements** happen as a result of the behavior, and can be a natural consequence or imposed by the person or their social group. A reinforcement to eating a healthy diet might be that the person feels good, or that they reward themselves with a treat, or still further that a friend or family member gives them praise. Reinforcements are a key component of the SCT model (LaMorte, 2022, McKenzie et al., 2017). See Figure 13.3 for a diagram of the SCT.

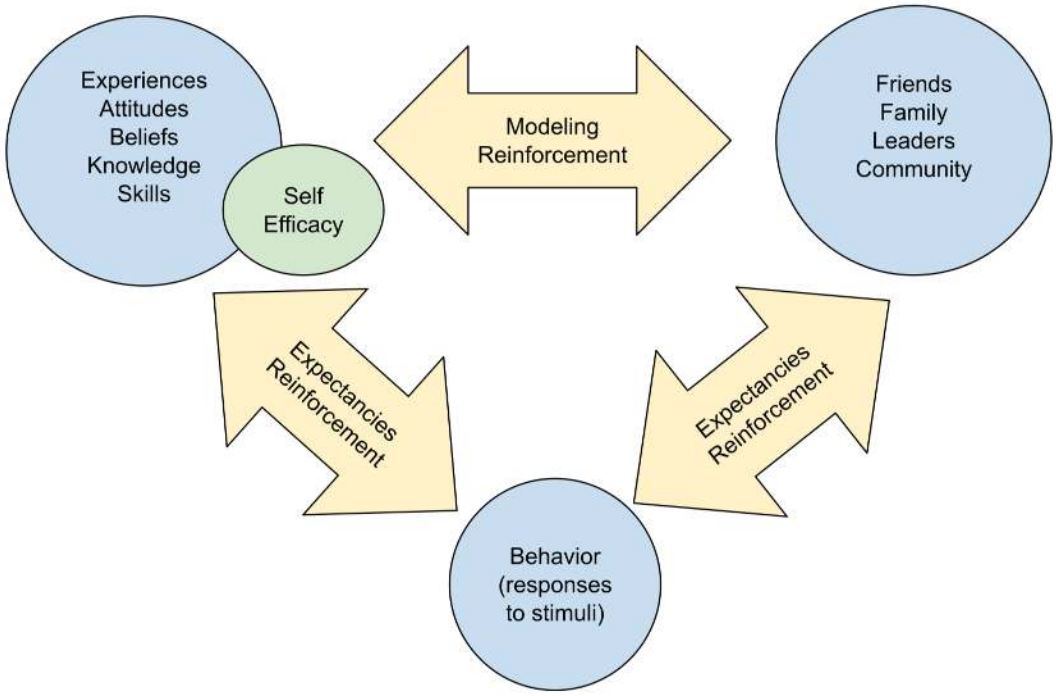


Figure 13.5.1: Diagram illustrating the dynamic interplay of factors in Social Cognitive Theory.

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13.6: Self-Determination Theory

Another theory that emerged in the 1970s and 80s was the self-determination theory, developed by psychologists Edward Deci and Richard Ryan. This model focuses on what motivates a person to perform a task or work towards a goal, whether it is an academic, occupational, or health-related goal. Instead of assuming that people will or will not perform a behavior based on the reward or punishment they might receive afterward, this model describes a person's motivation based on how much autonomy they feel they have (O'Hara, 2017). Motivation is described as "psychological energy directed at a particular goal" (Patrick & Williams, 2012). Traditional concepts of motivation include extrinsic or external motivation (as when someone is motivated by an external reward), vs. intrinsic or internal motivation (as when someone enjoys the behavior itself). Intrinsic motivation is considered the most powerful and long lasting type of motivation, and is therefore valued much more than extrinsic motivation. But Deci and Ryan proposed that there are still powerful types of extrinsic motivation, particularly for behaviors that people may not ever enjoy doing - and must therefore find a "why" that keeps them going.

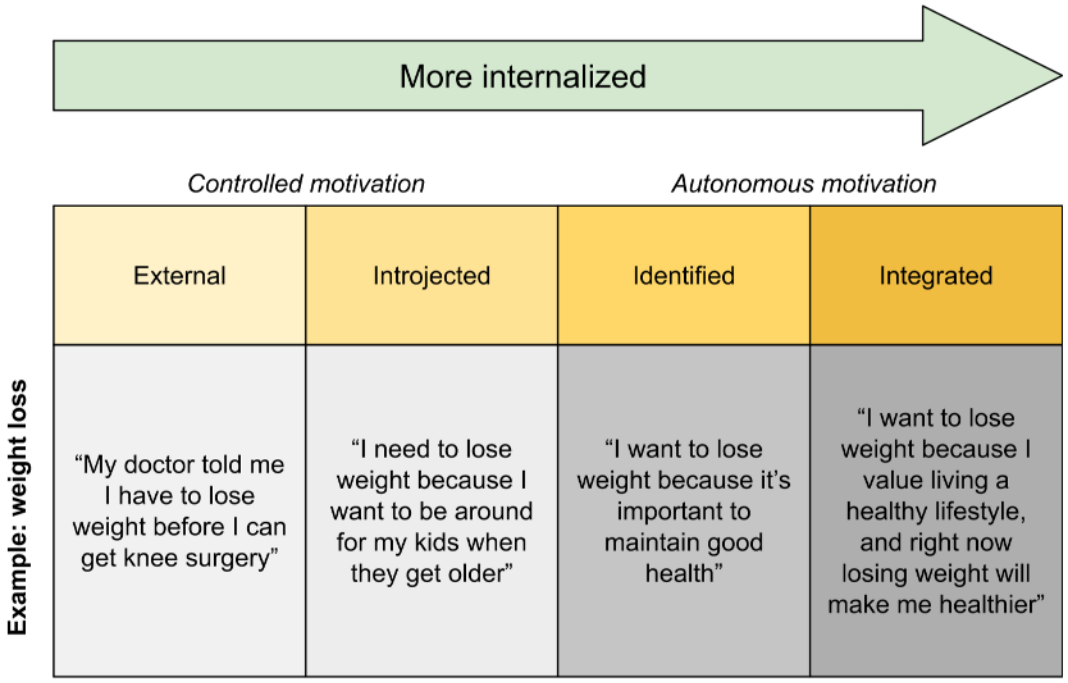


Figure 13.6.1: The Extrinsic Motivation Continuum

Self-determination theory expands on extrinsic motivation and includes the "internalization" of external forces; people can internalize social pressures and even be self-motivated for external benefits of a behavior (Patrick & Williams, 2012). Thus extrinsic motivation becomes a continuum including the following types of self-regulation:

- External regulation (in pursuit of a reward, or avoiding a negative impact),
- Introjected regulation (feeling guilty or obligated to others, or trying to prove something to themselves or others)
- Identified regulation (the behavior is important to them)
- Integrated regulation (the behavior aligns with their personal goals and values)(Patrick & Williams, 2012) (See Figure 13.4 above).

Intrinsic motivation is still identified as doing something simply for the sake of doing it, because the person enjoys the behavior itself. But the expansion of extrinsic motivation into a continuum also recognizes that with health behaviors in particular, someone can value a behavior and be strongly motivated without actually enjoying the behavior itself. Some behaviors may always have an extrinsic level of motivation, like "eating your vegetables". A person can also have several types of motivations for their health behaviors, and can move between these levels of extrinsic motivation over time (Patrick & Williams, 2012). The first two, external and introjected regulation, are considered "controlled motivation" because they are largely based on external pressures. Identified and integrated regulation are considered "autonomous motivation" because the reasons for changing are derived from the person themselves, rather than pressures from others (Sheeran et al., 2020). The more autonomous types of motivation are considered stronger and more persistent over time. See Figure 13.4 above for a diagram of the extrinsic motivation continuum.

The SDT is further built on the concept that humans have 3 basic psychological needs that influence their motivation: autonomy, relatedness, and competence. Autonomy is the sense that someone has that they are in control of their life and making their own decisions. Relatedness refers to the social connections that the person has with others, particularly supportive relationships. Competence describes the person's perceptions of their own capabilities relative to achieving their goal - essentially their self-efficacy. In order for a person to develop longer-lasting and powerful types of extrinsic motivation, they need to have these three needs met (Patrick & Williams, 2012). See Fig. (\PageIndex{2}\) for a diagram of the SDT needs.

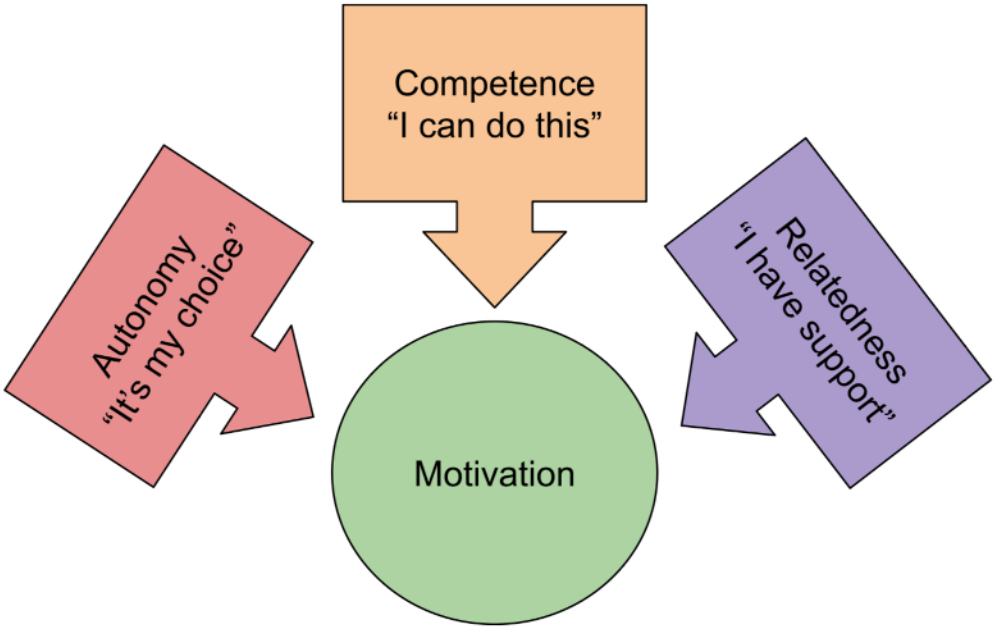


Figure 13.6.2: Diagram of Self-Determination Theory - motivational needs.

Physicians, therapists, and coaches can use several strategies that support an individual's perceived autonomy, competence, and relatedness. For example, instead of simply telling a patient with obesity that they must diet and exercise to lose weight, a practitioner might ask the patient about their prior experiences with attempting to lose weight, validate their feelings of apprehension about trying again, explore why losing weight is important to them. They might ask the patient about how this weight loss aligns with their health goals and values, and provide some information on evidence-based weight-loss methods. This supports the patient's **autonomy** in making their own decisions about their weight management. Practitioners can help patients build self-efficacy and **competence** by reviewing past experiences, and reframing "failures" as short successes - even leveraging memories of success in other areas of life. They can help the patient set small, achievable goals that will add up to the larger goal - giving them small "wins" to reinforce their competence. Finally, supporting the patient in setting their own goals, outlining a plan, and strategizing for potential challenges can allow for the patient to feel more autonomy - and more competence when they are successful. It is especially important that the practitioner provides their support (**relatedness**) in a non-judgmental way, putting the patient in the "driver's seat" rather than taking control themselves. Several interventions have shown that SDT can be successful in helping people to quit smoking, lose weight, take their medications, and even practice better oral hygiene (like flossing and brushing techniques) (Patrick & Williams, 2012).

