Course Book

INTRODUCTION TO PUBLIC HEALTH

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INTRODUCTION TO PUBLIC HEALTH

MASTHEAD

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INTRODUCTION

WELCOME

SIGNPOSTS THROUGHOUT THE COURSE BOOK

This course book contains the core content for this course. Additional learning materials can be found on the learning platform, but this course book should form the basis for your learning.

The content of this course book is divided into units, which are divided further into sections. Each section contains only one new key concept to allow you to quickly and efficiently add new learning material to your existing knowledge.

At the end of each section of the digital course book, you will find self-check questions. These questions are designed to help you check whether you have understood the concepts in each section.

For all modules with a final exam, you must complete the knowledge tests on the learning platform. You will pass the knowledge test for each unit when you answer at least 80% of the questions correctly.

When you have passed the knowledge tests for all the units, the course is considered finished and you will be able to register for the final assessment. Please ensure that you complete the evaluation prior to registering for the assessment.

Good luck!

BASIC READING

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LEARNING OBJECTIVES

Healthy populations are more likely to be productive, save more time and money, and live longer than those that are less healthy. People's happiness and well-being depend on their physical and mental health, which has a significant positive impact on success, prosperity, and even economic development. It is at this nexus that we experience the impact and importance of public health. Whether it is access to clean water, receiving sufficient nutrition, being able to receive high-quality healthcare services, or having the tools to improve one's lifestyle, members of society frequently work together to promote group health. The objective of public health is to prevent sickness and promote well-being for all.

Key elements of public health include implementing health policies, respecting public health laws, ensuring equitable establishment of and accessibility to public health programs, and creating a public health workforce to regularly assess and improve public health programs. Public health can encourage basic wellness practices, such as staying hydrated and getting enough sleep, but it often denotes a concerted effort to safeguard the health of a huge population. For instance, public health can guide populations around the world on what to do when there is a global pandemic or how to prevent chronic diseases through lifestyle changes.

This **Introduction to Public Health** course book introduces students to the principles, values, and practices of public health. It will demonstrate how public health theory may be used to examine current problems with local and global health, as well as their causes. The physiological, cognitive, environmental, behavioral, social, and international determinants of health, as well as their interactions, shall be the main topics of this text. Additionally, it will enable students to apply theory, exercise critical thinking, and talk about public health ethics in a variety of contexts.

UNIT 1

WHAT IS PUBLIC HEALTH?

STUDY GOALS

On completion of this unit, you will be able to...

- define public health.
- discuss the various disciplines of public health.
- describe the analytical methods of public health.
- differentiate between medical care and public health.
- understand the sources of public health data.
- explain what evidence-based public health is.

1. WHAT IS PUBLIC HEALTH?

Introduction

This unit will be an introduction to public health. It will be defined, its origins and disciplines will be discussed, and its importance will be highlighted. Then, we will explore the different analytical methods used in public health, followed by the differences between medical care and public health, which will be shown by comparing and contrasting both concepts and examining the relationship between them. Finally, the various sources of public health data and information will be explained, and the unit will end with a discussion of evidence-based public health.

1.1 Origins of Public Health: Historical Perspective

Health
This is defined as the "state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization [WHO], 2020a, p. 1).

Before delving into the origins of public **health**, it is important to define and explain the term.

~~What is Public Health?~~

Public health has been defined as the science and art of preventing disease, prolonging life, and enhancing health and well-being via coordinated efforts and intelligent choices made by governments, public and private organizations, communities, and people (Schneider, 2020). Public health strives to enhance and protect people's well-being, including the communities in which they live, learn, work, and play. Another definition of public health is planned actions (public or private) to safeguard the population's health, prevent disease, and lengthen lifespans. From this definition, we can understand that public health aims to create settings that promote overall population health instead of focusing on specific patients or disorders. In addition, the study of public health examines the elements that influence the health of the public and the threats that it faces. The public ~~may cover~~ a small number of people, an entire town or city, or many continents (in the case of a pandemic). It is crucial to understand that, while talking about public health, the concepts of physiological, psychological, and sociological well-being are all taken into consideration (Schneider, 2020).

Public health is characterized by interdisciplinarity. For instance, social sciences, epidemiology, biostatistics, and health management are all relevant (Turnock, 2012). However, it also includes other significant subfields, such as workplace safety, disability, gender issues in health, sexual and reproductive health, health economics, public policy, mental health, and politics of health. Thus, it can be said that a country's healthcare system should include public health, as well as primary, secondary, and tertiary care, because

carrying out public health activities includes examining health indicators, such as life expectancy, while promoting behaviors that improve health (Turnock, 2012). Some examples of public health interventions and initiatives include

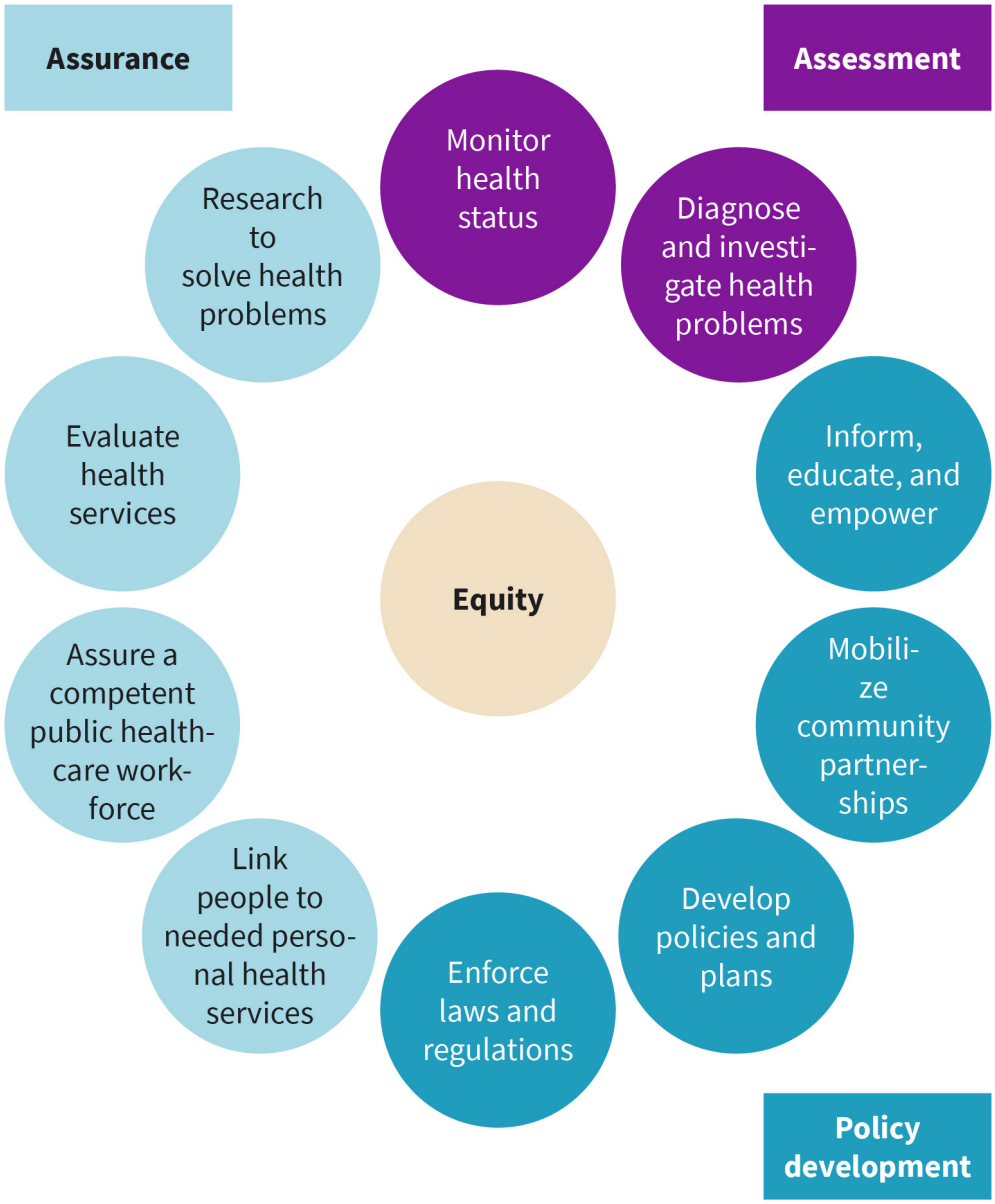
- vaccination against preventable diseases,
- improving road safety,
- creating safer workplaces and environments,
- passing regulation for safer and healthier foods,
- the provision of safe drinking water,
- tobacco control, and
- promoting mental health awareness.

Essential Functions of Public Health

Public health is known to include ten essential functions (CDC, 2022a):

1. Keep track of health statuses to spot and address issues at the level of the overall populace.
2. Recognize and research health issues and dangers.
3. Educate, empower, and inform the public about health issues.
4. Encourage community cooperation to find and address health issues.
5. Create plans and policies to support community and individual health initiatives.
6. Uphold laws and rules that establish safety and promote good health.
7. Ensure the provision of healthcare when it is otherwise unavailable and connect people to the necessary personal health services.
8. Ensure a skilled workforce in both public and private healthcare.
9. Assess the quality, efficiency, effectiveness, and accessibility of health services.
10. Gain new insights, inventive approaches, and creative remedies for health issues, which are developed through research.

Figure 1: Essential Public Health Functions



Source: Mirna Naccache (2023), based on CDC (2022a).

A typical plan of action in public health includes the following steps:

1. Determine and describe any health issues.
2. Name the elements or determinants contributing to the issue (risk factors).
3. Create and evaluate interventions to manage or stop the issue.
4. Evaluate the success of the interventions.

History of Public Health

The history of public health was influenced by many historical ideas, trial and error, the development of the basic sciences, innovation, and epidemiology (Rosen, 2015).

Examples of historical developments with modern applications include the discovery that **cowpox** vaccination restricts smallpox and the 1756 clinical trial of specific nutritional therapies for British sailors with vitamin-C deficiency (Rosen, 2015). These approaches were established through scientific investigations and trial and error. It is beneficial to explore historical perspectives on community health challenges and how to handle them, as nutrition and immunization have a significant influence on health in both high- and low-income countries.

Cowpox
This is an infectious disease (CPXV) that normally manifests as huge skin blisters, fever, and swollen glands after contact with an infected cow. There have been isolated occurrences of cowpox in people (Baxby et al., 1994).

This perspective enables us to assess how earlier societies coped with sickness (Rosen, 2015). All civilizations must accept the reality of disease and death and establish concepts and methods for coping with them. However, these concepts are also connected to social and cultural norms, beliefs, and practices that are essential for determining one's health status, as well as for therapeutic and preventive health treatments (Rosen, 2015).

The history of public health is centered on the quest for effective strategies to uphold population health and prevent disease (Rosen, 2015). Infectious diseases that are endemic or pandemic promote innovation and advancement in disease prevention prior to the scientific identification of the cause. Key elements of preventing disease in communities include identifying diseases, monitoring their prevalence, and seeking effective interventions (Rosen, 2015).

Public health developed through trial and error and the advancement of scientific medical knowledge, which were frequently prompted by conflict and natural disasters (Rosen, 2015). In particular, urbanization, social change, and other elements of the expansion of community life enhanced the need for coordinated efforts for health protection. Religious and societal perspectives had an impact on how communities and governments described contagious disease and attempted to manage it via sanitation, urban planning, and the provision of medical care. Historically, societal systems and faiths have often viewed scientific investigation and the sharing of knowledge as dangerous. This has limited progress in public health, as exemplified by opposition to birth control, immunizations, and food fortification (Rosen, 2015).

The historical burdens of communicable diseases (also known as infectious diseases) still plague societies today, along with non-communicable diseases (also known as chronic diseases) such as heart disease, cancer, mental illness, and trauma (Rosen, 2015). Public health professionals must find fresh approaches to averting the negative social repercussions that the rise of acquired immunodeficiency syndrome (AIDS), severe acute respiratory syndrome (SARS), avian influenza (also known as bird flu), and drug-resistant bacteria may have. Health risks in a world with severe climate change and ecological destruction have harsh and perhaps disastrous repercussions for society (Rosen, 2015).

Pathogens (like bacteria, viruses, and fungi), the environment, and their host all change as the state of public health evolves (Berridge & Loughlin, 2003). Understanding the past is essential for dealing with the challenges that lie ahead. Although the present has many novelties, current debates and controversies in public health have roots in the past. A crucial tool in the creation of health policy is past experience. Public health professionals may better navigate the public health landscape of today and tomorrow if they are aware of how such issues have developed, their context, and innovative remedies (Berridge & Loughlin, 2003).

Before and During the 19th century

Public health can be traced back to ancient times. It is important to review the evolution of various public health concepts considering the field's long history, which dates back to antiquity. For example, during the Middle Ages, patients diagnosed with **leprosy** were held in isolation (Tulchinsky & Varavikova, 2014). Similarly, in the 14th century, there were efforts to promote more hygienic practices. As Europe's population increased, so did hospital construction and knowledge of infant mortality. Contemporary public health agencies and organizations were created as a result of these advancements to manage disease within communities and supervise the availability and distribution of medications. Additionally, the relationship between environment and disease became better understood over time, and from the early 15th century onward, plague epidemics sparked initiatives to advance sanitation (Tulchinsky & Varavikova, 2014).

Leprosy
This is a chronic infectious illness caused by the bacteria *Mycobacterium leprae*. The upper respiratory tract mucosa, peripheral nerves, skin, and eyes are the primary organs affected by the illness. Leprosy can be cured, and early treatment can reduce disability (WHO, 2022b).

In the 16th and 17th centuries, years of technological advancement culminated in a number of scientific discoveries. Educated leaders of the era understood that maintaining the population's health was essential to the state's political and economic power (Tulchinsky & Varavikova, 2014). However, globally, there were almost no national health programs created, as the vast majority of governments lacked the administrative capacity and expertise to implement them. As a result, just as in the Middle Ages, local communities continued to tackle public health issues. The foundations of anatomy and physiology were laid by scientific discoveries in the 16th and 17th centuries. During this time, more accurate identification of diseases was made feasible by observation and classification, and the hypothesis that microscopic creatures may spread contagious diseases began to take shape. English statistician John Graunt was one of the early innovators in public health medicine. In 1662, he released a book of statistics that included numbers of deaths and, occasionally, causes of death that had been collated by parish and municipal governments. Despite the data's inevitable inaccuracy, this successfully laid the groundwork for epidemiology (Tulchinsky & Varavikova, 2014).

Another breakthrough took place in 1854 with John Snow's discovery of a contaminated public water well as the cause of a London cholera outbreak, which laid the groundwork for the science of epidemiology (Tulchinsky & Varavikova, 2014). Snow disagreed with the dominant miasma hypothesis and supported the germ theory of disease. He discovered the cause of the epidemic to be the public water pump on Broad Street by speaking to locals. Despite the fact that Snow's chemical and microscopic analysis of a water sample from the Broad Street pump could not definitively demonstrate its danger, his studies of the disease's pattern were persuasive enough to convince the town council to shut the well pump simply by removing its lever. Later, Snow used a dot map to show the fre-

quency of cholera cases close to the pump. Additionally, he provided data to demonstrate the connection between cases of cholera and water source quality. He demonstrated how the Southwark and Vauxhall Waterworks Company was supplying dwellings with water that had been drawn from sewage-contaminated areas of the Thames, which increased the cholera prevalence. Snow's study was a significant development in the history of geography and public health. It is for this reason that John Snow is considered to be the father of the science of epidemiology, which is one of the cornerstone disciplines of public health. Equally as important is the fact that, in the 1800s, vaccination became a common practice as a result of Edward Jenner's groundbreaking work in treating smallpox (Tulchinsky & Varavikova, 2014).

During and After the 19th century

Living conditions for working people started to deteriorate with the start of the Industrial Revolution, as crowded and unhealthy urban settings proliferated (Tulchinsky & Varavikova, 2014). In countriesthat experienced the Industrial Revolution (~~such as~~ England), the population doubled in the first four decades of the 19th century alone, while the new industrial towns experienced even faster growth rates. In the vast conurbations that sprung up around the factories and workhouses, this rapid urbanization made it easier for diseases to spread. These towns lacked formal sanitation and were small and crowded. Due to the residents' subpar living conditions, disease was rampant among these communities. Slums grew quickly as a result of a lack of housing, and the per capita death rate drastically increased, nearly tripling in most industrialized countries (Tulchinsky & Varavikova, 2014).

At the start of the 19th century, philanthropists and humanitarians tried to educate the public and the government about issues relating to population growth, poverty, and diseases. English economist and demographer Thomas Malthus wrote on population growth, how it was affected by food availability, and how contraceptives could be used to reduce reproduction (Tulchinsky & Varavikova, 2014). The greatest good for the greatest number was a concept devised by the utilitarian philosopher Jeremy Bentham as a standard by which to assess the morality of various actions. Thomas Southwood Smith, a British physician, founded the Health of Towns Association in 1839 and established a new governmental organization called the General Board of Health in 1848. He also authored papers on cholera, yellow fever, and the advantages of sanitary practices. Consequently, the development of public health, particularly in England, had a significant impact on the US, where appropriate administrative systems for the supervision and regulation of community health were fundamental issues. Yellow fever, cholera, smallpox, typhoid, and typhus outbreaks that recurred in the US made the need for efficient public health administration urgent (Tulchinsky & Varavikova, 2014).

French chemist and microbiologist Louis Pasteur, German scientists Ferdinand Julius Cohn and Robert Koch, and other pioneers created techniques for isolating and describing bacteria in the final decades of the 19th century (Tulchinsky & Varavikova, 2014). English physician Ronald Ross discovered the mosquito as the malarial vector around this time, and English physician Joseph Lister pioneered notions of antiseptic surgery. Additionally, it was shown that yellow fever is caused by a filterable virus spread by mosquitoes, as demonstrated by Walter Reed and James Carroll, and, according to French epidemiologist

Plague
This is caused by the bacteria *Yersinia pestis*. Millions of people were killed by an outbreak of the plague in Europe in the Middle Ages. Nowadays, plague can be effectively treated with current antibiotics. The disease can cause serious illness or even death if it is not treated quickly (CDC, 2021b).

Paul-Louis Simond, **plague** is predominantly a rodent illness spread by fleas. As a result, the early medical bacteriologists have much to do with modern public health and preventive medicine. In 1881, Pasteur developed the concept of prophylactic vaccines, which aroused interest in the function of the immune system. In the 19th century, health authorities and ministries tried to improve the environment in order to combat infectious diseases. As bacteriologists identified the germs that cause specific infectious diseases, progress was made toward their systematic control. Microbiology and immunology's advancements had a significant impact on public health (Tulchinsky & Varavikova, 2014).

While environmental sanitation advancements throughout the first decade of the 20th century were helpful in addressing some issues, they were only marginally helpful in addressing the numerous health issues that were prevalent among the poor (Tulchinsky & Varavikova, 2014). Additionally, the establishment of voluntary health agencies, health education initiatives, and occupational health programs, as well as improvements in maternal and child welfare and schoolchildren's health, marked the first half of the 20th century. The public health nurse also made a comeback during this time (Tulchinsky & Varavikova, 2014).

This was accompanied by two notable attempts to offer healthcare for populations. The first attempt involved a system of medical care in rural areas that was put in place in Tsarist Russia (Tulchinsky & Varavikova, 2014). After the communist revolution, this was extended to include universal, fully subsidized medical and public healthcare. Since then, numerous nations in Europe and Asia have established similar systems. The second attempt involved prepayment for medical treatment, which is a type of social insurance that was first implemented in Germany where prepayment for medical care was already widespread (Tulchinsky & Varavikova, 2014). Many other European nations adopted comparable insurance policies.

With the start of the 21st century, prenatal care made a significant contribution to preventive medicine, with mothers' education influencing families' physical and mental health and passing on to subsequent generations (Tulchinsky & Varavikova, 2014). Prenatal care provided the chance to teach mothers about personal cleanliness, food, exercise, the harmful effects of smoking, the prudent use of alcohol, and the risks of drug usage. Furthermore, interests in public health also shifted to conditions including cancer, cardiovascular disease, thrombosis, lung disease, and arthritis, among others. There was also mounting proof that a number of these ailments were brought on by environmental causes; for instance, smoking cigarettes is unmistakably linked to the development of some lung and cardiovascular ailments. The national, local, and nonprofit sectors of government all became responsible for health education, which is especially important because it aims to prevent disease. Almost every nation that had initiatives to lower the frequency of preventable disease has seen an improvement in life expectancy (Tulchinsky & Varavikova, 2014). Below are some of the most important achievements of public health that took place in the last century (Rosen, 2015; Tulchinsky & Varavikova, 2014):

- vaccination to reduce epidemic diseases
- eradication of smallpox
- control of infectious diseases

- improvements in maternal and child health
- fluoridation of drinking water

Public Health in the 21st Century

Today public health has evolved and continues to evolve; however, there are current trends that tend to vary between low-, middle-, and high-income countries, as presented below. The following trends are visible among many high-income countries.

National governments are becoming more interested in new approaches

Governments formerly focused primarily on issues related to fundamental health, such as environmental sanitation, low-income people's access to healthcare, quarantine, and the management of communicable diseases (Whitsel et al., 2019). To provide complete healthcare for entire communities, many have gradually expanded their activities into the field of medical care services in the home, clinic, and hospital. This tendency has been affected by three factors: rising medical care expenses, a greater understanding of the economic damage that illness causes a nation, and a greater public interest in social services (Whitsel et al., 2019).

Concepts of preventive disease are evolving

The term "preventable disease" used to apply to a certain subset of infectious diseases (Sidney et al., 2015). However, as many common noninfectious diseases can also be prevented, the definition has expanded. Preventive health services are now available to help people avoid a variety of health risks, including cancerous tumors, rheumatism, cardiovascular illnesses, other chronic and degenerative diseases, and even accidents (Sidney et al., 2015).

Combining medical and preventative services

Preventive health services emerged from the necessity to safeguard a healthy environment from pandemic diseases, whereas medical care had its roots in the humanitarian goal of caring for the sick. They drifted apart, but the trend was to include them in a full-service healthcare system. Today, public health brings the two branches together (Park, 2017).

Health services aimed at improving psychiatric health

The availability of outpatient clinics and inpatient beds in medical centers for mental health cases, a rise in clinics that offer marriage counseling and child guidance services, and programs to treat alcoholics and drug addicts are just a few examples of improvements in the arrangements for mental health (Sharma et al., 2017). Significant changes have also been made in how society treats citizens that have mental health issues. The growth of research facilities and advances in general practitioners' understanding of psychoneuroses are equally noteworthy (Sharma et al., 2017).

Changes brought on by an aging population

The growing number of older people in increasingly affluent countries necessitates the need for public health institutions to offer specialized services for them (Centers for Disease Control and Prevention, 2003). Elderly healthcare includes taking precautions against early aging, chronic illnesses, and degenerative diseases, as well as dealing with the psychological issues brought on by inactivity and loneliness. The rising incidence of dementia in elderly people presented serious issues for public health in the 21st century (Centers for Disease Control and Prevention, 2003).

In low- and middle-income countries (LMICs), the public health trends are as follows.

Control of infectious diseases

Examples of contagious illnesses that have been effectively eradicated globally include polio and the measles (Detels et al., 2015). In 1980, smallpox – once a terrifying contagious illness that affected children – was officially deemed extinct. There has been significant progress in our understanding of other diseases, such as cholera and meningitis, which may help us eventually control them. Similarly, a drop in new occurrences of AIDS, a disease that was first identified in 1981, and a decline in AIDS-related mortality, were brought on by improved access to pharmacological therapies and more knowledge of prevention in the early 21st century in developing countries. Yet, certain parasitic diseases proliferated as humans altered their environment; one example is the rise of schistosomiasis (an infestation of blood flukes that use snails as intermediate hosts) in irrigation and lake settings (Detels et al., 2015). The new mosquito-borne diseases, including Zika fever and chikungunya fever, as well as their transmission routes and prevention measures for stopping the spread of extremely dangerous illnesses like Ebola, have all been the subject of research (Silal, 2021).

Malnutrition

Malnutrition is still a problem that affects many people in developing countries, especially protein-calorie malnutrition in young children. In order to combat undernutrition and malnutrition in low-income countries, protein-rich food supplements and more effective educational programs are being used (Müller & Krawinkel, 2005).

Obesity and metabolic syndrome

In transitioning LMICs, the prevalence of obesity and the metabolic syndrome is rising quickly, which is increasing morbidity and mortality from cardiovascular disease and diabetes (Roth et al., 2020)

Family health

Rapid population growth issues have significant effects on both family and national levels (Mbizvo & Phillips, 2014). Human reproduction, genetics, and mother and child health issues are all subsets of the larger issue of family health as a fundamental social institution. Family health, which includes family planning, has become a crucial aspect of public health services in developing countries (Mbizvo & Phillips, 2014).

Health professional shortage

The shortage of health professionals in terms of both quantity and education in developing countries is widely acknowledged (Drennan & Ross, 2019). The trend is to match a health professional's education to the specific health service where they will work. This development necessitates tight collaboration between educational institutions and the organizations in charge of providing healthcare services (Drennan & Ross, 2019).

Comprehensive services for community health

Community health is significantly influenced by the integration of curative and preventive services in complete health organizational patterns. One network of integrated services that extends to the community brings together health promotion, disease prevention, and the treatment and rehabilitation of the ill (Asweto et al., 2016).

Planning national healthcare

Allocating scarce healthcare resources to large populations involves complex decision-making, which underlines the need of health planning and calls for efficient health service systems (Rudnicka et al., 2020). In a number of countries, the ministry of health or the national planning agency have established health planning units. The close cooperation between planning, budgeting, implementing, and assessing programs is a crucial component of national health planning (Rudnicka et al., 2020).

Public Health-Related Definitions and Fields

Global health, or population health in a global setting, is connected to public health, as it is the field of study, research, and practice that prioritizes achieving equity in health for all the people of the world (De Cock et al., 2013). International health is a field of medicine that addresses health issues across international or national borders, typically with a focus on public health. It should also be noted that public healthcare is different from public health, whereby it is defined as healthcare that is publicly-funded (De Cock et al., 2013).

Preventive medicine is a concept used in relation to public health. For many scholars, preventive medicine should be regarded as the medical specialty for public health. Specialists in preventive medicine have received clinical training to handle the complex health needs of a population, such as determining the need for disease prevention programs, putting these programs in place using the most effective strategies, and evaluating their success (Park, 2017; Zargaran et al., 2014).

Another related field is population health. Many public health academics have been using the term population health since the 1990s (Kindig & Stoddart, 2003). Population health is not directly addressed by any medical disciplines; it must take health equality into account on a fundamental level. It is argued that the concept of population health is the end result of the public health performed through the field of preventive medicine. Similarly, lifestyle medicine, which can be regarded as a part of preventive medicine and public health, uses individual lifestyle adjustment to prevent or reverse disease (Kindig & Stoddart, 2003).

Importance of Public Health

Before a catastrophic hurricane strikes an area of interest or a pandemic affects the entire world, the majority of us rarely give public health its due consideration. Public health professionals, many of whom likely hold academic public health qualifications, consider these possibilities every day to keep individuals safe and healthy, both locally and globally, by preventing sickness and damage (Parmet, 2009).

International health is a field of medicine that addresses health issues across international or national borders, typically with a focus on public health (Cabaj et al., 2019). The impact of health issues, from heart disease and obesity to infectious diseases and environmental dangers, is sought to be reduced by close cooperation between different stakeholders, such as healthcare researchers, public health experts, government officials, and community stakeholders. This is typically achieved by conducting in-depth research involving the public and creating educational materials that meet the needs of different populations. This strategy relies on public health to safeguard underprivileged or marginalized communities who may not have access to good quality public health activities (Cabaj et al., 2019). The development of an evidence-based consensus regarding health issues and suggested remedies is one of public health's most crucial responsibilities. Put simply, the goal of public health is to raise the life expectancy and general health of various populations (Bloland et al., 2012).

This can improve the quality of life for countless individuals, both domestically and internationally, particularly in nations that might not have the necessary infrastructure to carry out public health research independently (Cabaj et al., 2019). Vaccines are possibly the simplest example of an application that has improved quality of life; the polio vaccine has also been used widely to lower the infection rate worldwide and virtually eradicate the disease from contemporary life (Cabaj et al., 2019).

Many public health initiatives, including family planning, vaccines, vehicle safety laws, and clean air and water legislation, have increased life expectancy (Parmet, 2009). Another positive effect of public health involves decreasing health disparities and improving health equity. Health equity and health disparities are mutually exclusive (Braveman, 2014; Braveman et al., 2011). Access to high-quality healthcare products and services, regardless of one's age, gender, ethnicity, race, education, or financial status, is known as health equity. There has been significant progress in the last three decades toward reducing health disparities and raising health equity, which can be largely attributed to the evolving science and practice of public health and its disciplines (Braveman, 2014).

Social Determinants of Health

Another area where the role of public health is crucial is considering the social determinants of health (SDH) as part of decreasing health disparities and improving health equity. Social variables that influence health both directly and indirectly are known as social determinants of health (Braveman & Gottlieb, 2014; WHO, 2008a). These determinants are elements that people are either exposed to or born into. Social norms, political systems, and policies (economic, social, occupational, agricultural, trade, and foreign) are a few examples of these factors and systems that have an impact on the general public's health both directly and indirectly. Health inequity and SDH are closely related; they cause health inequities that can exist even within high-income nations (WHO, 2008a). Since socioeconomic status, specifically income level, has been demonstrated to be a significant predictor of health status in the majority of countries, those with lower socioeconomic status are more likely to have worse health (Daniels et al., 1999). Some examples of SDH include food insecurity, income level, residential setting and employment situation.

SDH may have a negative effect and can account for up to 50 percent of health outcomes (Braveman & Gottlieb, 2014). As a result, non-health sectors, such as economics or agriculture, occasionally have a greater impact on health than the health sector itself (WHO, 2008a). Therefore, to reduce health inequities, the SDH must be addressed through policies and initiatives. Taking these factors into account is essential for both short- and long-term health improvement, as well as health inequality reduction (WHO, 2008a). The purpose of an increasing number of health policies worldwide is to address these determinants both inside and outside the health system (Saunders et al., 2017).

It is here that the role of public health becomes critical. For example, public health initiatives, like nutrition programs and early childhood education programs, are among those aiming to improve the health of underprivileged groups and advance health equity. Another example is improving the infrastructure and livability in low-income areas by putting suitable sewage systems in place and growing vegetation (Saunders et al., 2017).

Public Health Disciplines

While there are numerous disciplines related to public health and subspecialties, the following are the core public health disciplines.

Epidemiology

To uncover trends, the field of epidemiology uses data that they collect, examine, and apply in public health regarding ailment, injury, and other detrimental health impacts (Rothman, 2012). The study of patterns in health, sickness, injury, and related health risks at the population level is known as epidemiology, which can be used to predict disease trends in populations. Accordingly, it examines the prevalence of illness and injuries in human communities and describes the scope of a health issue in terms of the people, period, and location (Rothman, 2012).

Biostatistics

Biostatistics uses statistical testing for connections and correlations (Pagano et al., 2022). It analyzes and draws conclusions from the findings of quantitative research using statistical tools and reasoning to address issues in both public health and medical research. The most efficient use of resources to treat populations can be determined with the use of biostatistics. The aim of epidemic control is to stop the spread of the disease throughout the population and determine the best way to treat an affected person. Interventions given to individuals may influence others in the community in both behavioral and infectious disease research. Research techniques that enable examination of the connection between reactions at the patient and population levels are necessary for this understanding (Pagano et al., 2022).

Environmental health

Environmental health describes the hazardous reactions and key environmental elements' effects on people (Moeller, 2011). It analyzes the risk factors for developing adverse health effects after being exposed to environmental dangers and includes the investigation of elements in the human-made and natural environments, such as biological, physical, and chemical elements, which have an impact on people's health (Moeller, 2011).

Health behavioral sciences

To understand how public health issues influence specific individuals, public health practitioners analyze data and research from the health behavioral sciences. They seek behavioral science-based therapies that can assist in preventing ongoing health issues, including cancer, heart disease, and sexually transmitted infections (Gravetter & Forzano, 2018).

Health education and promotion

Health education informs target populations about certain health topics, including the health advantages and risks they encounter, and provides tools to improve ability and promote behavioral change in a proper context (Whitehead, 2004).

With the aid of health promotion, governments, communities, and individuals are able to manage health challenges. This can be accomplished through constructing solid public policies, encouraging favorable environments, and boosting civic engagement and individual capability (Whitehead, 2004).

Healthcare management

Healthcare administration, also known as healthcare management, refers to the administration, management, or monitoring of hospitals, health institutions, public health systems, clinics, or other medical organizations (Buchbinder et al., 2021). Healthcare managers allocate both human and material resources to healthcare services to improve the quality of healthcare and evaluate the quality control in hospitals, clinics, and community centers. Healthcare delivery, quality, and cost for individuals and populations are the focus of health management (Buchbinder et al., 2021).

Health policy

Health policy refers to the laws, rules, activities, and decisions made by society to promote welfare and ensure the achievement of certain health goals (Buse et al., 2012). Both official laws and community involvement programs are included in the range of health policies. By establishing objectives or legislation, health policy seeks to affect and enhance both individual and societal health. Health policy experts do research, assess laws, pinpoint problems, and balance the advantages and disadvantages of suggested efforts (Buse et al., 2012).

Other non-health related disciplines include

- education,
- nutrition,
- agriculture,
- engineering,
- medical lab sciences,
- medicine and nursing,
- pharmacy, and
- social work.

1.2 Analytical Methods of Public Health

Several methods to analyze public health issues and problems will be discussed in this section.

Quantitative Methods

The process of gathering and analyzing numerical data is known as quantitative research. In general, quantitative research is used to evaluate trends, identify means, form hypotheses, verify causality, and extrapolate findings to a larger population (Stockemer, 2019). The natural and social sciences, including biology, chemistry, medicine, psychiatry, economics, sociology, and management, frequently use quantitative research (Stockemer, 2019). Public health also tends to rely on quantitative methods to measure the magnitude of public health issue. For example, quantitative methods can be used to calculate the prevalence of lung cancer in a certain population. This could lead to interventions to mitigate it, such as anti-smoking campaigns.

Descriptive, correlative, or experimental research can be conducted using quantitative methodologies (Stockemer, 2019). Only an overview of the survey variables is sought by the descriptive survey. Studies of correlation (i.e., the relationship between two things like a risk factor and a disease) look at the connections between research variables. Experimental studies methodically check for a causal connection between variables. Statistics can be used to objectively test hypotheses or predictions through correlation and experimental investigations. Depending on the sample technique employed, the findings can be applied to a larger population. To gather quantitative data, operational definitions must

be used to translate abstract notions, like mood, into measurable, observable, and quantifiable phenomena (e.g., self-reports of emotions and energy levels; Stockemer, 2019). There are four main types of quantitative research, which are explained in the following (Nardi, 2018).

Descriptive studies

Descriptive studies seek to explain the current state of the variables that have been identified. These research endeavors must methodically reveal knowledge concerning the phenomenon. Typically, researchers don't begin with a hypothesis, but they could do so after gathering evidence (Nardi, 2018). A hypothesis is tested through the integration and analysis of data. You must carefully choose the units you are researching and meticulously measure each variable to collect data in a systematic manner (Nardi, 2018). Examples of descriptive research include describing the smoking behaviors of teenagers and young adults and the opinions of people on mental health.

Correlation studies

Correlation studies seek to quantify the degree of a relationship between two or more factors using statistical data. Many relationships between facts must be interpreted and required in this type of design (Nardi, 2018). Although this kind of research does not yet have an analysis to support the source of the observed patterns, it does identify trends and patterns in the data. The foundation of this form of observational study is not causes and effects but rather variable distributions, relationships, and dates. Such investigations do not change the variables; they identify them and examine them for what they are (Nardi, 2018). Examples of correlation studies include studying the correlation between stress and binge eating or between exercise and mental health.

Causal comparison

Establishing causal relationships between variables is the goal of causal comparison and quasi-experimental investigations. Real-world experiments and these kinds of structures are quite similar, but there are some significant distinctions (Nardi, 2018). The influence of the independent variable on the dependent variable is measured, but the independent variable is not changed by the investigator. Instead of creating random groups, researchers should employ naturally occurring or preexisting groupings. Identified controls were exposed to the treatment's variables to compare them to the group that were not given the treatment. Results and conclusions are then drawn to establish clear cause and effect with the same caution as others using known and unknown variables, both of which could still have an impact on the outcome (Nardi, 2018). Examples of such studies are the effect of car gas exhaust on lung capacity or the effect of alcohol on the liver in teenagers.

Experimental studies

To ascertain the causal linkages between the sets of variables that make up the study, experimental studies, frequently referred to as real experiments, use scientific procedures (Nardi, 2018). The general perception of actual experiments as laboratory research are not usually accurate; the conditions in the lab are unrelated. A study that tries to identify and

control all but one variable is considered an experiment in which changing the independent variable will affect the dependent variable. Each variable has subjects assigned at random (Nardi, 2018). Examples of experimental studies could be the impact of a new drug on heart disease or the effect of art therapy on people suffering from depression.

Systematic reviews, randomized controlled trials (RCTs), cohort studies, cross-sectional studies, and case-control studies are the five main types of quantitative study designs utilized in public health (Vandenbroucke et al., 2014).

A cohort study is a type of research in which a sample of individuals is tracked throughout time while some of them are exposed to certain things (for instance, carcinogens or specific health services; Nohr & Liew, 2018). To find differences in one or more predefined outcomes, cohort studies are conducted, which are prospective in design and in which participants are followed backward across present or historical times. At the start of a study, baseline measurements are typically made, followed by repeated comparisons at set intervals to look for changes and trends. Only one subject group has been used in certain cohort studies. The primary goal of a cohort study is to describe subject characteristics using a number of variables, such as the provider's usage pattern for specific medical services or the standard of care over a predetermined time frame (Nohr & Liew, 2018).

Cross-sectional studies, which solely compare exposed and unexposed people, are regarded as a sort of cohort study. They offer glimpses of the traits connected to the cohort results at a specific moment in time (Wang & Cheng, 2020). An example is looking at COVID-19 symptoms in those who took the vaccine versus those who did not.

Case-control studies evaluate differences in some predetermined results between persons in samples who have undergone an exposure and those who have not but who have similar compositions (in terms of sociodemographic variables; Tenny et al., 2022). Retroactive in nature, case-control studies choose people who have already been exposed to the incident and compare them to subjects who have not. Based on their shared traits, participants from the exposed and non-exposed groups are matched (Tenny et al., 2022). An example is examining whether or not people diagnosed with lung cancer were smokers.

RCTs are experimental effect evaluations in which randomly selected study participants are randomly divided into a treatment group (which will get a program or policy intervention) and a control group (which won't get an intervention; Hariton & Locascio, 2018). The primary characteristic that sets RCTs apart from other types of trials is randomization, which refers to the random assignment of units. It also highlights whether or not the intervention (and not other confounding factors) was the cause of the findings produced, which is one of its benefits, as it establishes causality (Hariton & Locascio, 2018). An example is giving a group of people a new drug for diabetes while the control group is on a drug that is already used, like insulin, and seeing if this new drug improves blood sugar levels more than the current drug.

A systematic review gathers secondary data and uses a repeatable analytical procedure to assess them. It is a type of evidence synthesis that develops a broad or specific research topic and locates and incorporates the information immediately pertinent to the question of the systematic review (Pollock & Berge, 2017). Systematic reviews are frequently used

to offer a thorough summary of the most recent data supporting a research subject. For instance, systematic reviews of RCTs are a significant source of evidence for evidence-based practice, and evaluations of prior research are frequently quicker and less expensive than initiating a new study (Pollock & Berge, 2017).

Advantages and disadvantages

In the table below, the advantages and disadvantages of quantitative methods in public health are presented.

Table 1: Advantages and Disadvantages of Quantitative Methods

Advantages	Disadvantages
Rapid collection and analysis of data	Cannot be used for certain types of public health issues
Makes comparisons easy	Important issues may be overlooked, such as experiences, perceptions, etc.
Results can be easily used to make recommendations.	May be expensive
It can give an accurate assumption of risk factors for public health.	False focus on numbers can lead to researchers overlooking broader themes and relationships.

Source: Mirna Naccache (2023).

Qualitative Methods

In contrast to quantitative research, qualitative research does not solely rely on collections and counts to better comprehend ideas, opinions, or experiences (Gerring, 2017). The main purposes of qualitative research are to obtain a thorough understanding of the issue and to come up with fresh concepts for the research at hand. Qualitative research methods contrast and complement quantitative research, which gathers and evaluates numerical data for statistical analysis. Numerous disciplines, including the humanities, social sciences, anthropology, sociology, education, health sciences, and history, frequently use qualitative research (Gerring, 2017). Some examples of research questions that can be addressed using qualitative research include the following:

- How do people from different countries perceive stress?
- What is the knowledge of the public in South Africa when it comes to antibiotic overuse and misuse?

Qualitative research is used to better understand how individuals see and experience the world. Although there are numerous ways to conduct qualitative research, they are all adaptable and frequently concentrate on extracting deep meaning from the data (Smith & Smith, 2018). Despite having some similarities, their emphasis is on various objectives and viewpoints. When it's necessary to comprehend how various people perceive the world and everything going on around them, qualitative research is employed (Hamilton & Finley, 2019). The following qualitative techniques are most frequently used (Gill et al., 2008):

- observation: The researcher takes thorough on-site notes on everything they see, hear, or come across.
- interview: The researcher has direct, one-on-one talks with people. They might be open-ended, semi-structured, or structured.
- focus group discussions: Individuals with comparable experiences or backgrounds are brought together to discuss a certain issue of interest. Questions concerning their views, attitudes, beliefs, opinions, and other concepts are part of this process.
- survey: Forms with unstructured questions are distributed.
- secondary research: Information is gathered from previously published text, photos, audio, or video recordings.

There are several methods for analyzing the gathered data and producing findings because the sources of qualitative data are varied. They can be found in text, image, audio, and video formats and originate from interviews records, survey responses, field observations, or documents from the natural environment. The majority of qualitative data analysis, however, follows five processes (LeCompte, 2000):

1. Data preparation and organizing: This entails typing in field notes or duplicating the interview.
2. Verifying and researching the data: The data are analyzed to look for trends and concepts that recur.
3. Creating a system to code the collected data: The researcher develops a set of codes based on the first hypothesis that can be used to categorize the data (Elliott, 2018).
4. Giving the data a code: This can entail looking at each participant's responses and coding them into a table in a qualitative research analysis, for instance. The researcher can create new code while analyzing the data and adding them to the system as required (Elliott, 2018).
5. Finding topics that come up frequently, then connecting the code to those topics in-depth (Elliott, 2018)

As a result, there are various distinct methods for analyzing qualitative data. These approaches use a similar procedure but place a different emphasis on certain ideas:

- content analysis: This explains and categorizes widely used terms, expressions, and concepts using qualitative data. As an illustration, researchers can use content analysis to discover the language that patients use to describe their experiences during particular treatments, such as cancer treatment (Sgier, 2014).
- thematic analysis: This is used to identify and explain patterns and themes in qualitative data (Frasso et al., 2018). Theme analysis can be used, for instance, by psychologists to discover how social media tourism influences mental health.
- text evaluation: The text's organization, style, and content are examined (Frasso et al., 2018). Text analysis can help researchers analyze how media coverage of health-related issues, such as carbonated beverages and soda, has changed over the past 10 years.
- discourse evaluation: Communication and the consequences of language in various contexts is researched (Frasso et al., 2018). For example, public health professionals can use this type of analysis to look at what affects people in terms of moral and aspiration when designing health awareness campaigns.

The use of qualitative research in public health can be very beneficial (Green & Thorogood, 2018). This is because qualitative research examines stakeholders' lived experiences (patients, health providers, health ministers, **non-governmental organizations** [NGOs], etc.), provides detailed context, and offers nuanced insights on public health issues that cannot be obtained through any other type of research, particularly via quantitative research methods (Murphy & Dingwall, 2017). Furthermore, it can offer a wider picture and practical insights for issues that are challenging to "quantify," such as patient experience in health facilities or public perception on certain public health issues, like pollution (Green & Thorogood, 2018).

Non-governmental organizations
A non-governmental organization is one that, in most cases, is founded without the involvement of the government. They are often nonprofit organizations, and many of them are involved in humanitarianism and health (Delisle et al., 2005).

However, it should be noted that quantitative methods are still the traditionally preferred methods of analysis in public health. However, this is slowly changing, and the use of qualitative methods in public health research, health education interventions, health policymaking, and developing environmental health programs has been exponentially increasing in the past decade (Rolfe et al., 2018).

Advantages and disadvantages

In the table below, the advantages and disadvantages of qualitative methods in public health are presented.

Table 2: Advantages and Disadvantages of Qualitative Methods

Advantages	Disadvantages
Helps understand the patterns of health behaviors, describe illness experiences, design health intervention, etc.	Analysis and interpretation of the data: Qualitative research cannot be replicated.
The richness of the data and the descriptions and depth of exploration makes it valuable when examining public health issues.	Small samples are frequently used to get thorough information on a specific situation. It is challenging to obtain generalizable findings.
Creates fresh concepts and allows for the discovery of previously unimagined issues and opportunities in public health	Requires a lot of work, as software can manage and store large amounts of text, but data analysis frequently requires manual review or performance (Drisko, 2020).

Source: Mirna Naccache (2023).

Mixed Methods

A mixed method study is one in which both quantitative and qualitative data are gathered and analyzed (Schrauf, 2016). In the last 10 years, mixed methods research has become increasingly used in the field of medicine. This resulted from the delivery of healthcare becoming more complex. This approach enables academics to investigate many viewpoints and elucidate the connections between the intricate layers of multiple research problems (Schrauf, 2016). This is relevant for our field of study, as researchers are interacting with contemporary public health trends in a landscape in terms of stakeholders, settings, and other issues (Wisdom et al., 2012).

For issues like knowledge about certain public health issues (like the anti-vaccination movement) that cannot be satisfactorily addressed either statistically or qualitatively, the mixed method approach is appropriate. The relationship and differences between qualitative and quantitative data can be better understood using mixed methods (Palinkas et al., 2011; Schrauf, 2016). Participants may be able to express their strong ideas, discuss experiences with one another, add to the body of data, and make use of a number of exploratory tools that allow for more in-depth replies to questions. Diverse viewpoints enlighten the research topic and enhance the researcher's experience. However, combining several approaches in one study can make it more difficult to carry out the research. Because they must be knowledgeable with diverse research paradigms and a variety of methods for sample selection, data collection, and data analysis, interdisciplinary research teams frequently require extra resources (Palinkas et al., 2011; Schrauf, 2016). According to Creswell and Plano-Clark (2011), an effective mixed method study has the following characteristics:

- gathering and evaluation of both qualitative and quantitative (closed) data
- use of strict protocols for data collection and analysis in the manner prescribed by each method, making sure to use the proper sample sizes for both quantitative and qualitative analysis
- integrating data when gathering, analyzing, or discussing data
- implementing qualitative and quantitative components in the same sample or in other samples concurrently or sequentially
- creating procedures for philosophical or theoretical research models that aim to comprehend several viewpoints on a single subject (e.g., how nurses, clinicians, and patients believe the quality provided by the **primary healthcare** system is in a certain country)

Primary healthcare
This addresses the majority of people's health needs throughout their lives. This covers social, psychological, and physical wellness. Instead of being disease- or treatment-centered, it is prevention-focused (WHO, n.d.-e).

Advantages and disadvantages

In the table below, the advantages and disadvantages of mixed methods in public health are presented.

Table 3: Advantages and Disadvantages of Mixed Methods

Advantages	Disadvantages
Helpful in understanding the discrepancy between quantitative and qualitative results (Agency for Healthcare Research and Quality, 2013)	Complex in terms of analysis and conclusion
Allows for methodological adaptability and can provide more information than can be obtained from quantitative or qualitative alone	Time and resource consuming
Collects a lot of information and captures how people naturally gather information by fusing quantitative and qualitative data (Agency for Healthcare Research and Quality, 2013)	Expensive

Source: Mirna Naccache (2023).

1.3 Medical Care and Public Health

The fields of medicine and public health have been compared to parallel trains with windows facing in different directions but overlooking the same setting (Lurie & Fremont, 2009). According to Lurie and Fremont (2009), passengers on the medical train notice the distinctions in size, color, age, and health of each tree. On the public health train, passengers may see the forest, which is made up of groups of comparable trees that coexist and experience the same storms. Despite the potential for the two viewpoints to be complementary, scattered data systems and a lack of communication between medical and public health specialists make it difficult to improve care, as well as individual and population health (Lurie & Fremont, 2009).

Prior to delving into the similarities and differences, as well as how these two fields complement each other, it is important to discuss and explain the field of medicine.

What is Medicine?

Managing the clinical condition, diagnosis, prevention, and treatment of a person's injury or disease and promotion of their health is defined as the science, art, and practice of medicine. Another definition of medicine is the study of health and healing. Nurses, physicians, and a range of experts practice medicine, and the purpose of medicine is to promote and sustain health (McKeown, 2016).

Among many other aspects of health, medicine involves clinical research, diagnosis of diseases, treatment, and prevention (McKeown, 2016). Additionally, a variety of medical treatments that have developed over time to maintain and improve health by treatment and prevention of diseases are included in medicine. Modern medicine employs biological sciences, biomedicine, genetics, and medical technology to identify, treat, and prevent illness and harm. While most treatments involve drugs or surgery, other options include psychotherapy; use of medical devices; biologics, such as vaccines; radiation for the treatment of certain types of cancers; etc. (McKeown, 2016).

Medicine has been practiced since ancient times. For most of that time, it was an art because it was a field requiring skill and knowledge and was frequently connected to the religious and philosophical convictions of the local culture (Castiglioni, 2019). For instance, a healer would use herbs and recite prayers for healing, or a physician would resort to bloodletting. However, with the development of contemporary science in recent decades, the majority of medicine has evolved into a blend of art and science. For instance, understanding what occurs at the cellular and molecular level in the tissues being sewn derives from science, whereas stitching technique for sutures is an art that is taught through practice. It should be noted that what is known today as alternative medicine refers to prescientific medical practices that are still widely practiced in the absence of scientific medicine. These practices are also known as traditional medicine or folk medicine and include aromatherapy, acupuncture, ayurveda, homeopathy, and energy therapy. While these treatments are still widely used in some areas of the world (mostly in Asia and Africa), there are questions about their efficacy and safety (Castiglioni, 2019).

Divisions of medicine

The field of medicine is very diverse and includes many different divisions, such as the following (Castiglioni, 2019; McKeown, 2016; Nabavi, 2021; Rose, 1994):

- Anatomy studies physical makeup of the human body.
- Biochemistry examines chemical substances and the effects they have on the body.
- Biomechanics uses a mechanical approach to study the structure and function of biological systems in the body.
- Biostatistics uses statistics in the study of biology. This is essential for effective medical practice and many aspects of research.
- Biophysics studies how biological systems function using models developed from physics, mathematics, chemistry, and biology.
- Cytology and pathology studies cells under a microscope for medical and scientific purposes
- Biology's study of embryogenesis, early growth, and development is known as embryology.
- Endocrinology studies how hormones affect the body.
- Genetics studies the effects of genes on a person's physical and mental well-being.
- Histology examines the shape of structures under a microscope. It also goes by the name of microscopic anatomy.
- Microbiology is the study of microscopic creatures, also referred to as microbes. Bacteriology, virology, mycology, and parasitology are all divisions of microbiology.
- Neuroscience studies the nervous system and the brain, as well as nervous system illnesses. Psychophysics and computational modeling are both aspects of neuroscience. Cognitive neuroscience, cellular neuroscience, and molecular neuroscience are a few varieties of the field.
- Nutrition researches the effects of food and drink on health, as well as their potential to treat, prevent, and cure various illnesses and ailments.
- Pathology studies the science of illness. A pathologist frequently works in a lab, doing tests on samples of blood, urine, or body tissue to assist in the diagnosis of diseases and ailments.
- Pharmacology studies medications, including their origins, mechanisms of action, physiological effects, and chemical makeup.
- Radiology uses X-rays and scanning technology both during the diagnostic process and occasionally during the course of treatment.
- Toxicology investigates poisons to determine what they are, how they affect the body, and how to recognize them.

It is important to note that not all divisions and facets of medicine are listed above. For example, in addition to the several disciplines from which doctors can select, such as emergency medicine, there are numerous people who work in patient transportation, dentistry, and other related fields.

Evidence-based medicine

Making medical judgments using the most recent data and evidence in health and medicine is known as "evidence-based medicine" (EBM). In other words, evidence-based medicine combines medical knowledge and competence, the treatment option chosen by the patient, and the most recent data resulting from in-depth study (Masic et al., 2008).

The objective of the initiative is to promote the application of quality clinical research to health decision-making (Masic et al., 2008). EBM calls for and encourages the acquisition of new clinical competencies, such as speedy literature searches and the application of rigorous evidence criteria when evaluating clinical literature. In the context of evidence-based medicine, which is a continuous, self-directed, problem-based learning process, providing care for one's own patients leads to the necessity for clinically relevant knowledge regarding diagnosis, prognosis, therapy, and other clinical and healthcare concerns (Masic et al., 2008).

The Relationship Between Medical Care and Public Health

In public health and medicine, the issues surrounding health and healthcare are handled from many complimentary angles (Fineberg, 2011). The individual patient is given priority in medicine within the context of their family and their community. In contrast, population health is prioritized in public health since disease often shows up in people's everyday lives. The biological sciences, statistics, physics, chemistry, and even some areas of engineering are the primary inspiration sources for medicine (Fineberg, 2011).

A wide range of academic fields, particularly those in the quantitative and social-behavioral sciences, are essential to public health, which has its roots in the environmental, engineering, and biological sciences. Public health focuses on illness prevention, while medicine is responsible for the prevention, assessment, and treatment of patients. Medications, surgery, and other forms of customized intervention are the main tools of a medical professional (Fineberg, 2011).

Public health employs a broad range of social and community initiatives, from immunization programs to urban planning, to preserving and protecting health. While public health is linked to the public sector and regulatory responsibilities, medicine is based on private enterprise (Fineberg, 2011).

Table 4: A Comparison of Public Health and Medicine

Medicine	Public health
Emphasizes the individual	Emphasizes the population
A personal service ethic that is influenced by social responsibility	A commitment to public service that is tempered by individual needs
Places a focus on therapy and diagnosis	Places focus on health promotion and prevention

Medicine	Public health
The medical paradigm prioritizes medical treatment.	The public health paradigm uses a variety of initiatives that focus on the environment, people's actions and lifestyles, and healthcare.
A well-known occupation with a positive public image	Several professional identities and a vague public reputation
System of certification that is uniform for specialists with training beyond the general medical degree	Specialists with varying certifications beyond a professional public health degree
Organ systems, patient groups, etiology and pathophysiology (infectious illnesses, oncology), technical skill, and lines of expertise (cardiology, neurology) are listed in order of importance (radiology, surgery).	Lines of expertise, such as epidemiology and toxicology, arranged by analytical method; setting and population; occupational health and international health; fundamental health problem (environmental health, nutrition)
The study of social sciences is typically an elective in medical school.	Social sciences are crucial to the teaching of public health.
Relevant engineering and physical sciences include materials science, electronics, imagery, and information systems in particular.	Engineering relevant, especially systems analysis, operations management, sanitary engineering, and information technology
A crucial component of public health training is clinical science.	Relevant engineering, particularly in the areas of process improvement, hygienic engineering, and information technology

Source: Mirna Naccache (2023).

Despite these divergent viewpoints, there is continuity and overlap between the interest in populations that public health practitioners have and the individual duty that clinicians have (Krishnan et al., 2014; Lurie & Fremont, 2009). Public health and medical education have developed in parallel for a variety of historical and pragmatic reasons. The ideas, beliefs, experiences, and analytical views of public health are now being integrated into the routine practice of medical education, thanks to a number of initiatives (Lurie & Fremont, 2009).

The importance of public health to medical care

Understanding the origin and spread of disease requires an understanding of epidemiology, which is the foundational field of public health. Without some background in the quantitative fields of biostatistics and epidemiology, one cannot possibly aspire to examine the medical literature independently and sensibly or to logically apply it to a single patient. Sound medical care, health policy, and public health practice depend on the ability to deal with ambiguity and use probabilistic thinking (Lurie & Fremont, 2009).

The impact of environmental, nutritional, social, and behavioral factors on well-being, sickness, and recovery is covered in public health. A thorough understanding of the various causes of sickness, including those usually highlighted in public health, is necessary to determine the etiology of disease and the best ways to manage patients. The views of

medicine and public health must be combined to provide comprehensive explanations of illness that incorporate genetic, molecular, biochemical, and physiological variables with behavioral, social, nutritional, and environmental elements (Krishnan et al., 2014).

Medical professionals should recognize the value of public health interventions, such as public education, health awareness campaigns, the interconnections between individualized medical treatment and community health protection, the factors that promote health, and the significance of disease prevention (Unger et al., 2020). Public health also places a strong emphasis on cultural sensitivity (defined as similarities and differences in values and practices), community involvement, and **health literacy** because these factors directly affect patients' capacity to take an active role in their own care and safeguard the health of their families (Unger et al., 2020).

Health literacy
This is when a person is competent enough to comprehend fundamental medical knowledge and able to make an informed decision about their health accordingly. Older people and marginalized groups are more likely to have low health literacy levels (Andrus & Roth, 2002).

The engineering idea of systems thinking, which emphasizes how connected pieces interact in a number of interdependent ways to explain observed performance, is important in public health. The same line of reasoning has immediate implications for patient safety and the standard of medical treatment, and it offers a means of defining and comprehending the operation of everything from a single medical interaction to the health system as a whole (Fineberg, 2011).

Physicians who specialize in public health can pursue intriguing and rewarding careers in a variety of fields, including health policy, emergency preparedness, and environmental health. Many medical professionals may discover that public health encourages growth for part-time involvement in one or more population health-related areas, such as general and specialty medicine. Additionally, there are those who decide to specialize in a discipline related to public health, such as epidemiology, general preventative care, or occupational health. Many medical practitioners discover that public health is an extension of medicine by other methods, possibly influencing millions of people at once (Rao et al., 2020).

1.4 Sources of Public Health Data

The cornerstone of contemporary public health practice is the effective utilization of data and information (AbouZahr & Boerma, 2005). Accurate, timely health data and information are needed for public health interventions, such as outbreak investigations, cancer prevention plans, and performance and quality improvements to the healthcare system. To better understand and respond to developing public health emergencies, a range of public and private institutions employ public health information, whether consolidated, de-identified, or linked to individuals who need care (AbouZahr & Boerma, 2005).

Public Health Data and Information

Before discussing the sources of public health data, it is very important to be able to define what data are, distinguish between data and information, know the difference between primary and secondary data, and differentiate between population health data and individual health data.

Data versus information

It is crucial to understand the distinction between data and information before learning more about the many public health data sources and types (Boisot & Canals, 2004). Despite the fact that these terms are often used interchangeably, they are different. A collection of disjointed facts called data must be processed. They might be something small and trivial that demands organization, or they could be something complicated and time-consuming. Data that have been processed, categorized, structured, or presented in a format that makes them useable are known as information (Boisot & Canals, 2004).

To give an example, if a public health professional says there are 132 cases, these are data, as we do not know what the outbreak is, where it is, who is affected by it, when it started, if it is still ongoing, etc. However, when the public health professional says there is a measles outbreak that started five days ago and is ongoing in city X, affecting 132 children aged seven and eight, then it is information.

Primary and secondary data

It is also crucial to understand the difference between primary and secondary data. If a particular dataset has been acquired for the first time, it is known as primary data (Hox & Boeije, 2005). Data are mostly collected by surveys, observations, physical examinations, lab testing, questionnaires, one-on-one interviews, focus groups, and other techniques (Mazhar et al., 2021). Given that this is the first time the data have been gathered, the organization and analysis may take some time and effort (Hox & Boeije, 2005).

If someone besides the original user that collected the data uses them, then they are considered secondary data. Secondary data have previously been gathered, examined, and documented. They are a type of data that have been collected from numerous sources and are easily accessible (Johnston, 2017). Sources of secondary data include census data, publications from the government, insurance claims, internal documents from organizations, papers, books, scientific journals, and websites (Johnston, 2017; Mazhar et al., 2021).

Population health data versus individual health data

Individual health is focused on an individual's health outcomes, whereas population health is focused on the health of large groups of individuals. To determine a person's diagnosis, course of therapy, or prognosis of illness progression, individual health data are employed (Rowlands et al., 2015). Data on population health are used to establish health programs aimed at improving public health outcomes, identify areas that need improvement through awareness campaigns, and improve health policies (Rowlands et al., 2015).

Sources of Data

There are many sources of data and information on public health. Below are some of the most widely used sources:

- census: This is a survey of a country's population that is conducted to determine how many people reside there, as well as specifics, such as people's ages, occupation, residence area, etc.
- administrative records: Every time a person interacts with the healthcare system, whether it be through a doctor's appointment, a diagnostic test, a hospital admission, or the filling of a prescription, administrative data are produced (Cadarette & Wong, 2015).
- medical records: These include all pertinent information regarding a patient's medical history, examination findings, diagnosis, and test results (Honavar, 2020).
- claims data: These are assembled based on millions of medical appointments, bills, insurance details, and other communications between patients and providers.
- surveillance data: This is the systematic ongoing data gathering, collation, and analysis, as well as timely information transmission to those who need to know so that action may be performed, usually done for infectious diseases like cholera (Andrejevic & Gates, 2014). The distribution of illness, the natural course of a disease, the development of theories, the encouragement of research, the assessment of control techniques, the monitoring of changes, and the ease of planning may all be calculated using surveillance data (Snyder & Merson, 1982).
- **peer-reviewed** literature: This is research conducted by academics who have amassed their own data through surveys, experimental study designs, or other methods. Additionally, they showcase the work of scientists who have undertaken fresh analysis of already-existing datasets. These mainly include health journal articles (DeAngelis, 2015)
- miscellaneous: This includes books, health reports from health authorities, guidelines published by health authorities, and health reports published by the WHO or other global health regulatory agencies.

Peer-reviewed
A peer review is an evaluation procedure where editors and other knowledgeable academics critically evaluate an article, its research quality, and its scientific worth (Spier, 2002).

In cases where primary data need to be collected, the following are usually used:

- interviews: These can include open-ended or semi-structured questions. Interviews can be conducted with subject matter experts or the general public, depending on the topic.
- surveys: These can include closed or open-ended questions. Who and the number of people filling out the survey will depend on the sample size needed for the project, program, or study.
- focus groups discussions
- observations from the field

Sources of data for the general public

To understand more about their disease, people might turn to medical literature, articles, and websites (Cullen, 2005; Theofanos & Mulligan, 2004). However, most people turn to websites that might or might not have reliable and accurate information. This is increasingly common in the present digital era (Theofanos & Mulligan, 2004).

People have the right to utilize any platform to improve their knowledge, which has been found to improve ability to make health-related decisions (Theofanos & Mulligan, 2004). Therefore, it is imperative that people be guided, whether by public health professionals or by their health services providers, concerning where to get credible data and information pertaining to their own health and that of the general public (Cohen et al., 2014).

Data Privacy and Security

Any industry faces significant, ongoing issues with data security and privacy, but healthcare, including public health, is particularly affected (Knoppers & Thorogood, 2017). Every day, public health professionals deal with health information pertaining to other human beings that must be kept confidential and properly safeguarded. Security may be an issue because of this, as well as the fact that the data are sourced from a number of different places (Knoppers & Thorogood, 2017).

Adhering to regulatory standards, doing regular audits to make sure everything is running properly, and educating people about data security and privacy best practices if they are dealing with the data are essential to preventing breaches in data security (Knoppers & Thorogood, 2017).

One way to ensure the privacy of the public health data and information is anonymizing them by removing names, dates of birth, residential addresses, etc. (El Emam et al., 2009).

1.5 Evidence-Based Public Health

Using evidence generated from research, projects, and previous experiences to make decisions that help communities and populations improve their health protection, disease prevention, and health maintenance is defined as evidence-based public health (EBPH; Brownson et al., 2009). EBPH is described as the conscious, explicit, and prudent use of the best, most up-to-date evidence. It is the procedure for carefully locating, evaluating, and using current research findings as the foundation for public health choices and programs (Brownson et al., 2009).

In addition to basing public health programs and initiatives on evidence, EPBH also considers the preferences of communities when developing, implementing, and assessing public health initiatives (Brownson et al., 2017). These preferences may relate to religion, culture, morals, or values. EPBH also acknowledges cultural sensitivity, which is defined as the capacity to respond correctly to the attitudes, sentiments, or situations of groups of people who share a shared and unique racial, ethnic, religious, linguistic, or cultural heritage (Office of Minority Health, 2001). Consequently, EPBH aims to contextualize public health programs, initiatives, and research to increase its likelihood of their uptake and, in turn, their success (Brownson et al., 2009, 2017).

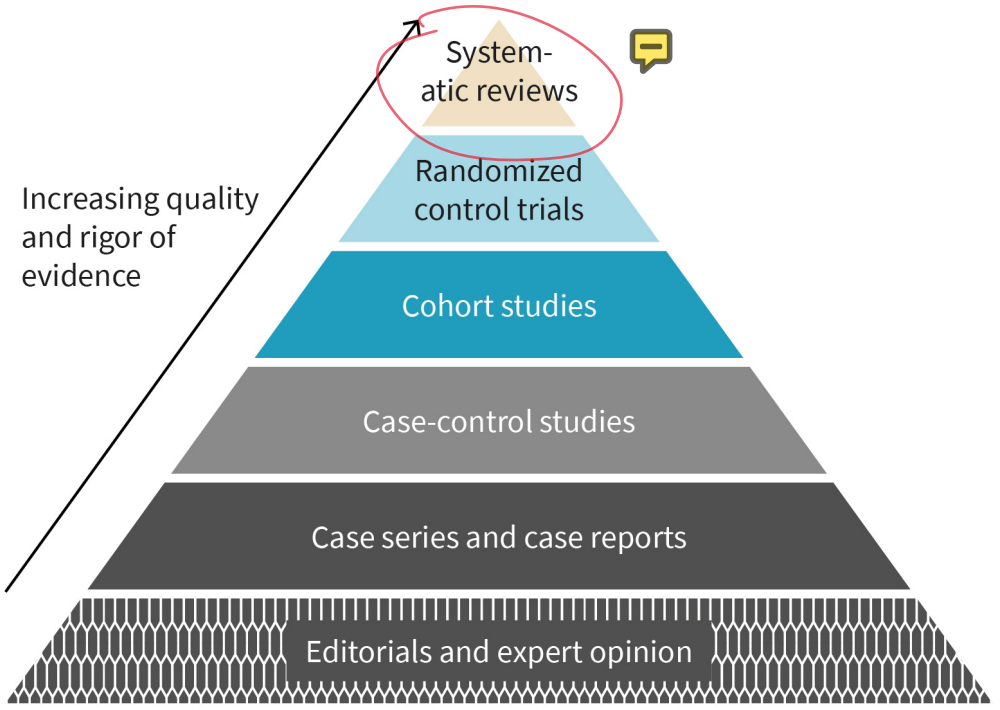
By using the principles of evidence and reason, including the meticulous use of data and information systems and the appropriate use of program planning models, EBPH aims to develop, implement, and assess efficient and effective public health programs and policies (Lhachimi et al., 2016). Accordingly, a public health initiative that uses evidence that has been collected from a variety of scientific and social scientific research and assessment approaches is known as an EBPH initiative (Lhachimi et al., 2016).

Hierarchy of Evidence

A system for ranking evidence to be used in EBPH is known as the hierarchy or level of evidence. To rate the relative potency of scientific study findings, this top-down methodology is used (Canadian Task Force on the Periodic Health Examination, 1979). There is broad consensus regarding the relative efficacy of in-depth epidemiological research. Over 80 hierarchies have been presented to evaluate medical evidence (Murad et al., 2016).

The strength of the evidence is influenced by study design (such as individual patient case reports and randomized controlled trials) and measurable endpoints (such as survival and quality of life). The best proof of a therapeutic benefit in clinical investigations typically comes from RCTs (Brighton et al., 2003). Systematic reviews are typically regarded as the highest-quality evidence or the "gold standard" (Doleac, 2019). Numerous hierarchies of evidence have been devised since the 1970s to allow different research methods to be rated according to the reliability and validity of their findings (Canadian Task Force on the Periodic Health Examination, 1979). These hierarchies can be applied in a number of different ways to "grade" the research's quality (Murad et al., 2016). In the 21st century, the application of the hierarchy of evidence has come under scrutiny (Tugwell & Knottnerus, 2015). Some of these criticisms point out that the "gold standard" systematic reviews are not without flaws and limits, and that this hierarchy disregards the value and use of qualitative investigations (Bigby, 2003; Tugwell & Knottnerus, 2015). The figure below presents the most widely used scheme for the hierarchy of evidence.

Figure 2: Hierarchy of Evidence



Source: Mirna Naccache (2023), based on Canadian Task Force on the Periodic Health Examination (1979).

The degree of confidence in the estimate of the effect that is necessary to support a certain recommendation is reflected in the "quality" of the evidence (Guyatt et al., 2008). There are two key meanings in this term. Public health professionals should first evaluate the evidence's quality in light of the particular context in which it is used. Second, new definitions are needed for systematic reviews because they do not, or at least should not, make recommendations. In this instance, the strength of the evidence represents how confident we are in the accuracy of the effect estimate (Guyatt et al., 2008).

In a similar manner, evaluation of evidence rigor is crucial. Rigor is a means to increase trust or confidence in the findings of research studies, qualitatively speaking (Polit & Beck, 2012). This enables researchers to demonstrate methodological consistency across time. Additionally, it gives a true picture of the population under study. Credibility, transferability, reliability, and conformability are factors related to rigor. Credibility is a term used to describe how trustworthy and acceptable a piece of evidence, research finding, or other information is, particularly in terms of the degree of agreement between participants and researchers (Polit & Beck, 2012).

Comparable to **external validity** in a qualitative sense, transferability refers to the capacity to apply study findings or methodologies across groups (Polit & Beck, 2012). Explaining the demographic and geographic characteristics of the study and providing a thorough description of the group under study are two ways to demonstrate transferability. Due to this, the term "reliability" also refers to the consistency and dependability of study results, as well as the degree to which research procedures are documented so that those who are not researchers can understand, assess, and critique the research process. Dependability is an important quality factor for ecological and nature preservation applications in the early phases of evaluating outcomes in many contexts to strengthen the reliability and credibility of evidence. Last but not least, conformability describes a study's objectivity in terms of collecting and analyzing data. The accuracy, relevance, or significance of the data shall be determined by at least two separate parties. Conformability also provides a technique to verify quality (Polit & Beck, 2012).

External validity
This is the ability to use a scientific study's findings outside of its original context, known as external validity. It refers to how broadly the findings of a study may be applied to and across different contexts and subjects (Findley et al., 2021).

EBM Versus EPBH

Public health decision-making can be a difficult process because of the complexity of the inputs and the need for collaborative decision-making (Lhachimi et al., 2016). However, public health practice and research made significant advancements over the past century, which helped explain the 30-year increase in life expectancy. Despite these successes, it could be beneficial to pay more attention to evidence-based practices. EBPH can been seen as the application of the ideas of EBM to the field of public health. However, the gold standard in EBM, RCTs, isn't necessarily appropriate for analyzing public health issues (Lhachimi et al., 2016).

Important components of a broader definition of EBPH include making judgments based on the most up-to-date scientific information, using reputable data collection and research procedures, and involving the affected populations in the decision-making process (Lhachimi et al., 2016). An evidence-based approach to public health may have a number of direct and indirect benefits, including better access to more and higher-quality

information on best practices; a higher likelihood that prevention policies and programs will be successful; an increase in workforce productivity; and more efficient utilization resources, whether public or private (Lhachimi et al., 2016).

SUMMARY

Public health is science and art of avoiding disease, extending life, and promoting wellness through coordinated efforts and informed decisions by relevant stakeholders. It can also be defined as the planned actions aimed at safeguarding the health of the public to prevent disease and lengthen lifespans. The history and origin of public health dates back to ancient times, and this field continued and continues to evolve and grow in importance. Consequently, the main disciplines of public health are epidemiology, biostatistics, environmental health, health behavioral sciences, health education and promotion, health management, and health policy.

When it comes to the analytical methods of public health, there are three main methods: quantitative, qualitative, and mixed. Each method has its tools, purposes, advantages, and disadvantages.

In medicine, the needs of the particular patient are given priority within the context of the family and the community. In contrast, population health is prioritized in public health since disease often shows up in people's daily lives. Therefore, even if medical care and public health are often confused as being the same, these two fields are quite different yet complementary.

When speaking of data, it is important to distinguish between data and information, between primary and secondary data, and between population and individual health data. Accordingly, the main sources of public health data and information are census, administrative records, medical records, claims data, surveillance data, and peer-reviewed literature, as well as other miscellaneous sources, such as health reports.

Evidence-based public health is the practice of making decisions to assist communities and populations in improving in the areas of health protection, disease prevention, and health maintenance. When it comes to evidence, there is a hierarchy based on quality and rigor.

UNIT 2

INFECTIOUS DISEASES

STUDY GOALS

On completion of this unit, you will be able to...

- understand infectious diseases.
- recognize the burden of infectious diseases.
- explain bacteria, parasites, viruses, and fungi, and discuss the various infections they cause.
- identify different ways of controlling infectious diseases.
- discuss vaccination, its history, and different types of vaccines.
- explain vaccine hesitancy and the role of public health in vaccinations.

2. INFECTIOUS DISEASES

Introduction

This unit will delve into infectious diseases, including the different types and how they are transmitted. It will highlight how the epidemiologic and demographic shifts have affected the spread of infectious diseases, including their incidence and prevalence. Similarly, it will highlight how the social determinants of health (SDH) are intertwined with infectious diseases. The burden of disease will also be discussed. In the second section, different types of microorganisms that cause infectious diseases will be discussed, followed by an overview of different ways of controlling infectious diseases. The last section of this unit will discuss vaccination in detail, including its different types and history. This section will also shed light on vaccine hesitancy and the role and relationship between vaccination and public health.

2.1 Measuring the Burden of Infectious Diseases

The burden of disease is defined as the impact of a health issue, as determined by monetary cost, death, illness, or other indicators associated with this health issue (Bhutta et al., 2014). It is frequently measured in terms of **quality-adjusted life years** (QALYs) or **disability-adjusted life years** (DALYs). The overall disease burden can be viewed as a measurement of the difference between the current health state and the ideal health status (Bhutta et al., 2014).

Quality-adjusted life years
This is used to assess the health impact of a medical intervention or prevention program and assists in allocating healthcare resources. It is frequently employed in health economic analyses (Sanghera & Coast, 2020).

Disability-adjusted life years
This reflects the loss of one year's worth of healthy living. One DALY can be thought of as one year of healthy life wasted (where the individual lives to old age without disease and disability; McDonald et al., 2020).

Prior to measuring and discussing the burden of infectious diseases, it is important to learn more about infectious diseases, including their etiology and how they are transmitted.

What are Infectious Diseases?

Infectious diseases are caused by organisms like bacteria, viruses, fungi, or parasites. Numerous organisms reside in and on human bodies, but they are generally advantageous or even protective. However, in specific circumstances, some have the capacity to cause diseases (Gorbach et al., 1992).

Infectious diseases may spread from one human to another, while others are spread by animals or insects. In some cases, people can contract infectious diseases through the consumption of contaminated food or water or when in contact with certain organisms in the environment (Gorbach et al., 1992). Frequent indicators and symptoms of infection include fever and exhaustion, though they may differ depending on the organism causing the infection. While hospitalization may be necessary for serious, life-threatening conditions, lesser infections can sometimes be managed at home with rest (Gorbach et al.,

1992). Numerous infectious diseases, including measles and chickenpox, can be avoided with vaccinations. Furthermore, routine hand washing helps protect patients from several contagious diseases, such as COVID-19 (Long et al., 2022). Infectious diseases can be caused by the following (Gorbach et al., 1992; McArthur, 2019):

- bacteria: These single-celled organisms cause strep throat, tuberculosis, and infections of the urinary system.
- viruses: Among the various diseases caused by viruses include the common cold and acquired immunodeficiency syndrome (AIDS). The size of viruses is even smaller than that of bacteria.
- fungi: Ringworm and athlete's foot are two skin disorders that are caused by fungi. The majority of organs can become infected with fungi.
- parasites: These include the one that causes malaria, which is released by a mosquito bite. Humans may get additional parasites from animal waste.

In low-income countries, particularly among young children, infectious illnesses are a primary cause of death (Simen-Kapeu et al., 2021). Lower respiratory infections and diarrheal diseases are two highly infectious disease categories included in the top 10 global causes of death worldwide, according to the World Health Organization (WHO). There are numerous infectious agents that can cause either of these disorders (Simen-Kapeu et al., 2021).

Human immunodeficiency virus (HIV)/AIDS and tuberculosis are no longer among the top 10 global causes of death due to the sharp decline in their respective death tolls in recent years. However, in low-income countries, chronic illnesses continue to be a major cause of death. Another infectious disease that is a leading cause of death in developing nations is malaria (Makam & Matsa, 2021).

In 2020, the COVID-19 pandemic started due to a newly viral disease brought on by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which surpassed all other causes of mortality in several countries (Watson et al., 2022). For example, in the United States, COVID-19 became the third-most common cause of death in the country, behind only heart disease and cancer (National Institute of Mental Health, 2022).

Transmission of infectious diseases

A person can contract an infectious agent through a variety of different channels. Humans must come into contact with an infection source, such as tainted food, water, feces, body fluids, or animal products, to contract some diseases (Seventer & Hochberg, 2017). Infection can be spread through the air when combined with other agents. It is obvious that an infectious agent's mode of transmission plays a significant role in how quickly it can spread throughout a population. In comparison to an agent that is distributed by direct touch, an agent that may spread through the air has a greater chance of infecting a larger population. The infectious agent's ability to survive in the environment is another crucial aspect of transmission. For example, a virus that can live in the environment for hours, days, or even longer will be able to infect more people than one that can only last a short time between hosts. These elements must also be taken into account while assessing the dangers of potential **bioterrorism** agents (Seventer & Hochberg, 2017).

Bioterrorism
This is the intentional release of viruses, bacteria, etc., that can infect or kill humans, animals, or food (Lim et al., 2005).

Effect of the Epidemiologic and Demographic Shifts on Infectious Diseases

The epidemiological shift or transition, or the change in terms of morbidity and mortality causes from infectious diseases to chronic non-communicable diseases, was once believed to be a one-way process that started when infectious diseases predominated and ended when non-communicable diseases dominated the leading causes of mortality (McKeown, 2009). However, it has become clear that this shift is more complicated and dynamic than previously thought (Geard et al., 2015). As a result of demographic, social, technological, cultural, environmental, and biological changes, a society's health and illness patterns vary in several ways (Anderson, 2016). Instead, there is a constant process of alteration, with some diseases vanishing and others arising or resurfacing. This suggests that the process in question is not one-way. In truth, the tendency can occasionally change. The emergence of novel infectious diseases, like AIDS in the 1980s, and the rise of infections previously under control, like tuberculosis and measles, are a few notable examples (Baker et al., 2022).

It is also important to keep in mind that a sovereign country may experience multiple stages of transition at once (Baker et al., 2022). For instance, non-communicable diseases may be expanding quickly in one segment of the same population, while infectious diseases may be declining slowly or staying the same in another. This still occurs in most countries but is more prominent in low- and middle-income countries, wherein wealthier parts of a country exhibit radically different disease patterns from the less wealthy sectors, which have a high frequency of infectious diseases, especially among children and older adults (Baker et al., 2022).

In 1969, many people, including US Surgeon General William Stewart, believed that the era of infectious diseases was over and it was time to "shut the book on infectious disease as a serious health danger" (Bristol, 2008, p. 110*;* Van Doorn, 2014). Without a doubt, these people were unaware of the global HIV/AIDS pandemic; the epidemics brought on by newly discovered viruses, like Ebola or Zika; the dangers posed by antimicrobial resistance; or, more recently, the global COVID-19 pandemic (MacPherson et al., 2021; Reperant & Osterhaus, 2017). In the modern world, malnutrition, poverty, environmental degradation, rapid population growth, and globalization provide an ideal environment for the emergence of previously rare pathogens or the spread of infections that were originally under control (Church, 2004; Semenza & Paz, 2021).

Despite the fact we are experiencing an epidemiological transition toward chronic, non-communicable diseases, infectious diseases caused by new and emerging microorganisms (especially vector-borne viruses) and re-emerging (especially multidrug resistant bacteria) still pose a threat globally (Khabbaz et al., 2015).

The fact that it might be difficult to distinguish between infectious and chronic diseases adds yet another layer of complexity (O'Connor et al., 2006). In fact, gastrointestinal ulcers caused by the bacteria *Helicobacter pylori* and cardiovascular disease or type 2 diabetes caused by low-grade chronic inflammation are just a few of the chronic diseases that are largely attributable to infectious agents and the inflammatory process they cause. Evidence of inflammation has also been found in a wide range of non-communicable diseases, such as autism and other mental health disorders (O'Connor et al., 2006).

All of this emphasizes how, in order to address the difficulties in **global health**, we must go beyond the epidemiological shift (Holst, 2020). This entails creating a number of interventions that are specific to the dangers and realities of each population. The most cost-effective strategies are available to combat infectious diseases that impact the poorest people (Platt et al., 2016). Due to the multiplicity of diseases brought on by the double burden of disease, interventions must be more diverse and involve a wide range of sectors and actors (Min et al., 2018). Finally, the attempts to lower the dangers related to sedentary behavior and "hypernutrition" shouldn't overwhelm the current and genuine threat posed by infectious diseases that are emerging and reemerging (Min et al., 2018).

Scientists believe that, in the coming decades, the risk of disease introduction will grow because of climate change, increased urbanization, and shifting land-use patterns. For example, climate change may modify the range of global pathogens, allowing infections (particularly those spread by vectors) to spread to new areas (Baker et al., 2022).

Social Determinants of Health and Infectious Diseases

Although diseases do not discriminate against individuals, people do, which places a disproportionate cost of sickness on those who are subject to discrimination (Marmot, 2005). This is, of course, also the case when it comes to infectious diseases. Infection risk and disease consequences are influenced by socioeconomic factors, like poverty and living conditions (Braveman, 2011). People who are poor frequently experience living in cramped quarters, experiencing limited access to high-quality healthcare, having to work while ill, eating less nutritive food, sleeping less, experiencing more stress, and being more likely than others to abuse drugs and alcohol. All of these things lower immunity and make people more vulnerable to illness, namely infectious diseases, and, thus, death (Braveman, 2011).

The social and economic factors that influence people's health are known as social and behavioral determinants of health (SDH; Braveman, 2011). Accordingly, since the 19th century, social conditions, particularly extreme poverty and its effects, have a significant role in determining the spread of infectious diseases. Despite the fact that knowledge of the social determinants of noninfectious disease is much more recent, a substantial body of knowledge has been gathered since the 1990s recognizing various social variables, such as socioeconomic factors and credible mechanisms, that show how those factors affect health, as well as infectious and noninfectious diseases (Braveman, 2011). Therefore, a larger burden of disease is experienced by some population groups because they are more prone than others to being exposed to and contracting infectious diseases. Groups that are more at risk due to structural injustices are more likely to catch an infectious disease, suffer from illness, and recover more slowly (Bishwajit et al., 2014). Such groups include refugees, racial or ethnic minorities (like indigenous people), LGBTQ+ populations, people with special needs (namely, people with mental health issues), and those with diagnosed with HIV/AIDS (Marmot, 2005).

People from a lower socioeconomic background are more likely to be at a higher risk of catching an infectious disease due to their living and residential circumstances, such as poor sanitation, overcrowding, and scarcity of safe drinking water (Bishwajit et al., 2014).

Additionally, malnutrition, which could be the result of a lack of access to high-quality food or an inability to pay for food, was linked to a greater risk of infections (Gardner et al., 2022).

Similarly, healthcare disparities are differences in the rates of illness and disability across population groupings, defined by socioeconomic factors, such as age, ethnicity, financial resources, or gender, and populations located in certain geographic areas (Butler-Jones & Wong, 2016). They also include differences in access to or availability of medical facilities and services. Hence, SDH and health disparities go hand in hand, meaning that people with lower socioeconomic backgrounds are expected to face health disparities, as they are less likely to have access to quality **health commodities**. This, in turn, will increase their risk of not only getting an infection but their risk of morbidity and mortality as a result of infections (Butler-Jones & Wong, 2016). The majority of infectious diseases are directly caused by poverty, including poor nutrition, cramped living quarters, lack of access to healthcare, inadequate hygiene, and unsanitary circumstances.

Health commodities
This is any device or item that is essential for the delivery of healthcare services. They include medicines, vaccines, consumables, and medical supplies (Bray & Awuah, 2019).

The expanding scope of public health's obligations demonstrates its growing significance in tackling the SDH and their effect on both infectious and noninfectious diseases (Shi et al., 2009). However, historically, public health has been credited with helping reduce and manage infectious diseases through initiatives that tackle SDH, like environmental sanitation (by ensuring clean air and water), sanitary habits, the eradication of smallpox and polio (through vaccination), improving access to quality health services, and the alleviation of overcrowding (Shi et al., 2009).

Burden of Infectious Diseases

Focusing on mortality or, more specifically, child mortality and life expectancy, which are dependent on mortality estimates, is an easy approach to evaluate the health state of a population (Mathers, 2008). However, a concentration on mortality ignores the fact that the burden of diseases includes the pain and suffering they bring to those who live with them, as well as the death they cause. A more complete picture of health outcomes is provided by measuring mortality and morbidity (the prevalent diseases; Mathers, 2008).

The term "burden of disease" refers to the total of mortality and morbidity, and it can be calculated using DALYs (Michaud, 2009). A DALY is a standardized statistic that enables direct comparisons of various diseases between nations and various populations, measuring lost health. The concept of a DALY is the loss of one year of healthy life due to an early death, illness, or disability. One year of healthy life is equal to one DALY (Michaud, 2009).

Throughout history, people have been afflicted with infectious diseases, sometimes even changing the course of history (Pinheiro et al., 2009). A few instances are the Spanish flu epidemic of 1918, the plague (also called the Black Death) in the Middle Ages, and the plagues of biblical periods (Pinheiro et al., 2009).

It is estimated that the 1918 flu pandemic contributed to the end of World War I and claimed the lives of up to 50 million people worldwide (Pinheiro et al., 2009). Although epidemics and pandemics have historically had significant social and economic effects on the populations they affect, in today's interconnected globe, these effects are truly world-

wide. The most recent example to highlight this is the COVID-19 pandemic. Infections can quickly move from one area to another, and a spike in cases in one region can trigger a rebound of cases in other regions until the virus can be controlled globally (Pinheiro et al., 2009).