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13.7: Transtheoretical Model (Stages of Change)

Unlike the previous theories which mostly describe why a person engages in a particular behavior, or antecedents (prerequisites) to behavioral change, the Transtheoretical Model (TTM) instead describes the process of changing behavior. Drawing from several different behavioral theories (hence the name), psychologists James Prochaska and Carlo DiClemente developed the TTM in the late 1970's. The TTM makes the (perhaps obvious) assertion that behavioral change is not immediate: people do not wake up one morning and start exercising and eating a healthy diet, nor does someone quit smoking overnight. Instead, behavior change is a process, and not even a linear process - people usually enter for the first time at the first stage but then may exit or re-enter the process at any stage in a somewhat circular fashion. Each stage in the TTM is based on the person's individual readiness to change their behavior. (LaMorte, 2022a, McKenzie et al., 2017). Below are the 5 stages with a description of each, followed by a diagram in Figure 13.6.

- Precontemplation. Before a person decides to make any change to their behavior, they may be unaware of the risks of not changing behavior, or they may be resistant to change. In this stage, a person has no intention of changing their behavior in the next 6 months.
- Contemplation. At this stage, a person is considering changing their behavior in the next 6 months, and they may be thinking about all of the pros and cons to making this change. Barriers can be perceived as enormous, and it may be difficult to see the path forward, especially if the person lacks self-efficacy in this area.
- Preparation. This stage begins when the person intends to change their behavior in the near future, usually within the next month. They may have already started to make a few small changes, are in the process of planning how they will change their behavior, and believe that this is an important thing to do.
- Action. A person in the action stage has begun to change their behavior recently (within the last 6 months). The risk of relapse is high in this stage.
- Maintenance. This stage is reached when the new behavior has been relatively consistent for 6 months or more. A person in the maintenance stage intends to continue this behavior, and the longer they do so the more a part of their lifestyle it becomes.

Relapse, or exiting the stages of change and reverting back to old behavior patterns can occur at any stage, but is less likely the longer a person stays in maintenance. A sixth stage, called termination, occurs when the new behavior is so ingrained in the person's lifestyle that they have no risk of relapse. For many health behaviors, termination is impossible since the temptation to go back to old behaviors still lingers, or since barriers to the behavior must still be planned for and overcome. Most public health practitioners will therefore not use the termination stage (LaMorte, 2022a, McKenzie et al., 2017). See Fig. 13.7.1 for a diagram of the TTM.

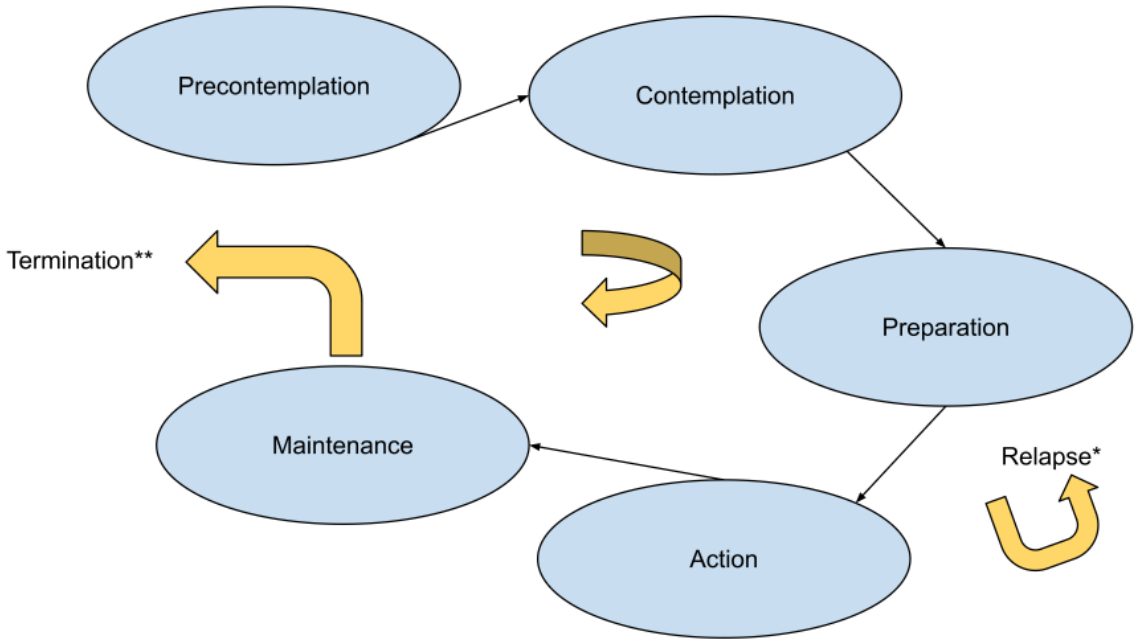


Figure 13.7.1: Diagram of the Transtheoretical Model. *Relapse can occur at any stage of the model, as can re-entry. **Termination does not occur for all behaviors, and so is not always used by public health practitioners.

There are also 10 processes that people can use to move from one stage to the next. Some processes work better for earlier stages and others for later stages. These processes include the following (adapted from LaMorte, 2022a):

- Consciousness raising. Learning information about the behavior change, the risks of not changing, and the benefits of changing can help in the decision-making process, particularly in early stages.
- Dramatic relief. Many decisions to change behavior are emotional decisions. Experiencing a significant event can often bring this on (such as a diagnosis, or loss of a loved one), but so can taking the time to consider what a person's dreams and desires are. When a person experiences this emotional response - whether positive toward the new behavior, or negative toward the consequences of not changing - it can spur motivation to take action.
- Self re-evaluation. This involves creating a discrepancy between where the person is now and where they want to be, as well as the realization that the desired behavior is part of who they want to be.
- Environmental re-evaluation. Other people are affected by an individual's behavior, often those that are close to them. Knowing how their behavior affects others can become a significant motivator as well.
- Social liberation. There need to be opportunities that demonstrate the new, healthy behavior as being socially accepted. This helps to "normalize" the healthy behavior.
- Self liberation. When a person has self-efficacy, and believes that change is possible for them, they can make a commitment to the new behavior.
- Helping relationships. Identifying social support is key to both starting and maintaining a new behavior.
- Counter conditioning. This involves substituting negative behaviors and thoughts for change-inducing behaviors and thoughts. For example, a person might have had negative thoughts like "I'll never be able to change, it's too hard", and will need to reframe those thoughts to more positive statements such as "I've had challenges in the past, and I will learn from them moving forward". If a specific behavior happens to be a trigger to relapse into old habits, a similar but healthier behavior can be substituted. For example, driving is often a trigger for former smokers. Other behaviors like snacking on sunflower seeds or carrots can be a substitute.
- Reinforcement management. Rewards can still be helpful to reinforcing behaviors, especially if the person chooses the reward themselves. They can also reduce the "rewards" from the undesired behavior, by making it less pleasant.
- Stimulus control. This involves changing the environment to remove triggers for the undesired behavior and instead place conspicuous cues for the desired behavior. For example, if someone wants to stop snacking while watching TV at night, they can avoid purchasing common snack foods. If a person wants to exercise in the morning, they might lay out their workout clothes the night before.



Figure 13.7.2: For many smokers, driving is an activity that triggers cigarette cravings. Counter conditioning (i.e. substituting sunflower seeds or another snack while driving) and stimulus control (i.e. removing lighters from the car, keeping windows rolled up, etc.) are processes that can be used in the TTM to assist behavior change. . (Copyright; Photo by Elsa Olofsson on Unsplash.).

Any and all of the aforementioned behavioral change models can be potentially useful in helping people change their behavior. They might be used by medical professionals, addiction specialists, counselors and therapists, or nutrition and fitness practitioners as helpful tools. However, some of them may have slight conflicts with public health goals. For example; SDT values autonomy in decision-making. Therefore, if a person decides that they do not want to quit smoking, that choice should be affirmed by practitioners (Sheeran et al., 2020). This obviously conflicts with a public health interest of reducing smoking behaviors! Another potential problem with these models is that they focus exclusively on the individual - their experiences, motivations and/or sense of behavioral control (aka self-efficacy, or competence). Social influences are recognized in several of the models, yet other influences such as environment, politics and public policy, health literacy, access, and economic variables are not. These models

describe how an *individual* may change their own behaviors, but not necessarily how to nudge a group, community, or larger population in the direction of health-behaviors. Therefore, we need to "zoom out" and take a look at human behavior in the larger context of the community.

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13.8: The Social-Ecological Model

The Social-Ecological Model is a framework for identifying the causes, risk factors, and protective factors that contribute to health outcomes in a community and populations at large. This model asserts that health outcomes - and perhaps more specifically, health behaviors - are influenced by the interaction between an individual, their community, and the physical, social, and political environments in which they live. Figure 13.7 is a visual representation of this model.

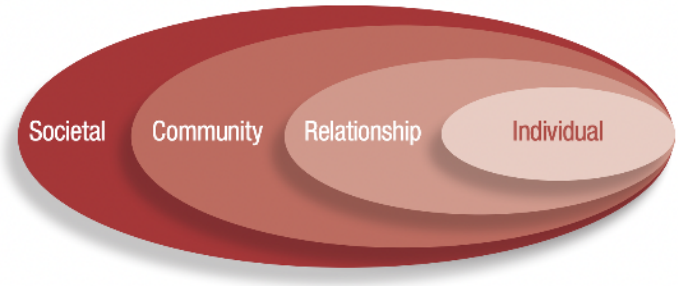


Figure 13.8.1: The Social Ecological Model - A Framework for Prevention

Each circle describes specific risk factors or protective factors for a health outcome, and therefore also provides opportunities for public health approaches at each level.

- The individual circle includes each individual's own risk factors or protective factors. Genetics, age, personal history, education, income, attitudes, beliefs, and behaviors are included in this circle. All of these factors can make a person more or less likely to engage in a specific health behavior, and have an effect on their health status. For example, a person who experienced childhood trauma or abuse may be more likely to abuse drugs or drink alcohol. Someone who never graduated from high school may earn less income over their lifetime, and therefore not have consistent access to healthcare - or even avoid going to the doctor over concern about the medical costs. In a more positive example, a person who has experienced the benefits of eating a healthy diet and being physically active as a child is more likely to continue those healthy habits into adulthood - particularly because they may have a positive attitude towards nutrition and exercise.
- Relationships with other people are highly influential in a person's attitudes, beliefs, and behaviors - and vice versa - these relationships are influenced by that person. Primary relationships are especially important, and include a significant other or spouse, parents, siblings, and children, as well as close friends. If a person is part of an abusive relationship, they will probably be more likely to be the victims of or to perpetrate violence. Conversely, if a person has a physically active friend group, they are more likely to engage in physical activity themselves.
- The community level includes organizations that the individual is a part of, and the broader social context in which they live. This could also include the built environment, and socio-political landscape of that person's community. An example of this could be the social support provided by schools, churches, sports and recreation clubs. A built environment could encourage less stress and physical activity with accessible parks and greenspaces, or it could promote higher stress levels and alcohol consumption with high traffic roads and several liquor stores in the neighborhood.
- At the societal level we also have social norms, macro-economic and political factors, and environments that affect health outcomes. For example, social norms around alcohol consumption influence alcohol use at young ages, alcohol abuse, and addiction. Economic poverty is associated with higher crime rates, drug abuse, and mental illness. Political administrations can create laws that support or undermine public health efforts, and either provide or cut funding to public health programs (*The Social-Ecological Model: A Framework for Prevention*, 2022, McKenzie et al., 2016).

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13.9: Community Intervention Models

The social-ecological model identifies several potential areas for intervention and health promotion within a community at each different circle. Yet, just as individuals have varying levels of readiness to change behaviors, so do communities have varying levels of readiness for intervention (McKenzie et al., 2017). Due to group dynamics, physical environments, and political powers which are involved in every community, we cannot necessarily apply the same behavior change theories to a group that we might to an individual. Several researchers have described different approaches to community interventions, some which emphasize looking for deficits (needs-based) and others that emphasize identifying what is already working well (strengths-based). These different models work via social action, advocacy, capacity building, grassroots organizing, and leadership development in order to cause positive change (Seabert et al., 2021).