Despite the advancements in health over the past century and the worldwide trends discussed above, the world's most vulnerable populations continue to lose their lives to infectious diseases that can be prevented, a burden that is made worse by malnutrition and poverty (Michaud, 2009). This causes the double burden of disease for so many low- and middle-income countries (LMICs), including new health issues, like chronic diseases connected to a Western lifestyle and population aging, in addition to old health issues, like infectious diseases and high maternal and newborn mortality. These distinctions are clear when comparing LMICs and high-income countries, but they also persist within a single nation, where those in the bottom quintile are significantly more likely to die from infectious diseases. Ironically, these same groups will also suffer from obesity, cardiovascular disease, and diabetes, despite the fact that the wealthier people – those who first experienced these conditions – have already begun to embrace therapies and lifestyle changes to prevent them (Michaud, 2009). For instance, research reveals that obesity **prevalence** and body mass index have grown linearly with income in underdeveloped countries, but obesity has been inversely connected to income in more industrialized nations (Michaud, 2009).

Prevalence
This is when a particular attribute in a population is measured over time, for example, the prevalence of cancer in a given population in the past five years (National Institute of Mental Health, n.d.).

Measuring the burden of infectious diseases

Although tackling some infectious diseases, such as measles, diarrheal illnesses, and respiratory infections, has seen improvements, overall conditions haven't altered much since the early 2000s. In 2000, infectious and parasitic diseases still accounted for close to 30 percent of the worldwide burden and close to 32 percent of the burden in developing nations (WHO, 2008b). Five infectious diseases made up the top 10 global causes of DALYs in the 2000s: lower respiratory infections (the number one cause), HIV/AIDS, diarrheal illnesses, malaria, and tuberculosis. In Africa, where infectious and parasitic diseases account for 60 percent of the burden, the situation is especially dire (WHO, 2008b). This bleak result is mostly the result of the HIV-AIDS epidemic, which is currently responsible for 5.3 percent of all fatalities and 6.1 percent of all burdens globally. It largely explains why communicable diseases still accounted for 26 percent of all fatalities globally in the 2010s, down from 27 percent in 1990 (Roser et al., 2021).

Over the past 10 years, the number and rates of deaths from some communicable diseases, such as measles, tuberculosis, and diarrheal illnesses, have decreased (Cassini et al., 2021; Roser et al., 2021). However, other diseases, such as malaria and HIV, have increased, especially in low-income countries (Cassini et al., 2021). This has been accompanied by an increase to in the proportion of DALYs worldwide, caused by non-communicable chronic diseases, such as cardiovascular diseases and diabetes (Ram & Thakur, 2022). Therefore, communicable and non-communicable diseases have a "double burden" on LMICs. For example, in 2019, DALY losses were higher than 25,000 per 100,000 people in the majority of these nations, reaching over 50,000 in South Asia and sub-Saharan Africa. In comparison, rates in Europe and North America were typically more than 10 times lower, at less than 2,500 per 100,000 (Roser et al., 2021).

The majority of LMICs do not have the financial means to effectively combat diseases like tuberculosis, malaria, and HIV/AIDS (Boutayeb, 2010). The majority of the time, illnesses cost billions of dollars in lost productivity and skills. Since most diseases strike either children or adults during their most productive years of life, LMICs are most affected by the global burden of infectious diseases. As a result, communicable diseases have an impact on life expectancy, education, income, and all other aspects of human development in LMICs (Boutayeb, 2010). The burden of disease is a significant issue for public health and a genuine worldwide concern for overall economic and human growth.

As a result, vaccine technology has such a broad application in the fight against infectious illnesses, and initiatives to increase access to these resources must continue to rank highly on the agenda of public health. Furthermore, public health initiatives to combat communicable diseases have experienced both successes and failures, according to an examination of the worldwide burden of infectious disease during the previous 10 years (Khan et al., 2022).

2.2 Bacteria, Parasites, and Viruses

Infectious diseases are caused by different organisms. The main organisms are bacteria, parasites, viruses, and fungi, and each of these are discussed below.

Bacteria

Bacteria are tiny, single-celled creatures that are present almost everywhere on the planet and vital to its ecosystems. There are many types of bacteria, which can resemble spheres, rods, or spirals. Some species can endure in conditions with extreme temperatures and pressure (Doron & Gorbach, 2008). Perhaps the most fascinating aspect of bacteria is that they comprise a stunning 10 times more of our body's cells than human cells, although most of these bacteria are harmless (many have been modified to become benign by immune system defenses) and many others, particularly those in the gut, are actively beneficial. Bacteria are also essential to **biotechnology** since they help the body maintain a healthy state (Doron & Gorbach, 2008).

Biotechnology
This is a field of engineering that utilizes biological systems and live organisms, such as yeast, to develop or produce various goods (Botella et al., 2018).

Although microscopic, bacteria are powerful and sophisticated and can withstand challenging conditions due to their tough exterior, which makes them more resistant to the white blood cells in the body (Doron & Gorbach, 2008). While most bacteria are not thought to be dangerous, some strains can cause disease. If people come into contact with them, infectious bacteria can grow and release toxins that harm the body's tissues and can cause flu symptoms. Pathogenic (disease-causing) bacteria are harmful and can cause diseases and disorders including the following (Bannister et al., 1996):

- cholera
- tuberculosis
- bacterial meningitis (affects the protective layers of the brain)

Lower respiratory infections rank third and diarrhea sixth among the leading causes of death worldwide; both are mostly caused by bacteria. The seventh most frequent cause of mortality is tuberculosis, which is also caused by a bacteria (Doron & Gorbach, 2008).

Bacterial infections are brought on by a number of factors. An organism's infectivity is the first factor that can determine how many people will become infected compared to how many are susceptible and exposed (Doron & Gorbach, 2008). Another factor is pathogenicity, which can measure an infectious organism's ability to cause disease. Pathogenic microorganisms that can cause disease are able to avoid the body's defenses and use its resources. Finally, virulence is an organism's potential to spread disease due to, for example, invasiveness and toxin production. In predicting whether a disease will spread after a bacterial agent has been transmitted, host characteristics are crucial. These variables include genetic make-up, nutritional status, age, length of organism exposure, and co-occurring diseases. In addition, the host's environment affects susceptibility. The body's defenses and immunity against bacterial infection can be weakened by environmental pollutants, toxins, and air pollution (Doron & Gorbach, 2008). Common infectious diseases caused by bacteria include the following (Bannister et al., 1996):

- pharyngitis
- pneumonia
- sexually transmitted infections (STIs), such as chlamydia, gonorrhea, and others
- urinary tract infections (UTIs)

Transmission

Humans can contract bacteria via the air; water; food; or living things, such as other human beings or animals. Accordingly, the main means of bacterial infection transmission are as follows (Seventer & Hochberg, 2017):

- contact: This includes straightforward physical contact, including skin-to-skin or mucous-membrane-to-mucous-membrane (mucous membranes are found in the nostrils, mouth, throat, and ears) and fecal-oral transmission of intestinal bacteria. In addition, several bacterial illnesses (like hepatitis C) are transmitted when infected blood products are transfused or due to the exchange of bodily fluids, for example, during sexual intercourse (like HIV/AIDS).
- airborne: This is mainly in the form of droplets expelled into the air through sneezing or coughing, while some bacteria are transported by air currents. For example, tuberculosis is spread widely from its original location.
- vectors: These include living organisms, such as mosquitoes, ticks, flies, fleas, and lice that spread infectious bacteria from a sick animal to other animals and even humans.
- droplet: Since a droplet that is more than five micrometers in diameter is unlikely to move more than one meter through the air, this form of spread is not regarded as airborne. They are typically more prone to removal if they are filtered by a mask covering one's mouth or nose.
- transmission by vehicles or vectors: These vehicles include food (poultry, vegetables, etc.), water (drinking water, tap water, etc.), and fomite (utensils, clothes, etc.). Bacterial infections brought on by food and water often start when bacteria enter the mouth and travel to the intestine. If organisms are able to get through the stomach's acidic environ-

ment without being removed by the small intestine's mucous, they stick to the cell surfaces. There, they might produce poisons or infiltrate the host cells, which can result in diarrhea.

Bacterial infection prevention and control

Naturally, the prevention of infection has a significant impact on morbidity and mortality (Lacotte et al., 2020). Given how challenging infection can be to cure, prevention is crucial in this era of rising antibiotic resistance. The three main principles for controlling bacterial infections are to stop the spread of the illness, remove the infection's source, and protect the host from disease or infection. Additionally, it is now understood that removing significant cofactors, such as air pollution from vehicles or indoor cooking, can significantly lower the frequency of bacterial illnesses. The most successful course of action frequently depends on the infection's reservoir. Secondary prevention refers to the care given to infected people to stop symptomatic illness, whereas tertiary prevention refers to the care given to infected people to stop transmission to other people. Infection prevention, such as through vaccination, is generally referred to as primary prevention (Lacotte et al., 2020).

To reduce the spread of infection between people, either within a small group or internationally, there are numerous guidelines to follow. An international concern is infection prevention and control on a population-based scale. Identifying at-risk categories can also help focus measures to protect these groups, such as children, the elderly, and people with chronic illnesses (Lacotte et al., 2020). The first step in infection control may be to alter community practices, such as the following (Doron & Gorbach, 2008; Lacotte et al., 2020; Seventer & Hochberg, 2017):

- regular hand washing
- wearing face masks when necessary to protect against and stop the spread of respiratory infections
- using insect repellents
- ensuring that routine vaccinations are current and participating in immunization programs
- taking prescribed medications, such as antibiotics, as instructed by medical professionals
- quarantining and isolating to avoid interpersonal interactions
- using condoms, especially with a new partner, during sexual activity

Other ways to stop the spread within communities include the following environmental factors (Doron & Gorbach, 2008; Lacotte et al., 2020; Seventer & Hochberg, 2017):

- altering the environment
- monitoring diseases
- food safety
- monitoring air quality

Treatment

In addition to straightforward measures to prevent and control infections, biochemical interventions can hasten the healing process and, in some situations, totally prevent infections. The creation of antibiotics and vaccines can hasten healing, halt illness progression, and even eradicate infectious diseases from entire populations (Hauser et al., 2016).

Antibiotics

Antibiotics are administered to treat bacterial infections and help the body's defense mechanism get rid of the bacteria that are causing the ailment (Hauser et al., 2016). They are made to either eradicate bacteria or prevent them from procreating. However, inadequate usage of antibiotics, overprescribing, and bacterial mutation have contributed to the emergence of resistant bacteria. In these situations, larger doses or a combination of antibiotics are necessary (Hauser et al., 2016).

There is growing concern over **antibiotic resistance**. This can happen due to misuse and overuse of antibiotics, reducing their effectiveness (Hauser et al., 2016). Bacteria may develop antibiotic resistance through evolution. If antibiotics are used when they are not needed, this may increase one's risk of developing antibiotic-resistant bacteria. Although antibiotics can save lives, studies show that more than 28 percent of associated prescriptions are unnecessary (Hauser et al., 2016).

Antibiotic resistance
This is an issue in which bacteria, fungi, and other microorganisms become resistant to medications that are supposed to kill them, so they evolve. Treating resistant infections can be challenging and may even be impossible (Frieri et al., 2017).

Vaccination

The purpose of vaccinations is to increase immunity to a certain disease. By introducing minute quantities of the disease-causing virus or bacterium into the host, vaccines enable the host to develop innate immunity (Rodrigues & Plotkin, 2020). Regular vaccinations have decreased the spread of several diseases like polio, measles, mumps, whooping cough, and rubella and have even eradicated them in some circumstances (i.e., for measles). There are other vaccines available to prevent chickenpox, but they are only given to people who are at a high risk of passing the illness to people who have compromised immune systems. This is because chickenpox frequently affects children under 10 years old and its symptoms are typically mild; this strategy enables them to develop a natural immunity and helps increase a community's immunization rate. Herd immunity is the term for this form of defense (Rodrigues & Plotkin, 2020).

Parasites

A biological organism that lives in, feeds off, and uses its host as a resource is called a parasite (Raga et al., 2008). Parasite characteristics range widely: While certain worm parasites can grow to be more than 35 cm long, many parasites, such as the malarial parasite, are invisible to the human eye. Without a host, a parasite cannot grow, mature, or breed, meaning that, while parasites can transmit diseases (some of which have the potential to be fatal) they rarely lead to the death of their hosts (Raga et al., 2008).

There are many different parasites, and their symptoms can vary widely. The symptoms of these can occasionally resemble those of other ailments, such as pneumonia or food poisoning (Cox, 2009). Human parasites come in three different forms (Poulin & Morand, 2000; Pritt et al., 2012):

- protozoa: These are single-celled organisms that are able to develop inside humans. Insect bites, contaminated food and drink, and human interaction are ways that these parasites can spread. *Plasmodium malariae*, which causes malaria, and *Cryptosporidium*, which can be consumed, are examples of protozoa.
- helminths: Parasitic worms, also known as helminths, typically live in a person's gastrointestinal tract. Since these parasites cannot split or multiply within a human body, they eventually exit the body through a person's stool. They frequently result in gastrointestinal symptoms, like diarrhea and pain in the intestines.
- ectoparasites: These are microscopic organisms that live externally rather than in the human body. Ticks, fleas, and lice are examples of these.

Parasitic infections

Infections due to parasites occur all over the world; however, tropical, subtropical, and more temperate regions experience a significant burden of disease due to parasitic infections. Malaria is the deadliest parasitic disease (Katz et al., 2012). Each year, more than 400,000 people die from malaria, and most of these are children in sub-Saharan Africa (Ngowi, 2020). Furthermore, the public health community has generally neglected parasitic diseases, such as lymphatic filariasis (spread by mosquitoes to humans and typically affecting young people, where it does the lymphatic system covert harm), onchocerciasis (also called river blindness after blackflies repeatedly bite a person, leading to blindness), and Guinea worm disease (which is caused by a parasite and is prevalent among underprivileged groups in rural parts of Africa without access to safe water. There is no medication to treat this disease, nor a vaccine to prevent it). These diseases are referred to as neglected tropical diseases (NTDs; Katz et al., 2012). More than one billion individuals worldwide are affected by NTDs, mostly in rural parts of low-income countries (Ngowi, 2020). These diseases place a heavy toll on endemic populations, meaning people lose the capacity to go to work or school, children's growth slows, young children's cognitive skills and development are impaired, and a severe economic burden is placed on entire nations (Katz et al., 2012).

Prevention

There are currently no vaccinations available for the prevention of human parasitic infections, despite significant expenditure and research. Avoidance tactics are the foundation of prevention (Pritt et al., 2012). Most parasite transmission can be stopped by the following (Bahk et al., 2018; Gai et al., 1995; Pritt et al., 2012):

- waste management for feces
- hand washing
- adequate food preparation
- provision of clean water
- using bug nets

- putting on protective gear
- getting rid of standing water
- practicing safe sexual behavior

Parasitology

Parasitology is the study of how parasites and their hosts coexist (Cox, 2009). In general, fields such as bacteriology, microbiology, and virology concentrate on parasites and other infectious agents, whereas parasitologists frequently concentrate on eukaryotic parasites, such as lice, mites, protozoa, and worms. From dysentery and diarrhea to malaria, parasites are a major cause of some of the deadliest diseases in the world (Cox, 2009).

Most of the time, research and public health organizations use parasitologists to test drugs, vaccinations, and other preventative measures against parasitic illnesses (Cox, 2009). Parasitology is a vital component of public health since it aids in the treatment of human parasitic disorders, prevents losses in aquaculture and agriculture, and keeps people's pets clean of worms and fleas. This is because public health needs parasitology to understand parasites' deoxyribonucleic acid (DNA), proteins, life cycle, and development to manage parasitic infections and anticipate future outbreaks since parasites, like bacteria, can evolve to have medication resistance (Cox, 2009).

Viruses

For a virus to be an infectious microorganism, it must have a protein-coated stretch of nucleic acid (either DNA or ribonucleic acid [RNA]; Sen, 2001). A virus is unable to replicate itself on its own, so it must invade cells and use the components of the host cell to do so. Frequently, a virus harms the host body by causing the host cell to die (Sen, 2001). Well-known examples of viruses that can cause human disease include AIDS, COVID-19, measles, and smallpox.

Viral Infections

Although the diseases that viruses cause were the foundation for their discovery and first classification, most viruses that infect bacteria, plants, and animals (including humans) do not result in disease (Woolhouse et al., 2012). Viruses of plants and animals may transmit genetic information between similar species, aiding their hosts in surviving in harsh situations, and bacteriophages may be useful in that they quickly transfer genetic information from one bacterium to another. In the future, humans might also experience this. Biotechnology holds a lot of potential for fixing genetic flaws. Infected individuals receive injections of cells modified by viruses that carry a functioning copy of the human gene that is faulty, and the virus incorporates the regular gene into the human cell's DNA (Woolhouse et al., 2012).

Some viruses cause illnesses that are recurring or long-term (chronic), whereas others cause short-term (acute) illnesses (Virgin et al., 2009). Some viruses cause acute illnesses that heal rather quickly, but they may stay dormant for a long time in the tissues before becoming active again and causing significant illness decades later. Viral diseases that

advance slowly have protracted incubation periods before symptoms appear. As mentioned above, some viruses' DNA can integrate itself into the host cell's genome, frequently leading to a cancerous cell transformation (Virgin et al., 2009).

A virus's ability to cause disease is typically a genetic trait shared by the virus and its host cells (Burrell et al., 2016). However, a lot of viruses can lay latent in the host's tissues, such as the human papilloma virus (HPV). Whereas acute, disease-causing viruses, such as influenza, are typically (although not always) those that rapidly damage or kill cells and have the ability to halt normal functions within the host cell, fewer diseases that develop after a virus infects a vertebrate are actually caused by the virus itself than by a secondary immune reaction (Burrell et al., 2016).

Transmission

Viral transmission can occur vertically (from mother to child) or horizontally (from one person to another; Louten, 2016). The hepatitis B virus and HIV are two examples of vertical transmission, where the baby is born with the infection already present. Another less common example is the varicella zoster virus, which can be lethal to a pregnancy or a newborn baby, despite only causing relatively minor illnesses in children and adults. In populations, horizontal transmission is the most frequent method of viral spread. For example, hepatitis B and HIV are transmitted horizontally (Louten, 2016).

Horizontal transmission can happen when saliva is exchanged, when body fluids are transferred during sexual activity, or when contaminated food or water is consumed (Louten, 2016). Additionally, it can happen when a person breathes in virus-containing aerosols or when an infected mosquito bites a person. Most viral types, which are often known as respiratory viruses or enteric/gastrointestinal viruses, are limited to just one or two of these pathways. The number of susceptible people (or those who lack immunity), the population density, the quality of medical care, and the weather are among the variables that affect how quickly viral illnesses spread (Louten, 2016).

Prevention

Proper sanitation, effective sewage disposal, fresh water, and hygiene practices are all aspects of hygiene that can halt the spread of many viral illnesses. Active immunization with vaccines has effectively prevented widespread epidemics caused by severely contagious viruses (Cheng et al., 2017).

The best illustration of a preventable illness is smallpox, which is brought on by a virus that was formerly widespread throughout the world (Cheng et al., 2017). The milder cowpox virus, identified in 1796 by the English physician Edward Jenner, might be used as a live vaccine (an antigenic preparation made up of viruses whose ability to cause disease has been diminished) to prevent smallpox (Baron, 2014). One of the biggest medical success stories in history is the vaccination campaign that Jenner's discovery led to after he announced his results in 1798. In 1980, the WHO pronounced that the disease had been eradicated (Baron, 2014).

Treatment

The bulk of viral diseases can only be treated temporarily, while patients wait for their immune systems to destroy the virus. Antibiotics cannot be used to treat viral infections; however, numerous viral illnesses can be prevented with the help of vaccines. Antiviral drugs help the body's defense against dangerous viruses by reducing viral infection symptoms and minimizing the period of illness. These drugs also reduce the likelihood of infecting others or contracting herpes and HIV (Meganck & Baric, 2021).

Viruses and some types of cancer

Several viruses are connected to various types of cancer (Lambert & Sugden, 2020). When a person contracts a virus, the virus spreads its DNA through the body, affecting the genetic make-up of healthy cells and possibly leading to cancer. For example, HPV infections cause the host's DNA to fuse with the virus' DNA, impairing the ability of cells to operate normally. By interfering with the body's immune system, other viruses, including the hepatitis C virus and HIV can increase a person's risk of getting cancer. Most of the time, a particular virus only affects a certain type of cell in the body; for example, common cold viruses exclusively attack the nose and throat lining. This explains why certain viruses are only associated with specific types of cancer. The four DNA viruses that can result in the growth of human cancers are as follows (Lambert & Sugden, 2020):

1. Human papilloma virus: This can cause cervical, head and neck, anal, oral, pharyngeal, and penile cancers.
2. Hepatitis B virus: This can cause liver cancer.
3. Human herpes virus-8: This results in Kaposi sarcoma, which is a rare type of cancer that affects the skin, lymph nodes, and other tissues of the body.
4. Epstein-Barr virus: This can cause liver cancer and some types of lymphomas.

It is very important to avoid contracting these viruses, namely through safe sex practices and following instructions when exposed to other infected people (Lambert & Sugden, 2020).

Viral versus bacterial infections

Bacteria and viruses are often confused with one another, but they could not be more different in terms of their characteristics (size, shapes, features, and modes of infection; Mahajan, 2021). Although the signs of bacterial and viral infections may be similar, their treatments differ. Viruses are not treatable by antibiotics, but antibiotics can treat some bacterial infections. On the contrary, antiviral medications may be used to treat some viruses but not bacterial infections (Tsao et al., 2020). Additionally, a secondary bacterial infection can occur when a bacterial infection follows a viral illness. If the signs of a viral infection persist for more than 10 to 14 days, you can also develop a secondary infection (Beadling & Slifka, 2004).

Fungi

Fungi can be single-celled creatures or extremely complex multicellular animals (Garber, 2001). They can be found practically anywhere; however, the bulk of them prefer land (primarily soil or plant materials) rather than fresh or salt water. Yeasts, rusts molds, and mushrooms are all examples of fungi. Agricultural fungal infections can result in significant financial losses for farmers. Animals can become ill from even a small amount of fungi. Some conditions include ailments of the skin, such as athlete's foot (fungal infection usually on the foot) and thrush (a white layer in the mouth, predominantly on the tongue; Garber, 2001).

Fungal infections

Fungal infections can affect anyone, regardless of whether or not they are healthy (Hay, 2006). Fungi are widespread in our environment, so people regularly breathe in or have contact with fungal spores without becoming ill. Nevertheless, patients with compromised immune systems are more prone to contract an infection from these fungi. Fungal infections can be caused by a variety of fungus species (Badiee & Hashemizadeh, 2014; Hay, 2006).

On rare occasions, fungi that are inside a person's body may colonize it and cause a disease (Kauffman & Hedderwick, 2006). Fungi that are frequently found on or within the human body might grow and cause an infection in specific circumstances. It is possible to transfer fungi-borne illnesses, as they can spread from one person to another. In rare cases, disease-causing fungus can transfer from sick animals or contaminated surfaces to people (Kauffman & Hedderwick, 2006).

Opportunistic fungal infections

Opportunistic fungal infections are infections that develop due to a compromised immune system (Badiee & Hashemizadeh, 2014). Such infections are usually harmless in people who have a healthy immune system. These ailments may be brought on by fungi, viruses, or bacteria. Numerous fungi-related illnesses are opportunistic illnesses. Some people have compromised immune systems from birth, while others may suffer from an infection, like HIV, that damages the immune system. The body's capacity to fight infections can also be impaired by some medications, such as corticosteroids or cancer treatment. Fungal infections can occur, so a person and preferably their healthcare provider should be aware of this if their immune system is compromised, but knowing more about fungi can aid in diagnosing fungal diseases early on. Vulnerable groups include the following (Badiee & Hashemizadeh, 2014):

- HIV-positive individuals
- organ and stem cell transplant recipients
- people diagnosed with cancer
- hospitalized individuals
- people on immune-suppressing medications

Treatment and prevention

Antifungal drugs tailored to the individual fungus that caused the infection are used to treat fungal infections. These drugs might come in tablet, cream, suppository, or ointment form. Antifungal medications administered intravenously are used to treat fungi that cause sepsis. For fungal infections, conventional antibiotics are not utilized since they are ineffective. When it comes to prevention, it is important to maintain one's health whenever possible and practice good hygiene, such as washing socks after working out, not walking barefoot in communal toilets, and keeping skin clean and dry, particularly the folds of the skin, etc.

Burden of fungal infections

Fungal infections kill more than 1.5 million people worldwide each year, most of whom have weakened immune systems (Rayens & Norris, 2022). This is problematic because, in the last decade, the number of immunocompromised people has increased, particularly people without HIV. As mortality and healthcare expenditures have drastically increased, fungal illness has remained a critical clinical problem, especially for those already at risk. Increased surveillance, standardized treatment recommendations, and advancements in diagnostics and therapies are required to assist the growing number of at-risk patients (Rayens & Norris, 2022).

2.3 Infectious Disease Control

Infection control practices must be used to reduce the spread of illnesses from one individual to another, for example, from a health professional to a patient, or vice versa (Kim-Farley, 2015). Programs and actions that attempt to lower disease prevalence and **incidence** (new infections in a specific population at any given time), or entirely eradicating the disease, are referred to as infectious disease control. According to the WHO, infection prevention and control (IPC) is a scientific approach and practical remedy designed to reduce the harm that infections can cause to patients and medical staff (WHO, 2020b). Although it is a branch of epidemiology, sociology, global health, and communicable diseases all depend on it. Effective IPC is a critical public health problem for both patient safety and the healthcare system. Effective IPC measures are the cornerstone for preventing global health-related epidemics (such as the 2013–2016 Ebola outbreaks) and pandemics (such as the 2009 flu pandemic and the COVID-19 pandemic; WHO, 2020b).

Incidence
This measures the number of new cases of a characteristic that appear in a population within a given time frame (National Institute of Mental Health, n.d). For example, the number of new cancer cases in population X in 2022.

The primary prevention of infectious diseases can be viewed as measures aimed at lowering the incidence of communicable diseases and their related risks. Primary prevention protects health through both individual and group initiatives, such as ensuring proper excrement disposal, being active, getting inoculated against communicable diseases, supplying clean water, and maintaining a healthy weight (Kim-Farley, 2015).

Secondary prevention of infectious disease can be defined as measures taken to reduce the prevalence of an infectious disease by shortening its course (Kim-Farley, 2015). Secondary prevention, which includes acts like screening a result in early disease discovery,

quick antibiotic treatment, and providing enough nutrition, corrects deviations from good health through individual and community-wide efforts. It is important to note that the same management strategies for secondary prevention in an infected population may also culminate in primary prevention in an uninfected population. For example, prompt and focused drug treatment for tuberculosis (TB) that results in sputum transformation to culture-negative status results in patients no longer being a source of infection for others. Another example is treatment for HIV-positive pregnant women, which lowers the risk of HIV transmission to their babies (Kim-Farley, 2015).

Tertiary prevention of infectious diseases can be viewed as measures to lessen or perhaps completely eradicate long-term impairments caused by infectious diseases (Kim-Farley, 2015). The provision of orthopedic surgery appliances and the associated rehab for poliomyelitis patients, as well as counseling, skill-building programs, and the prevention of opportunistic infections, are examples of tertiary prevention efforts. These measures alleviate misery, lessen suffering, and encourage adaptation to permanent disability. For instance, preventing HIV-related opportunistic illnesses is a form of tertiary prophylaxis (Kim-Farley, 2015).

Tools for Control of Infectious Diseases

The primary objective of infectious disease control in public health, whether in low-, middle-, or high-income countries, is the decrease, elimination, or even eradication of infectious disease (Heymann, 2010). Control methods can be directed at the agent, transmission pathways, or hosts to achieve this. Infectious agent reduction or elimination at sources and reservoirs, disruption of or interference with infectious agent transmission channels, identification of sensitive populations, and reduction or elimination of their susceptibility are a few examples of such control techniques (Heymann, 2010).

The methods for controlling infectious diseases pertain to the identification and assessment of disease patterns and the outcomes of control measures (Heymann, 2010). The most crucial instrument for evaluation and recognition in the fight against infectious diseases is disease surveillance, which is defined as the methodical gathering, analysis, and evaluation of relevant data, followed by quick distribution of the findings to those who need to know about them and, in particular, to those who can act. It involves the methodical gathering and assessment of the following (Heymann, 2010):

- mortality and morbidity statistics
- special reports on pandemic field investigations and individual case studies
- laboratory isolation and identification of infectious agents
- information on the accessibility, use, and adverse effects of vaccinations, toxoids, immune globulins, insecticides, and other control agents
- information on immunization levels in different population groups
- additional pertinent epidemiology data

To those who are collaborating and those who need to know the outcomes of the surveillance operations, a report summarizing the data should be created and delivered (Heymann, 2010). All public health jurisdictional levels, from local to international, must follow the method. Therefore, surveillance is "information for action." The following are some control measures for interventions (Heymann, 2010; Kim-Farley, 2015):

- Active immunization, passive immunization, **chemoprophylaxis**, behavioral modification, reverse isolation, obstacles, and enhancing host resistance are all examples of control techniques used on the host.
- Vectors are controlled via chemical, environmental, and biological methods.
- Human infection control strategies include chemotherapy, isolation, quarantine, activity restrictions, and behavioral modification.
- Animals are subjected to active immunization, isolation, quarantine, restriction or reduction, and chemoprophylaxis as control strategies.
- Environmental control measures include the provision of clean water, adequate feces disposal, food and milk cleanliness, and facility and equipment design.
- Cleaning, chilling, pasteurization, disinfection, and sterilization are control measures for infectious pathogens.

Chemoprophylaxis
This is the use of chemicals, including antibiotics, to stop an infection or its progression to a clinically evident disease. Chemoprophylaxis can also involve treating a condition to avoid its complications.

Combining many of these interventions may be necessary to have the greatest impact on the control of a particular infectious illness. For instance, measures including active immunization, proper food preparation and hand-washing habits, the availability of safe water, food sanitation, and correct feces disposal can help restrict the spread of some types of viruses and bacteria (Heymann, 2010).

The methods of control can also be put into three categories: community-based, institutional, and individual-based (Kim-Farley, 2015). Control efforts are usually started by a clinician and focused on a person's particular infectious disease concerns at the individual level. Examples include the administration of diphtheria antitoxin in a diphtheria patient, pre-exposure prophylactic inoculation against rabies for veterinarians, and chemoprophylaxis to avoid wound infection (Kim-Farley, 2015).

At the institutional level, control measures are typically implemented by the institution's officials and are targeted at a population that is in close proximity to one another, such as those residing in daycare centers, schools, military barracks, hospital wards, nursing homes, and correctional facilities (Kim-Farley, 2015). Examples include isolating institutionalized young children during a measles outbreak; administering chemoprophylaxis; and immunizing staff and patients of institutions against certain types of microorganisms, such as pneumococcal diseases, influenza, measles, etc. (Kim-Farley, 2015).

Local, statewide, or national public health agencies often initiate control efforts at the community level (Kim-Farley, 2015). Examples include campaigns to immunize children, provide access to clean water, regulate food sources, and recall contaminated food products. Some preventative measures, like vaccination, may be implemented at all levels, while others, like providing a community with safe water, are more particularly implemented at a given level (Kim-Farley, 2015).

Globalization and Infectious Diseases Control

The process by which nations, peoples, and economies become more interconnected and interdependent is referred to as globalization (Labonté, 2015). Globalization has improved health by disseminating modern medical knowledge, inexpensive medical technologies, and human rights. However, it has heavily impacted the spread of infectious diseases. In just a few days, or even hours, microorganisms (including bacteria, viruses, and fungi) can travel the entire earth (Labonté, 2015). For instance, the severe acute respiratory syndrome (SARS) pandemic in 2003 quickly traveled from Asia to North America in a period of days. The economies of the affected nations suffered significant economic losses from this pandemic, which are estimated to be $30 billion per day, in addition to the diseases and deaths it caused (Lam et al., 2003). A recent example is the COVID-19 pandemic, which began in Wuhan, China, and swiftly spread across the world, resulting in fatalities and significant economic losses, especially because of the use of lockdowns as a method of containment (Chen et al., 2020). These illustrations unequivocally demonstrate that infectious diseases control is a global health issue that requires global regulations and collaboration.

International Health Regulations (IHR)

About 196 nations entered into a legally binding agreement known as the International Health Regulations (IHR) in 2005 to develop the capacity to identify and report potential public health emergencies globally (WHO, 2021a). The IHRs state that all nations must be able to identify, evaluate, communicate, and react to public health emergencies. According to the IHRs, all countries must possess the following tools (WHO, 2021a):

- identification: This involves ensuring that laboratories and surveillance systems are capable of spotting potential dangers.
- analysis: This involves making choices in conjunction with other nations in the event of a public health emergency
- reporting: This entails notifying regional IHR officials or the WHO if there is a chance that an infectious outbreak may spread worldwide and cause a public health emergency.
- response: The IHR also outline how to handle arbitrary travel and trade restrictions to neighboring nations while dealing with public health emergencies, as well as what actions should be taken at the nations' entry points in the event of a health emergency.

Global collaboration

Threats from infectious diseases will keep developing, including the different COVID-19 strains and other infections with pandemic potential (Jit et al., 2021). In the wake of COVID-19, the world must overcome the pandemic's severe setbacks if it is to make serious progress toward lowering poverty and inequality. In particular, if governments adopt austerity measures as they seek to recover from budgetary growth during the pandemic, health infrastructure and human resources will take several years to recover from their overstretched condition. Therefore, for the world to mitigate any public health emergency, like a global pandemic, strong global collaboration is vital. The necessity for global collaboration is especially required in a variety of fields, including research and knowledge exchange when it comes to emerging and re-emerging infectious disease; the discovery,

production, and distribution of vaccines; and policies on how to control the spread, such as travel restrictions, border control, surveillance and reporting, and ensuring the effective implementation of the IHR (Jit et al., 2021).

2.4 Vaccination

A biological product known as a vaccination provides effective acquired defense against a particular infectious disease (Ada, 2001). A substance that resembles a disease-causing germ is usually included in vaccines; this substance is frequently made from a virus's toxin and a bacterium's weakened or dead form or one of its proteins. The material causes the immune system to become activated, allowing it to recognize the molecule as a threat and destroy it, as well as any subsequent associated microorganisms with which it may come into contact (Ada, 2001).

Vaccines can be therapeutic or preventive, meaning they either lessen the symptoms of a future infection by a natural or wild virus or fight a disease that has already occurred. Some vaccines provide complete infection prevention by full sterilizing immunity (Ada, 2001).

Vaccination can be simply defined as the process of administering vaccines (Ada, 2005). The most successful way to prevent infectious diseases is through vaccination; as a result of vaccination, smallpox was practically eradicated worldwide and diseases, including polio, measles, and tetanus, have mostly been kept under control in much of the world. The effectiveness of vaccinations has been thoroughly studied and proven; the chickenpox, HPV, and influenza vaccines are examples of those that have proven effective (Ada, 2005). According to the WHO, there are already licensed vaccinations available for 25 different avoidable illnesses (Jansen et al., 2021).

In 1721, Lady Mary Wortley Montagu imported the smallpox inoculation from Turkey to Britain (Halliday, 2011). The words "vaccine" and "vaccination" are taken from the Latin phrase *Variolae vaccinae*, which means "cowpox" and was coined by Edward Jenner, who also discovered the idea of vaccines and produced the first vaccine. He coined the word in 1798 to explain the cowpox vaccine's ability to protect against smallpox in his lengthy work, *Inquiry into the variolae vaccinae known as the cow pox*. Complementing Jenner's work, Louis Pasteur proposed that the terminology be broadened to include the strong defensive immunizations that were then being developed in 1881. Vaccinology is the scientific field that studies the design and production of vaccines (Halliday, 2011; Stern & Markel, 2005).

A vaccine's injection helps the immune system create disease immunity. Components of vaccines include proteins or toxins from the organism, as well as weakened, living, or dead bacteria or viruses. They help by increasing the body's adaptive immunity, which helps prevent disease from an infectious organism (Rappuoli et al., 2011). Herd immunity occurs when a sufficient proportion of a population has received a vaccination. Those who may have damaged immune systems and are unable to receive a vaccination (because even a weaker version would harm them) are protected by herd immunity (Clem, 2011).

A lot of research has proven that vaccinations are effective. The most effective way to avoid infectious diseases is through vaccination; broad immunity brought on by vaccination is primarily credited for the worldwide eradication of smallpox and the global eradication of diseases like polio and tetanus (Şenel, 2012). However, due to some decrease in vaccination rates since the mid-2010s, which can be partly blamed on vaccine hesitancy, some previously controlled infectious diseases have witnessed a resurgence with increased outbreaks. An example of this is several large-scale measles outbreaks experienced in some parts of Western Europe and the US. The WHO estimates that vaccinations prevent 3.5 to five million deaths annually (Dror et al., 2020).

History

Vaccinations have been used for several centuries. Buddhist monks used snake venom to ward off snake bites, and in 17th-century China, "variolation" (the administration of cowpox to a skin tear to ward off smallpox) was practiced (Plotkin & Plotkin, 2004). The first vaccinations in the West were created when Edward Jenner immunized a 13-year-old boy with the *Vaccinia virus* (cowpox) in 1796; the boy demonstrated protection against smallpox. In 1798, the very first smallpox vaccine was developed. In the 18th and 19th centuries, a meticulous mass vaccination drive against smallpox led to its ultimate eradication in 1979 (Plotkin & Plotkin, 2004).

Louis Pasteur's research led to the development of the reduced virulence cholera vaccine in 1904 and the human inactivated anthrax vaccine in 1897 (Plotkin, 2014). The plague vaccine was also created in the late 19th century. One of several bacterial vaccines created between 1890 and 1950 was the Bacillis-Calmette-Guerin (BCG) immunization (Plotkin, 2014). People continue to use this vaccine today.

In 1923, Alexander Glenny discovered the most effective method for using formaldehyde to render the tetanus toxin inactive (Plotkin & Plotkin, 2004). A similar procedure was used in 1926 to develop a diphtheria vaccine. A whole cell pertussis vaccine took significantly longer to produce; it was first authorized for use in 1948. The Salk (inactivated) and Sabin (live attenuated) oral polio vaccines were created as a result of the advancement in culturing techniques between 1950 and 1985. Due to widespread immunization campaigns, the disease has been eradicated in many parts of the world. For use in vaccines, attenuated measles, mumps, and rubella strains were created (Plotkin & Plotkin, 2004).

Currently, measles is the next disease that could soon be eradicated by vaccines. Vaccination programs benefit health, although some groups have consistently shown vaccine resistance. In the late 1970s and early 1980s, fewer companies manufactured vaccines due to rising litigation and falling vaccine manufacturing profitability (Xu et al., 2021).

Since the beginning of the 21st century, the area of vaccination research has profited from the use of molecular genetics and its expanding understanding of immunology, microbiology, and genomics. Recent developments include less reactive pertussis vaccines, synthetic hepatitis B vaccines, and improved methods for making seasonal influenza vaccines (Plotkin, 2005).

The development of new adjuvants; more effective tuberculosis vaccines; and vaccines against diseases, such as pandemic influenza and HIV, are just a few of the promising developments in vaccine development that are made possible by molecular genetics. Additionally, therapeutic vaccinations for autoimmune conditions, addictions, and allergies may soon be accessible (Tahamtan et al., 2017).

Eradication of polio

The majority of people who contract poliomyelitis (polio), a highly contagious viral disease, are less than five years old (WHO, n.d.-d). After multiplying in the colon, the virus travels to the nervous system and causes paralysis. It spreads mainly through the fecal matter and less frequently through shared vehicles (such as contaminated water or food; WHO, n.d.-d).

Eradication of polio globally began in 1988, whereby the Global Polio Eradication Initiative (GPEI), the WHO, the Rotary Foundation, the United Nations International Children's Emergency Fund (UNICEF), and The Gates Foundation led the global prevention of polio spread through a massive global vaccination campaign. As of 2020, all countries in the world, except for Afghanistan and Pakistan, have completely eradicated polio (WHO, n.d.-d). The eradication of polio is regarded as a key public health achievement globally and highlights the importance of international collaboration to improve health across the planet.

COVID-19 vaccine

One of the worst health disasters in recorded history is the COVID-19 pandemic. It led to worldwide lockdowns, which gravely affected economies and societies (Ciotti et al., 2020). As a way to combat this pandemic, vaccines were created using decades-old scientific knowledge (Sallam, 2021). Thus, these vaccines were not experimental but underwent all the necessary steps in the clinical trial process (Khan et al., 2021). These vaccines were proven to be both safe and efficacious via extensive testing and observation. The most thorough safety monitoring ever conducted on a vaccination was done with the COVID-19 virus. The vaccine rollout came along with global awareness campaigns that highlighted the benefits of receiving this vaccine (Sallam, 2021). As of late 2021, approximately 2.1 billion individuals worldwide have received all three doses (Sandmann & Jit, 2022). The development of the COVID-19 vaccines and subsequent global vaccine rollout led to restrictions being eased or removed in most countries by mid-2022 (Sandmann & Jit, 2022). This is another example of the importance of public health in mitigating pandemics and protecting the health of populations across all countries globally.

Types of Vaccines

Vaccines come in many varieties, but they all generally perform the same function: training the immune system to identify a pathogen (or a portion of it), which is an organism that causes disease (Clem, 2011). If this immune system training is successful, the virus will be eradicated from the body if the body is exposed to the virus again. The immune

system detects foreign antigens (unusual disease components in the body), which can be found inside or on the surface of a pathogen (Clem, 2011). There are six types of vaccines that are in use, as of 2022, which are discussed below.

Live attenuated vaccines

Live pathogens from bacteria or viruses that have been "attenuated," or weakened, are included in live attenuated vaccines (Minor, 2015). Live attenuated vaccines were created by choosing bacteria or virus strains that elicit a strong immune response but do not cause disease. "Vaccinia," the first vaccine to protect against smallpox, was a live attenuated vaccine. The benefit of live attenuated vaccines is that the immune system responds well to these vaccinations because they contain a live pathogen, and they usually retain a memory of the pathogen for a very long period. Booster shots or additional doses are not usually necessary. Examples are the varicella (chickenpox) vaccine and the measles, mumps, and rubella (MMR) vaccine (Minor, 2015).

Inactivated vaccines

An inactivated pathogen is potent enough to elicit an immune response when the vaccine is administered to a human, for example, but it is unable to spread illness. It frequently takes several doses to fully protect a person and develop immunity. Inactivated vaccines are generally affordable to produce in large quantities. For example, vaccines against polio and influenza are inactivated (Ramirez et al., 2017).

Subunit, recombinant, conjugate, and polysaccharide vaccines

Subunit vaccinations are created from a portion of a pathogen rather than full, live pathogens, such as polysaccharide, conjugate, and protein-based vaccines (Hansson et al., 2000). They can make the body develop strong immunological reactions due to the particular component of the pathogen used, but these vaccinations may eventually need to be updated. Since subunit vaccinations do not contain the entire pathogen, they do not have the potential to make people ill or infect them. Therefore, they are suitable for individuals who shouldn't receive "live" vaccines, such as young children, older adults, and those whose immune systems are compromised. Examples include the polysaccharide or conjugate vaccine against **pneumococcal disease**, and the recombinant protein vaccine against hepatitis B (Hansson et al., 2000).

Pneumococcal disease
This is an infection (that is preventable with vaccination) that results from pneumococcus bacteria. Ear infections, sinus infections, pneumonia, and bloodstream infections are aftereffects of pneumococcal infections (Bogaert et al., 2004).

Toxoid vaccines

Instead of attacking the germs themselves, toxoid vaccinations target the harmful activity produced by the bacteria using inactivated toxins. The purpose of toxoid vaccines is to provide individuals with the means of producing antibodies that will allow them to neutralize the toxins. Tetanus, diphtheria, and pertussis are just a few of the diseases that toxoid vaccines are particularly effective at avoiding. Typically, booster shots are advised every 10 years or so. Examples are the **diphtheria** and tetanus vaccines.

Diphtheria
This is an infection caused by a dangerous bacterial strain known as *Corynebacterium diphtheria*. It may result in

Messenger ribonucleic acid (mRNA) vaccines

Messenger ribonucleic acid (mRNA) vaccines are one of vaccine science's most recent developments (Jackson et al., 2020). mRNA vaccines can be created with a pathogen's genetic code, whereas traditional vaccinations can take several months or even years to culture. At least one of the vaccination trends of the future is probably going to involve mRNA. When an mRNA vaccine is administered, the RNA material instructs the body to produce a harmless protein that is particular to the virus, resulting in the production of antibodies that can detect the protein. In this manner, if a person were to come into contact with that virus in the future, the body would be equipped (through antibodies) to combat it. Some of its benefits include the ability to produce a large quantity of a vaccine quickly (Jackson et al., 2020). The technology's high adaptability is also a benefit. So, by changing the formulation's mRNA, it is possible to target a new antigen and quickly create a significant amount of high-quality vaccine material. The Pfizer-BioNTech and Moderna COVID-19 vaccines are examples of this type of vaccine (Verbeke et al., 2021).

breathing difficulties, irregular heartbeat, and even death. To prevent diphtheria, vaccination is advised for newborns, kids, teens, and adults (Hadfield et al., 2000).

Viral vector vaccines

Viral vector vaccines convey the gene sequence of the pathogen that we want the immune system to fight to the hosts cells through a harmless virus. In essence, they function as a gene delivery mechanism. Information about the pathogen is transmitted as a result, stimulating the immune system. Immune responses to viral vector vaccinations are frequently robust. Usually, immunity can be built up with just one dose of the shot. Boosters could be required to keep immunity strong (Ura et al., 2014). The Ebola and the AstraZeneca and Johnson & Johnson COVID-19 vaccines are some examples (Vanaparthy et al., 2021).

Vaccine Hesitancy

Vaccine hesitation is the refusal or delay of taking a vaccine, regardless of the availability of vaccine services. The phrase refers to blatantly refusing vaccinations, postponing vaccinations, taking vaccinations but being unsure of their efficacy, and using some vaccinations but not others (Dubé et al., 2013). The vast majority of scientists agree that immunizations are typically both safe and effective. Disease outbreaks and mortality from diseases that can be prevented by vaccines are frequently caused by vaccination reluctance. As a result, one of the top 10 global health hazards, according to the WHO, is vaccine reluctance (Dubé & MacDonald, 2020).

Absolute resistance to immunization is referred to as "anti-vaccinationism"; in more recent years, this opposition has also been referred to as "anti-vax," with proponents of this dubbed "anti-vaxxers" (Dubé et al., 2013). Vaccination hesitancy is complicated and context-specific and varies across time, place, and vaccines. It can be influenced by factors like people's lack of trust (fear and distrust of the vaccine and/or health provider), complacency (the person may indeed not see the need for the vaccine or does not recognize the significance of the vaccine), comfort, and a person's lack of awareness about how vaccines are made or whether they function properly, as well as psychological factors like a person's apprehension about needles and skepticism of public authorities (e.g., access to vaccines; Dubé et al., 2013).

Vaccine hesitancy has existed since the development of vaccinations and is over 80 years older than the terms “vaccine” and “vaccination.” The specific assumptions put forth by opponents of vaccinations evolve with time. Although vaccine hesitancy and public debates about the ethical, legal, and medical implications of vaccines are sparked by misconceptions, conspiracy theories (such as those shared regarding the COVID-19 vaccines that they contain a chip that can control those who receive it), and misinformation (such as the theory that vaccines cause autism) spread by the anti-vaccination movement and some pseudo-healthcare providers (Dubé et al., 2013; Dubé & MacDonald, 2020). However, in medical and scientific circles, there is little to no debate or skepticism when it comes to vaccine efficacy and safety (Dubé & MacDonald, 2020). Anti-vaccination groups and organizations have resisted proposed laws that require vaccination in countries ~~including~~ such as Australia~~, for example.~~ Mandatory vaccination may be opposed due to anti-vaccination sentiment, worries that it infringes on civil liberties or decreases public confidence in vaccinations, or suspicions of pharmaceutical company profiteering (Troiano & Nardi, 2021).

Vaccines and autism

Autism
This is a range of developmental impairment illnesses caused by differences in the brain. People who have autism often struggle with repetitive or constrained hobbies, as well as social interaction and involvement (Silverman, 2011).

The idea that there is a link between vaccines and **autism** first appeared in a 1998 study written by Andrew Wakefield and published in scientific journal, *The Lancet* (DeStefano & Shimabukuro, 2019). His research found that after receiving the MMR vaccine (immunization against measles, mumps, and rubella), eight of the twelve patients (ages 3–10) had behavioral characteristics associated with autism. Wakefield was found to have fabricated data in the article, which led to the article receiving harsh criticism for its lack of scientific rigor (DeStefano & Shimabukuro, 2019). Then, in 2004, 10 of the original 12 co-authors of this article (excluding Wakefield) released a statement retracting the article, stressing that in the study they had found no causal relationship between the MMR vaccine and autism, as the data were insufficient. *The Lancet* formally withdrew the study in 2010 and stated that it contained multiple errors, including fabricated data and improper processes (Eggertson, 2010). An even larger anti-vaccination movement, particularly in the US, has been sparked by this paper. One in four parents still think vaccines can cause autism, despite the story being retracted and proved false (Leask et al., 2010).

All confirmed and conclusive research to date has demonstrated that there is no connection between vaccinations and autism (DeStefano & Shimabukuro, 2019). There is no connection between autism and the MMR vaccine, according to a 2015 study. Infants were given a health regimen, which included the MMR shot, and were subjected to ongoing research until they turned five years old. There was found to be no connection between the vaccination and children’s increased risk of getting autism if they had an autistic sibling or a sibling who was typically developing (DeStefano & Shimabukuro, 2019).

When incorrect information is received before correct information, it becomes challenging to convince people of the original falsehood (François et al., 2005). Studies and research are being done to figure out the best ways to rectify false information that has become ingrained in public memory (Oubari et al., 2015). Since the Wakefield report was published more than 20 years ago, it might be simpler for younger generations to receive the necessary vaccine education. Only a very small number of people experience negative side effects from vaccinations, and when they do, they are frequently moderate. Autism is not

one of these reactions (Motta & Stecula, 2021). Accordingly, public health professionals' role, along with healthcare providers, is to spread awareness on the effectiveness, efficacy, and safety of vaccines to encourage people to get vaccinated and vaccinate their children.

Vaccines and Public Health

One of the most cost-effective ways to prevent many infectious diseases, including acute (e.g., measles and mumps) and chronic diseases (e.g., chronic hepatitis B), as well as several virus-related human malignancies (such as liver and cervical cancer), is through vaccination (Echeverria-Londono et al., 2021). Vaccines are, therefore, a key pillar of public health; yet the relationship between vaccination and public health goes beyond that. Public health has established the framework for immunization systems that guarantee that, irrespective of whether a vaccine is privately or publicly purchased, immunization programs and policies should support equal access to effective and safe vaccines, especially for the pediatric population (National Vaccine Advisory Committee, 2013). Public health has specific roles at the global, regional, national, state, and local levels. Additionally, public health encourages the use of tested methods to raise vaccination rates among kids, teens, and adults through educational materials, training sessions, and field trips to medical facilities. Examples of such strategies include awareness campaigns and nationwide vaccine drives. Furthermore, public health plays a role in promoting and spreading the correct information about vaccines to the general public (National Vaccine Advisory Committee, 2013).

Vaccination policy

A vaccination policy is a public health measure put in place to stop the spread of infectious diseases (Field, 2008). Local governments typically implement these regulations, but private institutions, like companies and schools, may also do so. Since vaccines were initially made widely accessible, numerous policies have been created and put into place. Implementing a vaccination program is mostly done to completely eradicate a disease, as was done with smallpox. To achieve or even confirm this, though, can be challenging. Numerous government public health agencies rely on vaccination procedures to help their populations develop herd immunity. Typically, vaccination advisory committees are responsible for providing information to those in leadership positions so that they may decide on immunizations and other health-related measures (Field, 2008).

Different nations have varying vaccine requirements, while others strongly advise against them (Field, 2008). In certain areas, they are only required if a person is enrolled in a public school or receiving government aid. The government or an institution may pay all or part of the cost of vaccinations, as in the case of a mandatory statewide immunization program or a work requirement. **Cost-benefit analyses** of vaccinations have shown that

Cost-benefit analyses
This is when the costs and benefits of an intervention are both described in monetary terms and then compared.

there is a monetary incentive to establish policies because they save the government time and money by reducing the burden that preventable diseases and epidemics have on healthcare institutions and resources (Field, 2008).

SUMMARY

Infectious diseases are conditions brought on by organisms, such as bacteria, viruses, fungi, or parasites. An infectious agent can be transmitted and acquired by a person through a variety of different means. Numerous organisms live inside our bodies, but they are generally harmless or advantageous; however, in specific circumstances, some have the capacity to cause disease. The epidemiologic and demographic shifts have both had tremendous effects on infectious diseases, whereby their incidence and prevalence has changed. There are still discrepancies between countries when it comes to the incidence, prevalence, and burden of infectious diseases. Similarly, social determinants of health are related to the risk of infections, whereby people with a lower socioeconomic background are at a higher risk of developing infectious diseases.

While bacteria, viruses, fungi, and parasites cause infections, each causes different diseases and requires different modes of action, transmission routes, prevention methods, and treatments.

Infectious disease control refers to actions and programs aimed at decreasing disease incidence, decreasing disease prevalence, or completely eradicating a disease. This can be done in several ways. Infectious disease control is crucial on a global level and requires extensive collaboration.

The act of providing vaccines is referred to as vaccination and is the most effective means of preventing infectious illnesses. The history of vaccinations is long and includes several success stories, such as the eradication of polio. Today, there are six types of vaccines in use. However, despite the effectiveness and safety of vaccines, there is an increased prevalence of vaccine hesitancy. The role of public health in spreading awareness, promoting vaccines, and developing policies is vitally important.

UNIT 3

NON-COMMUNICABLE DISEASES

STUDY GOALS

On completion of this unit, you will be able to...

- understand what non-communicable diseases (NCDs) are.
- recognize the burden of disease of NCDs.
- identify the role of lifestyle in NCDs.
- explain the different lifestyle risk factors associated with NCDs.
- describe the screening, detection, and control of NCDs.
- appraise the role of NCD prevention.

3. NON-COMMUNICABLE DISEASES

Introduction

This unit focuses on non-communicable diseases (NCDs). It will delve into what these diseases are, their etiology, their risk factors, and how they can be managed. Then, the effect of the epidemiologic and demographic shifts on NCDs will be discussed. Similarly, the role on the social determinants of health (SDH) when it comes to NCDs is covered, culminating in the discussion of the burden of NCDs on both economic and health levels. Section two of this unit will discuss the role of lifestyle in NCDs and how certain lifestyle habits are associated with a higher risk for developing NCDs. The unit will end with an exploration of how NCDs can be prevented through different means and public health approaches.

3.1 Measuring the Burden of Non-Communicable Diseases

The impact of a health problem as measured by monetary costs, deaths, illnesses, or other indicators linked to this health problem is known as the burden of disease (Bhutta et al., 2014). It is typically quantified in terms of disability-adjusted life years (DALYs) or quality-adjusted life years (QALYs). When compared to the ideal health level, the total burden of disease can be seen as a gap in health (Bhutta et al., 2014). It is crucial to have more knowledge about NCDs, their etiology, risk factors, different types, etc. before discussing their burden.

What are Non-Communicable Diseases?

NCDs are illnesses that cannot be spread from one individual to another directly (Hunter & Reddy, 2013). They are often brought on by bad behaviors rather than through infection or contact with other individuals. They are the greatest cause of death globally and pose a serious danger to development and health. Examples of NCDs include autoimmune disorders, strokes, most heart diseases, cancer, kidney disease, arthritis, osteoporosis, and other conditions (Hunter & Reddy, 2013). NCDs can be acute or chronic.

It is established that risk factors, such as a person's background, lifestyle, and environment, raise the likelihood of developing some NCDs (Budreviciute et al., 2020). This means that these diseases may be brought on by a mix of physiological, environmental, lifestyle, and hereditary factors, such as age; gender; genetics; air pollutants; and habits like smoking, eating poorly, and not moving around much that can result in hypertension and obesity, which increases the risk of several NCDs. The majority of NCDs are seen as avoidable since their risk factors are changeable. Examples of risk factors include smoking and exposure to secondhand smoke, excessive alcohol usage, use of illicit drugs, and eating a diet very rich in fat (Budreviciute et al., 2020). Additionally, SDH like socioeconomic background, educational level, and occupation can also be considered risk factors for NCDs.

The top 10 health hazards according to the World Health Organization (WHO) include five significant risk factors for NCDs (WHO, 2022c). These include having high blood pressure, high cholesterol, using tobacco or alcohol, and being overweight. According to estimates, 80 percent of cases of heart disease, stroke, and type 2 diabetes, and 40 percent of malignancies might be avoided if the main risk factors were eliminated. The burden of disease could be significantly reduced by interventions that focus on the primary risk factors. It has been demonstrated that initiatives to improve diet and increase physical activity can reduce the prevalence of NCDs (WHO, 2022c).

Additionally, the economic and social circumstances of an individual are linked to a higher risk of NCDs (WHO, 2022c). The SDH, as well as their role and relationship with NCDs, will be discussed below.

Types of NCDs

Over two-thirds of deaths worldwide are caused by the five following NCDs (WHO, 2022c).

Cardiovascular or heart diseases

Cardiovascular disease (CVD) is a category of conditions that affect the heart or blood vessels. Angina and myocardial infarction (commonly known as a heart attack) are examples of CVDs, alongside stroke, heart failure, and thromboembolic disease. Depending on the ailment, different underlying mechanisms apply (Nabel, 2003). About 53 percent of CVD deaths are thought to be attributed to dietary risk factors (Mehra et al., 2020). **Atherosclerosis** is a factor in CVD, stroke, and peripheral artery disease. High blood pressure, smoking, high cholesterol, a poor diet, drinking alcohol, smoking, and restless sleep are some of the factors that might cause this (Nabel, 2003). Estimates show that 13 percent of CVD deaths are caused by increased blood pressure, nine percent by smoking, six percent by diabetes, six percent by inactivity, and five percent by obesity (Mehra et al., 2020).

Atherosclerosis
This is the accumulation of fats, cholesterol, and other substances, both inside and outside the walls of the arteries (known as plaque). Atherosclerosis can constrict the arteries and obstruct blood flow (Libby, 2002).

Cancers

Cancer is largely a preventable NCD since environmental or lifestyle factors account for the great majority of cancer risk factors (Feinberg, 2004). It is possible to eliminate risk factors, such as cigarette use, obesity, low fruit and vegetable intake, inactivity, alcohol use, sexually transmitted infections (STIs), and air pollution, to prevent more than 30 percent of cancer cases (Wu et al., 2018). Some cancers are brought on by infectious agents; for instance, the human papilloma virus (HPV) infection is almost always the cause of cervical cancer (Schiffman et al., 2007).

Diabetes

Chronic type 2 diabetes mellitus is mainly preventable and managed, but it is challenging to cure (Serbis et al., 2021). Euglycemia, or maintaining blood sugar levels close to normal, is the aim of care. This is done without putting the patient at undue risk. With careful food management, regular exercise, and the use of the proper medications (insulin alone in the context of type 1 diabetes mellitus), this is mostly possible. In the event of type 2 diabetes, oral medicines like insulin may be administered. Patient education, knowledge, and

involvement are crucial since the effects of diabetes are greatly reduced and less severe in those with well-managed levels of blood sugar. Wider health issues, such as smoking, having high cholesterol, being overweight, having high blood pressure, and not exercising, could hasten diabetes' harmful effects (Serbis et al., 2021).

Chronic respiratory conditions

The lungs and airways can be affected by chronic respiratory disorders (CRDs), namely asthma and **chronic obstructive pulmonary disorder** (COPD). It is estimated that CRDs affect hundreds of millions of individuals (Labaki & Han, 2020). Asthma, COPD, occupational lung illness, and pulmonary hypertension are examples of common CRDs. Although they cannot be cured, there are a number of treatments that can help patients live better lives. Major airways are typically dilated during treatments to alleviate symptoms like shortness of breath. Allergens, cigarette smoking, air pollution, and occupational dangers are the main risk factors for developing CRDs (Labaki & Han, 2020).

Chronic obstructive pulmonary disorder
This refers to a set of diseases that can obstruct airflow in the lungs and lead to breathing issues (Barnes & Celli, 2009).

Chronic kidney disease (CKD)

There is compelling evidence that CKD is not only widespread, dangerous, and treatable but also a significant contributor to the incidence and consequences of at least three of the diseases targeted by the WHO, even though it is not currently listed as one of their primary targets for global NCD control (these are diabetes, hypertension, and CVD; GBD Chronic Kidney Disease Collaboration, 2020). Obesity and smoking are major risk factors for CVD, diabetes, and hypertension, which are the main causes of and can aggravate CKD. Additionally, people with CKD who also have diabetes, hypertension, or CVD have a higher risk of negative outcomes and high medical expenses (Foley et al., 1998; GBD Chronic Kidney Disease Collaboration, 2020). As a result, CKD, diabetes, and CVD frequently coexist, share risk factors, and have similar therapies. Therefore, prevention and control efforts should be coordinated on a worldwide level (GBD Chronic Kidney Disease Collaboration, 2020).

In addition to these primary diseases, mental health issues are thought to have a significant role in the economic losses brought on by NCDs.

Mental health disorders

A mental health disorder is defined as an intellectual, emotional, or behavioral disability that is clinically serious (Stein et al., 2021). It frequently has a connection to distress or impaired functioning in important areas. Psychological diseases come in many different subtypes. Mental health issues are another name for "mental problems," which is a larger phrase that encompasses mental illnesses; psychosocial issues; and (other) states of mind linked to considerable discomfort, functional impairment, or danger of harming oneself. Some examples of mental illnesses include depression, anxiety, schizophrenia, disordered eating, and obsessive behaviors (Stein et al., 2021).

Major depressive disorder, anxiety disorders, schizophrenia, dysthymia, and bipolar disorder are the five mental illnesses with the highest global burden of disease. Consequently, researchers contend that the worldwide burden of mental illness is underreported because of the following five problems (Vigo et al., 2016):

1. Psychiatric and neurological illnesses co-occurring
2. The classification of self-harming behaviors and suicide as a separate category outside the realm of mental illness
3. The combination of musculoskeletal diseases and all chronic pain syndromes
4. The exclusion of personality disorders from assessments of the disease burden due to mental illness
5. Inadequate recognition of the role of serious mental illness in relation to mortality

Furthermore, a 30-year global systematic review found that the prevalence of mental illnesses has been increasing, and they continue to be a key leading cause of disease burden globally (Vigo et al., 2022). Yet, the impact remains underreported and under studied, especially in low-and middle-income countries (LMICs) and countries where mental health is still stigmatized, which indicates why mental health is a hot topic in public health.

Risk Factors

Examples of non-modifiable risk factors, or characteristics that cannot be changed by an individual, include age, sex, and genetics (or the environment). They cannot be the major targets of treatments, but they can still have an impact on and help determine the effectiveness of many treatment and prevention strategies (Boehme et al., 2017). Modifiable risk factors are characteristics that people or societies can change to improve health results. The four main causes of NCDs are poor diet, lack of physical activity, tobacco use, and dangerous alcohol intake (Boehme et al., 2017). They are prevalent components of economic change, fast urbanization, and 21st-century lifestyles and are largely to blame for NCDs (Ng et al., 2020). In line with the underlying socioeconomic variables, LMICs and the lower-income segments of all populations are increasingly affected by these risk factors. These communities may experience a vicious cycle, whereby poverty and SDH, such as social and economic status, exposes individuals to lifestyle factors that can cause NCDs, and the resulting NCDs may significantly contribute to the downward trend that drives families into poverty (Ng et al., 2020).

Management of NCDs

Palliative care must always be made accessible to those who require it to diagnose, test for, and manage NCDs (Hassan et al., 2020). To aid in early detection and timely treatment, high-impact NCD medications can be provided through a primary healthcare model. According to the research, these therapies are great investments since, if given to patients right away, they can prevent or significantly reduce the need for more expensive therapy. Although managing NCDs has a wide range of possibilities, they are not as easy to treat as infectious diseases. It should be noted that there are no available cures for NCDs. To alleviate symptoms of any NCD, a doctor may instead prescribe drugs and make lifestyle suggestions. Thus, controlling NCDs is of the utmost importance. Even though some NCDs cannot be prevented, keeping healthy habits can reduce one's risk. It is noteworthy that

prevention plays an essential element of the NCD management, as it allows for early screening and detection, resulting in better management of NCDs in the future (Hassan et al., 2020).

Effect of the Epidemiologic and Demographic Shifts on Non-Communicable Diseases

The epidemiologic transition shifted mortality and morbidity away from communicable or infectious diseases, such as malaria, smallpox, measles, and mumps, and toward chronic diseases referred to as NCDs, such as cancer, strokes, heart diseases, and chronic lung disease. The epidemiologic transition can be defined as the process through which a population's pattern of mortality and disease changed to one of chronic diseases from one of increased infant mortality rates, maternal deaths, and infectious diseases (Phillips, 1994). The epidemiologic shift has been accompanied by a demographic shift that altered population patterns in terms of life expectancy (increased), age distribution (a higher percentage of older adults), fertility rates (decreased), and causes of death (Braveman & Gottlieb, 2014).

Accordingly, NCDs are responsible for an increasing percentage of mortality as populations age (United Nations, 2012). Population ageing, when an increasing percentage of the population is concentrated in older age groups, is caused by rapid fertility declines mixed with survival gains. Populations with advanced age structures experience lower death rates from communicable diseases than populations with relatively young age structures, where children are disproportionately affected by illnesses like pneumonia and diarrhea, which tend to incur a bigger percentage of deaths attributable to NCDs. More than 20 percent of the population in many high-income countries is over the age of 60, and NCDs account for more than 80 percent of all fatalities (United Nations, 2012).

However, the disproportionately high risks of NCD mortality observed in the developing world are concealed by differences in population age structure (NCD Countdown 2030 Collaborators, 2018). When age structure is not taken into account, NCD death rates show that the risk of mortality from these causes is roughly half as high in Africa as in high-income countries, but when this effect is taken into account, the age-standardized NCD death rate in Africa is nearly twice as high as that in developed countries in Europe (excluding Eastern Europe) and North America. These trends suggest that the older population in developed countries was primarily responsible for the higher death rates from NCDs than in other regions. Therefore, when considering age structure, people with relatively young age structures, such as those in Africa, Latin America, and Asia, actually have a higher chance of dying from an NCD (NCD Countdown 2030 Collaborators, 2018).

Even if there are no changes in the age-specific risks of dying from an NCD, future population expansion and population aging will cause significant increases in the burden of mortality attributable to NCDs (United Nations, 2012). The annual number of NCD fatalities in Africa would increase to nearly 14 million in 2050 if age-specific NCD death rates remained constant. Population growth would account for around 45 percent of the increase, with population aging accounting for the remaining 55 percent (United Nations, 2012).

While the majority of the increase in NCD fatalities by 2050 in Asia, the Caribbean, and Latin America (including high-income countries), would be attributable to population ageing, population growth would also have a significant impact on the increase in NCD deaths in Africa (Devaux et al., 2020). Additionally, population ageing would be entirely responsible for the 54 percent increase in NCD mortality by 2050 in middle-income countries, such as those in Eastern Europe, where very low fertility is anticipated to result in a diminishing population size (Devaux et al., 2020).

Social Determinants of Health and Non-Communicable Diseases

SDH are economic and social variables that have a direct and indirect impact on health (Braveman & Gottlieb, 2014; WHO, 2008a). These determinants are elements that people are exposed to and born into, such as social norms, political systems, and policies (economic, social, employment, agricultural, trade, and foreign; WHO, 2008a). Health inequity and SDH are closely related; SDH cause health inequities that can exist even within high-income countries (Braveman & Gottlieb, 2014; WHO, 2008a).

The prevalence of NCDs and related risk factors are influenced by the aforementioned sociodemographic factors (Mwangi et al., 2020). These changeable habits are formed during youth or young adulthood and result in NCDs later in life. The difficulties are made worse by the high rates of poverty and inequality in the area; residing in low-income areas is an antecedent to NCD risk factors (Mwangi et al., 2020). For example, despite two of every three deaths among women being caused by NCDs and the overall number of NCD mortality among women being similar to that of men, reproductive and maternal health receive more attention internationally than NCDs in women (Marmot & Bell, 2019).

Additionally, studies have shown that social injustice during pregnancy and the early years of life has long-lasting repercussions that can lead to NCDs (Marmot & Bell, 2019). A child's early years of growth, which include their physical, cognitive, behavioral, and emotional growth, are marked by social gradients. The development of brain areas involved in behavior control and regulation is impacted by early socioeconomic disadvantage.

Awareness of physical activity and diet are two very important factors when it comes to NCD risk. This may be the cause of the apparent cognitive control that more affluent people appear to have over their diet and exercise in upper-middle- and high-income countries, which contributes to societal differences in NCDs (Marmot & Bell, 2019). Links between NCD risk behaviors, psychosocial stress, and socioeconomic disadvantage have also been discovered (Canudas-Romo et al., 2017). Living in substandard housing can result in difficult social, economic, and environmental circumstances. Depending on personal resilience and the level of social support available, bad eating patterns, drinking alcohol, and smoking are all coping techniques for stress that may make NCD disparities worse. Long-term stress, thus, directly contributes to physiological responses related to NCDs and problems with mental health. For instance, several Latin American nations experience high levels of violence, which exacerbates the social unrest that the people there already experience. According to a study conducted in Mexico, between 2005 and 2014, there was a concurrent rise in killings and perceived vulnerability. Long-term stress

exposure, such as living with this type of threat, will likely increase the risk of harmful behaviors and NCDs. Addressing the root causes of violence is therefore likely to be an effective public health approach to lower NCDs (Canudas-Romo et al., 2017).

Additionally, pollution killed more people in 2015 than the primary known risk factors for NCDs, with the exception of combined dietary risk factors and hypertension (Landrigan et al., 2018). Worldwide, air pollution causes more deaths than other types of pollution, and middle-income countries are more likely than high-income countries to be affected. The likelihood is higher that populations with lower income will be exposed to pollutants and develop diseases associated with them. For example, inequalities in NCDs are exacerbated by environmental contaminants, which are more prevalent in areas of disadvantage, as seen in studies done in the UK (Landrigan et al., 2018).

Burden of Non-Communicable Diseases

NCDs are the main cause of morbidity and mortality around the world as of December 2022, and there are signs that this trend will continue to rise. More than 80 percent of early NCD fatalities worldwide occur in LMICs. Compared to only 13 percent in high-income countries, nearly 30 percent of NCD fatalities in LMICs happen to adults under 60 who are at the height of their economic production (Mwangi et al., 2020).

Due to their prolonged, chronic courses; requirement for lifelong treatment and follow-up; and requirement for sophisticated strategies for managing complications, this has a significant influence on the financial livelihoods of individuals, their families, and health systems (Mwangi et al., 2020). Globally, NCD mortality exceeds that of infectious, maternal, perinatal, and nutritional diseases put together, with the exception of Africa. In LMICs, NCDs are predicted to cause approximately five times as many deaths and three times as many DALYs by 2030 when compared to communicable illnesses, maternal, perinatal, and nutritional disorders combined (Mwangi et al., 2020).

Due to the high burden of communicable diseases, difficulties with child and reproductive health, and violence and injury within frail health systems, the impact of NCDs on individual, societal, and national economic development is greater in LMICs. These countries struggle to diagnose NCDs, implement extensive public health initiatives, and handle problems brought on by subpar care or delayed diagnosis (Mwangi et al., 2020).

Around 74 percent of all deaths worldwide, or 41 million yearly fatalities, are caused by NCDs (WHO, 2022c). Every year, 17 million individuals globally die from an NCD before the age of 70; 86 percent of these premature deaths occur in LMICs. Cardiovascular diseases make up 17.9 million NCD fatalities annually, which are followed by cancers (9.3 million), CRDs (4.1 million), and diabetes (2.0 million; WHO, 2022c). Consequently, NCDs have also been shown to lead to the loss of 121 million years of life owing to premature mortality, 226 million years of life lost due to disability (i.e., 226 million DALYs), and 105 million years lost due to ill health or impairment (i.e., 105 million QALYs; PAHO, 2021).

When it comes to mental health, studies have shown that the number of DALYs caused by mental diseases increased dramatically from 80.8 million in 1990 to 125.3 million in 2019. The percentage of those DALYs also increased from 3.1 percent in 1990 to 4.9 percent in

2019 (Vigo et al., 2022). According to the findings, there were an estimated 654.8 million instances of mental disorders in 1990 versus 970.1 million cases in 2019, which is a 48.1 percent rise (Vigo et al., 2022). However, the global burden of disease due to mental health remains underreported, particularly in countries where mental health is still stigmatized.

Lastly, it should be noted, that as the incidence of risk factors for chronic diseases like diabetes, heart disease, and cancer rises, and many countries continue to battle to minimize death brought on by infectious diseases, an increasing number of countries (e.g., Ghana, Bangladesh, and Somalia) are dealing with a double burden of disease (Ahmed et al., 2020; Luna & Luyckx, 2020) However, this double burden does not only plague LMICs; it is increasingly affecting high-income countries (Luna & Luyckx, 2020). An example of this is the COVID-19 pandemic, which hit high-income countries like the US, the UK, and Italy harder than it hit most LMICs (Boccia et al., 2020).

NCDs and Health Expenditure

NCDs have a huge economic cost in terms of lost lives and livelihoods, as well as costs associated with healthcare and a detrimental impact on human capital and productivity (NCD Alliance, 2022a). Between 2010 and 2030, it is predicted that the five most common NCDs (CVD, CRDs, cancer, diabetes, and CKD) will cost an average of $47 trillion, or greater than $2 trillion annually (NCD Alliance, 2022a).

The direct and indirect expenses of NCDs are depleting economies (Bloom et al., 2012). Due to serious disease, incapacity, and death, NCDs raise healthcare expenditures while reducing productivity and human capital. Every year, NCDs damage the economy of millions of families, which is both a cause and a result of poverty. Every year, it is estimated that 100 million individuals globally fall into extreme poverty as a result of **out-of-pocket medical expenses** from seeking care for NCDs (Bloom et al., 2012). Additionally, NCDs also have non-healthcare costs associated with them, such as lost productivity from morbidity or mortality and informal care expenses.

Out-of-pocket medical expenses
These are medical expenses that are not covered by any form of health coverage, so people have to pay it in full from their own money (Sirag & Mohamed Nor, 2021).

NCDs are expected to continue to expand economically in the future among low-, middle-, and high-income countries, but particularly in less developed economies (Ebrahim et al., 2013). Life expectancy is rising due to declining mortality rates at all ages, but if morbidity is rising rather than falling, this will result in more years of chronic illness (Jan et al., 2018; Marthias et al., 2021).

The following are three tiers of important causes for the high socioeconomic cost of NCDs (Beaglehole et al., 2011; European Comission, 2022; Jan et al., 2018):

1. Costs at the individual and household level: There is an increase in disability and early deaths; a decline in household income; an increase in expenses, such as out-of-pocket medical expenses; a loss of savings and assets; and a reduction in opportunities.
2. Costs associated with providing healthcare: Since there are more people living with NCDs, there is an increase in the need for more expensive treatments, high medical treatment costs, and higher use of NCD-related healthcare services.
3. Reduced labor supply, decreased labor outputs (such as absenteeism), lower tax receipts, and worse returns on human capital expenditures are all costs to national economies.

The household financial burden of healthcare in LMICs is significantly higher than in high-income countries, where more than 150 million people experience catastrophic costs each year and unplanned out-of-pocket expenses for expensive services (Kazibwe et al., 2021). This is because, in LMICs, safety nets are weak and health systems are vulnerable. They are also dealing with numerous concurrent health challenges, such as the double burden of disease (Kazibwe et al., 2021). In addition to the absence of **universal health coverage** (UHC) and financial risk protection programs, more than two billion individuals living in LMICs are unable to access an effective, equitable, and sufficiently funded healthcare system. For example, a study conducted in China indicated that one stroke drove almost two-thirds of people without insurance into poverty and that 37 percent of patients and their families fell below the poverty level of $1 per day per person. Another example is that a diabetic child's family in Sudan spent about a fifth of their income on medical care. In Pakistan, 27 percent of cancer patients took out loans to pay for treatment, while 63.5 percent turned to personal savings (Kazibwe et al., 2021).

Universal health coverage
This is a type of health coverage that ensures that everyone in the country has access to health services. It is meant to allow everyone to access health services, not only those who cannot afford them on their own (WHO, n.d.-f).

3.2 The Role of Lifestyle

NCDs are caused by a combination of many lifestyle variables, including smoking, drinking, eating poorly, and being inactive, according to research (Musaiger & Al-Hazzaa, 2012). Accordingly, since lifestyle decisions have a strong influence on NCDs, these conditions are frequently referred to as lifestyle diseases. Therefore, people's daily habits are primarily the cause of these illnesses. Habits that inhibit exercise and promote inactivity can lead to a number of health issues, especially chronic NCDs with possibly deadly consequences (Musaiger & Al-Hazzaa, 2012).

NCDs and the risk factors that go along with them have quickly emerged and are now posing a significant global public health concern. There is a wealth of research showing that lifestyle factors, such as a bad diet, physical inactivity, and active and passive smoking, increase the risk of NCDs (Budreviciute et al., 2020). However, preventing these factors can lower the rates of NCDs and overall mortality. Taking known lifestyle risk factors out of the equation may prevent up to 80 percent of CVD, strokes, and diabetes, as well as 40 percent of cancer deaths (Budreviciute et al., 2020).

NCDs were once thought to be "Western diseases" or "ailments of affluence," as they were more common in high-income, industrialized countries. Studies show that the lifestyle changes that came after the Industrialized Revolution, and the development in the West

post World War II have been associated with increasing the incidence and prevalence of NCDs (Kopp, 2019). These habits include Western pattern diet, which is a contemporary eating style that is typically characterized by high intakes of pre-packaged and ready-made foods, red meat, processed meat and poultry, high-sugar drinks, candy, fried foods, food high in **trans-fats**, other high-fat dairy products, and high-fructose corn syrup, along with low intakes of fruits, vegetables, whole grains, fish, nuts, and seeds. This is also accompanied by a more sedentary lifestyle and an exponential rise in smoking tobacco and alcohol intake (Rakhra et al., 2019). However, with globalization, these habits have proliferated into the East and led to a rise in NCDs (Kopp, 2019). For example, the discovery of oil reserves and subsequent industrial development in the Arabian Gulf led to the adoption of many Western values, such as fast-food culture, which has been directly attributed to the rapid increase in the prevalence of obesity in those countries. This, in turn, has led to an increase in the incidence and prevalence of NCDs (Balhareth et al., 2019). Today, these habits are adopted globally and contribute greatly to the increase in the burden of NCDs (Budreviciute et al., 2020; Kopp, 2019).

Trans-fats
These are the worst fats to eat. In contrast to regular dietary lipids, trans fats, also known as trans-fatty acids, raise "bad" cholesterol and decrease "good" cholesterol (Downs et al., 2013).

It is widely known that having two or more risk factors together increases the likelihood of acquiring NCDs beyond what would be predicted by adding their individual impacts together. To create and implement integrated preventative strategies, it is crucial to look into the co-existence patterns of preventable risk factors (Oni & Unwin, 2015). With a few notable exceptions, the majority of previously published research from different countries either examined the interaction of biological and clinical risk factors for NCDs in the general population or studied particular populations of adults and the elderly, leaving out adolescents, who make up more than one-fifth of the world's population (approximately 1.2 billion people; Aggarwal et al., 2020).

Lifestyle Factors Related to Non-Communicable Diseases

The lifestyle factors associated with NCDs are discussed below.

Smoking

Smoking is when the smoke surrounding a chemical burn is inhaled so it can be tasted and absorbed into the circulation (CDC, 2010). The substance that is most usually used is dried tobacco leaf that has been formed into a tiny cylinder and wrapped (CDC, 2010). Cigars, pipes, and hookah are other apparatuses used for smoking.

All of the body's organs are damaged by cigarette use. More than 5,000 compounds, some of which are carcinogens (molecules that cause cancer), are released into the lungs, blood, and organs when a person smokes tobacco; this includes nicotine. Smoking-related damage can significantly shorten one's life expectancy, and smoking is the leading avoidable cause of death (CDC, 2021a).

Up to half of those who use tobacco die from it, making it the biggest global cause of needless deaths (WHO, 2022e). About eight million people are killed by tobacco use each year, including 1.2 million non-smokers who are exposed to secondhand smoke. Tobacco smoking is a significant risk factor for NCDs, like cancer, diabetes, heart disease, and strokes, as well as some infectious diseases like HIV/AIDS and tuberculosis (WHO, 2022e).

Over 80 percent of the 1.3 billion tobacco users worldwide live in LMICs, in which the impact of tobacco-related sickness and death is at its highest. The use of tobacco is linked to higher healthcare expenses, overburdened healthcare systems, and decreased worker productivity (WHO, 2022e). In addition to the known cancer dangers, smoking results in a number of other chronic NCDs and medical conditions (including erectile dysfunction) that call for ongoing care. The following NCDs are specifically linked to smoking (CDC, 2021a; Gallucci et al., 2020; Vellappally et al., 2007):

- High-density lipoprotein (HDL), which is considered good cholesterol, declines, thus increasing the risk of heart attacks and strokes.
- Blood pressure rises, thus increasing the risk of CVDs and diabetes.
- Blood flow to the heart and other body parts is reduced, resulting in growing dangers of diabetes, peripheral arterial disease, and coronary artery disease.
- More frequent colds occur, especially in children who live with smokers.
- There is a higher risk of CRDs, namely COPD, asthma, bronchitis, or emphysema, as a result of poorer lung function, which affects lungs' ability to get and distributed enough oxygen to the body.

Smoking is a hard habit to break because tobacco contains nicotine, which is highly addictive, so the body and mind quickly get used to the nicotine in cigarettes. Nicotine will quickly become necessary to feel normal (Guydish et al., 2011). People begin smoking for a number of reasons: Some think it's fashionable, and others start smoking because their family members or friends do. Most adults who smoke started before they turned 18 years old (Freedman et al., 2012). Most people never anticipated getting addicted (Baumeister, 2017). It is far simpler to avoid starting to smoke at all; however, by quitting smoking, individuals can lengthen their life by reducing their risk of smoking-related illnesses.

Obesity

Body mass index
This is determined by dividing a person's weight in kilograms by their height in meters squared. A high BMI may suggest high levels of body fat (CDC, 2022b).

Obesity and being overweight refer to weight gain that is abnormal or excessive and poses a health risk and involve having too much body fat (Nuttall, 2015). **Body mass index** (BMI) thresholds for overweight and obesity are 25 and 30, respectively. Obesity develops when a person eats more calories than they burn via normal daily activities and exercise (Nuttall, 2015). These extra calories are converted by the body into fat; hereditary, behavioral, metabolism, and hormonal factors all affect body weight.

A lot of people eat too many calories each day, frequently from fast food and calorie-dense beverages, which has been related to obesity and excessive weight gain (Fuhrman, 2018). Obese people might eat more calories before fullness, get hungry more quickly, or eat more in reaction to anxiety or stress. People don't often expend as many calories working in high-income countries, as many jobs there are significantly less physically demanding (Fuhrman, 2018). Even routine jobs now consume fewer calories because of conveniences like drive-through banking, escalators, and remote controls.

Obesity is a problem that goes beyond appearance. Cardiovascular disease, diabetes, hypertension, and several cancers are just a few of the illnesses and ailments that it increases the risk of. Accordingly, obese individuals are more likely to experience a variety of NCDs and serious health issues, such as the following (Garrow, 1988; Hariharan et al., 2022; Piché et al., 2020):

- CVD: Obese people are more inclined to have high pressure and elevated cholesterol levels, which are risk factors for CVD.
- diabetes: Obesity can affect how well the body uses insulin to control blood sugar levels. The likelihood of developing diabetes and insulin resistance increases as a result.
- the likelihood of developing some cancers, including uterine, breast, colon, rectum, esophageal, liver, gallbladder, pancreatic, kidney, and prostate cancer, may rise as a result of obesity.
- digestive issues: Among other conditions, obesity raises the risk of developing heart disease.

There are a variety of reasons some people struggle to lose weight. The good thing is that even a small amount of weight loss can help or even avoid the health issues linked to obesity (US Institute of Medicine, 2004b). Changes in behavior, increased physical activity, and a healthier diet can help people lose weight. Prescription medications and weight-loss methods are additional options for controlling obesity (US Institute of Medicine, 2004b).

Diet

Malnutrition happens when the body does not receive enough of the right nutrients to operate (Olatona et al., 2018). The risk of diet-related NCDs, like CVD, diabetes, and a number of cancers, is increased by undernutrition, which includes stunting and wasting in addition to being overweight and obesity (Olatona et al., 2018).

Many nations are currently bearing a “double burden” from malnutrition. Here, undernutrition coexists with overnutrition, and unsuitable diets contribute to unhealthily excessive weight gain and other diet-related illnesses (Wells et al., 2021). These unhealthy diets include foods and beverages with high energy (calorie) content, as well as foods rich in fats, especially synthetic trans-fats, sugar, and salt. As a result, 462 million adults globally are underweight, versus 1.9 billion who seem to be overweight or obese. Poor nutrition was shown to be the cause of one in five fatalities in the literature that examined global deaths from the early 1990s until the late 2010s (Onyango et al., 2021).

When speaking of unhealthy diets, malnutrition, and even obesity, it is important to define what a healthy diet is (Cena & Calder, 2020). Fiber, fruit, vegetables, lentils, beans, nuts, and whole grains are all vital to healthy diets. They should be balanced; varied; and satisfy a person’s needs for macronutrients (protein, fat, carbohydrates, and fiber) and micronutrients (minerals and vitamins), depending on their stage of life. Healthy diets often contain the following (Cena & Calder, 2020):

- Less than 30 percent of total energy is consumed as fat. With less from saturated fats, they should mostly consist of unsaturated fats. It is not advisable to consume trans-fats.
- Less than five percent, but preferably less than 10 percent, of total energy should be consumed as sugar.
- Less than 5g of salt should be consumed every day.
- At least 400g of fruit and vegetables should be consumed each day.

The capacity to maintain a healthy diet is frequently beyond a person's control; it is influenced by the food environment in which they live, nutrition during the first few years of life, income, and accessibility. The term "food system" refers to each step involved in getting food from the farm to our tables. Location, climate, culture, consumer behavior, business practices, and the regulatory environment are just a few variables that frequently influence the food chain (Fanzo, 2019).