Community-based health promotion programs often take a holistic approach, in that they are not limited to a single location (like a hospital), they often have multiple, coordinated interventions, and may also focus on environmental and policy changes to support the desired behaviors (Merzel & D'Afflitti, 2003). There are four major models that most community-based interventions fall into according to McLeroy et al. (2003). Most successful community interventions are not only multi-faceted, they also utilize more than one of these models.

- Community as a **setting**. Sometimes the community is simply the geographical location in which the intervention takes place. Health promotion programming might take place at various locations within the community, such as city parks, community centers, churches or other faith-based organizations, hospitals, schools, worksites, or other non-profit organizations. Mass media (like billboards, paper flyers, radio, T.V., or Youtube advertisements, etc.) may be used to convey specific health messaging. When the community is the setting, the goal of the intervention is to elicit personal behavioral change. Therefore, any improvement in population health is the sum of all of the individual behaviors. This model may fail to address environmental, economic, or political influences of behavior and health.
- Community as a **target**. Interventions that target the community seek to make changes to the environment, programs, and/or policies available to community members. Instead of focusing on individual health behaviors as outcomes, these interventions might focus on other environmental or policy measures related to health, such as acreage of park-space per person, or the number of seniors participating in a free lunch program. The assumption is that if the community environment is changed, this will improve healthy behaviors and quality of life.
- Community as a **resource**. This approach seeks to utilize the people and resources within the community to either drive or at least contribute to health-promoting changes. A public health practitioner might bring a health priority to the community and seek input on intervention design as well as leveraging and supporting current resources, or they might ask the community members themselves to identify the highest priority for the community, and build an intervention from there.
- Community as an **agent**. This model assumes that the community already has the solutions and resources to its own health problems. It attempts to "meet people where they are" in supporting the community itself to identify needs, come up with solutions, and implement them. This model might fail to address disparities in social determinants of health that many communities face such as economics, environment, and policy.

Public health interventions are indelibly tied to current cultural perceptions and beliefs about society, and their success depends upon how well they are designed, received, and implemented. To what extent does the responsibility for health lie within each person (individualism) or within society (collectivism)? What role should the government play in protecting and promoting health? As McLeroy et al. (2003) states:

Public health is more than a body of theory and intervention methods. We cannot separate how we do public health from why we do public health. Whether we talk about changing behavior, changing community structures, or building community capacity, these changes cannot be separated from our ideals about what constitutes a good community or a good society.



Figure 13.9.1: Bicycle lane marking on an empty road. (Copyright; hoto by Dave Meier fromfreerangestock.com.)

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13.10: Health Promotion Program Planning

In order for any type of health intervention to be successful, it should first be evidence-based - the rationale, design, implementation, and assessment of the program rooted in scientific evidence. It may not be possible, however, to simply find a peer-reviewed research article on a successful intervention for a specific health behavior in a similar community, and then "copy and paste" that intervention into a new community. Effective program planning therefore involves a thoughtful process, taking into account the specific needs, desires, and capacities of the community, as well as considering funding, timing, and how the program will be evaluated for efficacy (whether or not it worked). Most community-based programs are grant funded, and so must demonstrate this process in order to justify the use of those funds. Below are a few of the most widely used health promotion programming models.

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13.10.1: Generalized Model

The generalized model includes four basic steps: conducting a needs assessment, setting goals and objectives, implementing an intervention, and evaluating the intervention.

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13.10.2: Needs Assessment

The first step in the generalized model is to conduct a needs assessment of the target population or community. A needs assessment is important for several reasons; whether or not the program planner is a part of the target community, they may have their own biases and priorities that may not actually reflect the needs or priorities of the community. A well-conducted needs assessment also provides justification for funding (as most community programs are funded by grants), and can also be used to get buy-in from the community members, while preventing duplication of resources or programs that already exist. It can also establish a baseline level for goals and objectives which will need to be measured at the beginning and end of the program (and sometimes mid-program) in order to evaluate whether the program is working or not. According to Seabert et al. (2021), a needs assessment includes the following 6 steps:

1. Designing the needs assessment. This includes determining both the purpose of the needs assessment, and how it will be conducted - including the personnel needed. What tools will be used (i.e. surveys, interviews, etc.)? Whom is the target population? How long will the needs assessment take to complete? Getting input from community members can be extremely helpful in designing an effective assessment, since they may have insights into the communication preferences of the target population, and how to recruit the maximum number of respondents.
2. Gathering data. Once the purpose and scope of the needs assessment have been decided on, then the data must be collected. Two main types of data can be used: primary and secondary. Primary data includes surveys, interviews, or any data gathered from the target population itself. Secondary data is information gathered on a similar population or on the target population but for a different purpose. This could include nationally representative surveys (i.e. vital statistics, behavior risk factor surveillance system data) or health insurance claims, health risk assessments etc. collected earlier from the target population. Care must be taken to respect Health Insurance Portability and Accountability Act (HIPAA) Privacy rules for health data.
3. Data analysis. Formal statistical analysis is typically only performed in research studies, since it requires more sophisticated software and controlling for potential biases and confounding factors. Many program planners do an informal analysis of the data to identify the most pressing problems for the community. Once again, getting input from community members can be invaluable in this process. Often there are many potential health problems, but a program can only be designed to address one or two, so they must be ranked according to which problems have the highest need, and can be addressed most easily and effectively.
4. Identifying risk factors. After the health problems have been prioritized, risk factors that contribute to those health problems should also be identified. There are three types of factors involved in a behavior:
    a. **Predisposing factors**, or those needs that a person has before starting a behavior. For example, knowledge of the health risks of smoking is a predisposing factor for smoking cessation. If someone does not know that smoking poses a risk to their health, they are unlikely to try to quit.
    b. **Enabling factors**, or those things that help someone perform the behavior. For example, if someone wants to start exercising, it helps if they have access to a gym, park, walking paths, exercise classes, etc.
    c. **Reinforcing factors**, or those that keep a person going in healthy behaviors. Social support, for example, is especially powerful in maintaining a behavior. Reinforcing factors might include workplace wellness programs, recreational clubs, or support groups (like Alcoholics Anonymous).
5. Setting the focus of the program. The program planner will now have the information needed to identify the direction of the program: which health problems are priorities, and which behavioral risk factors are going to be targeted. The planner should always pursue those problems and factors that have the greatest importance: either because of the severity of the health problem, number of people affected, and/or because community members have identified it as being important to them. But they also need to prioritize health problems that are changeable - that is there is scientific evidence that community interventions can be effective for this problem. Finally, planners should always take into account the resources available (funds, personnel, space, time, etc.) If there are not enough resources to address the problem effectively, then perhaps the particular grant funds they are working with is better used to target another priority problem on the list.
6. Validating prioritized needs. Once again community input can be helpful in double-checking the assessment results. This also allows for the planner to identify if anything is already being done to address the priority health problem, or if other interventions have been attempted in the past. Additionally, they should check for redundancies or programs that are already addressing that need in the community. Are there ways to support those programs that are already in existence and successful, rather than competing with them?



Figure 13.10.2.1: This photograph depicts Epidemic Intelligence Service (EIS) officer, Daniel Nguyen (Class of 2022), as he was interviewing community members for a Rapid Needs Assessment, after the August 2023 Maui wildfires at the Maui District Health Office in Maui, Hawaii. (Copyright; Photo credit: CDC/Daniel Nguyen.)

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13.10.3: Goals, Objectives, and Activities

A goal of a program is the overarching target that the program is attempting to accomplish. This is usually stated in a single sentence, and encompasses the general mission of the program. Below are some examples of program goals:

- To increase the number of adults achieving the minimum physical activity recommendations.
- To help breast cancer patients access social support resources.
- To reduce teen violence incidents in high school.

Goals are written in a very broad and general way, but include both who will be affected (target population) and what will be changed (outcome) (Seabert et al., 2021).

Objectives are specific outcomes that will lead to the overall goal being achieved. Objectives come in different forms, and must be written in a very specific way, as they are typically describing outcomes that are measured at the beginning and end of the program in order to determine its effectiveness. Well-written objectives follow the SMART acronym:

- **S** - specific. The objective states specifically what will change, and by how much. It should be stated in quantifiable terms.
- **M** - measurable. The objective needs to have a metric that will be measured at the beginning and end of the program (or part of the program). Vague objectives such as changing things like knowledge or perceptions can often be measured by validated surveys or tests, which can be quantified (represented numerically) by a score.
- **A** - achievable. The objective has to be achievable given the resources available and the baseline measurement. This is where the scientific evidence - studies of previous interventions - can help the program planner set reasonable expectations.
- **R** - realistic. The objective must be realistic for the given timeframe. Not only should these objectives be evidence-based, they should also be realistically achievable for the target community. If more or fewer resources are available, or if a shorter or longer timeframe is utilized, that can change the effectiveness of the program.
- **T** - timeframe. All objectives should have an "end date", or date which the objective is re-measured. This may not be the end date of the program itself, particularly if it is an ongoing project, but it will be the target date for the completion of the objective, and the evaluation of the program.

Compare the following objectives against the SMART acronym:

- *In the next 6 months, program participants will improve their scores on the single-leg balance test by 10%.*
- *Senior citizens will improve their balance.*
- *The community pool will be utilized more by the end of the year.*
- *More children will know how to swim at the end of the summer.*
- *The employees of the local grocery store chain will have no low back pain complaints by the end of the year.*

The first objective is the only one that follows all of the guidelines in the SMART acronym. It provides a specific population (program participants), a specific measurement (score on the single-leg balance test), and a specific, achievable outcome (improvement by 10%), as well as a realistic timeframe (6 months).

Objectives can be set for different aspects of the program. Some objectives will be **process objectives**, or targets of the implementation of the program itself. Process objectives might include activities like:

- Distributing a specific number of flyers.
- Hiring personnel (e.g. a Registered Dietician)
- Recruiting participants (getting people to sign up for the program)
- Purchasing equipment
- Conducting a certain number of health education classes

Impact objectives include outcomes that affect the target population's learning, behaviors, or environment. For example, **learning objectives** assess the knowledge or skills obtained, such as:

- Test scores on a written test.
- Survey results identifying knowledge of a specific resource.
- Pass rate of a skills test.

Behavioral objectives include specific behaviors performed by community members. These could be things like:

- Getting blood pressure, cholesterol, or blood glucose levels checked.

- Performing regular exercise.
- Reporting consumption of fruits and vegetables.
- Attendance in support group meetings.

Environmental objectives include changes to the environment in which the target population lives, works, or plays. For example:

- The city enacts smoke-free policies in all public places.
- There is no longer a waitlist for the seniors free-lunch program.
- Cardiopulmonary Resuscitation (CPR) classes are offered every weekend at the community center.

Lastly, **outcome objectives** are the actual measures that will lead to the overarching goal of the program. These are health outcomes that address the health problems identified in the needs assessment. Some examples might be:

- A decline in the number of teen pregnancies.
- Improvements in Health-Related Quality of Life (HRQL) as reported on a community-wide survey.
- Program participants decrease their body mass index (BMI).

Designing the intervention itself will typically include **activities** or specific actions or pieces of the program which are designed to achieve the objectives. If possible, these activities should be evidence-based, or at least based on previous best-experiences (whether or not these prior interventions have been published as peer-reviewed research). Typically, multiple activities tend to be better than a single activity (Seabert et al., 2021). Community members and key stakeholders can provide invaluable feedback on whether planned activities are likely to work within a particular community. The cultural values, beliefs, attitudes, and behaviors of the target population are important to understand before designing a program - otherwise it may not be well-received or at worst, it may make the health problem worse. Lastly, behavioral change theories and models can be useful in this stage to help inform the program design and select the appropriate activities.



Figure 13.10.3.1: A Biology for Public Health course at Galena High School in Missouri. (Photo credit: CDC/Ryan Lacson, 2019)

This photograph depicts Ryan Lacson, a high school biology teacher and 2019 Centers for Disease Control and Prevention (CDC) Science Ambassador Fellow, as he was leading a Biology for Public Health course at Galena High School in Missouri. To design the course, Lacson used his experience as a Science Ambassador Fellow, and partnered with his county health department to identify the county's most pressing public health issues. As part of the course, students partnered with a local community organization to train other high schoolers on mental health first aid.

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13.10.4: Implementation

Once the program has been designed, it's time to actually put it into action. Implementing a program may require many smaller administrative tasks, as well as staying organized so as to make sure that the different pieces of the program come together smoothly. For example, if personnel must be hired, it may be necessary to have the human resources (HR) department post a job description, interview potential candidates, and then finalize the hiring process. Grant funds may take time to be released, and then be encumbered (assigned) to different departments. Equipment may need to be purchased, locations and rooms may need to be reserved or rented, and staff may need to be trained. Once the program gets started these different moving parts may need to be monitored and outcomes tracked or tested at different times. Often program planners will use logic models to help them organize the steps in the process, or a Gantt chart to give them an overview of priority tasks (McKenzie et al., 2017). See Table 13.10.4.1 for an example of a Gantt chart.

Table 13.10.4.1: An example of a Gantt chart

Tasks First Year	J	F	M	A	M	J	J	A	S	O	N	D
Conduct needs assessment	x											
Design program (goals, objectives, activities)		x										
Create pilot program		x										
Procure resources for next phase (personnel, equipment, locations)			x			x	x					
Create marketing tools			x									
Market program				x		x	x	x	x	x	x	
Pilot test program (6 weeks)					x	x						
Assess pilot program						x						
Conduct phase 1 program							x	x	x			
Conduct phase 2 (full) program									x	x	x	x
Assess and evaluate program												x

Running a smaller version of the program, or pilot program, can help identify challenges or issues early on. Pilot programs can be run at a single site instead of multiple locations, and include fewer participants, and be conducted for a shorter period of time. The pilot program can then be assessed, and necessary changes can be made to the program plan before expanding it to full implementation. For example, perhaps the pilot of a senior fall prevention program is conducted at a local community center, but the participants have trouble getting transportation to attend the program classes. This might inform the program planner that the location needs to be changed, or that transportation needs to be provided in order for the full program to be successful. After the pilot program and assessment, the program might have a phase-in process where a slightly larger version of the program is implemented, then expanded. Phasing-in can be beneficial on several levels: not all of the resources have to be ready at the same time, and challenges or barriers can be addressed before they affect the program at large. The process of phasing-in can be done by adding locations, by expanding the number of participants or the level of ability, and/or by adding activities of the program. For example, a smoking-cessation program might begin with support group meetings, then add stress management classes. Or a program might begin in one neighborhood park, then expand to others across the city (McKenzie et al., 2017, Seabert et al., 2021).

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13.10.5: Evaluation

An important component of any successful program is evaluating it for both its quality and efficacy. Evaluation occurs throughout all the phases of the program - in fact, the needs assessment is one form of evaluation. If the program includes a pilot test and phasing in, the assessments done at each of those steps can also be used to make changes to the program to make it better. This type of evaluation that seeks to test the quality of the program and make changes while it is ongoing is called **formative evaluation** (McKenzie et al., 2017, Seabert et al., 2021).

The second type of evaluation is the **summative evaluation** which typically takes place at the end of the program (or at a designated time if the program is ongoing). The objectives of the program must be assessed to determine whether or not it was effective. Evaluation of the impact objectives is called **impact evaluation**, and evaluation of the outcome objectives is termed **outcome evaluation**. These evaluations are often provided in a report which is shared to key stakeholders and decision makers in order to either justify continued funding of the program, suggest improvements to the program, or provide a rationale for the program to end. Of course, if the evaluation is done by the program planner, there is always the potential for bias and the temptation to portray the outcomes in the most positive light! Therefore it may be helpful to have an independent evaluation and/or make every effort to remain as objective as possible (McKenzie et al., 2017, Seabert et al., 2021). The Centers for Disease Control and Prevention (CDC) has created a framework to help guide program evaluation to ensure that it is ethical, accurate, and useful (CDC, 2023).

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13.11: Mobilizing Action through Planning and Partnerships (MAPP)

The MAPP model was originally created through a partnership between the CDC and the National Association of County and City Health Officials (NACCHO) in 2001. It has since been updated to MAPP 2.0, which “emphasizes community engagement, data-driven assessments, and a focus on health equity” (NACCHO, 2024). The redesigned MAPP model emphasizes the recognition of social determinants of health and the social inequities that cause them, including power dynamics and involving the community in the decision-making process. The MAPP 2.0 uses the following 3 phases (Clayton et al., 2020):

- Phase 1: Building the Community Health Improvement (CHI) Foundation. This phase involves identifying the people in the community who will have an effect on the program and whom the program will affect - the stakeholders. A committee is then created out of these stakeholders, and a shared community vision established. In this phase, the resources, budget, and administrative organization of the project is created.
- Phase 2: Tell the Community Story. This is where the community assessments are designed and performed. There are three assessments as part of the MAPP:
  - Community Partner Assessment - community partners such as local government agencies, non-profit organizations, medical offices, hospitals, schools, community health centers, faith-based institutions, and private businesses can assess themselves for strengths and capacities to improve health and health equity in the community.
  - Community Status Assessment - data collected on demographics, current health status, and health inequities of community members. This includes health behaviors and social determinants of health, as well as the systems of power that influence health outcomes.
  - Community Context Assessment - the historical and current socio-political context of the community includes the “community strengths and assets, built environment, and forces of change”. This assessment relies on the views and lived experiences of the people experiencing the health inequities (NACCHO, 2023).
- Phase 3: Continuously Improve the Community. The MAPP involves an ongoing process of community engagement, prioritization of issues, analysis of power (factors, people, and institutions that contribute to health), developing long-term goals and measures of success, creating action plans including short-term objectives, and finally setting up ongoing evaluation and assessment for continuous improvement (Clayton et al., 2020, NACCHO, 2023).

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13.12: PRECEDE-PROCEED Model

PRECEDE-PROCEED is an acronym that defines the planning and implementation stages of a community health intervention. PRECEDE stands for Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation. This model attempts to "reverse engineer" the program, by starting with identifying the desired outcome, and then working backwards from that to design the intervention. While this may certainly sound daunting, it's really describing a process of assessing the needs and context of the community, including the following phases (summarized from McKenzie et al., 2017, HRSA, 2024, University of Kansas, 2024):

- Phase 1: social assessment and situational analysis. A social assessment identifies the subjective needs of a population, including things like quality of life, perception of safety, and their own goals and aspirations for the community. This requires substantial input from the community members themselves on their own subjective experiences, needs and desires. This might include surveys, telephone or face-to-face interviews, focus groups, or questionnaires. The goal of this phase is to envision the ultimate outcome that the community wants to achieve.
- Phase 2: epidemiological assessment. This level of data collection and assessment involves more objective data, including mortality and morbidity rates, disability status, and behavioral, genetic, and environmental factors that influence health outcomes. Prioritizing health problems in this phase is important, as well as connecting them to the subjective needs and desires of the community (identified in phase 1). Program planners will need to use both scientific evidence and an understanding of the community resources available, as well as the priorities of the community itself, in order to appropriately prioritize health problems. For example, the program planner may identify that rates of type II diabetes are higher in the community than the national average, and community members might therefore benefit from a Diabetes Prevention Program (DPP). However, community members may identify that residential street safety is a much more pressing concern in phase 1. If the program planner tries to "shoehorn" or force their agenda on the community intervention, however well intentioned, it may not be well-received and at worst may lead to public distrust of health interventions.
- Phase 3: educational and ecological assessment. This last level of assessment looks to identify those factors that influence the behaviors, lifestyles, and health risks in the community. These include predisposing, enabling, and reinforcing factors (described earlier). Factors can include a lack of access or resources, an educational or informational gap, environmental influences, policies or something else. Often there are multiple factors that influence a health risk, necessitating multiple components in the intervention to address them.
- Phase 4: health program and policy development. At this stage the program is being designed based on the findings from the previous assessments, along with "best evidence" or "best practice" (using scientific evidence and/or behavioral change theory). The program should be connected back to both the social assessment and the epidemiological assessment, and should focus on those factors that were identified and predisposing, enabling, and/or reinforcing behaviors in phase 3. Another key component of this phase is to do an administrative and policy assessment, which determines two things: whether or not existing resources - including funding and personnel - are available and adequate to implement the program, and if there are any policies (local laws, regulations, etc.) that may influence the program implementation. An example of this might be a program designed to offer exercise sessions in a local park, which would require the program planner to check with the city parks and recreation office to find out if a contract or memorandum of understanding (MOU) is required, if liability insurance is adequate, and if there are any requirements for participants to sign liability waivers or other paperwork. Personnel may need to be hired and trained to lead exercise sessions, and equipment may need to be purchased.

The second part of the model is the acronym PROCEED, which stands for Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development. This is the process of implementing and evaluating the intervention created in the first four phases, and evaluating each different piece (see Figure 13.9 for a diagram of all of the phases together). Once again, there are 4 phases dedicated to this process, outlined below (summarized from McKenzie et al., 2017, HRSA, 2024, University of Kansas, 2024):

- Phase 5: implementation. This is where the intervention actually takes place! Phase 5 might include a pilot program, and/or phasing in process. It may be helpful to use a Gantt chart or other project management tools to ensure that each piece of the program is implemented in the right order. Phases 6 and 7 can be conducted as the program is ongoing, in order to provide valuable feedback that can be used to make the program better.
- Phase 6: process evaluation. Is the program being implemented as planned? This evaluation seeks to determine whether the activities of the intervention are actually being delivered. For example, are health education sessions being offered? Did some

need to be canceled? If so, why? What can be done to address problems with the program implementation early on, so that it actually gets completed as promised?

- Phase 7: impact or short-term evaluation. This evaluation addresses the impact that the program is having on knowledge, behaviors, or environmental objectives (see earlier in this chapter for definitions). These might be intermediate or short-term assessments, done in the middle of the program, as well as at the end of it. For example, if the program involves offering health education courses with the objective of improving knowledge about health eating patterns, has that knowledge actually improved for the participants? Do they score higher on a questionnaire about healthy eating? Performing impact assessments while the program is ongoing also helps to identify if changes need to be made to make the program more effective.
- Phase 8: outcome or long-term evaluation. The final assessment should be on the outcome objectives, which are typically the ultimate desired changes to health status for the community. Some of these changes may take years or even decades to be demonstrated. For example, the ultimate desired goal for a community might be a reduction in cardiovascular disease (CVD) rates. However, many of the participants in the community program might not be at risk for developing cardiovascular disease for several years, but the program activities may be helping them to prevent CVD. Sometimes a different marker can be targeted that is associated with the ultimate goal - such as an improvement in cardiovascular fitness, a reduction in body mass index (BMI), or lower blood cholesterol levels - but these will need to be maintained over the years in order to reach the ultimate goal of CVD prevention.