Over the past few decades, there has been a considerable global change in dietary practices. Convenience foods and beverages, unhealthy food, and eating at restaurants are on the rise as fewer people are growing or producing their own food (Popkin et al., 2012). These low-cost, ready-to-eat food and beverage items are frequently "ultra-processed"; heavy in calories, fats, salt, and sugar; and deficient in nutrients. For example, hamburgers, potato chips, cookies, candy, cereal bars, and sugary drinks are all high calorie food but are made to be extremely tasty and appealing to consumers. Extremely ultra-processed foods and beverages also often have a lengthy shelf life, making them appealing to businesses like supermarkets. The industry's aggressive marketing, particularly to children, has raised consumer demand for these products. These commodities are increasingly replacing wholesome, minimally-processed, fresh foods, which is changing people's diets and food systems. Lower-income and more vulnerable groups struggle to access and maintain a nutritious diet everywhere in the world. Ultra-processed food and beverage items are most common in these environments. According to estimates, three billion people cannot afford to eat healthily because of poverty, which also compromises the nutritious value of food (Popkin et al., 2012). Malnutrition brought on by unhealthy diets is associated with a number of NCDs, including the following (Cecchini et al., 2013; Fransen et al., 2017; Jayedi et al., 2020; Musaiger & Al-Hazzaa, 2012):

- heart disease and stroke, which are both cardiovascular conditions
- hypertension (high blood pressure)
- type 2 diabetes
- cancers, such as rectum, colon, and lung cancer

Common dietary risk factors for these disorders include the following (Cecchini et al., 2013; Fransen et al., 2017; Jayedi et al., 2020):

- High salt consumption is a major dietary risk factor for sickness and mortality worldwide.
- High salt intake raises blood pressure, which raises the risk of heart disease, stroke, chronic renal disease, and several types of cancer.
- High sugar intake can cause tooth decay, weight gain, and obesity. It can also raise blood pressure and increase the risk of cardiovascular disease, stroke, and several malignancies.

- High trans-fat consumption has been linked to heart disease and stroke.
- Low intake of fruits and vegetables has been associated with a number of malignancies, heart disease, and stroke.
- Low fiber, grain, nut, and seed intake is associated with diabetes, heart disease, stroke, and several types of cancer.

It is important to note that it is crucial for society as a whole to improve eating practices. A population-based, multi-sectoral, multidisciplinary, and culturally appropriate strategy is therefore necessary (Kumar & Preetha, 2012).

Sedentary lifestyle

Physical inactivity is the fourth greatest cause of premature death worldwide and a major risk factor for NCDs (Lee et al., 2012). According to recent estimates, 31 percent of people worldwide do not engage in adequate physical activity to maintain their health. According to the WHO, adults should engage in the equivalent of 2.5 hours of strenuous physical exercise each week (WHO, 2022d). Children need considerably more time, at least an hour daily (Lee et al., 2012). More exercise might be necessary for those who want to keep their weight under control or lose weight. There are numerous ways to be active, including biking, swimming, athletics, active play, and walking.

Higher risk of NCDs, such as heart disease, hypertension, diabetes, and breast and colon cancers, has been linked to physical activity (Saqib et al., 2020). Physical activity also promotes good mental health, prevents the onset of dementia, and can support good weight management. Excessive inactivity, however, has a detrimental influence on one's health, the healthcare system, the environment, the economy, the well-being of the community, and one's quality of life (Saqib et al., 2020).

Globally, physical inactivity is a problem, although high-income countries have the greatest rates (Katzmarzyk et al., 2022). Studies show that there were 36.8 percent more people who were physically inactive in high-income countries than in low-income ones (16.2 versus 36.8 percent). In middle-income countries, prevalence rates were 26 percent. In Latin America and the Caribbean, as well as high-income Western countries, the prevalence of inactivity increased by more than five percent, but it remained relatively stable in most of the rest of the world, and even decreased in East and Southeast Asia. Nearly everywhere in the world, females were more likely than males to be inactive (Katzmarzyk et al., 2022).

A number of NCDs and early death are known to be associated with physical inactivity. Physical inactivity is thought to directly cause six to 10 percent of all cases of diabetes, certain types of cancer, and early mortality worldwide. It is frequently directly related to obesity (Lee, et al., 2012).

To give everyone more opportunities to be active, countries and groups must act. Adopting strategies to promote and encourage physical exercise that are suited to a country's cultural and social setting demands a societal collaborative effort, both regional and national (Reis et al., 2016).

Alcohol

Alcohol is a cognitive stimulant with addictive qualities that has been consumed for generations in a wide variety of civilizations (WHO, 2022a). Alcohol abuse has a serious detrimental impact on society, the economy, and health. Along with oneself, drinking alcohol can be harmful to one's friends, family, coworkers, and complete strangers. Upwards of 200 diseases, accidents, and other health issues are brought on by alcohol use, which is also associated with a higher risk of developing major NCDs, including various cancers; cardiovascular conditions; and behavioral and mental disorders, including alcohol dependence (WHO, 2022a).

According to studies, alcohol usage caused 5.9 percent of fatalities and 5.1 percent of lost DALYs (Park & Kim, 2020). Nearly two times as many men (7.6 percent) as women (four percent) die from alcohol-related reasons. Globally, people over 15 years of age drink 6.2 liters of pure alcohol per person year; however, as only 38.3 percent of the population really partakes in alcohol consumption, this figure jumps to about 17 liters for those who do. There are even regional differences in drinking patterns (Park & Kim, 2020). Heavy alcohol consumption is associated with a number of NCDs, including the following (Costanzo et al., 2010; Lieber, 2003; Parry et al., 2011; Pelucchi et al., 2011; Ronksley et al., 2011):

- cancer: Alcohol and cancer of the mouth, throat, larynx, esophagus, liver, colon, rectum, and female breast have been linked causally. With more drinking, the risk of developing any of these malignancies rises steadily.
- CVD: Chronic, heavy drinking has been linked to bad cardiac outcomes, like hemorrhagic strokes, cardiac dysrhythmias, dilated cardiomyopathy, and ischemic heart disease (IHD). Less than 20g of alcohol per day is usually required for these results to materialize, and then only for certain cardiovascular outcomes. According to estimates, alcohol's harmful effects on CVDs surpass its beneficial effects by a factor of 2.4 (for fatalities) and 3.5 (for DALYs).
- liver disease: The most prevalent liver diseases related with **alcoholic liver disease** (ALD) include cirrhosis, fatty liver, and alcoholic hepatitis. Both the quantity and duration of heavy drinking affect the likelihood of developing ALD.

Alcoholic liver disease
This is a result of drinking more alcohol than the liver can handle, which harms the organ. The liver, which is in charge of carrying out numerous bodily activities, processes what the body requires and discards the rest, so when it is damaged, it will lead to morbidity and mortality (Seitz et al., 2018)

Overall, leading a sober lifestyle offers several advantages, including bettering one's physical and emotional health (Wigg & Stafford, 2016). The effects that alcohol can have on the body may even be partially reversed if people stop drinking. Alcohol withdrawal is a procedure that calls for deliberate tactics to get rid of it from their life. For example according to research, after people stop drinking, some of the harm done to their gut, liver, brain, and cardiovascular system will gradually repair (Wigg & Stafford, 2016).

3.3 Structural Prevention of NCDs

There is a widely known folk saying that an ounce of prevention is better than a pound of cure, and that is the case particularly when it comes to NCDs (Islam et al., 2014). NCD prevention is a major concern because 82 percent of premature deaths from these diseases can be tackled by addressing the risk factors, resulting in countries' economic develop-

ment being greatly accelerated, in addition to saving lives. NCDs, which primarily includes cancer, diabetes, heart, and lung diseases, are the leading cause of death globally, accounting for an estimated 38 million fatalities each year. Premature deaths make up about 16 million of all these deaths (under 70 years of age; Islam et al., 2014). The number of deaths globally can be significantly decreased if we lessen the global impact of risk factors.

Promoting a balanced diet, regular exercise, reduced alcohol use, and quitting smoking are easy and affordable ways to reduce NCD-related early deaths and disability (Budreviciute et al., 2020). Prevention methods are not only useful for preventing the occurrence of NCDs in populations but also for easing the burden of current illnesses and the likelihood of co-morbidities emerging. At any age, NCD prevention and control can be accomplished, and public health plays a role in achieving this. In this section, we will delve into how public health can help structurally prevent NCDs and how it goes after the source of the issue.

Screening, Detection, and Control of NCDs

Early diagnosis and treatment are essential for every disease or condition, especially NCDs (Luna & Luyckx, 2020). Any socioeconomic and other health impacts can be lessened by doing this. However, the majority of respondents think that, in contrast to diagnosis and detection, NCD treatment receives an excessive amount of emphasis. Early detection of diseases like cancer, diabetes, or heart disease can lessen the need for costly interventions down the road, as well as improve health outcomes (Luna & Luyckx, 2020).

Evidence shows that one of the most effective ways to detect NCDs early is integrating NCD detection strategies into primary healthcare, which, when used as the first line of treatment, has the ability to stop the progression of disease; prevent complications; and lower the number of hospital stays, medical expenses, and out-of-pocket expenses, all while improving access to care (Yifter et al., 2020). Detection strategies usually include performing screening tests, which are health examinations performed on people who appear to be in good health in an effort to detect hidden issues before people experience any disease signs or symptoms. As studies show the potential advantages of early identification and early intervention in decreasing morbidity and mortality, screening patients for serious diseases is gaining attention. For several of the most significant NCDs, such as CVD, diabetes, and certain site-specific malignancies, screening tests are available. However, because so many national and international organizations are creating their own standards, screening recommendations for diabetes, cancer, and CVD differ within and between countries (Yifter et al., 2020). For example, hypertension (high blood pressure) is detected by measuring blood pressure using a blood pressure monitor and seeing if it is within normal range or, to detect diabetes, the blood glucose level may be checked by blood test or through using a needle prick to draw a drop of blood and checking it on a special blood glucose measuring machine.

Management of NCDs

NCD management is essential and includes the identification, screening, and treatment of NCDs, as well as providing access to palliative care for those who need it (Bausch et al., 2021). High-impact, critical NCD medicines can be offered through primary health-

care centers to improve early detection and timely treatment. When given to patients promptly, these therapies can avoid the need for more costly therapy, making them excellent financial investments (Bausch et al., 2021).

NCD patients and those at risk for developing them need long-term care that is proactive, patient-centered, rooted in the community, and sustainable (Haque et al., 2020). Such care can only be provided in an equitable manner via health systems centered on primary healthcare. The first symptoms of an NCD, like a stroke or heart attack, may not manifest in a patient until the disease has progressed noticeably. To determine who is at high risk and give them the chance to prevent the disease from advancing, key risk factors can be checked in asymptomatic individuals. Primary care is the most popular entry point into the healthcare system, making it the greatest location to spot high-risk individuals who might be utilizing the services for reasons unrelated to their health (Bhatt & Bathija, 2018). Due to the prevalence of NCDs, it is also no longer practical to manage these illnesses exclusively through specialists or in hospitals. The volume of patients could overwhelm these referral-level services, causing significant costs for both patients and the healthcare system. At the primary healthcare level, **non-specialist healthcare professionals** can implement the complete risk approach. Therefore, offering basic healthcare is an efficient, reasonable, and fair way to take care of those who need medical attention due to NCDs (Bhatt & Bathija, 2018). However, most countries lack the necessary resources to produce evidence-based policies and strategic plans. They also have limited access and opportunities to use high-quality data for these purposes.

Non-specialist healthcare professionals
These are healthcare professionals with generalist rather than specialized training and licensure. General practitioners (GPs) treat all common medical conditions and refer patients who require emergency or specialist care to hospitals and other healthcare facilities (Van Ginneken et al., 2011).

Prevention of NCDs

Prevention stops people from getting a certain disease or stops a disease from worsening. Examples of preventative activities are as follows (WHO, n.d.-c):

- early detection programs
- health promotion activities that encourage people to live a healthier lifestyle and delay the onset of diseases
- strategies to manage diseases and their complications so that the progress of these diseases is slowed or stopped

Accordingly, the goals for prevention are as follows (WHO, n.d.-c):

- reducing disease incidence
- delaying the onset of illness and disability
- reducing disease severity
- extending life expectancy

Primary prevention describes the actions a person takes to stop a disease from developing (Kisling & Das, 2022). It includes maintaining a healthy lifestyle, such as eating healthy food and exercising. By diagnosing an illness early before any major or irreparable harm has been done, secondary prevention seeks to limit its effects (Kisling & Das, 2022).

When it comes to NCDs, prevention is imperative. The main risk factors for NCDs are unhealthy diets, lack of physical activity, cigarette smoking, and alcohol misuse. Since the majority of these illnesses eventually worsen due to lifestyle choices, they can be avoided (Kisling & Das, 2022). In the field of public health, there is growing global movement to mitigate these risk factors and, in turn, prevent or at least decrease the incidence of NCDs. For example, and in accordance with the Global Action Plan for the Prevention and Control of NCDs, Member States of the World Health Organization (WHO) prepared and executed national action plans for NCDs in 2016 (WHO, n.d.-c). Its aim was to decrease prevalence and death rates from chronic NCDs. Its objectives were as follows (WHO, n.d.-c):

- to give non-communicable diseases more consideration in national development plans and integrate NCD prevention and management into all government sector strategies
- the execution of national strategies and policies for the management and prevention of NCDs
- strengthen efforts to combat the key risk factors for NCDs, such as cigarette use, poor diet, and inactivity
- encourage NCD prevention and management research
- build collaborations for NCD prevention and control
- keep an eye on NCDs and the factors that influence them, as well as evaluate national progress

Health Policies

The prevention of NCDs and the promotion of well-being can be aided by evidence-based **health policy** (Sécula et al. 2020). For instance, smoke-free laws can encourage attempts to stop smoking and prevent people from starting. Laws that require fluoridated water from water utilities can improve oral health in a manner similar to this (Maybury et al., 2021). A complete set of policies aimed at enhancing the food systems, prompting exercise, and making access to alcohol and cigarettes harder should include measures to combat the risk factors that are associated with NCDs (Schouw et al., 2020).

Health policy
This consists of laws, regulations, initiatives, and decisions made (typically by the government) to promote wellness and ensure the accomplishment of health objectives and goals for a particular community or society as a whole (Buse et al., 2012).

Policies for NCD prevention and control must consider people's unhealthy behaviors, such as smoking, eating unhealthily, being inactive, and drinking excess alcohol (Budreviciute et al., 2020). Economic development, globalization, and unplanned urbanization all affect these behaviors. Health professionals' efforts at health education and counseling can enhance health literacy and are crucial; however, altering people's behavior is difficult and cannot be done by health education alone. Maintaining healthy behavior requires a supportive policy environment. This necessitates that health be a major factor in sector-wide governmental policies in industries including trade, transport, agriculture, education, finance, and social services. People can only adopt healthy behaviors in respect to nutrition, physical exercise, cigarette use, and alcohol consumption if there is a supportive policy environment that offers those chances and inexpensive options. A policy pertaining to NCDs can promote policy coherence, collaboration, and integrated **multisectoral action** of pertinent ministries beyond the health sector, especially if it is integrated with the national health strategy. The foundation for early diagnosis and treatment of risk factors and diseases must be established by complementary healthcare policies, preferably using a primary healthcare strategy that can ensure equity (Budreviciute et al., 2020).

Multisectoral action
This is when different stakeholder groups (such as the government, civil society, and the private sector) and sectors (such as the economy, the environment, and health) work together to achieve a policy outcome (Salunke & Lal, 2017).

People need to make healthy lifestyle decisions for the mitigation of NCDs. People's abilities, knowledge, beliefs, and knowledge influence their ability to adopt and maintain healthy behaviors (Arena et al., 2015). Health professionals frequently use counseling to educate patients, families, and communities and inspire behavioral change. Furthermore, environments that are favorable and helpful and that have regulations that make healthy options accessible and inexpensive are frequently needed for behavior change. In order to effectively prevent and control NCDs, policies that support tobacco control, a balanced diet, physical exercise, and the prevention of harmful alcohol consumption must involve multiple stakeholders. In both high-income and LMICs, multisectoral strategies have been successfully applied to settings of everyday life (Arena et al., 2015).

Although the ministries of health are primarily responsible for developing policies to preserve public health, historically, it has frequently been professional associations and nongovernmental organizations (NGOs) that have had to persuade ministries to act (Mendis, 2010). For example, in the UK, the Royal College of Physicians issued the first appeal for extreme measures to lower the incidence of smoking in 1962. Their effective campaigning work aided the early development and introduction of tobacco control regulations in the UK. More recently, advocacy initiatives led by international and national non-governmental groups have prompted government action to limit salt in processed foods (Mendis, 2010).

In order to prevent and control NCDs, health practitioners need to have a full understanding of the fundamental components needed at the policy and programmatic levels. They are frequently appointed to policymaking roles or as NCD focal points in the ministries of health, and they may serve as NCD champions, advocates, or educators (Mendis, 2010). They must specifically understand that a comprehensive public health approach is necessary to minimize the burden of NCDs and that NCD diagnosis and treatment alone are insufficient to do so (Mendis, 2010). By utilizing opportunities in their practice to encourage prevention at the individual and family levels, physicians may also significantly contribute to the execution of the comprehensive NCD policy agenda through patient-centered care, evidence-based clinical practice, and chances for advocacy.

Moreover, for the purpose of providing equitable care for NCDs, a sound health system is necessary (Mendis, 2010). When resources are scarce, it might be difficult to ensure that everyone in the public sector has access to all NCD interventions. Health system regulations must make sure that, depending on need, everyone has access to at least a basic set of affordable interventions in such contexts. Such interventions include the following (Mendis, 2010):

- identification and treatment of high-risk persons
- early treatment of NCDs that are present
- strategies to stop relapses in people who already have a disease

Equity should be a top priority in the provision of NCD care, and the health system also needs to be set up to deal with both the acute and chronic symptoms of NCDs (Mendis, 2010). Additionally, more focus might be placed on prevention, palliative care, and com-

munity care for aging populations to lower healthcare costs. The current medical treatment of NCDs in hospital settings places a strain on healthcare expenses in all countries (Mendis, 2010).

It should be noted that the majority of NCDs have lengthy **incubation periods**, necessitating long-term policy changes to effect change (Mendis, 2010). Additionally, the lengthy incubation periods offer windows of opportunity for the management of metabolic risk factors for NCDs (e.g., obesity, hypertension, and hyperlipidemia), as well as the avoidance of complications from NCDs (e.g., a heart attack, kidney failure, or lung cancer).

Incubation periods
These are the intervals between the initiation of an infection and the commencement of symptoms or the first positive test. It was measured using cases with a clearly defined window between exposure (e.g., starting smoking) and the onset of symptoms (e.g., start of symptoms of lung cancer, such as coughing blood; Reich et al., 2009).

Nutrition policy

Healthy food preparation and consumption need to be guided at the individual level through health counseling and education provided by medical professionals. To ensure the balance between food content and consumption, complementary nutrition policies must be implemented at the national level (Mozaffarian et al., 2018). Such regulations must promote baby feeding, healthy food distribution in schools, food labeling, child-targeted marketing practices, consumer education, and the development of key personnel's skills.

For example, eliminating trans fatty acids (iTFA) or industrially manufactured trans-fats from the world's food supply is one of the simplest nutrition health policies (NCD Alliance, 2022b). By 2040, 17 million lives could be saved if this dangerous substance that causes heart disease were eliminated from all countries. If worldwide salt consumption were lowered to the advised amount, an additional estimated 2.5 million deaths per year could be avoided. Strong health policies pertaining to nutrition must be implemented to produce healthier, more resilient communities that are better equipped to handle future health emergencies like COVID-19 (NCD Alliance, 2022b). They will also speed up progress toward the global NCD targets.

Tobacco and alcohol

Populations worldwide can be safeguarded from disease and premature death brought on by tobacco smoking if all countries enact and execute effective tobacco control measures (Mendis, 2010). These include monitoring tobacco usage, protecting individuals from cigarette smoke, encouraging people to stop using tobacco, informing the public about the risks of tobacco, enforcing restrictions on tobacco advertising, and increasing costs on tobacco products should be the goals of these policies. Similarly, policies are needed to reduce the negative consequences of drinking and alcohol intoxication. These strategies to reduce dangerous alcohol use are currently ineffective on a global scale, for example, limiting the marketing and promotion of alcoholic beverages, particularly to children and teenagers, both online and in public places (Mendis, 2010).

Physical activity

In most industrialized nations, a variety of regulations are in place to guarantee that the built environment supports safe and active transportation and fosters space for recreational activities (Devarajan et al., 2020; Handy et al., 2002). These policies include initia-

tives to develop urban planning regulations in the majority of LMIC that do not currently support leisurely physical activities and active transportation to work (e.g., walking, cycling). The current conditions in LMIC cities, which include heavy traffic, small streets, few cycling lanes, and no parks, are not favorable for physical activity and may even put people's health at risk (Devarajan et al., 2020). However, in recent years, riding to work and school has doubled in some large cities as a result of health-conscious transportation initiatives that have increased cycling opportunities and created safe cycling routes to schools. In LMICs, transportation policies must be created to encourage the use of public transportation and discourage the use of private vehicles. When using public transportation, one must typically walk to and from the bus stop or station, which promotes exercise. Additional implementation of these regulations would aid in lowering the health risk associated with air pollution in big cities, particularly in LMICs (Devarajan et al., 2020). Transportation policies can also affect neighborhood social interactions, social networking, and social exclusion, all of which have an impact on health (Handy et al., 2002).

Health Promotion 

As a component of public health, health promotion works to reduce the burden of NCDs worldwide (Kumar & Preetha, 2012). Services for promoting health have a critical role in raising awareness and enhancing knowledge of activities related to health. This helps the general public modify their understanding, perspective, and behavior toward various health conditions (Kumar & Preetha, 2012).

Giving users more control over their health-related quality of life via multisectoral action to encourage healthy behaviors and health literacy programs is the practice of health promotion (WHO, n.d.-c). Interventions for the general public or communities that are more susceptible to adverse health effects are included in this strategy. Health promotion frequently focuses on subjects like mental health, substance abuse control, and health-related behaviors associated with sexual health, in addition to lifestyle factors like diet, physical inactivity, and smoking. Disease prevention and health promotion have many common goals, and their respective functions frequently overlap. Conceptually, it is useful to distinguish between disease preventive care, which is primarily concentrated on the healthcare industry, and health promotion services, which depend on intersectoral efforts and are focused on the SDH (WHO, n.d.-c). Action is involved in health promotion

- to address the factors in the community that have the greatest impact on health and well-being and to educate people about healthy lifestyle choices.
- to focus on individuals who are at risk of particular diseases.
- to enable people to take more control over and take better care of their health.
- including everyone in the neighborhood in the setting of their daily lives. Activities intended to improve health and prevent diseases are prioritized over those at risk of specific diseases (WHO, n.d.-c).

There is strong evidence that targeting settings rather than only employing population-based approaches increases the effectiveness of health promotion treatments that aim to alter lifestyle behaviors (Glasgow et al., 2003). As a result, context-based strategies for health promotion that integrate action across risk factors and use holistic and interdisciplinary approaches have grown in significance. The constant and intensive engagement

with the participant is a major benefit of concentrating on these situations. It is also suggested that, particularly in these kinds of situations, the assistance of employees, proper infrastructure, a person's physical surroundings, and health-promoting policies have the ability to favorably influence health. By simultaneously focusing on one or more settings, settings-based approaches may be applied in a comprehensive and inclusive way to lessen the burden of proximal and distal drivers of NCDs, which have increased as a result of globalization and urbanization. To gain the greatest impact in terms of disease prevention, these must be led by the concepts of equity, encouraging environments, empowerment, community involvement, and multisectoral collaborations with stronger health services. Both the general population and subpopulations can be the target of efforts. Working through settings can have an additive or multiplicative effect because some settings, like workplaces, homes, and schools, are very closely tied to one another. From one setting to the next, a change in behavior patterns and, consequently, risk profile with regard to NCDs, might be anticipated. By lowering risk factor levels, this strategy is anticipated to change behavior patterns, which will change the incidence and prevalence of chronic respiratory diseases, malignancies, diabetes, and CVDs. Finally, by implementing tailored interventions in different settings, the pace of growth in the burden of illness and mortality owing to NCDs can be lowered. Examples of health promotion activities to prevent NCDs include the following (Glasgow et al., 2003):

- running campaigns across traditional (TV and radio) and social media in October to encourage women to do the annual mammography for the early detection of breast cancer
- promoting the use of bicycles as a means of transportation by decreasing their cost to encourage people to exercise more
- putting stickers and health warnings on cigarette boxes
- educating people through flyers and advertisements on how to read the dietary labels on foods before they buy

Health education

One way of implementing methods for the prevention of illness and the promotion of better health is through health education. Opportunities for learning about health-related subjects are provided via health education (Golden et al., 2015). The target audience is considered when developing health education initiatives, which provide tools to build competence and encourage behavior changes in a context that is appropriate while educating specific audiences on specific health subjects, including the health benefits and hazards they experience (Golden et al., 2015). Such activities can include the following (Claflin et al., 2022):

- lectures
- courses
- handing out leaflets
- media campaigns
- seminars
- workshops
- webinars

Studies show that the burden of NCDs can be significantly decreased with health education, especially in settings where it forms a cycle with other risk factors (Heine et al., 2021). Health education and promotion initiatives may have a significant positive impact on NCD primary and secondary prevention. For example, nutrition education and counseling in preschools, schools, workplaces and health centers can lead to a people adopting better dietary habits and, in turn, decrease their risk of CVDs and diabetes. Another example is using leaflets as part of a health awareness campaigns to lower NCD risk factors, such as smoking, among the rural population of a country.

SUMMARY

Non-communicable diseases (NCDs) are conditions that cannot be transferred directly from one person to another, as they frequently result from bad habits rather than from infection or interaction with other people. They are the leading cause of death worldwide and provide a significant threat to both development and health. The five main types of NCDs are cardiovascular or heart diseases (CVD), diabetes, cancer, chronic kidney disease (CKD), and chronic respiratory disease (CRD). There is no cure for NCDs, and the best possible solution is to prevent them.

The epidemiologic and demographic shifts have led to the increase in the incidence and prevalence of NCDs globally, thus, making their burden high, both on the health system and the economy. However, some countries still suffer from the double burden of disease. Socioeconomic and demographic factors also play a role and risk when it comes to NCDs.

NCDs are brought on by a complex interaction of genetics, environment, and lifestyle factors, meaning that lifestyle choices have a significant impact on the development of NCDs. These lifestyle choices and habits include smoking, obesity (and being overweight), unhealthy diets, living a sedentary lifestyle, and the overconsumption of alcohol.

The aforementioned risk factors can be tackled to prevent NCDs. Promoting a balanced diet, consistent exercise, consuming less alcohol, and quitting smoking are simple approaches to decrease NCDs. Additionally, the detection, screening, and treatment of NCDs are all crucial components of NCD management. This can decrease any socioeconomic and other health effects. That is why the management of NCDs is as important as their treatment. The two main ways that NCDs can be prevented are through health polices, health promotion, and education.

UNIT 4

THE ROLE OF GENETICS

STUDY GOALS

On completion of this unit, you will be able to...

- discuss genetic technologies and information.
- define phenotypes and genotypes.
- explain the notion of heredity versus environment.
- recognize the importance of population genetics.
- understand the different aspects of public health genetics and genomics.
- explain the relationship between nutrition, microbiome, and disease.

4. THE ROLE OF GENETICS

Introduction

This unit revolves around the role of genetics in health and public health. It will discuss how genetic technologies and information assist in both medicine and public health, including the different types of technologies used to improve public health. It will also mention some of the ethical considerations of the genetic technologies and information related to health. The basic concepts of genetics (such as genotypes, phenotype, alleles, etc.) will also be explained, followed by the notion of heredity versus environment and their effects on health. Furthermore, population genetics will be defined and explained while shedding light on the interaction of environment and genes in the development of diseases, especially the role of the social determinants of health (SDH). Public health genetics and genomics, including the role of genetic and genomics in public health, precision medicine, and the ethical considerations, will also be considered. The unit will end with a discussion on nutrition and the microbiome, including the relationship between genes and the microbiome, nutrition or diet with the microbiome, and diseases, ending with a focus on how public health can play a role in improving the health of the general public through interventions revolving around nutrition and the microbiome.

4.1 Genetic Technologies and Information

Any organism is a result of its genetic makeup and environment. Understanding how genes function, using genetic variety found naturally, modifying genes, and conveying genes to multiple hosts are all included in the large field of “gene technology” (Adrio & Demain, 2010). Genes are transferred from one generation to the next and are found in all living organisms. By following these preprogrammed genetic instructions, an organism produces the proteins that make up the structures and perform the functions of living organisms (Adrio & Demain, 2010).

Small segments of DNA’s extensive chain make up genes. They are the fundamental structural and operational components of heredity (Genetic Alliance, 2009). A human gene can range in size from just a few hundred DNA bases to more than two million. The Human Genome Project estimates that between 20,000 and 25,000 genes are present in humans. Every person possesses two copies of each gene – one from each parent. The bulk of genes are the same in everyone, with much less than one percent of all genes slightly varying between individuals. Alleles are genetic variants with slight differences in the DNA base sequence. Because of these minute differences, each person has unique characteristics.

The instructions for creating proteins are found in genes. Each cell can only function properly with thousands of proteins to carry out certain tasks at specific times and locations. When a gene undergoes alterations known as mutations, one or more of these proteins may become dysfunctional. If cells or organs change or cease to operate normally, it may

result in a disease. Disease is not caused by genes but by mutations. For instance, when someone is said to have "the **cystic fibrosis** gene," the term is typically used to refer to a mutant form of the CF transmembrane conductance regulator (CFTR gene), which causes the illness. The CFTR gene is present in all people, including those without cystic fibrosis (Genetic Alliance, 2009).

Cystic fibrosis
This is caused by an inherited faulty gene. It influences the lungs, the digestive system, and other organs. It also affects the cells that create mucus, sweat, and digestive secretions (Davis, 2006).

The genetic code has been fully mapped during the past 10 years, and the technological and medical sciences are beginning to notice a substantial impact from the knowledge gathered from this process (Hood & Rowen, 2013). It is estimated that around 25,000 new genes in the human genome will be discovered in the future years and will have a significant positive impact on disease diagnosis and treatment. However, genetic innovations have also given rise to a number of intriguing and challenging ethical problems that could have a positive or negative impact on communities in the future. Through the employment of genetic technology in the disciplines of stem cells, cloning, regenerative medicine, genetic manipulation, gene selection, and biological sex selection, the human race now has the ability to change and transform humankind as we know it on Earth. Therefore, it is crucial for leaders of countries to pay attention to developments in genetic technology and prepare themselves and the institutions they control to tackle the ethical, legal, and social difficulties that may arise from these new technologies (Hood & Rowen, 2013).

Genetic Information

A person's genetic information may include details about their own genetic testing, the genetic testing of their family members, and the manifestation of a disease or problem in their kin (i.e., family medical history; Suter, 2018). The concept of genetic information includes family medical history because it is frequently used to assess a person's risk of developing a disease, ailment, or condition. The genetic information of every embryo lawfully retained by an individual or a member of their family utilizing an assisted reproductive technology is considered genetic information, as well as the genetic information of any fetus being carried by the individual or a pregnant close relative of the individual (Suter, 2018). It also includes the request for or receipt of genetic services by an individual and the participation of the individual or a family member in clinical research that uses genetic services.

Interest in genetic information and research has significantly increased over the past few years. The use of genetic information as a source of knowledge has significantly improved biomedical research, personalized treatment, and medication development (Suter, 2018).

Genetic Technology and Medicine

Human health has made advances thanks to gene technology that was previously unimaginable. The following are some applications of genetically modified organisms (GMOs) in human health (Key et al., 2008):

- making medications or vaccines
- creating diagnostic tests
- employing gene therapy to cure genetic illnesses
- creating tailored medicines for conditions like cancer

Genetic technology is now used in two different types of medications (Cid & Bolívar, 2021; Taghinezhad et al., 2021):

1. Medications that use GMO: insulin produced by genetically modified (GM) bacteria
2. GMOs used as therapeutics: COVID-19 vaccines, such as Pfizer and Moderna, and Gardasil, which protects against **human papilloma virus** (HPV)

Human papilloma virus
This is the name of an extremely widespread family of viruses. Most people have no issues with them, but other varieties might result in genital warts or cancer (Braaten & Laufer, 2008).

Researchers are also working to create GM plants that can produce vaccinations that can be consumed and are absorbed by the body (Kurup & Thomas, 2020). These have the benefit of not requiring sterile needles or proper storage facilities, while making it simpler than administering via an invasive injection.

Genetic Technologies and Public Health

The molecular genetics field has made great strides in the last twenty years. The Human Genome Project, a lengthy attempt to map and sequence the human genome, is the result of these advancements (Durmaz et al., 2015). The majority, if not all human genes, have been mapped and sequenced. Small amounts of human tissue, such as cheek swabs, can now be examined genetically using relatively inexpensive methods. Concern about the use and abuse of genetic information in society is growing, along with the development of genetic technology. It is not totally obvious when and how genetics can be employed in this context, despite the advancements in molecular genetics and their implications for disease prevention. The appropriate use of genetic tests in the context of public health requires careful consideration as their global prevalence increases (e.g., ancestry tests that can be done online; Durmaz et al., 2015).

As a result of the Human Genome Project, numerous human genes have been shown to be linked to relatively rare diseases, including **hemophilia** (Jackson et al., 2015). Additionally, disease-related genes influence a portion of the more prevalent chronic conditions. Genes also play significant influence in the majority of, if not all, human illnesses, including cancer and heart disease. Genetic influences vary, ranging from genes that fully identify the illness state (i.e., disease genes) to interconnected genes utilizing different genes and environmental factors sickness (specifically the susceptibility gene; Jackson et al., 2015).

Hemophilia
This is a hereditary bleeding condition that results in abnormal blood clotting. Uncontrolled bleeding following injury or surgery could develop from this. Numerous clotting proteins found in blood can help stop bleeding (Franchini & Mannucci, 2012).

The multiple polymorphic characteristics and enzyme systems involved in the metabolism of medicines and carcinogens are among these genetic risk factors (Jackson et al., 2015). The identification of disease and susceptibility genes in family research is made possible by molecular technologies. These studies rely on the use of genetic analysis techniques, including linkage and segregation analyses, and are primarily based on high-risk families with several affected members. The intensive search for breast cancer genes in families at high risk is one such example. Researchers have discovered a gene on chromosome 17 using linkage analysis and, more recently, direct sequencing of the gene (BRCA1), which is known to be a risk factor for breast and ovarian cancer (Jackson et al., 2015).

Genetic engineering

A process called genetic engineering, also referred to as genetic modification, edits an organism's DNA using instruments created in laboratories (Nicholl, 2008). A single base pair of DNA may need to be changed, a portion of DNA may need to be deleted, or new DNA may need to be inserted. By passing a gene from one species to an organism from a different species, for example, genetic engineering may result in the desired characteristic. Genetic engineering has been used in research and business, among other things, to develop cancer treatments, brew yeasts, and genetically engineer plants and animals (Nicholl, 2008). Genetic engineering has advanced past lab cloning for analysis to fully synthetic biology for unique biomedical capabilities over time.

The hepatitis B vaccine, human growth hormone, and human insulin are examples of products created utilizing methods of genetic engineering (Baeshen et al., 2015; Tsuge et al., 2005). Using these methods, other genetically altered species, such as disease-resistant vegetation, have also been produced (Dong & Ronald, 2019).

Cloning

The processes of creating a cell, tissues, or organism with a genetically identical duplicate are referred to as "cloning" (Ramadass, 2019). A clone is a material that is genetically identical to the original and is produced in large quantities. The most famous clone was a Scottish sheep named Dolly. Cloning can have three different forms (Ramadass, 2019):

1. Gene cloning: This duplicates genes or DNA segments.
2. Reproduction cloning: This duplicates entire organisms. So far, this type has only been tried on animals.
3. Therapeutic cloning: Researchers seek to use these cells to create new, healthy tissue to restore harmed or ailing tissue in the human body.

Many genetics and pharmaceutical laboratories across the world routinely do gene or, more specifically, DNA segment cloning. It is now possible to clone certain cell types, like skin or liver cells, in the lab to research their characteristics after seven decades of scientific progress (Ramadass, 2019).

Genetic testing

Large portions (or the entirety) of a person's DNA are analyzed as part of genetic testing to look for variations that could be linked to a hereditary disorder (CDC, 2022d). This method is gaining popularity as a substitute for single gene tests. Genetic testing is used to determine risks in healthy individuals, as well as to diagnose genetic diseases. For patients, discovering the underlying cause of a genetic ailment can make a significant difference. In some cases, this enables them to connect with others worldwide who are dealing with a similar condition and receive support. A diagnosis may occasionally also serve as a treatment plan. The results of genetic testing can help clinicians create specialized screening programs for patients who are shown to have a higher risk of contracting a certain disease. Many diseases can be treated more successfully and with lower mortality rates if they are discovered early. Scientists have been able to design targeted cancer medicines by analyz-

ing the DNA of tumor cells using sequencing technologies. For example, these treatments eliminate cancer cells by preventing proteins that are specific to a certain type of tumor cell (CDC, 2022d).

Ethical Issues

Because using genetic technologies involves changing the DNA, the fundamental building block of the organism, there are several unique ethical concerns that arise (Sandel, 2007). The following ethical issues are raised by genetic technologies, such as genetic engineering, cloning, etc. (Annas et al., 2021; Rae, 2018; Sandel, 2007):

- What separates "excellent" usage of these technologies from "bad" uses?
- Who decides what traits are normal and what constitutes a disability or disorder?
- Will gene therapy's high price limit its use to the wealthy?
- Could the widespread use of gene therapy cause current societal tolerance for individuals who are different to decline?
- Should people be permitted to use gene therapy to improve naturally occurring human characteristics, such as height, intelligence, or athleticism?

Recent genetic technologies have centered on targeting somatic (body) cells, such as bone marrow or blood cells. It is impossible for a person to pass on this type of genetic mutation to their descendants; however, genetic technology might target germ cells, like sperm and eggs, which would allow the genetic changes to be passed on to succeeding generations (Rae, 2018). Germline gene therapy is the term used to describe this method. The idea of these germline alterations is debatable. While it might stop a certain genetic condition from running in a family, it may also have unexpected long-term effects or impacts on a fetus's growth. Since they have still not been born, individuals who would benefit from germline gene therapy are unable to make a decision regarding the procedure. Most people are concerned about these ethical issues, so the vast majority of governments prohibit the use of state funds for human germline gene therapy technologies or even research around this topic (Sandel, 2007).

4.2 Phenotypes and Genotypes

A gene is a section of DNA that encodes a trait or attribute. Nucleotide sequences comprised of a phosphate group, a sugar, and a base are found in genes (Lewis, 2010). Distinct versions of the same gene can have different arrangements of DNA. As a result, a gene might exist in numerous forms in different organisms. These several varieties are referred to as alleles. The exact fixed location on a chromosome in which a particular gene is present is known as a locus. When a creature is diploid, either its parents give it two versions of the same allele, or they give it one copy of two separate alleles. Some of the basic genetics' concepts are explained below.

Genetics: Basic Concepts

Heredity is the term used to describe the genetic legacy our birth parents have left behind; we resemble them because of this. More specifically, it alludes to the transmission of features through one generation to the next. These traits can be behavioral or physical, such as blood type, eye color, or even a disease (Lewis, 2010). For example, there are some diseases, like certain types of cancer (such as breast and colon cancers), that are liked to hereditary and family history.

Genes, which can contain several alleles, are responsible for determining hereditary features. In human cells, each gene is provided twice (with the exception of genes located on sex chromosomes). The sperm produces one copy, while the egg produces the other. These two copies, or alleles, may not be identical in one individual (Lewis, 2010). An individual is referred to as homozygous if both of their copies of a gene are identical, whereas when the gene is heterozygous, the two copies vary.

The connection between the alleles of the same gene might be dominant or recessive (Lewis, 2010). The dominant allele will be expressed when two alleles are heterozygous (distinct) and, at minimum, one of them is dominant (i.e., that dominant trait will be seen in the individual). Conversely, if both parents inherit the same gene, a recessive allele (non-dominant) will not manifest in the individual (homozygote). As an outcome, even if a recessive allele is present in a genotype (a person's genetic makeup), a dominant allele (the second copy of the gene) will prevent it from being visible in the phenotype (a person's collection of observable qualities). During reproduction, the DNA of the birth parents combines to form a new, unique person. Every one of us is unique because of this gene shuffle (Lewis, 2010).

Monk and botanist Gregor Mendel carried out tests in the 19th century (Lewis, 2010). He conducted experiments on various garden pea plant traits, such as white or purple blooms, yellow or green peas, etc. The rules by which genes are transmitted from one generation to the next were discovered by him and are referred to as Mendel's laws.

Phenotypes and Genotypes

The following will define phenotypes and genotypes and explain how they differ.

Phenotype

All of an organism's observable traits are called its phenotypes, and they are the outcome of how its genotypes (genetic inheritance) interact with its surroundings. Examples of observable qualities include behavior, biochemical traits, color, form, and size (Wojczynski & Tiwari, 2008).

A person's phenotype may change frequently throughout their lifetime due to environmental changes, age-related physiological changes, and morphological changes (Wojczynski & Tiwari, 2008). Different surroundings can modify the expression of comparable genotypes and impact the development of inherited features (e.g., the availability of food might affect growth, and twins growing up in different families may be raised with differ-

ent diets). Natural selection, which favors the survival of organisms with phenotypes best adapted to their existing settings, acts initially on individuals in nature and is based on the effect of the environment. Individuals with these traits are given a survival advantage that makes it possible for them to reproduce successfully at relatively high rates, passing on the successful genotypes to succeeding generations. However, the interaction between genotypes and phenotypes is incredibly complicated. Due to the fact that certain inherited traits are the product of "hidden," recessive, or repressed genes, not all inherited options in the genotypes are represented in the phenotypes (Wojczynski & Tiwari, 2008).

German biologist August Weismann was one of the first to make the distinction between the genetic material that is passed down from one generation to the next (the "germ") and the creatures that are formed from it (the "soma") in the late 19th century (Wojczynski & Tiwari, 2008). Later, it was discovered that the germ plasm contains DNA, which contains the instructions for assembling proteins into a live organism, or soma. However, Wilhelm Ludvig Johannsen, a Danish botanist and geneticist, is largely responsible for the development of modern knowledge of phenotype (Wojczynski & Tiwari, 2008). Johannsen coined the term "phenotype" in the early 20th century to refer to the observable and quantifiable characteristics of organisms. Johannsen also coined the term genotype to refer to an organism's heritable components.

Genotype

The genetic makeup of an organism is the genotype. From the time of embryonic development to adulthood, an individual's genotype determines their inherited potentials and restrictions (Orgogozo et al., 2015). In sexually reproducing organisms, such as human beings, a person's genotype is made up of the full collection of genes they got from both parents. Mathematically, it can be shown that sexual reproduction almost ensures that each person will have a distinct genotype, except for those human beings who are full biological identical twins (i.e., they come from the same fertilized egg; Orgogozo et al., 2015).

Phenotypes, the observable qualities and attributes of an individual or creature, are influenced by genotypes. Depending on the trait, genetics can influence phenotype to varying degrees (Orgogozo et al., 2015). For example, genotype alone influences the blood types of a human being. Depending on the alleles present, the blood type can be A,B, AB, or O. Other features, however, are only somewhat influenced by genotype. Since they are impacted by additional elements, such as environmental and epigenetic influences, these traits are frequently referred to as complex traits. Because appearance and behavior are influenced by environmental and growing situations, even people with the same genotype do not all look or behave the same, similar to how not all organisms with similar appearances share the same genotype (Orgogozo et al., 2015).

Differences between phenotypes and genotypes

The key distinctions between genotypes and phenotypes are listed below.

Table 5: Differences Between Genotypes and Phenotypes

Phenotype	Genotype
Phenotypes are the observable characteristics of an organism.	The organism's genetic information, which is stored in the DNA as genes, is constant throughout life.
Similar phenotypes may or may not have the same genotype.	The same genotype leads to an identical phenotype.
Gene expression is the outward manifestation of phenotypes.	This is genetic material that is present within the body.
The phenotype does not have to come from parents.	The genotype is passed on to the offspring from the parents.
It can be found out by simply looking at the organism.	Scientific techniques, like the polymerase chain reaction, can be used to ascertain it.
Environment and genotype both have an impact on it.	Genetic factors influence it.
Examples include physique, weight, muscle tone, etc.	Examples include blood type, eye color, height, hereditary illnesses, etc.