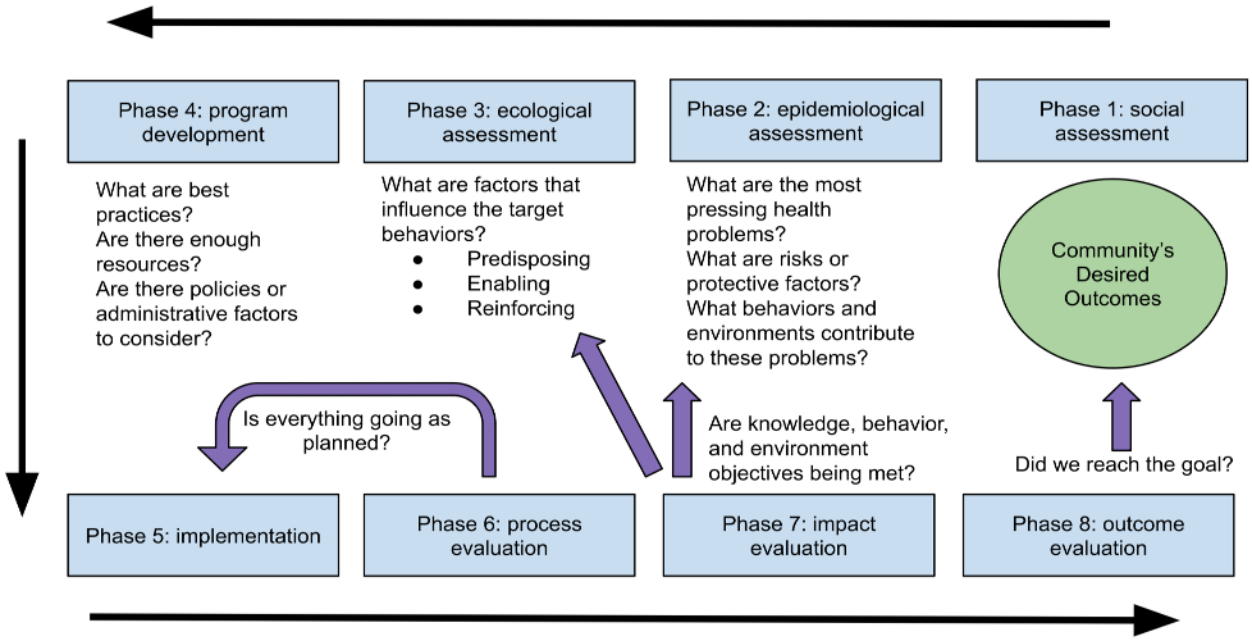


Figure 13.12.1: Diagram of the PRECEDE-PROCEED model.

There are several other program models that have proven successful besides those presented here (McKenzie et al., 2017). Ultimately each model is a guide that can be used to provide structure for a program planner. Each of these models highlights the importance of involving the community members themselves in both planning and implementation of the community health intervention, as well as the need for regular assessments of the program to ensure it is actually working to improve the health and lives of the population.

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13.13: Case Studies

With the two following case studies we will take a look at community interventions targeting health behaviors like physical activity and nutrition. With the first case study, we'll discuss it through the social-ecological model lens - how does this intervention affect each different level? The second case study is a great example of a multi-component community intervention which utilized several different program planning models to inform its design.

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13.14: Case Study 1- 3Wins Fitness

This first case study illustrates the use of the social-ecological model in a health promotion program to promote physical activity in a community. At California State University, Northridge (CSUN), the Kinesiology department began a fitness intervention in an underserved community nearby - the City of San Fernando. This program provided free exercise classes instructed by undergraduate students from the university to participants at several local parks spaces in the city. The program brought some portable fitness equipment, and was awarded grant money to install permanent exercise equipment at one of the parks. Moreover, the program also partnered with other programs and local businesses to provide opportunities for nutritional education, physical therapy consults, and even video lectures on weight loss and mindfulness. The 3 Wins Fitness program ran for 12 years and involved over 400 participants over its duration. The idea of "3 Wins" in the program were that there were benefits to three stakeholders:

- the student - via professional skill development, experience and networking,
- the participant - by providing structure and coaching for exercise, and
- the community - by providing programs that improve health and well-being of community members as well as utilizing park space for health promotion (3 Wins Fitness, 2017).

The 3 Wins Fitness program had an effect on students at CSUN and citizens of San Fernando on multiple levels of the social-ecological model, as analyzed in several academic papers (Chaudhari et al., 2022, Derose et al., 2022).

Individual

Participants in the program reported improving health measures such as A1C levels (a measure of blood sugar management and risk for diabetes), lowered resting blood pressure, weight loss, and improved mental health. Additionally, many participants reported improved physical fitness including mobility, and stamina (Chaudhari et al., 2022).

Interpersonal

Both participants and student-instructors in the 3Wins program reported social-emotional benefits from the program. Participants were motivated to exercise by the instruction and encouragement of the student-instructors, and the comradery from their peers in the program. Student-instructors in turn, also developed a sense of community with other students and participants, which supported their academic and career goals. Lastly, family members of the participants could be affected by the increased focus on physical activity and health (Chaudhari et al., 2022).

Organizational

Several organizations were affected positively by the 3 Wins Fitness program. First, the parks and recreation system within the city had a continuous, no-cost exercise program to offer residents. Parks in underserved communities are notoriously underfunded, less maintained, and underutilized greenspace (Derose et al., 2022). One park in particular benefited with additional grant funding for exercise equipment installation. Local churches got involved with marketing and awareness efforts for the program. Many local religious organizations are neighborhood hubs for social gathering, and also have a vested interest in connecting their members with health-promoting programs (Derose et al., 2022). As an academic institution, CSUN benefitted from the program providing opportunities for research and as a source of internships for students in kinesiology and public health.

Community

The American Council on Exercise (ACE) supported research with 3 Wins Fitness, and provided scholarships and personal trainer certification opportunities for the student instructors. This connected these undergraduate students to the larger community of fitness professionals, and opened doors for them through certification and professional networking (American Council on Exercise, 2023). For the local community in the city of San Fernando, the 3 Wins program utilized the park system heavily, and helped to create demand for other health and fitness related programs offered by the city - including an annual 1-mile run event through the heart of the city. Local and large businesses sponsor this event, creating a public-private partnership for the community (*Recreation & Community Services*, n.d.).

Policy

While the 3 Wins Fitness program offered by CSUN ended in the Fall of 2023, the City of San Fernando committed to expanding its own exercise offerings in parks and recreation for at least another year; creating part-time job opportunities for fitness

instructors, and continuing exercise classes at no cost for community members. Additionally, research has been conducted on the program and calls for action by local, state and federal policymakers to prioritize funding community-based physical activity opportunities (3 Wins Fitness, n.d.).

While this example demonstrates a specific program that was implemented using the social-ecological model, it also highlights how each of these areas determines health behaviors and eventually affect health outcomes. The health of an individual is affected by their interpersonal relationships, the community in which the person lives, works, and plays. The health of those members in a community is affected by the organizations they are a part of, the built environment of their community, the economic and political landscape, as well as specific policies that directly or indirectly relate to health. There are stark disparities that exist in the opportunities that individuals and communities have to achieve health, that are not solely based on individual choices. A holistic approach that recognizes the social determinants of health and advances change at all levels of the social-ecological model is necessary (National Academies of Sciences, Engineering, and Medicine, 2023).

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13.15: Case Study 2- Our Choice/Nuestra Opción- The Imperial County, California, Childhood Obesity Research Demonstration Study (CA-CORD)

A CDC funded program focusing on addressing childhood obesity in Southern California took a similar approach to address multiple drivers of health at the same time. In Imperial County, a community along the border of California and Mexico, the population is predominantly of Mexican origin. Communities are somewhat rural and surrounded by agricultural land, and poverty rates are higher than the national average. One significant health disparity exists there as well: childhood obesity rates in these communities are higher than the state and national average, something that this study aimed to change.

Using various theories of behavioral change, models of organizational change, and family systems theory to inform this project, the researchers took a multi-sector approach: involving pediatricians, community health workers, school teachers, restaurant owners, and families. The program included a healthcare approach for overweight and obese children and their families at federally funded healthcare clinics. Family workshops with trained Community Health Workers (CHWs), included education on healthy eating and physical activity. The CHWs also followed up with motivational interviewing phone calls to parents, and newsletters were sent to the families to encourage them in continuing healthy behaviors. Since local elementary schools didn't have specialized Physical Education teachers, current staff attended training sessions and received new PE equipment to use, both sponsored by the project. A few local restaurants worked with the program to develop healthy kid's menus. Additionally, the project funded education and supplies for community gardens to help families learn more about backyard gardening for fresh produce (Ayala et al., 2015).

While projects like these are time consuming and require the buy-in and contributions of many people, they can be instrumental in causing lasting changes in communities by addressing multiple social determinants of health at once. Ultimately, no single policy or program is likely to cause significant improvements to the social determinants of health alone. Using the social-ecological model (and other theories) can help public health practitioners design effective, meaningful programs that initiate positive changes for individuals, families, communities, and eventually - whole populations.

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13.16: Summary

Summary

Many health outcomes are related to behaviors, which are also influenced by individual experiences and beliefs, self-efficacy, social and cultural norms, as well as the communities in which we live - including the social, physical, economic and political environments that make them up. Changing behaviors at a population level may seem like an insurmountable task - akin to turning a cruise ship - but societies have done so over the course of history so it is not impossible or even improbable. Well-designed health promotion programs can be a part of initiating and continuing behavioral and societal changes that bring about better health for all.

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CHAPTER OVERVIEW

14: Healthcare Administration and Policy

Learning Objectives

- Analyze the organization, financing and delivery of various medical and population-based services in the U.S. healthcare system.

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14.1: Introduction

Compared to other wealthy countries, the U.S. is unique in that it does not have a universal or government-sponsored healthcare system. Instead, the federal government (through Medicare and Medicaid) and a few large health insurance companies are the primary payers for healthcare. Health insurance is either provided by an employer, or purchased privately by individuals. The Affordable Care Act provided subsidies for low income individuals which did help increase coverage - but to date has never reached 100%. In 2023, the uninsured were at the lowest percentage yet - only 7.7% or around 25.3 million Americans still lacked health insurance coverage. In this chapter, we will cover the basics of the U.S. healthcare system: government funded programs, health insurance terms, and a few key issues facing U.S. healthcare.

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14.2: The U.S. Healthcare Model

The United States has a long history and culture of independence, self-reliance, and individualism. There is a cultural belief that those who work hard over time will be successful, and reward should not be universal, but based on merit. This strong emphasis on the individual also seeps into the U.S. healthcare model and creates resistance against the more collectivist models utilized in other countries. Combine this sense of individualism with gigantic healthcare, pharmaceutical, and health insurance markets, and we get a sense of the U.S. healthcare model. Yet a long healthy life free from illness or injury is not guaranteed to those who work hard, nor is the healthcare market ever a "free" market - it will always be imperfect (Shi & Singh, 2017). The demand for healthcare is based on the health status of individuals, which is influenced by genetics, biology, environment, and behaviors, as well as other social determinants. On the supply side, technology, specialization, and accessibility will all play into how healthcare is delivered and distributed.

Thus, the United States healthcare system can be visualized as a four-part system or quad-function model (see Fig. 14.2.1 below). This includes the financing, insurance, payment, and delivery of care. Sometimes these components overlap or are closely integrated.

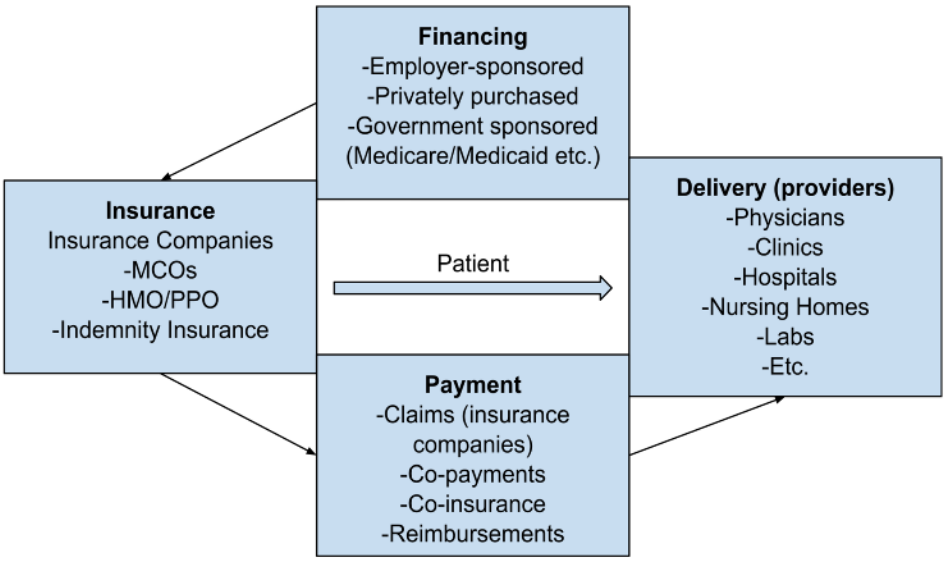


Figure 14.2.1: Diagram of the Quad-Function Model of Healthcare. Adapted from (Shi & Singh, 2017).

According to the Center for Medicare and Medicaid Services, the National Healthcare Expenditure in 2022 was up 4.1% from the previous year at $4.5 trillion, or about 17.3% of Gross Domestic Product (GDP). Essentially, 17.3% of the U.S. economy is taken up by healthcare. This amounts to about $13,493 per person. The average growth in healthcare expenditures has been about 4.8% per year on average between 2014-2020. In 2022, the federal government spending was the largest piece of the expenditure pie at 33%, and households (including premiums and out of pocket costs) were close behind at 28%, whereas private businesses contributed 18%. See Fig. \(\PageIndex{2}\ below.

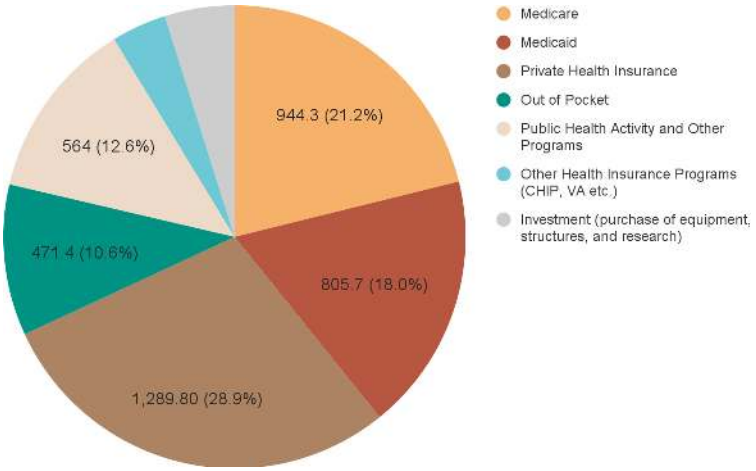


Figure 14.2.2: National Health Expenditures 2022. Amounts in billions. Source: NHE Fact Sheet, CMS.gov. (Centers for Medicare & Medicaid Services, 2023)

Although this chapter focuses on U.S. healthcare, it is enlightening to compare per-capita healthcare spending with other countries of similar wealth. The Organization for Economic Cooperation and Development (OECD) recorded the average spending for similar nations was equal to approximately $5000 U.S. dollars (USD) per capita in 2022. For example, Switzerland and Germany spent an average of $8000USD per capita, and Australia, New Zealand, and Canada spent between $6000-$7000USD. Several other European and South American countries have considerably lower expenditures (OECD, 2023). When expressed as a percentage of the gross domestic product (GDP) for each country, the U.S. healthcare expenditure still outpaces other wealthy countries. See Fig. 14.2.3 below.

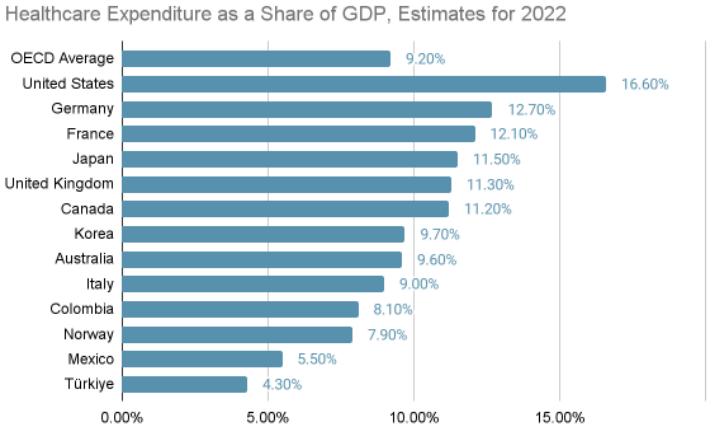


Figure 14.2.3: Healthcare expenditures by country estimated as a share of gross domestic product, 2022. Adapted from data downloaded at https://www.oecd.org/health/health-data.htm

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14.3: Privately Funded Healthcare

Health insurance originally began as catastrophic insurance - that is, if you were ill or injured enough to land in a hospital, it would help to pay for your stay so that you didn't experience financial ruin. One of the earliest of these plans was Blue Cross - which helped fund a person's stay at hospitals which were largely religious or charitable organizations. At first, Blue Cross was a non-profit entity, created along those same lines of charity. In the early part of the 20th century, technology was just beginning to advance medicine, and so often hospitals were solely places for those on death's door. After WWII, due to labor shortages and wage freezes, employer-sponsored health insurance emerged as a way to increase compensation for workers - and employers didn't have to pay taxes on it either. Thus, health insurance started to become an employment benefit more than a privately purchased commodity (Rosenthal, 2017).

In recent decades, the profit motive has started to affect health insurance substantially. For-profit health insurance companies like Aetna and Cigna came on the scene in the 1950's, and began to enroll primarily young, healthy people - who are obviously more profitable: they tend to pay premiums for longer, and they don't get sick as much. Over the decades, this has caused non-profit health insurers to have to become more like for-profit companies. All health insurance companies have focused on ways to control or cut costs, reduce risks, and many of them have been accused of prioritizing CEO pay and investor dividends over patient health outcomes (Rosenthal, 2017). Prior to the Affordable Care Act (ACA) of 2010 (aka "Obamacare), health insurers could deny coverage for patients with "pre-existing conditions", thus leaving those chronically ill on their own financially. The ACA also included an emphasis on preventative healthcare, which many health insurance plans have turned their focus to in order to decrease costs down the road.

Kaiser Permanente (KP), a non-profit organization, was originally developed for workers building dams, aqueducts, and eventually military ships. They prioritized prevention, and worker's health and safety. Over the decades they have evolved to include three parts: the Kaiser Permanente Foundation Health Plan, Kaiser Foundation Hospitals, and the Permanente Medical Group (practitioners) - and have grown to become the largest healthcare provider in the U.S. (Permanente, 2023, Kissell, 2024). The KP model provides just some examples of how the healthcare system can decrease costs: their large size, use of primary care physicians as "gatekeepers" to refer to specialists, integration of systems and emphasis on preventative care all help to reduce healthcare expenditures. All of these measures have both benefits and drawbacks.

Many people lack an understanding of healthcare systems and health insurance in general (see also Health Literacy in chapter 8). Below is a brief breakdown of common terms used in health insurance and their implications to the beneficiary (aka insured person).

Health Insurance Terminology

Health insurance plans come in a variety of types, with different coverages and costs to employers and beneficiaries. Here are some of the most common types of health insurance plans.

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14.3.1: Indemnity Plan

The oldest type of health insurance plan allowed for the insured person to visit any doctor - including primary care physicians and specialists. The doctor would then bill the insurance company for any visits or procedures done, the insurance company would pay the portion outlined in the plan, and then the doctor would bill the patient for the remainder. This type of insurance plan is also known as a fee-for-service model, and although it used to be the most common type of employer-sponsored healthcare plan, it is almost non-existent today. The problem with this fee-for-service model is that neither the doctors nor the insurance companies were incentivized to control costs and avoid any unnecessary “utilization” or medical procedures. In fact, doctors are incentivized to do just the opposite - perform as many tests and procedures as they could justify, thereby making more money from treating each patient. Similarly, insurance companies could simply pass on the high costs to employers by increasing premiums year over year. Since the 1990s, these plans have become untenable for most employers and beneficiaries (who could be charged large balance-bills), and so very few health insurance organizations offer indemnity plans (Shi & Singh, 2017).

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14.3.2: Managed Care Organizations

Managed Care Organizations (MCOs) include both Preferred Provider Organizations (PPOs) and Health Management Organizations (HMOs). MCOs make up the majority of health insurance plans in the marketplace today, including those offered by employers and on state or national marketplaces created by the Affordable Care Act (ACA). Doctors and other healthcare providers are paid in different ways, either through capitation (a per-member-per-month fee) or through established amounts for similar services (often called prospective reimbursement). Some organizations contract with a provider organization which pays doctors and other healthcare providers salaries, eliminating the need for doctors to be involved with costs at all. These methods reduce the incentives for doctors to perform unnecessary medical procedures or tests, and helps prevent premiums from rising uncontrollably. The primary difference between a PPO and an HMO is the choice of doctors. A PPO typically has contracts with providers (or provider organizations), and those “in-network” providers are covered by the insurance plan at a specific percentage. A PPO patient can go see another doctor, but an “out-of-network” doctor visit would be covered at a lower percentage. For example, an 80/60 plan would cover 80% of the cost of an in-network provider, but only 60% of the cost of an out-of-network provider. An HMO on the other hand, only covers specific providers, and requires a referral from a primary care physician for someone to see a specialist (Shi & Singh, 2017)

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14.3.3: Premiums

Premiums are the monthly costs of the health insurance plan, similar to a subscription for a streaming service for music or television shows. Typically these are set for a year at a time, and often insurance companies increase premiums in subsequent years to offset ongoing increases in healthcare costs. Premiums are paid by the employer, the insured, or shared by both, and are based on the number of people covered under the healthcare plan (i.e. whether a single person, their spouse and/or dependent children are covered). Premiums are not based on usage - so the premiums are the cost of the insurance regardless of how frequently the beneficiaries see the doctor or what their healthcare costs are. By collecting premiums, healthy people who visit the doctor less essentially cover the costs of sicker people who use healthcare more. If the insurance company has more healthy folks than sick folks paying premiums, then their financial risk is lower.

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14.3.4: Deductables

A deductible is the amount that the insured person must pay for their healthcare before the insurance “kicks in” to pay the remainder. If a person never gets sick or injured and doesn’t visit the doctor throughout the year, they won’t have to pay any more than their premiums. If they do get sick or injured, then they’ll have to pay up to the deductible amount, after which insurance pays the rest. Deductibles vary by plan, but typically have an inverse relationship with premiums. If premiums are high, deductibles tend to be lower, and if premiums are lower, deductibles tend to be high. For example, if a person breaks their arm and has a trip to the emergency room (ER), the entire visit might cost $2000. If their deductible is $3500, they would have to pay the full $2000. However, if they required surgery and a hospital stay that totaled $150,000, they would only be responsible for the $3500 deductible amount before their insurance would begin to help cover the cost. This doesn’t mean that the insurance would pay the remainder of the bill however - see coinsurance and out of pocket maximum below (Cigna Healthcare, 2023).

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14.3.5: Copayments

Copayments or copays are a flat rate that is charged at the point of service for specific services, such as doctor visits (apart from the yearly physical), specialty visits or therapy sessions. For example, if a person visits urgent care for a persistent cough, then is referred to a specialist, each of those visits might incur copayment costs. These don't usually factor into the deductible (Cigna Healthcare, 2023).