Source: Mirna Naccache (2023).

Heredity Versus Environment

The majority of human characteristics are genetically influenced, including several traits like height and eye color (Hopwood et al., 2011). However, psychological researchers are typically more interested in features that are sensitive to environmental factors and are less genetically determined, like the way a person feels, behaves, and thinks. How can one understand the complex interaction between genetics and environment, given that the degree of genetic predisposition appears to vary from one aspect to another, and how can one assess the respective influences of heredity and environment on various human characteristics (e.g., spatial skills versus learning languages; Hopwood et al., 2011)?

The nature versus nurture debate

What part do environment and heredity play in the evolution of different human traits? This enduring query is addressed in the nature-nurture debate. It's common to see the origins of this debate in the writings of a number of early philosophers. In the 17th and 18th centuries, philosophers like René Descartes and Immanuel Kant made the case that human intellect is mostly reflective of genetically established predispositions, as environmental variables cannot sufficiently explain the disparities in our cognitive skills (Lewkowicz, 2011). They adopted the nativist viewpoint, which holds that people have predisposed cognitive inclinations from birth.

The clean slate theory, put forth in 1690 by British philosopher John Locke, instead emphasizes the significance of the environment in characterizing human conceptions (Lewkowicz, 2011). Locke believed that people only derive reason and knowledge from

experience, likening the human mind to a blank piece of paper without any thoughts written on it. The effects of environment and heredity have since been extensively researched as a result of these diametrically opposed theories (Lewkowicz, 2011).

Heredity is what is meant by "nature"; it is the genetic makeup or "genotypes" (i.e., data contained in DNA) that a person bears from the moment of conception to the moment of death (Goldhaber, 2012). Heredity may include genetic predispositions that are unique to each person and may describe differences in individual characteristics (such as temperament), as well as predispositions that are thought to be shared by all humans and are commonly thought to distinguish humans from other species. Predispositions that are thought to be unique to certain groups may explain differences in related characteristics (such as gender and height) within those groups (e.g., the language acquisition device in humans). Therefore, the idea of nature relates to the biologically predetermined traits and talents that people have, which may manifest themselves over the course of a lifetime.

Contrarily, nurture refers to the different outside or environmental influences that a person is exposed to from conception until death (Goldhaber, 2012). There are various dimensions to these environmental influences; they comprise both physical (e.g., secondhand smoke and prenatal nutrition) and social settings (e.g., social media and peer pressure). The proximity of environmental influences to an individual also varies; they involve a variety of forces, from the most proximal (e.g., families, friends, and neighborhoods) to more distal settings (e.g., school systems and local governments) to macro causes (for example international politics and global warming). The fact that each of these levels influences and is influenced by components both inside and outside of it further complicates the situation (Goldhaber, 2012). For instance, a child's exposure to certain chemicals that are known to be health hazards, like lead and **asbestos**, are influenced by the housing regulations in the area and the sociodemographic background of the child's family.

Asbestos
This chemical can cause irritation and scarring in the lungs. Breathing becomes challenging as a result. Eventually, the lung tissue stiffens so it cannot contract and expand as it should. Prior to the year 2000, asbestos was used to build or renovate many commercial and residential buildings (Goswami et al., 2013).

As demonstrated, the majority of researchers concur that both heredity and environment have a considerable impact on the emergence of different human features and diseases (Chakravarti & Little, 2003). However, there may be disagreement among researchers regarding the relative contributions of genetics and environment to the development of a given dimension, as well as how different elements may interact to produce a particular human. This disagreement revolves around how much various genetic and environmental factors interact with one another to produce a specific characteristic or specific health conditions (Chakravarti & Little, 2003). Researchers in the fields of mental health, education, and applied psychology are particularly interested in improving the developmental and health outcomes for people from diverse backgrounds. In conclusion, when it comes to health, both genetics and environment play a role in person's health and their likelihood of developing diseases.

4.3 Population Genetics

Humans are 99.9 percent genetically identical. That could seem difficult given human diversity and all the small things that make people incredibly distinct from one another, but consider that the remaining 0.01 percent of human genome has roughly 6.5 million

DNA bases (Ayala, 2015). Additionally, DNA variations can be combined in a variety of ways, increasing diversity. These variations can be a priceless tool for geneticists to investigate and comprehend human health.

These variances and their ramifications are researched across several domains. In order to gather knowledge, the science of genomics examines individual genes and compares them to a "standard" reference sequence (Bentley et al., 2017). A very comparable field is population genomics, which looks at genetic diversity across the genomes of everyone within a defined group rather than just one individual's DNA. Researchers examine the DNA variation frequencies within different groups and how these frequencies have changed over time (Bentley et al., 2017). This strategy has the significant advantage of assisting researchers in identifying demographic trends that can be utilized to locate probable disease-causing variations.

It is vital to note that some racial groups have been neglected in genetic testing, despite the fact that populations are researched based on ancestry rather than simply race or ethnicity (Bentley et al., 2017). Until recently, most research focused on European genomes, which can result in testing results that are not conclusive for underrepresented ethnicities. Extending the diversity of testing sets is the best strategy to enhance test results for non-European groups. The 1,000 Genome Project sought to address this exact issue; it was the very first project to sequence the genomes of 2,504 individuals representing 26 different populations (Bentley et al., 2017).

When it comes to questions of health, it is also critical to be conscious of assumptions. Using race or ethnicity to choose who gets tested for what or treatment options could result in errors. For instance, cystic fibrosis is seen as a "white people's" disease, but it does not mean someone of a different race can't have it (Rubin, 2021).

What is Population Genetics?

A branch of genetics called population genetics, which is related to evolutionary biology, examines genetic variations within and between populations (Hamilton, 2021). Studies in this area of biology look at population organization, speciation, and adaptation. The study of population genetics, a subfield of biology, focuses on how natural selection and other processes affect the genetic makeup of biological groups. To accomplish these goals, population geneticists develop abstract parametric statistics of gene rate dynamics and seek to deduce the most likely patterns of genetic variation in actual populations from these models. These conclusions are subsequently validated using empirical data (Hamilton, 2021).

Traits that differ among human populations reflect genetic variations that can be passed down from one generation to the next. This can occasionally manifest as a dietary intolerance or a propensity for particular diseases (Hamilton, 2021). We can adjust genetic screening procedures for particular populations thanks to population genetics. Screening for sickle cell anemia in individuals whose parents are both of African descent is a well-known illustration of this. Similarly, people of European heritage are more likely to be identified as cystic fibrosis carriers, and Ashkenazi Jews are more likely to undergo prenatal testing for the extremely rare **Tay-Sachs disease** (Hamilton, 2021).

Tay-Sachs disease
This is a rare genetic illness inherited from one

parent. It results from the lack of an enzyme that aids in the breakdown of fatty compounds, which accumulate to toxic amounts in the brain and spinal cord and impair the nerve cells' ability to function (Fernandes Filo & Shapiro, 2004).

Additionally, population genetics aids in the discovery of pharmacogenetic variants – genetic changes that affect how various populations react to specific medications (Hamilton, 2021). For instance, we now know that a particular collection of genetic variations affects the dose of Warfarin (a medication that helps prevent vein thrombosis) that is advised for persons of European ancestry, whereas a different set of genetic variations affects the dosage for people of African heritage (Hamilton, 2021).

This does not imply that DNA has complete control over a population's overall health. Living situations, environmental dangers, availability of appropriate medical treatment, and diet quality frequently have greater significance. Given the complexity of DNA research and discovery, it is crucial to have larger datasets with higher-quality data (Hamilton, 2021).

Ancestry and population genetics

As human tribes traveled to new areas, they interacted with groups from whom they had been isolated for several thousand years, which is one reason that ancestral histories are so intricate and gene pools are so diverse (Veeramah & Novembre, 2014). The blending produced new groups. Modern Europeans, for instance, may attribute the majority of their lineage to at least two disparate groups that mixed when early farmers colonized a region that had previously only been occupied by hunter-gatherers. Recent DNA research has revealed that urban Mexicans' ancestry is primarily European and Native American, with a small amount of African (Veeramah & Novembre, 2014). This is the outcome of Spanish colonization and ~~mingling~~ with native populations that had been present in that region for ~~countless~~ years.

Other populations, like those in Iceland, have remained largely segregated. When attempting to uncover genetic variants that affect one's health, the Icelandic gene pool's lower genetic variation lowers the "background noise" of gene variation (Veeramah & Novembre, 2014). This makes them a perfect source for a lot of medical DNA research and discoveries, along with Iceland's enormous genealogy and medical data.

Environment Versus Genetics

Human health is heavily influenced by genetics, but environmental variables are also proven to have an impact (Rappaport & Smith, 2010). Few diseases are caused by alterations in one, two, or even more genes. Instead, the majority of illnesses are complicated and brought on by genetic and environmental factors. The environment can affect people in a number of ways, including through diet, grooming products, pesticides, mold, and chemicals that cause air or water pollution. Due to slight genetic variances, one person may respond to a similar environmental exposure differently than another. As a result, some people may develop an illness as a result of environmental exposure, whereas others might not. In other words, even when subjected to the same environmental exposure, variations in the genotypes in many genes lead to a variation in the phenotype (Rappaport & Smith, 2010). Therefore, health outcomes are said to be the product of a gene-environment interaction when they vary by genotype and necessitate one or more environmental stressors.

Additionally, a combination of hereditary and environmental factors contribute to the majority of common diseases (Sears & Genuis, 2012). The environment can encompass both internal and exterior elements, such as stress, clean water, and air quality, as well as interior factors like what you eat and the amount you exercise. One gene mutation causes a very small percentage of disorders. These single-gene illnesses include Tay-Sachs and Huntington's disease. Most illnesses, particularly common ones, are brought on by a combination of environmental factors and inherited risk. Since most illnesses include a combination of both, it has become more difficult to separate diseases into those that are entirely "genetic" or just "environmental." Emphysema, however, can arise from smoking, as well as a syndrome known as alpha-1-AT deficiency (Sears & Genuis, 2012). Other examples of diseases in which genetics and environment both play a role in their development include the following (Rappaport & Smith, 2010; Sears & Genuis, 2012):

- autism: According to research, persons who are genetically predisposed to this disorder may be at an elevated risk due to fetal exposure to pesticides or air pollution.
- breast cancer: Breast cancer can be brought on by a confluence of genetic, hormonal, and ecological risk factors. A few exposures connected to a higher risk of breast cancer include combination hormonal therapy, contraceptive pills, radiation, obesity, alcohol use, and some synthetic estrogens.
- Parkinson's disease: Pesticide exposures, poor diet, exercise, and smoking may have a greater effect on people who are genetically predisposed to this condition.

How do the environment and genes interact?

It's crucial to realize that overall health is frequently not determined by the genes. Two people can react to the same environmental exposure differently due to minor genetic variations. The following are some examples of how the environment and genes might interact (Reiss et al., 2013):

- Mutagens are environmental contaminants that get into the body and alter the DNA sequence. For example, cancer can be brought on by the toxins in cigarette smoke.
- Gene-gene interactions happen when contaminants in the environment trigger a chain reaction that affects the functioning of one gene, which then impacts the functioning of another gene without altering your DNA sequence. For instance, excessive alcohol use can prevent the TACE gene from producing enough of its protein. The MTHFR gene is designed to create enough TACE protein, which, in turn, helps the body process folate. Low levels of folate may contribute to depression because low levels of MTHFR protein alter the amount of another protein, folate, in the blood.
- Pollutants in the environment can modify transcription factors, which are in charge of kicking off the process of using genes to generate proteins required for various bodily processes to change the DNA sequence in an indirect manner. For instance, stress can alter the number of proteins produced by immune system-related genes, which may make people more susceptible to diseases.
- Epigenetics means that, by influencing the proteins that switch genes on or off, the environment has the ability to affect health. For example, when environmental toxins impact the proteins that cause familial or inherited cancer, half the genes that produce it are switched off. These genes are disabled, so they cannot prevent the growth of tumors or repair DNA.

Social determinants of health versus genetics

To understand how different factors affect health, they can be categorized into broad categories called "determinants of health." These factors include heredity, behavior, physical and environmental factors, medical care, and social issues (Braveman & Gottlieb, 2014). These groups are linked together. The topic of SDH includes economic and social elements that have an impact on people's and communities' health. These conditions are defined by socioeconomic standing, which refers to an individual's wealth, power, and resources and is affected by political and socioeconomic factors (such as laws, culture, and society values). Numerous factors, including a person's income, career, and degree of education, can have an impact on their socioeconomic standing. The neighborhoods in which people live and work, as well as their general health and happiness, are all impacted by these social factors (Braveman & Gottlieb, 2014).

Data have long been employed by conventional healthcare systems to comprehend the physiological components of a patient's condition. These statistics are crucial for making diagnoses and maintaining health, but they only provide a partial picture. Contrary to earlier belief, social and environmental factors are considerably more predictive of a patient's health prognosis (Kruk et al., 2018). According to studies, a patient's behavior, social and economic circumstances, clinical care, and genetics account for about 60, 10, and 30 percent, respectively, of the patient's healthcare outcome (Braveman & Gottlieb, 2014).

Genes play a role in a wide range of disorders and diseases (Sousa et al., 2011). Despite the fact that most illnesses are more complex, certain mutations may just affect one gene. Numerous diseases, including heart disease and diabetes, are brought on by several genetic problems combined with the effects of SDH, such as lack of possibilities for engaging in physical activity and lack of access to healthy foods (Sousa et al., 2011).

According to research, poverty leaves an imprint on approximately 10 percent of the genes in the genome (McDade et al., 2019). They found that levels of DNA methylation, the process of introducing new material to a DNA molecule, are related to socioeconomic class (Ehrlich et al., 2022). The process by which the instructions encoded in human genes manifest or not, known as gene expression, can then be impacted. Previous studies have shown that socioeconomic position significantly influences both health and disease in humans (McDade et al., 2019). For instance, certain factors like illiteracy or poverty increase the chance of contracting communicable diseases, cardiovascular disease, diabetes, and certain types of cancer. Additional physiological processes linked to lower socioeconomic position include chronic inflammation, insulin resistance, and **cortisol** deregulation, which may add to the development of illnesses. Additionally, numerous biological and social science research have shown how difficult it is to pinpoint the precise contribution of social and genetic factors to illness risk or resiliency (McDade et al., 2019). Recent research has also shown that these variables may be related through the biological process that allows for the modification of disease risk through the alteration of gene expression brought on by a variety of life experiences (Mulligan, 2021). These variations in gene expression can be linked to socioeconomic variables.

Cortisol
This is the primary stress hormone. It increases the number of substances that can be employed to repair cells, enhances blood sugar levels (glucose), and makes it easier for your brain to use. Cortisol also inhibits physiological activities that would be superfluous or harmful in a fight-or-flight situation (Katsu & Baker, 2021).

4.4 Public Health Genetics and Genomics

Public health genetics and genomics is an up-and-coming field. However prior into delving into it, there is a need to define and explain a few concepts.

Genomics Versus Genetics

Genetics is the area of biology that focuses on heredity, particularly the methods of genetic transmission and the variance of genetic traits among organisms (Frazer et al., 2009). Genomic research examines all chromosomal nucleotide sequences, encompassing associated genes, regulatory elements, and non-coding DNA segments. The field of genomics is still very young. Clinical genetics often focuses on a single individual and a single gene, whereas genomics examines the entire genome or substantial portions of it (many genes), as well as how these diverse components of the genome interact with one another and with the environment (Frazer et al., 2009).

The science of inheritance, known as genetics, frequently examines the operation and makeup of one gene at a time. Therefore, genetic research into disorders tends to concentrate on those that are linked to variations in just one gene (Smith et al., 2017). Diseases like cystic fibrosis and **muscular dystrophy** are examples of these "single gene syndromes" and are also often known as Mendelian disorders. The majority of prevalent diseases are multi-factorial, having several gene variations that interact with one another and with a variety of environmental variables to cause them. Scientists working in the field of genomics strive to learn more about these disorders. This area of study examines the genome, or all the genes present in an organism's cells, as well as how these genes interact with one another and the environment to influence an individual's growth and development. Due to the fact that diseases like cancer, diabetes, and heart disease have multifactorial drivers, including genes, lifestyle choices, and other environmental factors, genomics researchers are now able to investigate the etiology of these illnesses (Smith et al., 2017).

Muscular dystrophy
This is a group of illnesses that cause progressive weakening and loss of muscle. Faulty genes (mutations) in people with muscular dystrophy stop the body from producing the essential proteins for growing healthy muscle (Lovering et al., 2005).

Public Health Genetics and Genomics

The science and art of avoiding disease and extending life via the coordinated efforts of society, institutions, and individuals can be summed up as public health (Bartoshesky, 2021). The application of genetic and genomic knowledge to enhance public health and prevent disease has been referred to as public health genetics or genomics. The fascinating, multidisciplinary subject of public health genomics needs all the public health disciplines to interpret the importance of genetic variability within populations and use that understanding to improve the general public's health (Bartoshesky, 2021).

Accordingly, assessment, policy development, and ensuring that all populations receive access to suitable care are among the main duties of public health (Molster et al., 2018). Genomic applications for public health are based on these fundamental principles. Core responsibilities in public health genomics, for instance, might involve assessing a state-run non-communicable diseases (NCDs) screening program (assessment), proposing changes to the panel of disorders that are screened for (policy development), and setting

up a suitable advisory board to help ensure that the health screening program reaches all eligible adults (assurance). Another example would be to use a community-based molecular breast cancer screening program to apply the key tasks of genomics and public health (Molster et al., 2018).

At the moment, public health genomics is now being incorporated into the paradigms already in place for delivering conventional public health services (Molster et al., 2018). It can be anticipated that clinical genomics will continue to be in line with community-based public health initiatives aimed at improving population health. Clinical genomics is no longer thought to be only applicable to "rare" conditions; rather, it has aspects that are applicable to all disorders and diseases, including those like diabetes, hypertension, various cancers, mental health disorders, and hypertension, among others (Molster et al., 2018).

Prevention

Preventive treatments have typically been at the forefront of public health initiatives. There are three common methods of prevention: primary disease prevention, secondary disease transmission control in a person or population, and tertiary disease management of a persistent disease's long-term effects (Martins et al., 2018). Sometimes, laboratory results in clinical genomics are ambiguous and challenging to interpret. Quaternary prevention, or recognizing a patient or community with an unknown course placing them at risk for "hyper medicalization," may be a fourth type of prevention that is necessary (Martins et al., 2018). This can provide a method of preventive to recognize and safeguard those people and populations for whom receiving medical treatment poses a danger of doing more damage than good.

Risk Assessment and Diagnosis

In the past, diagnosing sickness was typically done on the basis of a set of observable or quantifiable qualities. With the use of genomic research, clinicians can go one step further and make a molecular diagnosis by looking at a patient's genes. As a result, numerous clinical genetic tests have been created as part of diagnostic technologies (Costain et al., 2021).

In light of this, scientists believe that researching the human genome will enable us to comprehend why some people stay healthy while others are more susceptible to illness (Costain et al., 2021). One day, utilizing knowledge of the DNA changes linked to an increased risk of these ailments, it may be feasible to predict a person's likelihood of developing common diseases like cardiovascular disease and diabetes. This knowledge might then be used to develop novel techniques for risk stratification or diagnostics in relation to the onset or recurrence of disease (Costain et al., 2021).

Public Health Genomic Activities

Nearly two decades after the link between public health and genomics was revealed, examples of how genomics can be applied to public health practice are shown below (Beskow et al., 2001; Khoury & Holt, 2021; Molster et al., 2018):

- To discover how inherited and modifiable risk variables affect disease burden and health status, evaluate their distribution and impact. Accordingly, a deeper comprehension of these risk factors may help with more precise resource allocation decisions, program prioritization and targeting, and new methods to illness prevention and treatment. Encourage the creation of tools that make it possible to keep track of populations' genetic health status.
- Assessing the incorporation of genomics data into the collection, management, and analysis of regular data, as well as working with major epidemiological groups and national surveys to get the most out of databases, are some of the key actions that might be undertaken. Examining the possibility of using population-based registries that are disease-specific to carry out disease surveillance is also recommended.
- Utilizing genetic technology to locate and monitor infectious disease outbreaks entails leveraging genetic technologies to accelerate the detection and treatment of infectious diseases.
- Giving the public and health professionals the knowledge they need to use genetic information wisely and with reasonable expectations about the dangers and rewards involves giving pertinent information on how genomic data are used to prevent disease, as well as information on the related ethical, legal, and social challenges.
- Helping initiatives for disease prevention and health promotion incorporate genetics more easily will enlighten and educate people about the limitations of genomics knowledge and technology.
- Developing policies and programs that could be created include
  - the proper implementation of genomic applications via standards and recommendations that take into the complexity of genomics and specify the circumstances in which genome-based data and technology.
  - policies that can be applied to prevent illness and enhance health, especially in clinical settings.
  - programs to promote equity and accessibility, ensuring that all people can access genomics knowledge and technologies.
  - using family health history data to educate individuals about the influence of inheritance on development of sickness and recognize those who are at risk.
  - assisting reproductive choices, such as those involving population-based carrier screening, prenatal testing, and genetic pre-implantation diagnosis.
- Determining the evidence foundation, quality, applicability, and preparedness of novel genome-based information and technologies for adoption in healthcare and public health practice is possible. Worries that the availability of genome-based technologies and tools, such as genetic testing, diagnostic tools, and medicines, are more driven by technological feasibility and economic potential than by implementation based on evidence have led to the need for review. Such assessments ensure that the advantages of genetic discoveries are realized effectively, efficiently, and fairly, and they are only put into practice when doing so serves the interests of the general public.
- Following the outcomes of the human genome epidemiology research can be helpful. By assessing the contribution of gene variants to the prevalence of disease in particular groups and the population as a whole, this offers a population perspective on gene-disease connections. Monitoring this research can uncover knowledge gaps at the level of the population and may influence public health disease management and prevention strategies.

Precision Public Health

The approach we take to clinical and public health practice is changing as a result of the introduction of genetic knowledge and technologies into the healthcare industry (Strianese et al., 2020). Precision medicine is a practice that uses information about an individual's biochemical and genetic makeup, as established by the interactions between their genetics, environment, and lifestyle, to give interventions and treatments that are specifically tailored to that person (Strianese et al., 2020).

The development of technologies that allow the production, accumulation, assessment, and dissemination of incredibly large amounts of individual- and population-level data on genetic makeup, environment, behavior, and other economic and SDH has occurred concurrently with advancements in precision medicine (Strianese et al., 2020). These data have been beneficial in discovering new relationships between illnesses, infections, exposures, habits, susceptibility (risk), and health outcomes in communities, especially those involving complex interactions.

Precision public health allows the incorporation of genomics into public health strategies within the larger context of other health determinants, including socioeconomic, behavioral, and environmental factors (Molster et al., 2018). Precision public health builds on the work of public health genomics from the previous 20 years. Thus, more accurate individual and population-based interventions may follow, ultimately improving the outcomes for population health. As a result of technological advancements and the data they generate, a number of fields, including epidemiology, understanding the determinants of health, focusing on health inequities, screening and preventative measures, diagnosis, surveillance, and response to infectious diseases, show how prevention programs and activities may become more "precise" (Molster et al., 2018).

To determine the effect of genetic differences in various demographic subgroups, genomic technologies, for example, could be employed in conjunction with a precision public health strategy (Molster et al., 2018). Then, it would be possible to target each subgroup with interventions that are more suited to their degree of risk and more efficient and successful in terms of disease prevention, screenings, and surveillance.

Ethical Considerations

There are a number of ethical considerations when it comes to public health genomic and genetics. These issues include the following (Lea, 2008; Newson, 2021; Roberts et al., 2014):

- privacy and discretion: This revolves around who should be permitted access to genetic data, who is in charge of them, and when some family members want to get tested for a genetic condition and others do not, how issues can be resolved.
- discrimination: Can genetic testing be imposed on individuals in the workplace, in their personal lives (e.g., when choosing to start a family), by insurance companies, etc.?

- equitable access to genomic technologies: Resource-poor countries like low-income countries, vulnerable populations like those of a lower socioeconomic background, people with no form of health insurance, rural areas, etc. are less likely to have the access to or the financial means to access genetic technologies to improve health, thus increasing health disparities and inequities.
- genetic information and its impact: Knowledge of genetic information, such as having a higher risk of a certain diseases like breast cancer, may negatively impact how people perceive themselves and how society views them.

4.5 Nutrition and the Microbiome

The microbiome of the human body and its relationship to disease are important topics of study. The microbiome plays a function in disease risk and protects the host. Researchers are still working to fully comprehend how the microbiome affects the likelihood of contracting chronic illnesses, including diabetes, heart disease, and obesity (Ogunrinola et al., 2020). This has been a challenging subject to research due to a variety of factors, such as individual variances and dietary preferences.

What is the Microbiome?

The microbiome is made up of the genes of microscopic creatures (bacteria, viruses, and other microorganisms) that are typically found in the small and large intestines of mammals (Ursell et al., 2012). The microbiome, often known as the normal gut flora, defends its human host. The proper balance must exist for the microbiome to thrive, with the healthy species overpowering the less healthy. The bacteria that make up the microbiome can be helpful or harmful. Few are hazardous (promoting disease), and the majority are symbiotic (helpful to the human body). Pathogenic and symbiotic bacteria can coexist together in a healthy body. However, deregulation of the microbiome may occur if there is a breakdown in that equilibrium, which can be brought on by viral illnesses, certain diets, or prolonged use of antibiotics or other therapies that kill bacteria (Ursell et al., 2012). As a result, the body could become more susceptible to sickness.

How the body benefits from the microbiome

B vitamins and vitamin K are among the specific vitamins and amino acids that the microbiome produces. It also breaks down potentially toxic dietary components (Rowland et al., 2018). For instance, only bacteria possess the crucial enzymes needed to make vitamin B12; plants and animals do not. Starches and fibers, which are more complex carbohydrates, are not as quickly digested and may travel lower into the large intestine. Sugars quickly absorbed in the top part of the small intestine include white sugar and dairy (milk sugar). There, the microbiome's digestive enzymes assist in the digestion of these chemicals. Short-chain fatty acids (SCFAs), which the body can use as a source of nourishment, play a crucial role in muscular function and possibly the prevention of chronic diseases, such as different cancers and intestinal disorders. They are created when indigestible fibers are fermented. Clinical research indicates that SCFA might be helpful in the treat-

ment of diseases like Chron's disease (Rowland et al., 2018). A healthy person's microbiome will also offer defense against harmful microorganisms that enter the body from sources like drinking or eating tainted water or food.

Prevotella, ruminococcus, bacteroides, and firmicutes are a few examples of the large families of bacteria that can be found in the human gut (Rowland et al., 2018). The anaerobic (they do not need oxygen to function) bacteria, peptostreptococcus, bifidobacterium, lactobacillus, and clostridium, can be found in the colon, which has low oxygen levels (Rowland et al., 2018). These bacteria compete for nutrition and locations to attach to the gut mucous membranes, a key site of immune activity, and the synthesis of antimicrobial proteins. They also inhibit the expansion of dangerous bacteria.

Prebiotics and probiotics

When speaking of microbiomes, it is important to discuss prebiotics and probiotics. A prebiotic is a type of food that the human body provides for the good bacteria that live in the gut (Davani-Davari et al., 2019). Prebiotics occur naturally in whole grains and vegetables (including artichokes, chicory root, bananas, cabbage, kale, and garlic). Some foods, such as yogurt, infant formula, cereal, bread, and even drinks, may also contain prebiotics (Davani-Davari et al., 2019). Thus, it is recommended that people consume enough of these foods.

Even though not all dietary fibers are prebiotics, the majority of prebiotics are fibers that the gut flora digests (Davani-Davari et al., 2019). As a result, some scientists prefer to use the term "microbiome-accessible carbohydrates" (MACs) to describe carbohydrates that are unavailable to humans but accessible to bacteria in the colon. Prebiotics can aid with bowel habits, such as reducing constipation and diarrhea, as well as with irritable bowel syndrome symptoms. This, in turn, can lead to a decrease in inflammation in the gut, which can contribute to a decrease in the risk of some chronic gut diseases, such as **ulcerative colitis** and **Crohn's disease** (Davani-Davari et al., 2019). Additionally, short-chain fatty acids, which are metabolites created when prebiotics are fermented by gut bacteria, may have an impact on satiety regulation alongside having a local effect. Prebiotics, however, can result in gas, bloating, and/or diarrhea when ingested in excess (Davani-Davari et al., 2019).

Ulcerative colitis
This is a persistent inflammatory condition that affects the lining of the colon and results in the development of tiny sores or ulcers, which cause gastrointestinal pain and the need to frequently clear the bowels because they release pus and mucous (Jewell et al., 2010).

Crohn's disease
This is a bowel condition that results in swelling of the tissues of the digestive tract, which can cause severe diarrhea, excessive tiredness, and malnutrition (Baumgart & Sandborn, 2012).

Probiotics are either supplements that contain live, active bacteria or foods that naturally contain microbiomes and are marketed to support digestive health. Sales of probiotic supplements surpassed $35 billion in 2015 and are expected to reach $65 billion by 2024 (Damari et al., 2021). There is a lot of debate around whether probiotics are effective or if they are a scam (Wang et al., 2020), but they are part of a multi-billion-dollar industry that is developing along with newly discovered scientific knowledge.

Despite the inconsistent results of published studies, probiotic supplementation may be beneficial in some circumstances (Kechagia et al., 2013; Wang et al., 2020). Since the microbiome is less robust in younger and older people, probiotics can be most beneficial to children and older adults. Probiotics may also be beneficial in other situations where the body is under a lot of stress, such as easing diarrhea after exposure to pathogens or repopulating healthy bacteria in the intestines following antibiotic treatment. These are

all instances where the intestine's internal balance has been upset. That being said, giving a probiotic to a healthy adult or older child who is not taking antibiotics is not likely to do much to improve their health (Kechagia et al., 2013).

It should be noted that probiotics are considered supplements rather than food or medication, so they are less strictly regulated by the Food and Drug Association (FDA), the World Health Organization (WHO), etc. (Venugopalan et al., 2010). This suggests that a probiotic pill may not contain the levels mentioned on the label or even ensure that the bacteria are alive and functioning at the time of administration unless the supplement producer voluntarily gives information on quality.

With added health benefits, synbiotics mix probiotics and prebiotics in food or dietary supplements. Inflammatory bowel illnesses, diarrhea, metabolic disorders, colon cancer, and kidney and liver ailments are among the conditions for which synbiotic therapies have been investigated (Markowiak & Śliżewska, 2017).

Effect of Genes on the Microbiome

The microbiomes in each human are affected and influenced by their genetics (Cho & Blaser, 2012). The microbiome may change due to variation in some host genes, increasing disease vulnerability. Additionally, genes implicated in immunological and metabolic functions, as well as disease, were linked to variations in the microbiome. Accordingly, one of the factors that shape the microbiome is genetic makeup. However, after extensive research, the processes that determine its composition are still unknown, and the over 80 percent variation in the gut microbiome across people is still not understood. The discovery of heritable bacteria, or those that are more prevalent among twins and family members, has often highlighted the participation of human genetic variations. For example, the lactase gene (LCT) and the fucosyl transferase gene (FUT2), according to studies, are at least two human genes that significantly influence the composition of the microbiome (Gilbert et al., 2018). There are other human genes that influence microbiome composition and play a crucial role in host metabolism, nutrition, and immunity.

Microbiome variability between people tends to be more influenced by diet, medicines, and other environmental factors as people age, which is interesting because the effect of the host genetic structure appears to be substantial at young ages and diminishes over time (Cahana & Iraqi, 2020).

Effect of Diet and Nutrition on the Microbiome

Daily transient fluctuations are seen, as each person's gut microbiome is unique and tends to be rather stable over the course of a lifetime, thus pointing to the possibility that therapeutic dietary methods could control microbial diversity. However, constitution, stability, nutrition, and diet are significant modifiable factors impacting the composition of the gut microbiome (Leeming et al., 2019).

Nutrition can alter the gut flora, although these modifications seem to be transient. Because there aren't many long-term dietary treatments for people or long-term reviews of short-term dietary interventions, it is unknown if sustained dietary changes can cause long-term changes in the microbiome (Leeming et al., 2019). It is plausible that chronic dietary approaches have less of an impact on the microbiome than regular diets.

In addition to nutrition, a variety of external (e.g., lifestyle and medicine) and internal (e.g., host genetics, immunological, and metabolic controls) factors affect the microbiome. It is commonly known that extrinsic variables, particularly food, have the greatest influence (Singh et al., 2017). According to data analysis, genetics only has a small influence on the microbiome with an average influence level of 8.8 percent (Leeming et al., 2019). In turn, the makeup of the microbiome is very specific to the host and forms across a lifetime, with this distinct makeup of the microbiome beginning at birth.

Nutrition, the Microbiome, and Diseases

Studies discovered that diet affects the microbiome's health and that the microbiome's makeup affects the chance of adverse health effects (Singh et al., 2017). The findings demonstrate that particular nutrients, foods, and general diet composition were related to particular gut bacteria. The microbiome appears to be most affected by diet-related alterations in illnesses like heart disease, diabetes, obesity, and general **inflammation**. For instance, less wholesome eating habits promoted gut species that were connected to blood sugar, cholesterol, and inflammatory measurements that are strongly linked to a higher likelihood of cardiovascular events, strokes, and diabetes (e.g., sugary desserts, unhealthy meats, processed foods; Singh et al., 2017).

Inflammation
This is the process by which the immune system releases white blood cells to damaged areas, resulting in swelling, or symptoms including fever. In response to harmful and alien stresses, it is the process through which the immune system recognizes, rejects, and initiates the healing process (Schmid-Schönbein, 2006).

Contrarily, a more varied microbiome was associated with good eating habits (high-fiber foods like spinach, broccoli, and almonds, as well as healthy animal products, like fish and eggs), and metrics associated with a reduced risk of developing several chronic diseases. The literature also highlights that polyunsaturated fats, which may be found in fish, walnuts, etc., promote the growth of healthy intestinal species that are associated with a lower chance of developing chronic diseases (Singh et al., 2017). So, increasing the consumption of entire grains, fruits, vegetables, nuts, and seeds allows the gut microbiome to flourish. Avoiding certain animal products, like red meat; dairy products; overly processed diets; and even processed plant foods, like sauces, prepackaged juices, sweets with added sugar, etc., keeps less-healthy gut species out of the gut (Conlon & Bird, 2014).

Food quality is crucial; processed or ultra-processed plant-based diets were not linked to wholesome clusters of gut bacteria (Conlon & Bird, 2014). When choosing foods, consider whether they are processed, as well as whether they are plant- or animal-based. Thinking about diet in terms of dietary patterns as opposed to specific foods or food groups might also be beneficial. Dietary patterns centered on whole-food, plant-based meals are those that prioritize foods that are good for the microbiome. These include ovo-vegetarian (vegetarian plus eggs) and vegan (no animal products) diets. The pescatarian diet, which favors oily and white fish as the main meats, is also beneficial to the microbiome (Conlon & Bird, 2014). Therefore, the microbiome can flourish when minimally processed plant meals are prioritized, as they offer protection from or lower the risk of chronic diseases, like heart disease, diabetes, metabolic disease, and obesity.

The Role of Public Health

The study of the human microbiome is developing quickly and appears to hold great promise for improving human health (O'Doherty et al., 2016). Particularly in the case of inflammatory, immunological, and systemic disorders, it is believed that including microbial information in the diagnosis and management of many diseases may significantly inform disease development and treatment. Promising improvements in human health are being made as a result of understanding the human microbiome in relation to certain specific body regions. For instance, research on the oral microbiome reveals that significant variations in these microbiomes increase risks for or protect individuals from issues with the mouth and teeth, like cavities (O'Doherty et al., 2016).

More research is being done to better understand demographic variances based on geography and socioeconomic status, which will help us understand the function of the human microbiome (O'Doherty et al., 2016). The disease burden brought on by global trends in obesity and other gastrointestinal health conditions, like inflammatory bowel disease, may be lessened in part as a result of these findings, which can help understand and develop strategies to change or shape the gut microbiome through individualized diets or therapies. Additionally, evidence indicates that the skin microbiome may contribute to heat control, perception, and metabolic synthesis, in addition to pathogen and physical agent defense (O'Doherty et al., 2016).

It is possible to comprehend this variation at the community scale and then implement best practices for public health to encourage the proper microbiome growth. There will be a much better understanding of which widespread public health strategies assist the establishment and maintenance of a healthy microbiome in 30–50 years (O'Doherty et al., 2016). Thus, public health researchers, practitioners, and policymakers are now able to take particular action by utilizing present and potential microbiome-based possibilities and best practices. The addition of vitamin D to milk as a public health initiative to prevent bone disease is a well-known example of this (Asbury et al., 2022). This initiative highlights the purposeful modification of the microbiome for the benefit of public health, such as by adding probiotics to milk or the water supply to offer the general public some positive or protective effects.

Recent studies demonstrate that there is a need to regulate the microbiome to easily shift diet and stop abusing chemicals, drugs, etc. For example, as poor nutrition is seen as one of the main risk factors for NCDs, it has been shown that providing people with the essential microbiome-based information and resources needed to follow a healthy lifestyle is a successful strategy for preventing NCDs. At the same time, eliminating microbiome-harm-

ing substances from our cities, grocery aisles, and homes has also been shown to be a successful public health strategy that uses knowledge and research done on the microbiome to prevent diseases and promote good health (Dietert, 2021).

SUMMARY

Any organism is a result of its genetic makeup and environment. Gene technology covers a broad range of endeavors, including understanding how genes express themselves, altering genes, etc. Genetic technologies play a big part in public health activities, such as disease prevention, through genetic engineering, cloning, and genetic testing. This comes with several ethical concerns pertaining to modifying the DNA and what it entails.

When speaking of the role of genetics, it is important to know basic genetic concepts, such as alleles and dominant and recessive traits. Each person's genotype is determined by their unique DNA pattern. This phrase refers more directly to the two alleles a person has for a certain gene. The external presentation of the DNA, i.e., the observable expression of the genotype, is the phenotype.

Examining genetic differences within and between populations is the focus of the field of population genetics. However, while genetics has a significant impact on human health, environmental factors have also been shown to have an effect. The majorities of diseases are complex and caused by environmental, hereditary, and genetic variables. These environmental factors include the social determinants of health, which have been shown to play a big part in the development of disease, along with genetic factors.

Accordingly, public health genetics and genomics refers to the use of genetic and genomic knowledge to improve the health of the public, increase disease diagnosis, and prevent diseases. This field also feeds into the notion of precision public health.

The microbiome defends the host and plays a role in illness risk. It is affected by genetics and lifestyle factors, such as diet and nutrition. In turn, the microbiome affects the chance of developing chronic illnesses, including diabetes, heart disease, etc.

UNIT 5

SOCIAL AND BEHAVIORAL FACTORS IN HEALTH

STUDY GOALS

On completion of this unit, you will be able to...

- define health law and health policy.
- understand the ethical principles that govern health.
- discuss the relationship between health and culture.
- recognize the effect of socioeconomic status (namely social determinants of health) on health.
- define health equity and health disparities and identify how discrimination can lead to health inequities.
- understand how social cohesion and social capital affect health.

5. SOCIAL AND BEHAVIORAL FACTORS IN HEALTH

Introduction

This unit focuses on social and behavioral factors in health, beginning with an explanation of how policies and law affect health. Ethics, as well as how they pertain to health and public health, will be covered. The second section discusses the role and effect of culture on health and public health. In section three, the relationship between health and socioeconomic status will be highlighted, alongside the role of the social determinants of health (SDH). Discrimination and health inequities will also be discussed, with a focus on how they specifically affect marginalized and vulnerable populations. The unit will end with a section examining the role and impact of social capital and social cohesion on health.

5.1 Health, Law, Policy, and Ethics

Being in good health is defined as not just the absence of illness, injury, or disease, but also one's level of physical, psychological, and social well-being (World Health Organization [WHO], 1984, p. 1). Health is a fundamental human right and is essential to happiness and well-being (Ghebreyesus, 2017). Additionally, it makes a major contribution to prosperity, wealth, and economic growth. According to research, healthy populations tend to be more productive and support both social and economic advancement. Accordingly, health is governed by laws, policies, and ethics to ensure that everyone has the right to access safe and high-quality healthcare commodities (such as medication) and services (Ghebreyesus, 2017).

Evidence-based health laws and policies can aid in disease prevention and wellness promotion (Ghebreyesus, 2017). For instance, smoke-free regulations and policies, like increasing taxation on cigarettes, can encourage people to stop smoking and prevent others from starting. Similarly, policies that require fluoridated water from public water systems can improve oral health.

Health Law

The words "legislation" and "law" broadly refer to the declarations, governmental memos, regulations, and other legal documents (such as ministerial decrees), and these may differ between countries (Schwartz et al., 2013).

With a focus on operational, regulatory, and transactional issues, the field of law known as "health law" includes all federal, state, and local laws, as well as rules, regulations, and other rulings among all healthcare stakeholders. This can include, but is not limited to, healthcare providers, health facilities, third-party payers (such as insurance companies), the pharmaceutical industry, and patients (Schwartz et al., 2013). As a result, formally

committing to goals, such as the objective of universal healthcare, creates pressure to act (Schwartz et al., 2013). To better collaborate and achieve health goals, people use law to create diverse institutions (like hospitals) and linkages (like agreements for providing health services). Organizations, including those in the business sector, civic society, and health ministries, have mandates, plans, and strategies based on legal regulations that direct their activity.

To safeguard the health and safety of individuals, a variety of regulatory techniques may be employed. Regulators are increasingly adopting a "responsive regulation" strategy. In order to achieve the intended behavior, this entails adopting mechanisms that are adaptive to the context, behavior, and culture of individuals being regulated (Schwartz et al., 2013). The goal is to employ incentives before sanctions where it makes sense to do so; however, sanctions may be used if the target population does not comply. These tactics can be grouped into five categories (Schwartz et al., 2013):

1. Voluntarism: the voluntary, non-coerced compliance of an individual organization
2. Self-regulation: a disorganized group, for instance, that controls its members' conduct through a voluntary code of conduct
3. Economic tools: financial penalties, rewards for healthcare providers, or demand-side policies that offer customers greater clout
4. Meta-regulation: the use of an outside regulating authority to make sure that safe and high-quality programs and practices are used by healthcare providers
5. Methods for command and control: including governmental enforcement

Health law may apply to the following legal disciplines (Schwartz et al., 2013):

- law of contracts
- medical negligence
- health law
- legal administration
- public health law
- consent

Law and health are related fields. This includes the obligation to treat a patient, which is fundamentally governed by contract law, regulated by the law, and gives a doctor the right to deny treatment if there is not an emergency or when there has not been a prior doctor-patient connection (Schwartz et al., 2013). Moreover in most countries, especially high-income countries (HICs), doctors in emergency rooms must screen, stabilize, and transfer patients; they are not allowed to discriminate against people with disabilities, abandon a patient, or refuse to provide services when there is an emergency (Schwartz et al., 2013). This law is also present in low- and middle-income countries (LMICs); however, reports and studies show that this law is not always upheld, especially if the patient is unable to pay for the necessary care. Laws also govern the doctor-fiduciary patient's obligations, like the Health Insurance Portability and Accountability Act (HIPAA) in the US, privacy laws, informed consent laws, and conflict of interest laws (Schwartz et al., 2013). There are also laws across countries worldwide that specify that the limitation of liability commences whenever the injury has been detected rather than when it occurred. Additionally, health laws are used by governments for the following (Schwartz et al., 2013):

- defining important health policy goals, like achieving universal health coverage (UHC)
- putting health policy into practice
- facilitating the effective operation of key health system functions and regulating inputs (such as service provision, the health workforce, healthcare commodities, funding, health information, and governance)
- outlining mandates, accountability, and obligations; creating the framework for health systems; and creating health organizations and networks
- applying economic development and health goals to international agreements
- managing and mitigating risks to one's own health and the health security of a nation
- establishing predictable, suitable, and fair regulations for facilitating the operation of health markets and establishing norms for responsible health behavior
- establishing strong foundations for effective governance to enable meaningful engagement by all sorts of people and health stakeholders

Malpractice

Medical malpractice
This is when a doctor delivering professional services neglects their professional obligations or fails to use an acceptable level of ability or knowledge, which causes harm, loss, or damage (Baker, 2005).

In relation to the quality of care, **medical malpractice** is another area where law and health are intertwined; in this case, the customary similar locality rule may be applicable (Baker, 2005). Alternative theories may exist, as well as several schools of thought where credibility is the key concern. Within the context of medical malpractice, other significant factors exist, like causation of harm and/or injury, where clinical probability and loss of chance are involved (Baker, 2005).

Example of UHC

UHC ensures that everyone in the country has access to health services. Its goal is to increase access to healthcare for all people to enhance health outcomes. This implies that everyone can receive the healthcare they need, when and where they need it, without having to pay a significant sum of money (WHO, n.d.-f). The state typically taxes its residents to pay for this form of coverage (the type and amount of taxation varies by country).

One of the main examples of how health laws can improve the health of the general public is through creating and developing laws that lead to the establishment of UHC (WHO, n.d.-f). This done by removing legal obstacles to universal access, such as discrimination, and by granting legal acknowledgment of access rights to vital health services, medicines, and vaccines. The two components of UHC are the establishment of a legislative mandate for universal healthcare access and evidence that most of the population has significant access to health services. Every country that has attained UHC (such as England and Sweden) has passed legislation to formally ratify the commitment. UHC is also attained by ensuring financial security. Legal methods are used in UHC finance reforms that are intended to provide financial protection. A legal framework is necessary for raising revenue, pooling resources, making purchases, and defining a nation's benefit package. To fulfill six healthcare quality goals – safety, equity, effectiveness, patient-centeredness, efficiency, and timeliness – health laws must be developed and implemented. Standardization, licensure of health professionals and commodities, accreditation of health services and facilities, treatment guidelines, reporting systems, the establishment of monitoring and accountability processes and mechanisms to check for compliance, auditing, and the use of sanctions are all legal tools for ensuring the quality of UHC (WHO, n.d.-f).

Health Policy

A policy is a set of rules or principles that serves as a roadmap for making decisions and choosing a course of action, focusing on both problems and solutions. A strategy, guiding concept, or course of action adopted by a government, political party, corporation, or organization with the intention of influencing and directing decisions and activities is also referred to as a policy. Laws, rules, contracts, procedures, administrative actions, inducements, guiding principles, and unofficial practices are all forms of policy. Both the public and private sectors make policies, which might be created by the government, big firms, small businesses, educational institutions, or healthcare organizations. Developing informed policy (i.e., based on sound evidence from research, or data) is essential for enhancing public health.

Despite the fact that there are several definitions, the World Health Organization (WHO) states that healthcare policy is "an expression of goals for improving the health situation, the priorities among these goals, and the main direction for attaining them" (WHO, 1986, p. 86). However, there are many other ways to define health and, therefore, various ways to define health policy; for instance, some dictionaries simply describe health as the absence of disease or harm (Oleribe et al., 2018). Health policy is concerned with the actions or inactions of the public and private sectors as they relate to the general people's health and every aspect of the healthcare system. This includes, but is not limited to, regulations on healthcare institutions, contractual dealings, healthcare financing, and policies relating to delivery of and quality of healthcare services. The laws, regulations, programs, and decisions that are enacted (often by the government) to promote health and ensure the accomplishment of health objectives and goals for a particular community or society at large are another interpretation of health policy (Buse et al., 2012).

Although every individual will utilize healthcare services and products during their lives, the need for medication and medical treatment is unpredictable; hence, health policy is deemed difficult. A good illustration of this is the COVID-19 pandemic, when the sudden, exponential increase in the number of infected individuals worldwide resulted in the necessity for ventilators to supply oxygen to COVID-19 patients who were unable to breathe on their own (Lee & Lee, 2021). The following are some of the most important subfields of health policy (Buse et al., 2012).

Public health policy

This centers on the laws, regulations, initiatives, and decisions taken by society to promote health and ensure that certain health objectives are achieved. It is multidisciplinary in nature and affects numerous industries, including, among others, the healthcare, education, agricultural, and environmental sectors. Vaccination laws, tobacco laws, and laws supporting breastfeeding are some more examples of public health laws.

Global health policy

Global health policy concentrates on national and international health systems, including public health and healthcare. It also emphasizes how resources are distributed across various nations and organizations, as well as how strategies and solutions are put into action

Global health
This aims to improve health outcomes for marginalized groups and communities around the world. Through research, instruction, and cooperative intervention, those who study or work in global health strive to minimize health inequities in low-resource settings around the world (Beaglehole & Bonita, 2010).

to attain health objectives (Munkholm & Rubin, 2020). An example of international health law is the "Global Action Plan on Antimicrobial Resistance." It was established to enhance international cooperation in the fight against the increasingly prevalent issue of antibiotic resistance (Munkholm & Rubin, 2020).

Healthcare services policy

This focuses on the improvement of healthcare services' availability, accessibility, efficacy, quality, efficiency, equity, and safety. Many LMICs, like Tanzania, have made it a priority to improve the delivery of healthcare services through the primary healthcare system. Tanzania was able to introduce the UHC program in 2019, which provides orthopedic services, general outpatient and inpatient care, optical services, specialist surgery, medications, and other services to the country's most disadvantaged inhabitants (Wang et al., 2018).

Pharmaceutical policy

This deals with the creation, distribution, and utilization of pharmaceuticals in the healthcare system. It covers laws governing pharmaceuticals (both branded and generic), biologics (i.e., goods made from biological sources rather than chemical materials), vaccinations, and natural health supplements. For instance, in Canada, the Patent Drug Price Review Board examines drug pricing and assesses whether the proposed price is "too high," in which case, the company must submit a recommended price to the relevant regulatory agency (Jackson, 2012).

Mental health policy

This is a relatively young area of health policy that has evolved and gained popularity since the 2010s. Governments, health agencies, and health ministries have therefore been developing visions and principles, setting objectives, and constructing a wide variety of action models. Promoting good mental health, lowering the incidence and prevalence of mental disorders (through prevention and treatment), lowering the extent and severity of related disorders (through rehabilitation), creating services for those with health issues, and combatting the stigma associated with mental health are all general goals of mental health policies (Pilgrim, 2019). For example, in several European countries, like the Netherlands, people with mental health issues can take paid time off from work for recovery due to a thorough sick leave policy and progressive views on mental health (Jenkins, 2003).

Ethics

Ethics is the systematic analysis of people's attitudes and behaviors. It is the study of how people treat one another and the environment (Gilman, 2005). Ethics requires a thorough evaluation of the values that influence our behavior and attitude in certain contexts, in addition to determining the values that should guide our attitudes and behaviors. We all use ethics on a daily basis, regardless of our cultural, socioeconomic, or professional backgrounds. We all hold certain values and ideas (opinions about the nature of existence and how we see the universe to be) that we consider being essential for their own sake. For instance, it is a commonly held belief that people should not be punished for things that

weren't their fault, as we may place a high value on justice or fairness. Many of us believe that we ought to aid the less fortunate members of our community, as we may embrace ideals like charity and generosity, as well as the fact that humans are connected to one another (Gilman, 2005).

Moral issues pertaining to science, health, treatment, and public health are addressed in health ethics (Holland, 2015), which entails discussions about the options for care and treatment that people, families, and healthcare professionals must consider. It necessitates a critical examination of the interactions between healthcare providers and the patients they serve, as well as the policies, plans, and systems put in place to enhance population health. Considering resource allocation and the difficult moral decisions brought on by continuing changes in the healthcare system and technological advancements are all part of health ethics (Holland, 2015), as well as analyzing the definition and factors that affect health from a critical, political, and ethical standpoint.

Legislators, academics, and healthcare providers are asked to take their values into account when prioritizing and supporting policies that may have an impact on patients, families, and society (Holland, 2015). Among the various facets of this multidisciplinary area are diagnosis and care, public health, and health research. A health ethics framework promotes methodical conflict assessment and mediation utilizing fundamental ethical concepts, like respect for the individual, autonomy, beneficence, justice, utility, and solidarity, while juggling conflicting interests and scarce resources. Examples of health ethics concerns include the following (Holland, 2015):

- deciding whether to allocate money for the treatment of disease or the promotion of health
- making decisions related to end-of-life care
- critically examining the differences in population health status and our moral need to ensure equitable access to healthcare services
- ensuring moral behavior in medical science
- thinking through the moral ramifications of genetic cloning technology

The main principles of health ethics are beneficence, non-maleficence, justice, utility, respect for people, veracity (truthfulness), and fidelity (trust).

Beneficence

Doing "good," or being benevolent, is acting in a way that is both beneficial to others and oneself. The best care and treatment are provided to patients by benevolent healthcare professionals. Being beneficent is synonymous with being kind; however, in the context of healthcare, being beneficent is when a healthcare provider provides treatment with the goal of ensuring that patients experience the best possible results (Pellegrino, 1988).

The ethical concept of beneficence and how to determine what is good or bad, objectively and subjectively, are widely debated topics. It is generally agreed that a judgment can be deemed "objective" if it is made in the exact same manner, regardless of who made it (Pellegrino, 1988).

Physicians have typically been in control of the ethical decision-making process with regards to patient treatment. Based on their knowledge and skills, various healthcare professionals now play a significant part in the decision-making process (Pellegrino, 1988). For instance, when it comes to matters relating to quality of life, case managers are deemed the authority. Their input is crucial in talks regarding choices that affect one's quality of life and prognosis in circumstances of terminal illness (Leeuwenburgh-Pronk et al., 2015).

Nonmaleficence

Nonmaleficence means not harming other people, purposefully or accidentally. Any healthcare given should guarantee that their behavior, or lack thereof, won't cause harm. This is a portion of the **Hippocratic Oath**, which was founded on the principle that a doctor should never hurt a patient (Veatch, 2019). When making decisions regarding a patient, a healthcare provider must ensure that there will be no harm, injury, or unfavorable results.

Hippocratic Oath
This is an ethical oath historically taken by doctors. A new doctor must swear that they will respect a variety of ethical guidelines.

As a result, injury may result from either an act of commission or omission. An act of omission is when something that may have been done to stop damage from happening is not done. For instance, failing to check that a mopped floor has dried properly could result in a patient slipping and hurting themselves. When an act directly causes harm (which, in some situations, is on purpose), this is known as harm by commission. An example of this is giving a patient medication that was meant for another patient (Gillon, 1985). If a healthcare provider does not adequately coordinate, they could be charged with damage by omission; an example is releasing a patient without implementing the necessary care setup or purposefully leaving a patient in a hazardous living situation (such as an elderly person's home without adequate modifications or an adult at danger of falling who lives alone). An example of harmful conduct by commission is a healthcare professional divulging details about a patient without their consent, compromising patient privacy (Gillon, 1985).

Justice

Justice is defined as equity and fairness in the context of healthcare delivery (Cookson & Dolan, 2000). This idea was also highlighted in the Hippocratic Oath, which emphasized how doctors might advance justice by interacting with their patients (Askitopoulou & Vgontzas, 2018). While treating patients fairly and with respect is crucial, a healthcare business must also treat its personnel and healthcare providers with the same decency and justice. As a result, treating a patient who is unable to pay for already-provided services is unfair to the healthcare company and its personnel (Buchanan, 2009).

While it is the goal of every health system to provide and deliver healthcare with fairness, there are numerous instances where this is not achievable. For instance, some health systems that aim to distribute their healthcare goods (which are viewed as scarce resources) equally will undoubtedly fail (Rahman, 2022). Every healthcare organization also has a finite amount of funding and resources; therefore, when the system is unable to offer all

the resources required for patient care, market changes may be required (Fourie & Rid, 2017). Another instance in which fairness may not be achievable is when a hospitalized patient's assigned payments from the insurance company have run out.

Due to disparities in the ability to pay for health insurance and access to high-quality treatment, not everyone has equal access to healthcare. There are legitimate and significant worries about the fair distribution of healthcare resources, especially when life expectancy is increasing and there is a higher need for healthcare services (Cookson & Dolan, 2000). The population of persons aged 65 and older continues to increase, and they require more healthcare supplies and services than people of other ages, resulting in a disproportionate distribution of them (Chrisler et al., 2016). This increases the strain on the health system, which is already overworked in the majority of nations, and makes it more difficult to deploy human and financial resources. It should be noted that political trends and changes have an impact on the idea of justice in healthcare decisions (Maphumulo & Bhengu, 2019).

Autonomy

Sometimes referred to as respect for people, the capacity to make independent decisions is referred to as autonomy. In a democratic legal framework, independence is encouraged and, as a result, such legal frameworks protect people's freedom to choose their own healthcare (Taylor, 2018). Patients must be fully educated so they can make informed decisions, they should be informed of the potential advantages and hazards of any proposed treatments, and they should have access to all information about their own health. Patients have the legal freedom to refuse treatment, which can be backed up by their knowledge of benefits and dangers of any potential treatments. In moral conundrums, such as those where the patient's actions and treatment refusal poses a threat to another person's safety or has the potential to do harm, the judicial system makes the choice after consultations with medical professionals (Olejarczyk & Young, 2021).

Prior to the advent of the internet and easily accessible resources, a patient's decision was solely dependent on the advice of their doctor. Now, however, patients are better equipped to make their own decisions and consult with their doctor and other members of their healthcare team to determine the best course of action. Due of their limited online literacy, the elderly experience this decisive freedom less frequently. This is anticipated to change when the current adult population (those under 60) ages (Gittell, 2016).

Veracity (truthfulness)

To sustain the idea of veracity, often known as truthfulness, healthcare workers must be honest in their interactions with patients. Regardless of whether it is feasible to lie to others or whether the falsehood will lead to a better outcome, traditional ethics states that misleading others is morally wrong since it shows a lack of respect for them. Being forthright and honest with patients fosters the development and upkeep of the kinds of bonds required for the delivery of high-quality patient care (Veatch & Haddad, 2008).

Similar to the other moral precepts, telling patients the truth is not always regarded as the right thing to do. Even though certain cultures place a great priority on honesty, others do not. In fact, informing the sick and dying about their situations, particularly when it comes to terminal illnesses, may be seen as cruel and even harmful by some racial and ethnic groups (Blackhall et al., 2001). The idea of stating the truth is impacted, perceived, and valued differently depending on the origins, degrees of schooling, and socioeconomic situations of both patients and physicians.

Fidelity (trust)

Respect and honesty are the foundations of fidelity. In relationships, keeping one's word is crucial, as it develops trust and shows how highly one person regards another (Purtilo et al., 2013). A person sets expectations when they make a promise. The promise will be relied upon by the other person, and they have an expectation that it will be upheld in good faith. When a nurse, for example, promises a patient that they will receive proper symptom management while receiving chemotherapy, the assurance is meaningless unless the nurse keeps their word (Purtilo et al., 2013).

Fidelity is crucial to relationships between coworkers on a medical team. In general, commitments made to peers are implied and proved through actions. Examples of behaviors based on fidelity include being honest, not taking advantage of others, and showing dependability by helping and assisting when required (Purtilo et al., 2013).

5.2 Health and Culture

A particular group or society's shared ideologies, traditions, and behavioral patterns are referred to as its culture (Napier et al., 2014). While generalizing specific characteristics of one culture can be valuable, do so with caution. These traits define a group of people and to set them apart from other groups (Napier et al., 2014). Because there are so many diverse factors that might have an impact, any cultural group will include a wide range of individuals. Any one or a combination of the following traits may be considered part of a culture (Napier et al., 2014):

- language
- religion
- spirituality
- gender
- age
- sexual preference
- place of birth
- people in the group
- history of education
- upbringing
- life experience

A culture is dynamic and transforming, as it is taught and transmitted over generations. It is shared by persons who share the same names for and conceptions of reality, often "symbolically" recognized by language, clothes, music, and behaviors, incorporated into every part of a person's life (Napier et al., 2014).

Two broad traits used to classify civilizations are collective and individualistic (Church et al., 2017). The bulk of cultures are placed midway between the two poles and exhibit characteristics of both. Each culture also has a vast spectrum of unique individual variations; however, practitioners can "discover" where a family belongs on their cultural spectrum and personalize patient care by being aware of the characteristics of individualistic and collectivistic cultures (Church et al., 2017).

Effect of Culture on Health

Different perspectives on human health, including those related to causes of illness, treatments, and diagnoses, might result from societies that are more collective or individualistic (Napier et al., 2014). As such, it may be beneficial to involve the patient's extended family in conversations concerning the cause, diagnosis, and course of treatment of their sickness, based on where they "fit" within the cultural spectrum. Before various diagnostic and therapeutic procedures can be carried out, signed consent forms may be needed from members of the family.

Since one's cultural background directly and indirectly affects one's health status, many consider health as a cultural term. In addition to other factors, culture contributes to the definition of the following (MacLachlan, 2006; Napier et al., 2014):

- patients' and medical professionals' perspective on health and illness
- opinions of patients and medical professionals regarding the causes of sickness: Some patients, for example, might not be aware of the scientific theories and ~~may prefer to believe in fate, a demon, the "evil eye," or djinns – evil spirits that capture infants in rural Afghanistan and cause illnesses similar to tetanus.~~ They may reject the diagnosis and believe they have no control over the situation. They must instead content themselves with accepting life as it comes.
- why some illnesses or disorders are stigmatized: Depression carries a stigma in many societies, and consulting a psychiatrist is seen as "crazy" behavior.
- what kinds of health promotion practices are used, advised, or covered: Being "strong" in some cultures ~~is what Canadians would refer to as "overweight."~~ Others may view them as beautiful and healthy, especially societies in which being strong means having a supply of energy in case of famine.
- how people experience and communicate illness and discomfort: In some communities, selflessness is the norm, even in the face of great agony. In some cultures, people publicly express mildly painful emotions. The same level of investigation or treatment of pain might not always be required.
- location, method, and perhaps time of patient's initial need for aid: Some cultures reserve trips to the doctor for when a condition gets serious and instead choose to consult with allied healthcare experts first.

- communication between patients and healthcare professionals: Avoiding eye contact is a sign of respect in many cultures; however, a caretaker may be worried that this conduct suggests depression in the patient.
- the degree of treatment awareness and compliance recommendations made by medical professionals who do not share their cultural views: Some individuals think their symptoms may not be being taken seriously by their doctor if they don't receive an injection.
- how chronic illness and available treatments are viewed by patients and healthcare professionals

Additional ways that culture influences health include the following (US Institute of Medicine, 2004a):

- acceptance of a diagnosis, including how, when, and to whom it should be communicated
- acceptance of health promotion or preventative measures (vaccines, birth control, etc.)
- perception of how much power people have over the prevention and management of disease
- attitudes toward death and dying, as well as opinions about who ought to be involved
- switching between direct and indirect communication: Depending on the culture, making or avoiding eye contact may be considered polite or disrespectful.
- willingness to talk about symptoms with a physician or with an interpreter present
- family factors, such as traditional gender roles, filial obligations, and family support systems
- perceptions of age
- how well the health system works and how easily it can be accessed

Examples of how culture effects health

All communities have systems of health beliefs that describe what causes disease, how it may be treated or cured, and who ought to be involved in the process. How well-received and helpful patients find the information can be greatly influenced by their perception of how culturally relevant it is to them. Because they see disease as the outcome of natural scientific processes, medical treatments that fight microorganisms or make use of innovative technology to detect and treat disease are preferred in Western countries, such as the US (Shaw et al., 2009). Other cultures encourage praying or other religious practices as a means of fending off the apparent hostility of spiritual forces because they think that illness is caused by supernatural events. Patient compliance is heavily impacted by cultural influences. One study found that a group of adult Cambodians with little formal education made tremendous attempts to adhere to their treatment plan, and they applied their fundamental knowledge of how medicines and the human body function (McLaughlin & Braun, 1998).

A significant ethnic group in the US is the Asian community (McLaughlin & Braun, 1998). Nurses should be aware of a number of significant cultural concepts shared by Asians and Pacific Islanders. The older male in the home often makes decisions and serves as the spokesperson, while the extended family exerts a substantial amount of influence. Individual family members' interests are not as crucial as the welfare or reputation of the entire

family. Family elders are revered, and their authority is typically accepted without question. Since sustaining peace is valued in Asian cultures, conflict avoidance is strongly encouraged (McLaughlin & Braun, 1998). To prevent disagreements with the suggestions of medical professionals, respect for authority is necessary. Even if the patient or their family do not object to the treatment proposed, that does not mean that they agree with or are willing to follow treatment recommendations. Chinese patients ~~may~~ experience shame and guilt due to mental illness or any behavior that implies a lack of self-control because the person's actions reflect on the family (McLaughlin & Braun, 1998). Chinese patients ~~could also be reluctant~~ to talk about symptoms of mental illness or depression as a result.

Some subpopulations of cultures, like those in India and Pakistan, are reluctant to accept a diagnosis of a serious emotional disorder or mental illness because of the considerable decrease in the possibility that other members of the family will be able to marry. In Vietnamese culture, mystical ideas are employed to explain both physical and mental illness (McLaughlin & Braun, 1998). A healthy equilibrium between the heat and cold poles that regulate how the body functions is the notion underpinning health in this culture. Vietnamese people do not simply accept Western mental healthcare or interventions, especially when self-disclosure is required. It is possible to accept assistance if trust already has been built.

Typically, Russian patients and doctors have authoritarian relationships with little room for open conversation or information sharing (Maercker et al., 2015). As a result, it can be difficult for most Russian patients to ask questions of a doctor and to openly discuss their medical problems. Patients expect competent healthcare professionals to have a paternalistic approach and direct patients rather than asking them what they would like to do (Maercker et al., 2015). This reliance on the doctor's experience undermines the patient's willingness to learn more about personal care and preventative health behaviors.

Despite the fact that they all share a shared heritage involving family and religion, each component of the Hispanic community possesses its own cultural views and practices (Velasco-Mondragon et al., 2016). Elderly family members and other members are respected and frequently consulted on important health- and illness-related concerns. Numerous Hispanic patients have pessimistic beliefs and believe that their illness is God's will or divine vengeance for previous or ongoing immoral behavior (Velasco-Mondragon et al., 2016). Hispanic patients may prefer to consult a *curandero*, which is a form of **traditional folk healer**, and look for natural remedies.

Traditional folk healer
These are individuals who practice healing with traditional methods and herbal treatments. Often, they have not received formal training or licenses.

As demonstrated by the aforementioned examples, every ethnic group brings distinct perspectives and beliefs to the healthcare system. Unfortunately, a lot of healthcare professionals have assumed that patients will follow cultural conventions. The language and educational gaps between patients and the professionals from various backgrounds make it more difficult to provide treatment.

Cultural differences impact patients' attitudes toward obtaining medical treatment and how they comprehend, manage, and cope with the effects of medical intervention; the course of an illness; and the relevance of a diagnosis (Napier et al., 2014). In light of this, patients and their families contribute concepts and values from their own cultures that are

particular to their perceptions of health and illness, reporting symptoms, expectations for healthcare delivery, and opinions about medications and treatments. Furthermore, cultural beliefs affect how much information is sought about illness and treatment, how mortality and suffering will be handled, how grieving is expressed, family and gender roles, and decision-making processes (Napier et al. 2014).

Providing healthcare services to various cultural groups

Writing a global guide to assist medical practitioners in comprehending cultural preferences and traits around the world would be a massive undertaking (Nair & Adetayo, 2019). Such a document would also be skewed by the authors' own cultural viewpoints. Health professionals are growing increasingly culturally diverse and have many perspectives of the world and the individuals with whom they interact. However, healthcare professionals should develop their **patient-centered care** and cultural competence abilities. The level of care and patient outcomes can be improved by using these skills as a guide for identifying, understanding, and leveraging cultural similarities and differences. Above all, it is important to take the following into consideration (Nair & Adetayo, 2019):

Patient-centered care
This occurs when a patient actively participates in their own healthcare.

- Cultures change with time.
- Every culture is incredibly diverse.
- Even when you believe you fully comprehend a particular culture, it can change or there will be exceptions.

Culture and Public Health

Public health is enhanced by the use of culture (McMullin & Rushing, 2018). It is emphasized how critical it is for public health treatments to comprehend cultural views, as well as local and global contexts. A wide range of topics and problems in health and public health research are addressed by the concept of culture. Population health disparities are linked to cultural factors that may encourage or hinder physical and mental health (McMullin & Rushing, 2018). For interventions and programs to be more successful, public health has discovered that it is essential to incorporate cultural practices and beliefs that contribute to different health statuses into their work. For cultural processes to be recognized and effectively integrated into public interventions and campaigns, this overview's main objective is to present the audience with works that describe, analyze, and prescribe approaches for the study of culture and health (McMullin & Rushing, 2018).

Understanding the local culture can be useful for preventing the spread of infections, enhancing sanitary procedures, and educating locals about the significance of adopting new health behaviors (McMullin & Rushing, 2018). For example, in a community at risk of contracting the **Ebola virus disease** (EVD), the use of gendered roles enables a more effective approach to community surveillance and treatment in places lacking sufficient health infrastructure (Nkangu et al., 2017). It is possible to lessen the burden placed on a country's meager hospitals and clinics by educating women on how to care for family members, quarantine protocols, and personal protection against transmission. In a similar way, offering young men – who would otherwise be jobless – jobs in community supply management and monitoring has helped reduce social tension by providing them with the sense of meaning that their culturally-motivated roles aspire to have.

Culture of Health

A culture of health, by any definition, is one where everyone has the power to make choices that support healthy lifestyles and where people of all ages, demographics, and social backgrounds enjoy good health and well-being (Chandra et al., 2017). Additionally, it supports wholesome, equitable communities. To do this, society must be free of all structures and organizations that uphold racial injustice. Therefore, a culture of health shows how a company's overall performance aligns with its members' personal and organizational ideals. These interrelated traits include cultural values, leadership positions that foster and support a strong organizational culture, organizational paradigms (mental models that bind employees to common rules and standards on how to behave), and organizational paradigms (pointing out characteristics that are common between people in a specific group). A culture of health might signify many different things. A nation's health culture must embrace a diverse range of customs, principles, and viewpoints. One day, it will be as diverse and intricate as the community it serves (Chandra et al., 2017).

Ebola virus disease
This is a deadly disease that can be contracted by both humans and nonhuman primates. It can be found mostly in sub-Saharan Africa. Infection can result from direct contact with an Ebola-infected person who is sick or dead, an infected animal (such as a bat or monkey), or both. There was an Ebola epidemic throughout West Africa from 2013 to 2016 (CDC, 2022c).

Enhancing personal and societal well-being is one of the three outcome categories emphasized by a culture of health. By definition, the construction of a culture of health involves a shift in how society views health. This is only possible as a result of extensive, system-level change. Therefore, focusing simply on conventional health outcomes, especially those that monitor particular medical conditions, is not broad enough (Chandra et al., 2017).

5.3 Socioeconomic Status and Health

Socioeconomic status (SES) is based on a combination of factors relating to economic and social backgrounds, including employment history, resources available on a financial basis, and place in society. It is a system for classifying people based on their employment status, household income, and educational attainment (Darin-Mattsson et al., 2017). Classifications based on low, middle, and high socioeconomic categories are frequently utilized. People with lower socioeconomic levels often have access to fewer financial, academic, social, and healthcare resources than those in higher socioeconomic positions.

The effect of SES on health has been shown by a large body of research. Previous research suggested that SES and health have a consistent and enduring association. According to some experts, SES may be among the most important social factors influencing a person's health and **life expectancy**. The findings of this study showed that SES had a considerable impact on physical health (Darin-Mattsson et al., 2017). Work, income, and education are the three areas of a person's life where this impact is most noticeable. Higher professional status is associated with more autonomy at work, less physical work, and less frequent exposure to health risks. Similarly, improved housing, healthcare, and nutrition are frequently associated with greater earnings. Furthermore, those with higher levels of education often have a better understanding of and knowledge of health issues. Therefore, it is possible that a higher SES is associated with better physical health (Adler & Snibbe, 2003).

Life expectancy
This is the number of years one could expect to live. A population group's estimated age of death is used to determine life expectancy.

Poverty has been shown to lead to physical and mental stressors. Moreover, a person's physical and mental health are two outcomes that SES consistently and accurately predicts throughout their lives. All areas of social and behavioral science, particularly public health, can benefit from SES research, practice, lobbying, and education (Wang & Geng, 2019).

Additional research highlights how survival rates differ between people coming from different SES. Some health conditions are more common in lower SES, like anemia, arthritis, and diabetes. According to studies, people with lower incomes are three times as likely to develop heart disease than those with higher incomes (Darin-Mattsson et al., 2017). Studies carried out in various nations have shown an inverse relationship between income and mortality rates, with participants from lower SES groups experiencing higher mortality rates. Further investigation revealed that the mortality rate difference has widened over the past thirty years (Darin-Mattsson et al., 2017).

Social Determinants of Health

Social determinants of health (SDH) are non-health-related conditions, such as gender, race, SES, education level, income level, employment status, occupation, and living conditions, which affect health both directly and indirectly (Saunders et al., 2017). Addressing these determinants is crucial for improving health and reducing long-term health disparities. An increasing number of public health interventions (such as policies) and programs are being developed worldwide with the aim of addressing the SDH both inside and beyond the healthcare system. Many organizations outside of the health system work to influence non-health sector policies and practices in ways that advance fairness in health and well-being. Nutrition programs and early childhood education programs for low-income communities are examples of these initiatives, which aim to promote health equity and improve the health of underprivileged communities. Examples of SDH include the following (WHO, 2008a):

- income level
- level of education
- environment and setting of habitation
- employment situation
- food insecurity

SES and Health

SES is linked to both communicable and non-communicable diseases (NCDs).

Socioeconomic status and communicable diseases

Communicable disease acquisition is frequently reported to be strongly correlated with low socioeconomic groups because poor living conditions enhance vulnerability and exposure (Ying et al., 2022). In high-, middle-, and low-income countries, associations between SES and communicable diseases have been documented. Diseases related to low SES are malaria, diarrheal diseases, respiratory diseases (namely tuberculosis [TB]), and AIDS/HIV (Ying et al., 2022). Poverty raises the chance of getting these diseases since there

is a lack of suitable housing, safe water to drink, nourishing food to consume, sanitary circumstances, and access to healthcare. Particularly for those living in slums, overcrowded and inadequate or nonexistent infrastructure increases the risk of communicable diseases.

Malnutrition is pervasive and frequently occurs alongside illnesses linked to low economic backgrounds (Ying et al., 2022). In addition, chronic diseases prevent affected individuals and the families who care for them from experiencing economic growth, which contributes to greater poverty. In contrast to diseases of affluence, which are illnesses assumed to be caused by rising prosperity in a community, these diseases that are partially caused by poverty (Ying et al., 2022).

Malnutrition
This is characterized by inadequate or excessive nutrient intake, an unbalanced intake of vital nutrients, or poor nutrient use.

Socioeconomic status and non-communicable diseases

Due to health behaviors and gaps in access to healthcare, people from low socioeconomic groups are especially susceptible to NCDs (Lago-Peñas et al., 2021). Additionally, low SES increases the risk of dying from NCDs like cancer, heart disease, stroke, and diabetes, as well as becoming disabled from them.

It should be noted that the relationship between low socioeconomic groups and health is quite context specific. For example, in high-income countries, low SES is linked to poor diet (eating food that is high in fat, etc.), inactivity, and use of tobacco and alcohol. In low- and middle-income countries, however, low SES is linked to malnutrition, exposure to harmful substances like lead, etc. (Lago-Peñas et al., 2021).

Consequently, studies reveal broad patterns in the behavioral risk factors for NCDs globally, revealing that low socioeconomic groups are more likely than high socioeconomic groups to use tobacco, drink alcohol, and eat insufficient amounts of fruits and vegetables (Allen et al., 2017). High socioeconomic classes typically consume more processed foods, fats, and salt, and are less active. Similarly, better housing, medical services, and nutritional status are frequently linked to higher SES. Higher education levels are also generally associated with improved overall health awareness and knowledge (Allen et al., 2017).

As a result, the mortality and morbidity brought on by NCDs appear to be significantly and consistently impacted by low SES. Health disparities in terms of care access, a higher incidence risk of NCDs, and early mortality are linked to social and economic disadvantages (Lago-Peñas et al., 2021). These data highlight the necessity of public health policies and studies to alleviate SES inequality.

5.4 Discrimination and Health Inequities

In healthcare, discrimination is defined as the lack of regard for or unfavorable treatment of a person or group because of a false, predetermined notion (Togioka et al., 2022). It is critical to keep in mind that bias can exist even when a person does not belong to the group that is being treated unfairly; using presumptive membership as a justification for

discrimination is possible. Furthermore, harm need not result from discrimination for it to exist. When one group is treated less favorably than another due to one or more of the following characteristics, discrimination has taken place (Togioka et al., 2022):

- race
- nationality
- sexual identity
- functional limitations
- level of income
- socioeconomic status
- gender identification
- native language
- place of residence

Macroaggressions and microaggressions are the two main types of discriminating behavior. The more overt and intense forms of racism known as macroaggressions have their origins in a system or a civilization, for example, being hostile towards a group of refugees and refusing to give them healthcare services (Togioka et al., 2022). The word "microaggression" refers to quick, innocuous insults or snubs that are hard to see, hardly noticeable, or convey the wrong message to anyone because they are a member of a minority group. Microaggressions may be unintentionally committed due to unconscious bias (Cruz et al., 2019). They may be hard to spot, simple to hide, and unintentionally conveyed through verbal or nonverbal communication, for example, underestimating the amount of pain a person of color is expressing since, historically, it was believed than people of color are more tolerant of pain. Microaggressions are frequently committed during one-on-one interactions, whereas macroaggressions are typically rooted in systems.

Discrimination occurs frequently and in a variety of ways in healthcare settings all over the world (Togioka et al., 2022). There are violations of basic human rights, which are protected by international accords, national laws, and constitution. Some of the most disadvantaged and stigmatized groups are targeted by discrimination in healthcare environments. Owing to past encounters with prejudice in the healthcare setting, people who are marginalized in society due to their gender, immigrant status, skin color, race, or religion may find it challenging to get healthcare (Togioka et al., 2022). Potential intervention targets that are ingrained in the healthcare experience itself as barriers to care should be considered by researchers and decision-makers.

Health Equity and Health Disparities

Equity and health inequities are at odds with one another (Braveman, 2014; Braveman et al., 2011). There has been significant advancement in reducing health disparities and raising health equity over the last three decades. Improving the health of those who are socially or economically disadvantaged, such as refugees and racial minorities, is necessary to move toward fairness. This must be done without compromising the ability of those in privileged groups (such as those with higher SES, university degrees, or other levels of education) to receive high-quality healthcare (Braveman, 2014).

Health equity

Access to high-quality healthcare products and services regardless of one's age, gender, ethnicity, race, degree of education, or financial status is known as health equity (WHO, 2008a). Healthcare inequities can occur in any country when one group of people in an economy has much worse health than another and has restricted access to care. It has been demonstrated that income differences are directly associated with health inequalities in both high- and low-income countries. According to studies, a person's health improves with a higher SES (Khullar & Chokshi, 2018).

This is related to the idea of SDH, which contends that elements like SES, educational attainment, place of residence, and employment, as well as one's physical and financial access to healthcare, influence one's health both directly and indirectly (Palmer et al., 2019). In addition, health equity is the idea that everyone has the capacity to achieve an optimal level of health. Working together with other sectors to address the factors that affect people's health while recognizing how discrimination based on race, religion, nationality, age, or gender is a factor contributing to health disparity is included in health equity (Pollack Porter et al., 2018). Systematic differences in access to opportunities for reaching optimal health, known as health inequities, have an unjust and avoidable disparity in health outcomes (Braveman, 2006). Racial identity, gender, employment and socioeconomic level, impairments and immigration status, geography, and other factors "structure" or organize unequal access to health chances. Health inequities may also be influenced by the following elements (Braveman, 2006):

- People from lower socioeconomic backgrounds are more susceptible to illness because of poor living circumstances, food instability, etc.: This can also lead to health disparities.
- There are inequalities in healthcare, when the best hospitals and medical technology may not be easily accessible in rural, low-income areas.
- Access to **health insurance** and/or other kinds of coverage is limited or nonexistent: Many members of the working class are unable to buy health insurance, and they are also ineligible for government health insurance programs, which are only available to the poorest. Additionally, health insurance firms around the world have increased deductibles, which have, in turn, increased patient medical costs.
- Disease can contribute to poverty: People who are ill are more likely to become poor since it is challenging for them to acquire and maintain well-paying employment. Additionally, addiction to substances like alcohol, illegal drugs, and painkillers may prevent someone from working consistently (Substance Abuse and Mental Health Services Administration, Office of the Surgeon General, 2016).
- Those who are older are more prone to sickness.

Health insurance
This covers all or a portion of the risk associated with a person needing medical care (Board on Health Care Services Staff, Institute of Medicine [US] Committee on the Consequences of Uninsurance, 2001). Similar to other types of insurance, risk is distributed across numerous people.

To achieve and maintain health equity, it is essential to remove or reduce obstacles including poverty, unemployment, and lack of access to education and healthcare (Braveman, 2006). Rigorous observations, surveys, and research, however, have demonstrated that many nations still have health inequities.

Health Disparities

Differences in the burden of illness, disability, aggression, or access to quality healthcare services and commodities that communities with low SES endure are known as health disparities. These variations are preventable. These tend to be caused by a variety of factors, including the following (Braveman, 2006):

- environmental dangers
- inadequate healthcare access
- behavioral and individual factors
- disparities in education
- poverty

Although racial and ethnic inequalities in health and healthcare are widely considered, these differences exist in a wide range of factors (Braveman, 2006). There are differences, for instance, in terms of wealth, age, area, dialect, gender, disability, nationality, and sexual orientation. Additionally, research shows that differences exist at every stage of life, from early childhood to middle age, and among seniors.

Though any country can be affected by global health disruptions, developing nations are more vulnerable because of their inadequate socioeconomic infrastructure (Birn et al., 2017). By looking at the interpersonal, social, economic, and environmental factors in the community, health professionals can promote wellness in a targeted way and limit the effects of diseases. The economy benefits as a result since fewer illnesses spread and productivity is unaffected (Birn et al., 2017). However, there have been challenges to policy-making using a global health focus. The COVID-19 pandemic highlighted these issues and challenges, including lack of preparedness against pandemics in most nations, as well as lack of communication between local and international health authorities (Zhang, 2021). Accordingly, working and addressing the SDH is crucial for improving health and reducing long-term health disparities.

Marginalized and Vulnerable Populations

Among vulnerable groups, or people who are more likely to have poor health and limited access to healthcare, there are substantial differences in average lifespan, access to and use of healthcare services, disease, and mortality (Wrigley & Dawson, 2016). Their complicated health needs are influenced by their socioeconomic and economic situations. Additionally, it's likely that people in this group have one or more physical and/or mental health problems.

Due to their economic, cultural, racial, or health features, vulnerable populations are more likely to have unequal healthcare access and outcomes. People with low income frequently have health problems that poor healthcare unwittingly makes worse. Groups and communities that experience social, political, and financial marginalization as a result of imbalance of power dynamics in the fields of economy, politics, community, and culture are known as vulnerable. The following are examples of vulnerable populations (Wrigley & Dawson, 2016):

- minority groups of all races and ethnicities
- refugees
- migrants
- those with special needs or impairments
- people who live with stigmatized conditions, such as HIV and AIDS
- members of sexual minorities (particularly the LGBTQ+ community)
- older adults (i.e., older than 65 years of age)
- children below the age of 18
- people from low socioeconomic backgrounds
- people with low levels of education

5.5 Social Capital, Social Cohesion, and Health

A collection of assets or shared values that enables people to successfully accomplish a task by working in a group is defined as social capital (Chuang et al., 2013). The ability to acquire resources like money, favors, or expertise thanks to personal ties is another facet of social capital.

Thanks to social capital, people have the capacity to cooperate well to accomplish a common purpose or objective. Through mutual respect, a common identity, norms, and values, it enables a community or institution, such as a company or non-profit organization, to work as a whole (Chuang et al., 2013). Social contacts are, put simply, how social capital has a positive influence on society as a whole. The social sciences, especially public health, are consequently permeated with the examination of how social capital works or does not work.

Research consistently shows important benefits of social capital, including happier and more fruitful career results for individuals who have higher levels of social capital. Additionally, it has been found that persons with close relationships report improved health and increased rates of community trust. The circle is completed when "healthy communities" frequently report greater levels of social capital (Ferlander, 2007). The existing research indicates the following (Chuang et al., 2013; Ferlander, 2007; Kawachi et al., 2008):

- Strong bonds between geographically distant family and community members could help buffer high-risk persons from the negative effects of isolation. This suggests that establishing a community, whether online or in person, may mitigate the detrimental effects of seclusion on one's mental health.
- Initiatives that aim to foster more empathy and solidarity between populations at high and low risk are given high importance in the field of public health. In a recent set of studies looking at the impact of compassion in physical separation and mask adherence, it was found that people are more motivated to follow these protective public health measures when empathy is awakened for individuals who are the most vulnerable to diseases.

- Strategies that consciously work to create bridge capital between groups at low and high risk may be successful tools when used to prevent certain public health issues (such as infectious diseases like chicken pox) by allowing members of the general population to recognize that their personal health decisions (such as vaccination) immediately affect the safety of those in their communities.
- The public's confidence in the reliability of public health responses may rise as a result of the widespread availability of reliable and transparent public health information, the adoption of public health policy conformance expectations within and between politicians, policy compliance between local agencies and departments, and policy compliance with reputable international health organizations.

Similarly, there are at least three pathways that could explain how social capital influences people's health in a good way (Rocco & Suhrcke, 2012).

Easier access to information on health-related topics

If a person interacts with people frequently (e.g., by keeping in touch with friends and family, attending gatherings and social events, and joining both formal and informal organizations), they are more likely to obtain information on how to treat or avoid diseases, the best therapies, and where the best hospital or the most knowledgeable doctor is. In the context of healthcare, where information asymmetries between patients and providers reflect a persistent market failure, better access to information is especially crucial.

Informal healthcare and support

Informal healthcare
This refers to unpaid help provided to elderly and dependent people by an individual to whom they have an interpersonal tie, such as a spouse, parent, child, other relative, colleague, friend, or other nonkin (Triantafillou et al., 2010).

Even in high-income countries, where access to official healthcare is widespread, there is still a sizeable demand for **informal healthcare** and support, housing services, and childcare in the event of a brief sickness. Sometimes, even financial assistance is required to replace sporadic out-of-pocket medical expenses. As a result, unofficial and covert processes appear as a replacement. This might come in the form of mutual aid between neighbors or friends, which would serve as risk-sharing mechanisms in addition to conventional health insurance. Given that the formal healthcare system is much less developed than in wealthy countries, these agreements are much more common in low-income countries. Since there is no legal contract guaranteeing commitments, reciprocal support and aid is only conceivable in the framework of reciprocal trust. Such types of cooperation are facilitated by repeated interactions; in low-income countries, repetition is further secured by the fact that families or kin groups – long-standing social organizations that stand above individuals – are the actual recipients of the reciprocal responsibilities. In contrast, duties in high-income countries are assumed by individuals (who may relocate frequently) and do not typically pass to the successors, making collaboration far more reliant on mutual confidence.