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14.3.6: Coinsurance

Coinsurance is a cost-sharing arrangement for medical expenses when the insurance does “kick in”. It’s typically a percentage of the total cost that is paid by the insured vs. the insurance company. So for example, our broken arm from earlier turns into an ER visit, X-rays, a hand surgery, and hospital stay, totaling $150,000. If the deductible is $3500, the patient would pay that first. Then let’s say they had an 80/20 coinsurance plan: their insurance company would pay 80% and they would pay 20% of the remaining bill (Cigna Healthcare, 2023).

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14.3.7: Out-of-Pocket Maximum

Most plans also have an annual out-of-pocket maximum, which is the total amount the beneficiary would have to pay that year. Deductibles, copays, and coinsurance all count toward this maximum. So let's add to our previous example that the person who broke their arm had a $7000 out of pocket maximum. They had already paid their $3500 deductible, then would be responsible for 20% of the remaining costs (coinsurance), up until that $7000 out-of-pocket maximum is met - then the insurance company is responsible for 100% of the remainder of the bill. So let's say that after this broken arm/hand surgery scenario, they required physical therapy visits. Normally they would have to pay a $50 copayment for each visit, but since their out-of-pocket maximum had been met the insurance company covers the copayment for the rest of the year. Now, if the broken arm had only required the ER visit and an X-ray, and the total bill was $5000, the insured would have to pay the $3500 deductible, then 20% of the remaining $1500 ($300), and would have to pay those $50 copays for physical therapy *until* the out-of-pocket maximum had been met for the year (Cigna Healthcare, 2023).

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14.3.8: High Deductible Plans and Health Savings Accounts

Certain High Deductible Health Plans (HDHPs) are also eligible for Health Savings Accounts (HSAs). These accounts are pre-tax savings accounts that rollover each year and can help someone put aside money to have in case of a medical emergency. By law, the HDHPs must have between certain minimum and maximum deductible and out-of-pocket maximum amounts. For 2024, the minimums were $1600 deductible for a single person, and $3200 for a family, and the maximum amounts were $8,050 and $16100 respectively (IRS, 2024). Often HDHPs will have a deductible that is close to the out-of-pocket maximum, so also having the HSA can help prevent medical debt from accruing on credit cards or causing bankruptcy in the event of a very costly medical bill. HDHPs tend to have lower premiums, and so are popular with younger, healthy folks who tend to not need a lot of doctor's visits, medications, or procedures (Healthcare.gov, n.d.).



Figure 14.3.8.1: (Photo by Big Pixel Photo from Freerange Stock)

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14.4: Publicly Funded Healthcare

Publicly funded healthcare in the U.S. is offered for specific groups, based on income, age, or military service. The beneficiaries, or people that benefit from these programs, must be in one of the covered groups in order to be eligible for coverage - and they may also be required to pay premiums or copays for certain aspects of their healthcare.

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14.5: Medicare

Title 18 of the Social Security Act Amendments of 1965 created a healthcare fund for seniors - anyone over the age of 65. In 1973 two other groups were added to the list: anyone receiving social security benefits, and those with end-stage renal disease (ESRD) who require dialysis (HHS/CMS, 2009). Medicare began with Part A and B, and more recently added Part C and D. The different parts of Medicare are funded through federal employer and payroll taxes, as well as premiums for those who sign up for additional coverage. Since it is a federal program, it has the same coverage no matter what state the beneficiary resides in, and anyone who qualifies can enroll - regardless of how much money they make. There are specific income-based subsidies for premiums though, designed to assist low-income seniors (Shi & Singh, 2017). Those who don't qualify for Medicaid can also purchase supplemental insurance coverage (Medigap) from private insurance companies, which can help to offset the costs of the typical Medicare deductibles and coinsurance (Medicare.gov, n.d.-b).

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14.5.1: Part A

Hospital Insurance constitutes Part A Medicare. The purpose of this insurance was to prevent financial ruin for seniors from an expensive hospital stay - which many seniors may experience. Part A does not require that beneficiaries pay monthly premiums if they or their spouse paid Medicare taxes for 10 years or more. If this is not the case, they can still receive Medicare but will have to pay a monthly premium (or the premiums may be covered by Medicaid if they cannot afford it) (Shi & Singh, 2017). Medicare Part A does have a deductible that must be paid for each benefit period before the insurance covers the rest. For example in 2024: the deductible is $1632 for each stay at a hospital or skilled nursing facility, and a benefit period is any incidence separated by 60 days or more. So if a person was admitted to a hospital for a week, and then came back the next week, they wouldn't have to pay their deductible again. However, if they had a hospital stay at the beginning of the year and then another admittance 3 months later, they would need to again pay that deductible for the second stay as well (Humana, 2023). Long-term care at a skilled nursing facility, home healthcare, and hospice care are also covered under Part A.

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14.5.2: Part B

Because Part A is only for inpatient care (aka staying in a hospital or skilled nursing facility), Medicare Part B was created to cover doctors visits and other medical needs such as the purchase of medical equipment. For 2024, the deductible for Part B is $240, after which patients pay a 20% coinsurance for the remaining expenses (Humana, 2023). It is important to note that Medicare also sets reimbursement rates for doctors. Doctors can either participate in accepting Medicare or non-participating practitioners may charge patients at the time of service. Then, either the doctor or the patient can submit a claim to medicare to get reimbursed. Non-participating doctors cannot charge over 15% higher prices than what Medicare has approved for a service (Medicare.gov, n.d.).

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14.5.3: Part C

Also called Medicare Advantage, Part C allows Medicare enrollees to use a plan offered by a private insurance company that includes Parts A, B, and D. This is often an MCO, and may require insureds to use in-network providers. However, there may be other benefits such as lower out-of-pocket costs and vision, hearing, and/or dental benefits (Medicare.gov, n.d.-b).

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14.5.4: Part D

Prescription drugs are covered under Part D, which can also be provided by a Medicare Advantage plan (Part C). As part of the Inflation Reduction Act signed into law by President Joseph Biden in 2022, Medicare will begin negotiating prescription drug costs which will take effect in 2026. The first 10 drugs that were chosen for negotiation are used to treat common, chronic diseases like diabetes and cardiovascular diseases (Centers for Medicare & Medicaid Services, 2024).

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14.6: Medicaid

Medicaid was first enacted as part of the social security act (title 19), with the intention of providing medical care to those experiencing extreme poverty. It is a joint-financed program with at least 50% of the funding coming from the federal government, and the remaining funds from the state. Wealthier states end up contributing more than poorer states (Shi & Singh, 2017). Along with the Children's Health Insurance Program (CHIP), Medicaid provides insurance to 77.9 million Americans. People are eligible for the program if they: have a disability or blindness, are over the age of 65, or are children whose family makes up to 133% of the Federal Poverty Level (FPL) in income. Recently, Medicaid expanded coverage to any adult that met the income threshold up to 138% of the FPL, but states can opt to participate in this expansion or not. (Centers for Medicare & Medicaid Services, n.d.). The expansion extends eligibility to nearly all adults making up to $20,783 per year, or $1731 per month (for an individual adult) in 2024. To date, only 10 states have opted out of the expansion: Alabama, Florida, Georgia, Kansas, Mississippi, South Carolina, Tennessee, Texas, Wisconsin and Wyoming. Texas has the lowest income threshold above which people are ineligible for Medicaid: for parents in a family of three this is just $4131 per year or $344 per month (Lopez et al., 2024). Many childless adults in these states fall into the "coverage gap" where they make too much income to qualify for Medicaid but not enough to qualify for federal subsidies to purchase healthcare through the marketplace. These folks often work low wage and/or part time jobs, and either may not be offered employer-sponsored healthcare coverage, or may find it too expensive (Drake et al., 2024).

During the COVID-19 era, states were required to maintain all enrollees during the emergency period. After the emergency period ended in March 2023, states began the process of "unwinding", or reexamining eligibility for the millions of Americans receiving Medicaid (Unwinding and Returning to Regular Operations after COVID-19, n.d.). Due to technical errors and the complicated enrollment and renewal processes, many Medicaid recipients were either incorrectly dropped or found it difficult to renew their Medicaid insurance. About 8% of those previously receiving Medicaid are now ineligible, and consider purchasing health insurance cost-prohibitive. The unwinding process is adding to the number of uninsured Americans (Lopez et al., 2024).

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14.7: Other Sources of Public Healthcare

Publicly-funded healthcare is also provided to the military and Department of Defense, federal employees, prisoners, American Indian and Alaska Natives (through the Indian Health Service) and veterans (through the Veterans Administration). The Veterans Health Administration (VHA) includes 172 VA Medical Centers and over 1100 outpatient facilities that provide for the healthcare needs of over 9 million veterans. The VHA also contracts with other community based clinics to provide easier access for outpatient services like primary care visits (Veterans Health Administration, 2023). This partnership was due to legislation passed by Congress in 2014 called the Veterans Choice Act, which was in response to increasing awareness and media coverage of the long wait times that veterans experienced at VA medical facilities. Because the VHA traditionally functions as both the provider and the payer, contracting the provider services out to community-based facilities creates new challenges for coordinating care to meet veterans' needs (Rasmussen & Farmer, 2023).

The history of the Indian Health Service (IHS) was covered briefly in chapter 3. Healthcare services covered through the IHS are funded differently than Medicare and Medicaid in that they are a part of the federal government's discretionary budget. Tribes can also have more local control via "compacting" ,which provides a block grant for the tribe to coordinate and provide their own healthcare services according to local needs. Health disparities still exist and access to healthcare is still challenging for many of the 2 million American Indian/Alaskan Natives (AI/AN) served through the IHS, due in large part to chronic underfunding, a lack of trained professionals, a lack of access to healthcare in remote locations, and the need for culturally sensitive healthcare practices (Kruse et al., 2022).

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14.7.1: Community Health Centers

Community Health Centers or local clinics provide comprehensive medical services to underserved populations - including those who lack health insurance or housing, those with low incomes, seniors (over age 65), and immigrants or refugees. Patients may be charged for medical services, but on a sliding scale - which means that fees are set based on what patients are able to pay (HRSA, 2024). These health centers receive funding in multiple ways: through block grants from the Health Resources & Services Administration (HRSA), the Centers for Disease Control and Prevention (CDC), Title X Service Grants (for sexual and reproductive health services), and reimbursement from Medicare, Medicaid, and CHIP or the VA. In order to become a Federally Qualified Health Center (FQHC), the clinic must:

- *Be located in or serve a high need community.*
- *Be governed by a community board that is at least 51% made up of health center patients.*
- *Provide comprehensive healthcare services on a sliding fee scale based on ability to pay.*
- *Become a Health Center Program award recipient or Health Center Program look-alike.* (CA Department of Health Care Services, n.d.)
- These clinics provide a broad range of services including:
- Primary care
- Dental and vision care
- Physical and occupational therapy
- Mental health services
- Substance abuse and addiction treatment
- STI/HIV testing and treatment
- Reproductive, maternal and pediatric healthcare
- Vaccines
- Health education

In order to receive Title X funding for reproductive healthcare, clinics must provide a variety of family planning methods, including contraception and infertility assistance. They must provide testing and treatment for sexually transmitted infections (STIs) including HIV. They may not provide abortion services, or even discuss abortion as an option (OASH, 2022). If the clinic does provide abortion services, there are recent (2019) requirements for clearly designating physical separation of those services in a different part of the clinic which receives a different source of funding. These requirements for separation caused many clinics to withdraw from title X funding (Seabert et al., 2021).

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14.8: Health Policy and the Future of Healthcare

Policymaking is an important part of public health. Typically we think of policies as laws, regulations, or funding requirements created and enforced by governments. In the U.S., public health is governed at the local, state, and national levels. The interplay between different bureaucracies - at times cooperative and at others in opposition with each other - can actually have just as much of an impact on health policies as the politicians (and interest groups) who propose them (Shi & Singh, 2017).

A prime example of health policies are those associated with smoking. At the national level, the sale of tobacco products to anyone under 21 years of age is prohibited, and the products must all carry a warning label from the Surgeon General. Additionally, the Food and Drug Administration (FDA) has authority to regulate tobacco products (Office on Smoking and Health, CDC, 2023). At the state level, California was one of the first states to ban smoking in indoor public spaces and workplaces in 1995. Smoking had been previously banned in public schools and daycare centers, and taxes are levied on cigarette purchases to fund tobacco-prevention programs through the CA Department of Public Health. In the 2000's, additional state legislation made smoking illegal on all government property - including state universities and community colleges - and it is also illegal to smoke in a car with a minor present (California Air Resources Board, n.d.). Cities can also enact local smoking bans to protect its residents from environmental tobacco smoke (secondhand smoke), as the city of Burbank in California has done. In Burbank, smoking is prohibited in or around any city facility or park, on any public transit or at any station, on sidewalks in the downtown area, outdoor cafes and event venues, as well as service areas (such as a delivery dock for a restaurant, or a ticket line for a concert) (Burbank Municipal Code, 2024).

Health policies also include the appropriation of tax revenue to fund specific government agencies. The Department of Health and Human Services (HHS) budget for 2024 was $2.37 trillion, which includes funding for Medicare/Medicaid, the Centers for Disease Control and Prevention (CDC), National Institute of Health (NIH), Food and Drug Administration (FDA), Health Resources and Services Administration (HRSA), Substance Abuse and Mental Health Administration (SAMHSA), and Indian Health Service (IHS) as well as other agencies (USAspending.gov, 2024).

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14.8.1: The Affordable Care Act

The largest piece of healthcare reform legislation was passed in 2009 under President Barack Obama, titled the Patient Protection and Affordable Care Act (ACA) and known colloquially as “Obamacare”. Different portions of it went into effect over the following years. One key piece of the ACA was the individual mandate - requiring that every U.S. adult provide proof of healthcare coverage or pay a tax fee - was eliminated by Congress during the subsequent administration of President Donald Trump. However, many states continued to enforce such a mandate or impose a state tax. Yet, other provisions have remained, and proved somewhat effective at reforming healthcare for Americans. Below are some of the most important actions of the ACA.

- Protection for pre-existing conditions. Health insurance companies can no longer deny enrollment to people who have pre-existing conditions, charge them higher premiums, or refuse to cover those conditions. These conditions include things like diabetes, asthma, pregnancy, and cancer. Previously, many insurance companies would reduce their financial risk by refusing to enroll people with pre-existing conditions (at the time of enrollment), or enrolling them but refusing to cover services related to those conditions. These practices are now illegal, however some insurance plans that existed before March 23rd, 2010 were given “grandfathered” status to continue without these protections (Assistant Secretary for Public Affairs (ASPA), 2022, U.S. Centers for Medicare & Medicaid Services, 2022).
- Allowance for young adults to stay on their parent’s insurance plans up until age 26. Young adults may be more likely to work part-time jobs and may not be able to afford purchasing health insurance on their own. They may also not be as concerned about getting coverage thinking they are “young and healthy”, yet 1 in 6 in this age group still has chronic health problems (CMS.gov, 2023).
- Expansion of Government subsidies. The ACA expanded Medicaid coverage to anyone earning up to 138% of the federal poverty level (FPL), and allowed states to choose whether or not to participate in the expansion (with up to 90% of the additional cost covered with federal funds). Additionally, federal subsidies for purchasing healthcare via the marketplace insurance plans can provide assistance via tax credits for people who have higher incomes (KFF, 2023).
- Emphasizing preventative care. The ACA made requirements that marketplace healthcare plans cover 10 essential services, which include the typical hospital stays and emergency services, as well as women’s health, pregnancy, maternity and newborn care, preventative and wellness visits, rehabilitative services, mental health and substance use disorder services, pediatric visits, labs and prescription drugs. The ACA also increased funding for Community Health Centers (Assistant Secretary for Public Affairs (ASPA), 2022)

Other provisions also emphasized health equity by establishing the Offices of Minority Health and focusing resources on improving STI and mental health awareness and access to treatment for the most vulnerable populations (Assistant Secretary for Public Affairs (ASPA), 2022).



Figure 14.8.1.1: US Capital, West Front. (Photo by Chance Agrella from Freerange Stocke)

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14.8.2: Cost Control

One of the biggest challenges facing healthcare administration today is the ballooning costs of healthcare. Healthcare expenditure increases have historically outpaced general inflation (Shi & Singh, 2017) up until the Covid-19 pandemic. During the pandemic, healthcare expenditure increased significantly, with a lot of it being emergency funding for public health initiatives such as research and development of testing kids and vaccines. At the same time, the economy was experiencing a decline due to closures, layoffs, and supply chain disruptions. So healthcare expenditures during 2021 were at an all time high of 19.5% of Gross Domestic Product (GDP), but have since returned to pre-pandemic levels as GDP recovered and Covid-19 policies and funding expired. Still, the general trend since the 1980s has been that healthcare costs are growing faster than general inflation, and taking up a larger and larger portion of the total economy (McGough et al., 2023). Healthcare costs incurred by a third-party payer (such as a private insurance company) are often passed on to the funder - the government, employer, or patient via premium hikes or cost-sharing (coinsurance and deductibles).

It is likely that the cause of increasing healthcare costs is the result of multiple factors. First, healthcare in the U.S. functions in an imperfect or “quasi-market”, not an idealized “free-market” of capitalism. The typical patient does not pay directly for their own healthcare, so they are not going to do the same researching of cost and quality that they might for a different purchase (like when buying a car) (Shi & Singh, 2017). As mentioned earlier, medical operations and medicines are also often needed for survival or physical function, and so patients have no option to wait or save up money. On the supply side of this market, doctors have a lot of control over what healthcare services are utilized. The saying “when you’re a hammer, everything looks like a nail” seems to apply to doctors too - in particular for procedures that have more controversy on their efficacy. Health services research has found that the number of procedures can vary by geographic location based on the availability and practices of specific providers - not any variation in demographics or need. This can result in an overuse of healthcare services, and potentially unnecessary procedures (Schneider, 2020). For example, some doctors might immediately recommend a hysterectomy for women experiencing severe endometriosis, and yet this procedure may not be the cure or remove all of the pain - and can have significant consequences for the patient’s life (Mayo Clinic, 2021).

Secondly, the U.S. population is aging, due to the baby boomer generation (those born between 1946 and 1964) who began reaching retirement age in 2011. Along with those in the previous “silent” generation, baby boomers make up over a quarter of the total U.S. population (Korhonen, 2023). While medical technology has increased the average life expectancy for several decades, this also means the potential for more healthcare utilization and an exponential increase in healthcare costs for this generation in the coming years (USC Sol Price School of Public Policy, 2023). Americans also have increasing rates of obesity and obesity-related diseases like diabetes, heart disease, and certain cancers, which may require long-term medication or treatment (CDC, 2022).

Thirdly, technology and culture surrounding healthcare in the U.S. emphasizes getting “the best of the best”, cutting-edge medicine. American culture still emphasizes individualism and capitalism in healthcare, and this ideology resists top-down government control of healthcare costs. Technology can be both costly and cost-saving, as with electronic health records (EHRs) and telehealth. Transitioning to EHRs may be initially costly, but may increase efficiency and reduce human errors (Shi & Singh, 2017). Similarly, telehealth is becoming more popular, particularly post-pandemic. Telehealth visits, particularly for mental health services, show promise at increasing access and removing some disparities in care (Egan et al., 2022). The use of telehealth highlights other needs such as broadband internet access in rural areas, and patient familiarity with the use of technology. Other advances in medical technology may not always be worth the costs they present (Shi & Singh, 2017).

Other potential reasons for increasing costs include: the practice of “defensive medicine” which is the utilization of procedures, diagnostics, or medications in order to avoid potential lawsuits, and fraud or system abuse. Well-meaning doctors may wish to provide their patients with procedures that might be considered lower-risk, such as performing an unnecessary C-section to reduce the risk of injury or legal liability from a vaginal birth (Shi & Singh, 2017). Medicare and Medicaid fraud are also big problems for the system, but don’t typically stem from improper use by beneficiaries. Organized crime and unethical billing practices by doctors and other healthcare providers are commonly the sources of costly fraud schemes (Zamost & Brewer, 2023).

When access to healthcare improves - whether that be through the expansion of government-sponsored health insurance, or the availability of local resources (like the building of a new healthcare facility) - the utilization of healthcare services increases. When people get on a health insurance policy and all of a sudden have access to a doctor, they might go in for check-ups and procedures they had been putting off due to the cost. The availability of a new diagnostic tool, surgical procedure, or medication might influence doctors to utilize it more, and patients to request it more. Yet the more utilization of visits, diagnostics, medicines and procedures occurs, the more healthcare expenditures continue to climb. One oft-cited study done by the Rand Corporation between

1971-1982, compared individuals in a variety of healthcare plans including a free version, and one with high coinsurance (95%) . The results of the study indicated that cost-sharing (with high coinsurance for patients) helped decrease utilization and avoid unnecessary doctor's visits, but didn't necessarily decrease health outcomes compared to free insurance plans. However, poor individuals with chronic diseases benefited greatly from free healthcare (Brook et al., 2006). Is it necessarily bad that more access equals more usage of the healthcare system? Does the utilization of healthcare services always reflect a direct need? Does the potential for profits drive the research and development of new and better medical care? The U.S. spends the most on healthcare compared to other wealthy nations, and yet has worse health outcomes in several areas (Peter G. Peterson Foundation, 2023). The discussion around healthcare costs and efficacy in the U.S. is certainly a complicated one.

So what measures are being taken to control costs, and who is taking them? With MCOs, the primary care physicians (aka PCPs, family doctors, internists, etc.) are responsible for "gatekeeping", or referring patients to a specialist, ordering laboratory or diagnostic tests (such as MRIs or X-rays) - thus preventing patients who don't need these services from taking up important resources. Health insurance companies have also moved away from fee-for-service models to paying providers with capitation (a fixed amount per patient per month), or with diagnosis-related groups (DRGs - a fixed amount for a specific type of illness or treatment), or with cheaper negotiated fees within networks. All of these changes in payment systems attempt to control costs and incentivize providers to provide both economical and effective care. Other methods include focusing on performance - using quality assessments and peer review to advise reimbursements or fee negotiations. Employers may also decide to increase cost-sharing with patients in order to deter them from overutilizing healthcare for unnecessary ailments. (Shi & Singh, 2017).

One of the areas that contributes to high expenditures in the U.S. but not in other countries is healthcare administration (Peter G. Peterson Foundation, 2023). It can be argued that this is mostly due to the complicated system of funding, paying, and providing healthcare, as well as the for-profit, capitalist model. Other OECD countries have different systems of providing healthcare that cost less to administer, including nationalized health insurance (as in Canada), nationalized health systems (as in the U.K.), and socialized health insurance (as in Germany) (Shi & Singh, 2017). This is also evidenced by the lower administrative costs incurred by traditional Medicare, vs Medicare Advantage plans (Part C) which are contracted out to insurance companies to administer via HMOs and PPOs. As more baby boomers are eligible for Medicare, and as Medicare Advantage plans are becoming more popular, these administrative costs are going up (Cubanski & Neuman, 2023).

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14.9: Summary

Summary

Healthcare in America is complicated, and fraught with corporate and political agendas. While public health is focused mostly on primary prevention at the population level, the healthcare industry meets the needs of individuals and communities for primary, secondary, and tertiary care. Access, cost, and quality of healthcare are all important factors for population health. Public health professionals may work within or adjacent to the medical field, or on policymaking at the local, state, or national level, and so should understand the history, current needs and political climate surrounding healthcare.

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