Political economic mechanism

Groups with more connections and organization are more successful at lobbying. Social capital may, on a more general level, help people organize their lobbying efforts to influence public officials to invest in public resources that support health, including parks, sports fields, traffic regulations, and medical infrastructure. As several communities within

a larger region can have different ideas about the best place for and price of these assets, the level of grouping cannot be too high. Additionally, these investments are effectively non-excludable public goods that will help both those who contributed to the lobbying efforts and those who did not. Therefore, rather than at the regional level, such cooperation is more likely to be accomplished at the village or borough level.

Social Cohesion and Health

Relationships are crucial for both mental and physical health and are conceptualized using words like social support; social networks; and social cohesiveness, which is the strength of ties and a shared sense of belonging among neighbors (Kawachi & Berkman, 2014). One indication of social coherence is the amount of social capital a society possesses. Shared group resources, like word-of-mouth knowledge about job openings, are important for social cohesion. People have access to social capital via their social networks, which seem to be webs of social ties. There are several forms of social help, including financial aid, physical support (such as a ride to a doctor's appointment) and emotional support (such as inspiration after a setback), which can even be found through social networks (Kawachi & Berkman, 2014).

Mutual trust also serves as the foundation for collective effectiveness, a social cohesiveness factor that shows a community's ability to adapt and exercise informal social control (i.e., shape conduct through social norms; Kawachi & Berkman, 2014). Greater access to resources that support health, such as healthcare, healthy food choices, and exercise facilities, as well as higher self-rated health, are all associated with collective efficacy (Kawachi & Berkman, 2014). As a result, social institutions like religion and family frequently contribute to social cohesiveness, as well as social capital, social control, social networks, and social support.

Positive effects on behavioral and psychological processes that influence health outcomes can be seen when social cohesiveness is high. For instance, social cohesion may help people maintain healthier diets and experience less emotional stress (Kawachi & Berkman, 2014). One of these pathways can have an impact on the biological functioning of the cardiovascular, neuroendocrine, and immune systems. Therefore, social cohesion can protect individuals from risk factors that could otherwise harm their health, both directly and indirectly. For instance, social cohesion was found to be a factor in lowering atherosclerosis levels in a study on the association between psychosocial factors and atherosclerosis (plaque in the arteries; Panza et al., 2019). For groups who are subjected to prejudice or exclusion, the protective character of social cohesion may be especially crucial. For example, first-generation immigrants discovered that social cohesion served as a buffer against the negative impacts of discrimination on their physical and mental health (Szaflarski & Bauldry, 2019).

Social connections can, however, spread unhealthy behaviors or increase stress, but social isolation is typically bad for health and raises mortality. Older people should be especially concerned about social isolation because friendship interaction declines with age (Stansfeld, 2008). For example, due to the COVID-19 pandemic, social isolation and loneliness are predicted to have a significant negative impact on older individuals' health outcomes. The literature also indicates that people in their 20s felt higher social isolation during

social distancing regulations than those aged 50 and older (Sepúlveda-Loyola et al., 2020). Elderly people in long-term care facilities or with illnesses like arthritis that make it difficult to go about everyday activities may experience loneliness and a lack of social support, which can have a negative effect on their health. Another example highlights that decreased neighborhood social cohesion and a higher chance of insomnia, which can have detrimental health impacts, were found to be associated with older persons (Chen-Edinboro et al., 2016). Similar to this, senior residents of low-social-cohesion neighborhoods may not receive social assistance from worried neighbors who will check on them during, for example, heat waves, and they have fewer safe communal spaces where they can seek sanctuary (Klinenberg, 2015).

Social interventions aimed to enhance health come in a wide variety due to the complexity of the interaction between social ties and health. To enhance community building and improve health, these interventions can take place at a variety of levels (e.g., household, community, neighborhood) and occasionally call for cross-sector cooperation (e.g., education, public health, housing). To fully comprehend how social cohesion influences health and how it might be leveraged to lessen health inequities, more research is required (Kawachi & Berkman, 2014). Thus, public health initiatives need to address social cohesion as an SDH.

SUMMARY

Health law focuses on rules, regulations, etc. among all parties involved in the provision of healthcare, as well as the laws, rules, initiatives, and decisions made that are referred to as health policies. As for public health ethics, there are six principles: beneficence, non-maleficence, justice, utility, respect for people, veracity (truthfulness), and fidelity (trust).

The shared beliefs, customs, and behavioral patterns of a particular group are referred to as its culture. These relate to a person's nationality, race, religion, etc. Culture has been shown to have a direct and indirect effect on both health and public health. A culture of health is one where everyone has the freedom to make decisions to support healthy lifestyles and in all facets of society, including sociodemographic and geographic. Individuals with lower socioeconomic levels frequently have less access to finance, educational, cultural, and medical resources than those in better socioeconomic positions, which has a direct impact on health.

In the context of healthcare, discrimination is described as the negative treatment of a person or group or a lack of regard for them due to preconceived notions. This can lead to health inequities and disparities. Discrimination can be based on race, nationality, gender, disability, etc. Examples of populations that are more likely to face discrimination include ethnical minority groups, refugees, the LGBTQ+ community, etc.

The term “social cohesion” refers to the strength of ties and a shared sense of community among neighbors. One indication of social coherence is the amount of social capital a society possesses. The more social capital and cohesion there is, the better public health likely is, and vice versa.

UNIT 6

BUILDING HEALTHY COMMUNITIES

STUDY GOALS

On completion of this unit, you will be able to...

- understand what community health is.
- differentiate between individual and community health.
- appraise environmental health and its importance.
- describe occupational health and safety.
- define nutrition, food safety, food security, and malnutrition.
- analyze the role of health communication, e-health, health literacy, and media.

6. BUILDING HEALTHY COMMUNITIES

Introduction

This unit will revolve around how to build healthy communities. As such, the first section will define community health and discuss its techniques, its importance, and the difference between community health and individual health. The second and third sections of the unit will talk about environmental health and occupation health safety and their relation to public health. The penultimate section will explain nutrition and define food safety, food security, and malnutrition. The unit will end with an exploration of how health communication, e-health, and social health can directly and indirectly, as well as positively and negatively, affect public health.

6.1 Community Health

Community health is a medical specialty that has the objective of improving the physical and mental well-being of the inhabitants of a specific geographic area (McKenzie et al., 2011). Programs to help locals maintain and improve their health, stop the transmission of infectious diseases, and get ready for natural disasters make up this important field of public health. Community health, in other words, refers to basic healthcare services delivered by laypersons outside of clinics and hospitals. Clinicians are taught about and engage in community health, which is a subset of public health. Community health volunteers and workers who work with primary care physicians promote community people's entry into, exit from, and usage of the formal health system. Individual well-being is intrinsically linked to community health. Community health services are categorized as follows (McKenzie et al., 2011):

- preventative healthcare, for example, services for cancer screening, diabetes hypertension treatment, and chemoprophylaxis for tuberculosis
- promoting health services like family planning, vaccinations, health education, and nutritional supplements
- curative healthcare services, such as treatment for lice, malaria, and pneumonia
- healthcare services for those who need **rehabilitation**, such as prosthetics, social work, occupational therapy, physical therapy, counseling, and other mental health treatments

Rehabilitation
This is the process of recuperation through various training after incarceration, addiction, or sickness (Cullen, 2013).

Specialists in community health ascertain how socioeconomic variables, such as income levels, nutritional preferences, crime rates, and accessibility to transportation resources, affect people (McKenzie et al., 2011). Additionally, they determine what improvements are required and how the community's healthcare and educational facilities affect the quality of life of its residents. The following are the crucial elements of community health (McKenzie et al., 2011):

- identifying the primary public health concerns in a given area, such as the environmental and social factors that affect choices about a healthy lifestyle
- developing an intervention strategy to address the community's resource shortages
- teaching locals about the benefits of preventative care and good lifestyles to assist them in improvements in their lives
- providing essential services
- reducing the necessity for costly hospitalization and urgent care
- lobbying with federal and state legislators for improved treatment for those who are at risk
- working with other local groups to tackle the social, cultural, physical, and psychological aspects of the community
- helping locals gain access to services like affordable dental, medical, and mental health care; insurance; interpreting; and transportation

As a result, a community health provider's goal is to offer comprehensive services that enable residents of the area to easily access resources, including medical, dental, drug, and psychiatric treatment (Dressler et al., 2018). Community health workers enable people to take charge of their own health by empowering them with knowledge about their options and access to care.

Community health initiatives are focused on identifying places with high levels of need and helping those groups remove barriers to living healthier lifestyles. Based on the American Public Health Association, inequalities in community members' average lifespans can be shortened by 20 to 30 years due to lack of access to nutrient-rich food, affordable healthcare, and mental health support (Woolf & Braveman, 2011).

Community health specialists establish close relationships with local residents, as well as social service and healthcare providers (Dressler et al., 2018). This makes it possible for them to finish crucial jobs like identifying local health concerns, advising locals on healthy habits, or setting up community health services to fill care shortages. For example, hospitals use community health management strategies to reduce readmissions or improve the treatment of chronic diseases (McKenzie et al., 2011).

Individual versus Community Health

Despite the fact that the terms "community health" and "individual health" are occasionally used synonymously, they are distinct concepts. Community health focuses on a population or group of people, unlike individual health, which focuses on one person. The choices a person makes regarding their behaviors, style of life, and risks they take are reflected in their level of health (McKenzie et al., 2011). Community health programs seek to contribute to the development of environments where people can live in good health.

There are three types of medical treatments that take place in communities: primary, secondary, and tertiary care. Every category has a distinct strategy for dealing with the community or people. Community health has its roots in advances in primary healthcare (McKenzie et al., 2011). Programs providing primary healthcare aim to minimize risk factors while promoting health promotion and prevention. In the context of secondary healthcare, "hospital care" refers to acute care that is provided in a hospital environment.

Tertiary healthcare refers to highly specialized care, usually for the treatment of a disease or physical impairment (McKenzie et al., 2011). Community health programs must have one-on-one or one-to-many interactions among health professionals and the general population to be successful (mass communication). Health promotion is the most recent trend.

Different Community Health Categories

There are many types of community health, which will be described and discussed in the following.

Primary prevention and primary healthcare

Primary prevention and a population-based approach are prioritized in community-based health promotion (traditional prevention; World Health Organization [WHO], n.d.-e). Community health aims to encourage residents of a particular community to adopt a healthier lifestyle or visit a physician. Health professionals with whom a patient first consults and who may refer patients to secondary or tertiary treatment are those who provide primary healthcare. Primary prevention is the early identification and avoidance of risk factors that might result in certain illnesses and impairments. Community-focused initiatives, like vaccines, classroom instruction, and awareness programs, are all excellent examples of how communities use primary preventive approaches to influence particular health habits. This conclusion also applies to all classes and groups of people. Prevention programs can effectively avert difficulties that children and young people confront as they grow up, provided they are thoughtfully conceived and written. One of the best strategies used by medical experts to greatly improve community, population, and individual health is prevention programs (WHO, n.d.-e).

Secondary healthcare and secondary prevention

The environmental, behavioral, and social cohesiveness factors in a community's environment all contribute to its health status (Aggarwal et al., 2017). Appropriate environmental changes can help to curb unhealthy habits and adverse health effects. The term "secondary prevention" describes changes made to a patient's environment or way of life after the beginning of a disease or impairment. Since it is too late to stop the patient from developing their current illness or handicap, this type of preventative care helps improve their quality of life. When people with lower back pain are given tips to keep their health from deteriorating, that is an example of secondary prevention; in some cases, secondary prevention may even offer more potential than primary prevention (Aggarwal et al., 2017).

Tertiary healthcare

Community health in tertiary healthcare can only be impacted by expert medical care that involves the entire population. Patients must receive sophisticated medical care and be sent to specialists. There are sometimes more medical subspecialists than primary care doctors in a given country. Economic advantage and social support are directly related to health disparities (Haroon & Thaver, 2022).

Health Promotion, Health Protection, and the Provision of Health Services

Health promotion, health protection, and the provision of health services and other resources are the three techniques used in community health practice.

Health promotion

Supports for individual, corporate, and community activity in health promotion include cultural, social, and environmental factors. To modify behavior (lifestyle, self-care, mutual help, engagement in community or political action), regulations or policies that affect health aim to mobilize neighborhood organizations, groups, or individuals (Sharma, 2021). The areas in which the sectors of health activity are located are where community health promotion occurs.

Recreation and fitness, as well as social and mental health, are where communities use health promotion tactics (Sharma, 2021). Despite the fact that both of these health issues appear to be problems of the individual, a health issue becomes a community health problem when it can be resolved by collaborative actions. A community assessment should identify the variables that affect the subpopulations' health and their needs before any action is taken to address these issues (Sharma, 2021). The three stages of preventive care can reveal the requirement in the case of social and mental health.

Health protection

Environmental safety and health are crucial to protecting the population's and community's health. To protect the population, community health professionals detect environmental dangers and problems. Controlling vectors, ensuring the safety of the air, water, and food supply; disposing of waste properly; and ensuring the security of living, working, and other surroundings are a few examples of protective measures (Sorensen et al., 1998). These safety precautions are frequently the product of educational initiatives, such as self-defense workshops; policy creation, such as limiting access to hazardous locations; and community planning, such as improving water purification systems or preparing for natural disasters (Sorensen et al., 1998).

Provision of health services

The third broad strategy in community and population health is the management and deployment of the resources and services required to design, carry out, and evaluate community health plans (Mchugh et al., 2010). Communities now are different from communities in the past in a number of ways. Communities are less independent and more reliant on people outside the group for support, despite the fact that members of the public are more well educated, mobile, and independent than in the past. Governmental, **quasi-governmental**, and non-governmental organizations (NGOs) are the three categories of organization that might help communities and populations (Mchugh et al., 2010). These groups can also be categorized according to the many levels (global, national, state/provincial, and local) at which they conduct business.

Quasi-governmental
These organizations combine the effectiveness of the public and private sectors. Investors believe they are investing funds in the government because these agencies are supported by the government (Mead & Warren, 2016).

Difficulties and Challenges in Community Health

Researchers may find it challenging to evaluate and pinpoint solutions because of the complexities of community health and its many issues. A distinctive option that integrates community involvement, investigation, and action is community-based participatory research (CBPR). CBPR assists researchers in approaching community issues from a wider perspective and collaborates with community members to identify valid, credible, and methodologies that are culturally sensitive (Collins et al., 2018).

Access to and the price of medical care are other problems. The vast majority of people around the world do not have enough health insurance. Less than 40 percent of all health expenses in low-income nations are covered by the public or the government (Collins et al., 2018). Since health sectors in poor nations are unable to connect the national authorities with local governments and community activity, community health is not promoted.

Concerns should also be raised about racial and ethnic differences in various populations' health situations. Interventions led by community coalitions may benefit this group of people (Collins et al., 2018). For example, a 2019 systematic study done in high-income countries, like the US and Canada, indicated that patients with poor English fluency who received care from doctors who communicated in the patient's own chosen language generally had better health outcomes (Saxena et al., 2022).

Population Health

An approach to health known as population health works to improve the well-being of the entire human population. It has been characterized as the clinical outcomes of a group of individuals. There are three parts, according to one description: health outcomes, trends of health determinants, and strategies and treatments (Kindig & Stoddart, 2003).

To achieve the goal of population health, it is imperative to reduce healthcare inequalities or inequities among diverse population groups induced, among other things, by the social determinants of health (SDH; Kindig & Stoddart, 2003). The physical, social, cultural, and environmental circumstances that different populations are born into, grow up in, and interact with during their lifespan are all included in the SDH and have the potential to discernibly affect the health of human populations. The concept of community health signals a departure from the individual-level emphasis that permeates the majority of mainstream health. A wider variety of issues that have been linked to affecting the health of various groups are being addressed in an effort to complement the traditional efforts of public health agencies (Kindig & Stoddart, 2003).

According to a report by the Commission on Social Determinants of Health of the World Health Organization, the majority of diseases and injuries are caused by SDH variables, which are also the main reasons for health disparities across all nations. SDH were believed to be responsible for 70 percent of preventable mortality in high-, middle-, and low-income countries (WHO, 2013). Consequently, health has been described from a population health viewpoint as the ability of individuals to adapt to, react to, or manage life's challenges and changes, rather than simply as a state free from sickness.

Population health is crucial because it allows for the identification of structural injustices by law and policymakers, resulting in increased efficiency and higher standards of treatment (Kindig & Stoddart, 2003). The distribution of health outcomes overall is streamlined and improved by splitting the population into groups with changing demands. Additionally, for communities to address these issues and eventually improve their health outcomes, population health specialists use statistics to understand how these factors affect health and health distribution. For example, moving toward **telehealth** and more integrated systems of digital treatment was sped up by the COVID-19 pandemic (Shen et al., 2021). Accordingly, it was possible to design clumsy procedures that would enable both in-person and remote healthcare, thanks to the implementation of new software systems. Population health can result in a more robust healthcare system when policies help more residents of a community achieve better health outcomes (Kindig & Stoddart, 2003).

Telehealth
This is the practice of providing long-distance healthcare, educating patients and healthcare professionals, promoting public health, and managing healthcare through the use of digital data and telecommunication technologies (Tuckson et al., 2017).

6.2 Environmental Health

Environmental health is a key component of any complete public health system. It is a sub-field or concentration of public health that deals with people and their relationship with the environment around them, as well as ways to promote safe and healthy communities (Moeller, 2011). The field strives to improve regulations and initiatives to reduce chemical and other exposure to substances in the air, water, earth, and food in order to safeguard individuals and develop healthy communities (Moeller, 2011).

Environmental epidemiology, toxicology, exposure science, environmental engineering, and environmental policy are the five fundamental disciplines that most commonly make contributions to the topic of environmental health. There is some overlap between them, but these five disciplines each offer a unique perspective on the issues and solutions related to environmental health (Moeller, 2011; Yassi et al., 2001):

Environmental Epidemiology

Generally speaking, this field of study examines how elements of the physical, biological, and chemical environment affect human health. Epidemiology in our environment also aims to clarify the relationships between environmental physical, biological, and chemical elements, and human health by concentrating on specific individuals or populations that have been exposed to varied ambient settings. It looks at the relationship between exposure to poisons, radiation, and other environmental irritants and how that affects human health. Environmental epidemiology typically makes use of **observational studies**, which document past exposures, as it is unethical to expose individuals to substances that are thought to be dangerous. Although this field does not support experimental study methods, environmental epidemiology directly assesses impact on human health rather than calculating effects through animal studies.

Observational studies
The impact of a risk factor, diagnostic procedure, treatment, or other intervention is observed by researchers without an attempt to alter who is or is not exposed to it (Rosenbaum, 2010).

Toxicology

This analyzes how particular environmental factors impact health outcomes. Toxicology offers the added benefit of the ability to perform experimental studies and randomized controlled trials.

Exposure Science

By detecting and quantifying exposures, this field investigates how frequently humans are exposed to environmental contaminants. By better defining environmental exposures that may result in specific health consequences and finding common exposure levels whose health effects may be better managed through a toxicology research, exposure science can be utilized to promote environmental epidemiology or for a risk analysis to evaluate whether current exposure levels may exceed advised levels. The advantage of exposure science is that it can measure chemical exposures extremely precisely; however, it does not come with any information on health outcomes like the aforementioned fields.

Environmental Engineering

This employs scientific and engineering principles to safeguard the environment from potentially negative impacts of human and natural activities, as well as improve overall environmental quality. It also protects human populations from adverse environmental repercussions.

Environmental Law

This is a body of regulations that addresses how human activity affects the environment. It is made up of a network of treaties, laws, ordinances, and common and customary rules.

Risks

Risk assessments for particular chemicals, chemical combinations, or other risk factors can be carried out using information from epidemiology, toxicology, and exposure research to establish whether an exposure poses a serious harm to human health; for example, exposure to certain chemicals can lead to **pollution**-related diseases (Moeller, 2011). From there, environmental health regulations that, for example, regulate chemical emissions or offer recommendations for good hygiene, can be established and put into effect. To minimize, monitor, and control the effects of exposure and meet the goals of environmental health policy, engineering and legal actions can be combined (Moeller, 2011). Examples of how the environment can affect health are as follows (Frumkin, 2016):

Pollution
This is the release of toxic substances called pollutants into the environment (Markham, 2019).

- Air pollution can lead to lung cancer, cardiovascular disease, and respiratory disorders.
- Unsafe drinking water can lead to gastrointestinal (diarrheal) disorders.
- Contaminated water used for recreation, such as swimming, can lead to gastrointestinal (diarrheal) disorders, as well as infections of the eyes, ears, nose, and throat.
- Ticks, mosquitoes, and other vectors can lead to diseases like malaria.
- Exposure to ultraviolet (UV) light can lead to cataracts and skin cancer.

- Crowded housing can lead to infectious diseases, namely lower respiratory infections.
- Changing weather and climate change can lead to heat strokes.
- Exposure to hazardous materials, such as asbestos and lead, can lead to dermatitis, burns, poisoning, breathing issues, and lung cancer.
- Exposure to high levels of noise can lead to hearing loss, heart issues, sleep issues, and psychophysiological issues.

Importance of Environmental Health

Healthy environments could prevent about a quarter of the global burden of disease. The COVID-19 pandemic, for instance, is another illustration of the fragility of the balance between individuals and the environment (WHO, n.d.-a). Clean air, a constant climate, sufficient water, sanitation and hygiene, the safe use of chemicals, radiation safety, healthy and safe jobs, sound agricultural techniques, wellness towns, built environments, and conserved nature are all prerequisites for optimal health.

Lowering environmental risks could prevent approximately 13.7 million deaths annually, or 24 percent of all deaths (Zarocostas, 2006). This shows that environmental causes are responsible for approximately one in four deaths worldwide. Therefore, the majority of illness and injury categories are affected by a variety of potential pathogens, exposure pathways, and undesirable environmental conditions. Non-communicable diseases (NCDs) include cancer, persistent respiratory diseases, and heart disease (the most frequent disease outcomes). Strokes, respiratory infections, and injuries are the next most common (Zarocostas, 2006). The following actions are being taken to advance the global goal for creating healthier ecosystems and populations (UN, 2008):

- assuming a leadership role in directing significant transitions, such as those in energy and transportation, and encouraging good governance in the areas of health and the environment
- directing research and tracking changes in health hazards and solution implementation
- providing related guidance on environmental medical services and occupational safety and health
- ensuring knowledge development and dissemination for effective norms and solutions based on evidence
- supporting capacity building and procedures for stepping up action in countries
- creating capacity for emergency response and preparedness in case of environment-related incidents

It is noteworthy that the burden of disease is significantly influenced by environmental variables, even in high-income countries. For example, in high-income countries in the Western Pacific, including New Zealand, Australia, Japan, and Singapore, environmental causes were responsible for 17 percent of all deaths (Coates et al., 2021).

Environmental Health Versus Environmental Science

Many people think that environmental health and environmental science are one and the same. However, while these two fields are highly interrelated and interconnected, they are different. Environmental health, which is a subset of public health, is entirely focused on

human health. It specifically examines elements of both the built and natural surroundings that have an impact on human health. Be aware that this covers subjects like occupational health, which you might not associate with the term “environmental” (Moeller, 2011). Environmental science is concerned with the effects that humans are having on the natural environment (Kriebel et al., 2001).

A simple way to distinguish them is simply by noting that environmental health is far more interdisciplinary than environmental science (Moeller, 2011). As such, in order to study the environment and find solutions to environmental issues, physical sciences, biological sciences, and geography are all included in the interdisciplinary academic discipline of environmental science. During the Enlightenment, environmental science developed from the disciplines of natural history and medicine. Today, it offers an interdisciplinary, integrated, quantitative method for the study of environmental systems (Kriebel et al., 2001).

6.3 Occupational Health and Safety

Occupational safety and health (OSH), often known as occupational health or safety in the occupation (i.e., in a workplace), is a multidisciplinary field that focuses on the welfare, health, and safety of people at work (Alli, 2008). Since they also refer to the goals of the field, these terms were initially used as an abbreviation for occupational safety and health programs, departments, etc. The goal of an occupational safety and health program is a safe and healthy work environment (Alli, 2008). OSH also safeguards all members of the public who may be affected by the workplace environment.

More than 2.78 million individuals worldwide lose their lives each year to workplace accidents or illnesses, or one every 15 seconds (International Labour Organization, 2022). An additional 374 million nonfatal occupational accidents occur each year. The yearly economic cost of occupational disease, injury, and mortality is estimated to be close to four percent of the worldwide GDP. High human costs result from this misfortune (International Labour Organization, 2022). In common-law jurisdictions, employers are bound by law (sometimes known as the duty of care) to take precautionary measures for the safety of their employees (Michaels & Barab, 2020). The specifics of this vary depending on the jurisdiction, but statute law may also impose broader requirements, introduce new specific obligations, and create government bodies with the power to oversee occupational safety issues. In summary, occupational health issues might arise at work or as a result of the type of employment you undertake. These issues may consist of the following (Alli, 2008):

- cuts, shattered bones, sprains and strains, and fractures
- missing limbs
- diseases involving repeated movements
- hearing issues brought on by loud exposure
- vision issues
- illness brought on by inhaling, touching, or ingesting dangerous substances
- illness brought on by radiation exposure
- exposure to pathogens in medical settings

Accordingly, the ultimate objective of occupational health is to avoid illnesses and accidents at work through a number of means, such as the following (Alli, 2008):

- promoting worker security through safer work procedures
- ensuring that workers are performing ergonomically sound activities and approaches
- looking for possibilities to improve workplace health and keeping an eye on it
- assisting workers who are enduring illness or absences due to illness
- giving those who experience stress at work or home ongoing mental health care

Employers can eliminate health hazards and remain compliant with changing requirements by taking a close look at their present environment with the aid of occupational health (Alli, 2008).

Workplace Risks

A wide range of workplace hazards (sometimes referred to as unsafe conditions) pose threats to people's health and safety at work, even while labor has numerous financial and other rewards (Mehrdad, 2020).

Physical risks

Many workers are affected by physical risks at work. Across the world, occupational hearing loss is the most frequent workplace injury (Abdalla et al., 2017). Falls are another typical source of occupational injuries and fatalities, particularly in the cleaning and maintenance of buildings, extraction, transportation, and healthcare industries. Machines can crush, burn, cut, shear, stab, or otherwise strike or injure employees if operated improperly because they have moving parts, sharp edges, hot surfaces, and other risks (Abdalla et al., 2017).

Biological risks or biohazards

Infectious microorganisms, like viruses, bacteria, and poisons, produced by organisms such as **anthrax** are examples of biological hazards (biohazards; Rim & Lim, 2014). Workers in a variety of industries are impacted by biohazards; influenza, for instance, has a widespread impact on workers. Outdoor workers, such as farmers, gardeners, and construction workers, risk contact with a variety of biohazards, including animal bites and stings, substances from toxic plants, and diseases like plague that are spread by animals (Rim & Lim, 2014). Workers in the medical field, including those in veterinary medicine, run the danger of contracting blood-borne infections and other infectious diseases, particularly newly emerging ones.

Anthrax
This is a fatal infectious disease that naturally occurs in soil and affects animals globally, both domestic and wild. People may contract anthrax if they come into contact with sick animals or polluted animal products (CDC, 2022e).

Chemical risks

Chemical risks can also arise at work. Hazardous chemicals can be put into a wide range of categories, such as immunological agents, skin-related agents, **carcinogens**, etc. (Montano, 2014). To reduce the danger of chemical risks, authorities set occupational exposure limits. Given that poisons can interact synergistically rather than just additively, research into the health impacts of chemical combinations is ongoing on a global scale. For

Carcinogens
A carcinogen is any substance that can lead to cancer. However, a material will not automatically cause cancer just because it has been classified as a carcinogen (National Cancer Institute, 2019).

instance, there is some proof that certain compounds are dangerous when combined with one or more other substances, even at low concentrations (Montano, 2014). Such effects may play a significant role in the development of cancer. Furthermore, some compounds (such as heavy metals, like mercury) can build up in the body over time. As a result, little-noticed everyday exposures might eventually add up to lethal levels.

Psychosocial risks

Psychosocial risks, such as job uncertainty, excessive hours, and an unsatisfactory work-life balance, are a danger to a worker's mental and emotional health. Based on data of average quality, job-directed therapies are found to lower the number of missed workdays compared to clinical therapy alone for depressed workers seeking therapeutic interventions (Franklin & Gkiouleka, 2021). Additionally, evidence shows that minimizing sick days can be accomplished by integrating cognitive behavioral therapy into primary or occupational care, as well as by integrating a structured communication and care management programs into standard treatment (Franklin & Gkiouleka, 2021).

Types of Occupational Health Services

Occupational health is intended to help employees treat any current health issues, as well as prevent health-related challenges in the job. This branch of medicine takes a proactive, preventive approach to handling problems at work and may offer a range of treatments, such as the following (International Labour Organization, 2014):

- on-site health clinics: Services might include employee tele-behavioral health services and access to outreach behavioral health professionals.
- tools for workplace health screening: This may be available in areas including behavioral health, addiction, and pain. It is also possible to evaluate potential employees for harmful and stressful professions.
- management of absences and disabilities: It is possible to offer fitness-for-duty assessments that contain a behavioral health component.
- digital mental health: Via self-guided cognitive behavioral programs, coaching, and brief counseling, digital technologies help prevention by fostering resilience and maintaining employees' mental health. Tools and coaching may be offered to promote the general wellness of the workforce.
- employee compensation: Individualized and overseen treatment programs are available for wounded workers who use opioids and are in pain. Additionally, centralized care management with doctors and psychologists might be offered.

Advantages Occupational Health

Employers suffer annual losses from occupational diseases and injuries of over $60 billion. The costs of injuries vary, but overexertion costs firms roughly $13.79 billion in direct expenses per year (International Labour Organization, 2003, 2014). Employees being hit by equipment costs businesses $4.43 billion yearly (International Labour Organization, 2003). Reducing workplace injuries and risk mitigation is one of the key advantages of putting a good occupational health program in place. The following are also advantages (Abdalla et al., 2017):

- decreased costs: Occupational health focuses on comprehending the different kinds of injuries that workers sustain and places a strong emphasis on assisting them in recovering and returning to work. This aids workers in receiving the precise care they require to manage injuries and helps businesses lower overall costs.
- employee compensation: Programs for occupational health are well aware of the worker's compensation complaint process and the value of open communication with all parties involved.
- safety: This kind of program can help in the development of preventative measures to make the workplace safer. To ensure that workers are operating heavy machinery or running vehicles safely, for instance, businesses may demand pre-employment drug testing. Additionally, a company could demand physical exams and other medical examinations.
- prevention: Prevention is one of occupational medicine's main objectives. Prevention programs are intended to reduce the risk of occupational health problems and stop workers from getting sick or hurt at work. These might include wellness programs, a health evaluation, and digital mental health resources.

Public Health and Occupational Health and Safety

Public health and OHS are interrelated. OHS is the branch of public health that studies trends in illnesses and accidents among the working population and suggests and puts into practice rules and regulations to prevent them (Quinn, 2003). Its scope is wide, encompassing fields as diverse as ergonomics and abuse prevention to toxicology and epidemiology. The following objectives are shared by occupational health practice and public health (Quinn, 2003):

- improvements in health, including surveillance; monitoring of certain diseases; risk factors; and lifestyle choices, like smoking and drinking
- protection of health, such as avoiding environmental dangers
- healthcare services, including service planning, equity, auditing, and evaluation

One of the main concerns of the late 19th-century social reform effort to enhance public health was worker welfare. Today, this concern persists. Globally, few state health agencies today have effective occupational health programs, and most of these are in high-income countries (Quinn, 2003). However, to meet the occupational health needs of disadvantaged groups of employees – such as workers in mines, manual labor, construction, etc. – state departments of public health and, in some cases, NGOs like the **International Labour Organization** may play a particularly significant role.

International Labour Organization
This is a branch of the United Nations dedicated to promoting social justice and broadly accepted labor and human rights (Standing, 2008).

6.4 Nutrition, Food, and Food Safety

The maintenance of a healthy body weight; prevention of chronic diseases; and support of healthy development, growth, and aging are all benefits of a nutritious diet that improve overall health and well-being (Whitney & Rolfes, 2015). Not only that, but food that is unsafe or contaminated can lead to diseases and even death.

The study of nutrition is first concerned with how food and drink affect human bodies, especially in relation to the essential nutrients needed to maintain human health (Whitney & Rolfes, 2015). It explores the biological and biochemical procedures involved in nutrient absorption in addition to how nutrients in food generate energy or are converted into human tissue. The body gets its energy from these nutrients, which include water, minerals, proteins, fats, fiber, vitamins, and carbohydrates (Whitney & Rolfes, 2015). Good nutrition consists of consuming the right amounts of nutrients from nourishing meals in the right ratios. The study of nutrition focuses on the effects of diet on the development of chronic disease and diseases that can result from malnutrition. Knowing why individuals choose the foods they choose, despite the knowledge that they might not be healthy, as well as understanding how cellular processes influence what people crave and result in unhealthy or dangerous food cycles, are also part of nutrition. The study of nutrition emphasizes the examination of diseases that might result from malnutrition, as well as the role that food plays in the onset of chronic disease. Below, this concept will be thoroughly examined.

Food Safety

To support life and advance good health, access to enough safe and adequate food is essential. Hazardous microorganisms (like bacteria or virus) or chemicals in unwholesome food can cause over 200 ailments, from cancer to diarrhea. Due to this, malnutrition and sickness can get out of control, particularly harming the old, the ill, young children, and infants (Fung et al., 2018). To achieve food safety and improved food systems, governments, suppliers, and consumers must properly collaborate.

Foodborne illnesses are therefore often caused by bacteria, viruses, parasites, or chemicals, which get into the body through contaminated food. These illnesses might be contagious or toxic in nature (WHO, n.d.-b). Chemical contamination can lead to acute poisoning or chronic diseases, like cancer. There is a chance that many foodborne infections will result in death or lifelong disability. For example, people might become infected with **cholera** through tainted food or water. Possible symptoms include nausea, vomiting, and watery diarrhea. Severe dehydration and sometimes even death may result from these situations. A number of foods, including seafood, vegetables, rice, and wheat gruel, have been associated with cholera outbreaks. Some viruses can also spread through food consumption. For example, the hepatitis A virus, which can cause chronic liver illness, typically spreads through infected raw foods or raw seafood. However, due to underreporting and the difficulty in establishing links between food contamination and the subsequent illness or death, the burden of foodborne diseases on public health and economies has frequently been underestimated (WHO, n.d.-b).

Cholera
In areas where there is insufficient water filtration, cleanliness, and sanitation, cholera is more likely to occur and spread (WHO, n.d.-b).

At the international and sub-regional levels, a World Health Organization (WHO) report on the global disease burden of foodborne diseases presented disease burden produced by 31 foodborne agents (viruses or bacteria, toxins, and chemicals), highlighting the likelihood of more than 600 million cases of foodborne diseases 420,000 fatalities annually. Children younger than five are the group with highest prevalence of foodborne diseases, which are most prevalent in low- and middle-income countries (WHO, n.d.-b).

Per the World Bank, the annual cost of care of foodborne illnesses is estimated to be $15 billion, and it is estimated that in low- and middle-income countries, foodborne illnesses result in an annual productivity loss of $95.2 billion (The World Bank, 2018).

Reliable and safe food supply supports sustainable development, international trade, and tourism. Because of urbanization and shifts in consumer behavior, more individuals are now purchasing and consuming meals prepared in public settings (WHO, n.d.-b). Globalization, alongside growing customer demand for a wider variety of foods, has resulted in a longer, more complex global food chain. Food safety is anticipated to be impacted by climate change because it will likely disrupt crops, farming, and other agricultural practices (WHO, n.d.-b). Governments and public health organizations should therefore place a high priority on food safety since it is crucial for developing legal and policy frameworks, establishing and executing effective food safety standards, and ensuring public health.

Food Security

Food security can be achieved when all people, at all times, have physical, interpersonal, and economic access to enough food for their dietary needs and preferences for a "healthy lifestyle" (Committee on World Food Security, 2006).

Environmental factors, like climate change, population growth, and growing food prices, will all have substantial but unknown consequences for food security in future decades. The need for adaption strategies and legislative changes that manage options for controlling water supply, land use patterns, food trade, post-harvest food processing, food costs, and food safety is urgent. The four primary aspects of food security are as follows (The World Bank, 2022):

1. A sufficient quantity of food at the local or global level does not always ensure food security at the household level.
2. The "supply side" of food security is related to food availability, which is also influenced by net trade, stock levels, and levels of food production. Because of worries about inadequate food access, governments place a higher focus on incomes, spending, markets, and pricing in order to achieve food security goals.
3. Food utilization refers to how the body makes use of nutrients found in food. With proper food preparation, a diverse diet, and intra-household food distribution, those who receive enough care and food will eat enough energy and nutrients. When combined with strong biological uptake of the food they eat, this describes a person's nutritional status.
4. The long-term stability of the other three aforementioned criteria is important. Even if you consume an appropriate amount of food now, you are still considered to have food insecurity if you sometimes lack access to enough food to jeopardize your nutritional status. Bad weather may affect your level of food security. Other influential factors include uncertain political conditions or economic issues (like increased food prices and unemployment).

These four dimensions should all be met for the goals of food security to be achieved (The World Bank, 2022).

Famine
This is a time of extreme and prolonged hunger that affects a sizable portion of the population in a region, resulting in considerable and extreme malnutrition in addition to death from starvation and sickness (Food and Agriculture Organization, n.d.).

Food insecurity is the primary cause of both **famine** and hunger (Food and Agriculture Organization, n.d.). Data indicate that a person's well-being suffers when they are exposed to food insecurity. These outcomes include nutritional status, mental health, and infectious and chronic diseases – particularly diabetes and HIV/AIDS. In particular, sociocultural implications must be considered because they have an impact on child development, sickness, and a person's nutritional status. Social and ecological issues must also be considered. The ability of households to cope depends on contextual factors, such as the place in which a person chooses to live, such as a rural, urban, or marginal area. Infectious and chronic diseases, nutritional status, and mental health are all impacted by how households respond to food insecurity. To offset the detrimental effects that food insecurity can have on a person's well-being, households must come up with a strong coping mechanism. Families who lack access to food typically employ more coping mechanisms than families who lack access to water (Food and Agriculture Organization, n.d.). Despite the existence of a pattern of common coping mechanisms, it is crucial to consider contextual elements, such as the social and geographic milieu.

For example, the Russian-Ukrainian war has hampered international food supplies, which were already severely hampered by the COVID-19 pandemic and the escalating effects of climate change (Jagtap et al., 2022). With notable effects on production, procurement, manufacturing, packaging, logistics, and substantial swings in demand between countries dependent on imports from Ukraine, the conflict has had a considerable influence on food supply chains (Jagtap et al., 2022). With roughly 1.1 billion people lacking a nutritious diet due to poverty and rising food prices, many countries in Asia rely on imports of basic food staples like wheat and fertilizer (Jagtap et al., 2022). As a result, many countries have been collaborating to develop short- and long-term initiatives, as well as combat climate change and the loss of biodiversity in order to increase agriculture and food supplies and avoid food supply crises in the future.

Malnutrition

When someone is malnourished, their intake of calories and/or nutrients may be insufficient, excessive, or out of balance. The word "malnutrition" refers to three main groups of ailments (WHO, 2021b):

1. Under-nutrition includes stunted growth (shorter height than normal for age), being underweight (lower weight than normal for age), and wasting.
2. Micronutrient-related malnutrition involves excess or lack of particular vitamins and minerals.
3. Overweight, obesity, and NCDs connected to diet (such as diabetes and heart diseases) are the third group.

Malnutrition affects every country in the world in some form (WHO, 2021b). One of the biggest problems in world health is the struggle against malnutrition in all of its forms. For expectant mothers, new mothers, children, and teenagers, malnutrition is particularly risky (WHO, 2021b). Early nutrition optimization helps children for a lifetime, including the 1,000 days between conception and their second year of age. It also gives them the best start in life.

Malnutrition risks and hazards are exacerbated by poverty (WHO, 2021b). People who live in poverty are more likely to experience different types of malnutrition. Additionally, inadequate nutrition reduces productivity, inhibits economic growth, and boosts healthcare costs, which can fuel a vicious cycle. Additionally, poor nutrition and unhealthy diets are among the main risk factors for chronic and infectious illnesses worldwide. Accordingly, 462 million persons worldwide are underweight, compared to 1.9 billion who are overweight or obese, according to data on the prevalence of malnutrition (WHO, 2021b). It was predicted that, in 2020, there would be 149 million stunted (too small for their age), 45 million wasting (too small for their size), and 38.9 million overweight or obese children younger than the age of five (WHO, 2021b).

6.5 Health Communication, E-Health, and Social Media

One of the ways that public health spreads awareness, health messages, etc. is through health communication via mainstream and social media.

Health Communication

The goal of spreading health information is to impact individual health decisions by enhancing health literacy (Schiavo, 2013). The study and practice of distributing health-promoting information includes public health campaigns, educational initiatives, and doctor-patient interactions. Healthcare workers can use communication techniques to inform and influence the public's decisions and actions to enhance health (Schiavo, 2013). Health communication is a specialized field within healthcare.

Research on health communication aims to develop communication techniques to inform people about how to improve their health or prevent certain health dangers because successful health communication must be adapted for the audience andsetting (Schiavo, 2013). Academically, the field of communication studies includes a discipline called health communication. Various health communications may aim to do the following (Schiavo, 2013):

- raise awareness of a health issue
- alter how people behave and think about a health issue
- show wholesome habits
- show how changing one's behavior has a positive impact on public health outcomes
- promote a stance on a health concern or policy
- raise the level of support or demand for healthcare
- dispel misunderstandings regarding health
- enhancing communication between patients and providers
- increase the efficiency of healthcare teams

Health communication can include oral and written techniques for influencing and empowering communities, individuals, and groups to make healthier decisions. Health communication often involves a combination of various theories and models when aiming to promote positive attitudes and behaviors (Malikhao, 2020). Social marketing is related to health communication; it involves developing projects and programs aimed at changing behavior. Efficient social marketing and health communication strategies include the following (Malikhao, 2020):

- understanding common wisdom, beliefs, languages, and objectives across a wide range of environments and civilizations
- considering the health literacy, internet access, press coverage, and cultural competence of the target communities
- creating content for a number of media platforms, such as pamphlets, television, social media, etc.

Health messages can use a range of communication channels to influence campaigns at the individual, small-group, or community levels. The following are some health communication initiatives that aim to alter people's perceptions, beliefs, and/or behaviors (Malikhao, 2020):

- raising people's awareness of danger
- promoting moral behavior
- changing societal norms
- expanding access to help and vital services
- motivating people to make modifications or improvements to their health

The following elements are examples of media tactics to transmit health messages (Schiavo, 2013):

- radio
- television
- newspaper
- flyers
- brochures
- internet
- social media (i.e., Twitter, Facebook, Instagram, TikTok, and YouTube)

According to public health professionals, health communication is crucial for public health programs that concentrate on illness prevention, health promotion, and quality of life (Schiavo, 2013). It has the potential to significantly advance and improve societal, local, and individual health. Health communication intervention examples include the following:

- Tobacco smoking cessation efforts commonly employ health communication to target a larger audience through health communication campaigns with a broad reach.
- HIV/AIDS communication and social marketing strategies are connected to HIV prevention and treatment.
- Diabetes prevention campaigns use a variety of media to inform communities about pre-diabetes screening and diabetes prevention

The intervention's overall communication aims should be considered when developing health communication or social marketing strategies. Understanding the target demography is essential for ensuring that the material offered is important to the targeted audience. It is crucial to customize messaging for the chosen communication channel. Using various media and communication techniques will also increase your reach. Verifying that the intended audience can access the used communication channels is essential (Schiavo, 2013).

Health advocacy

Health advocacy works to ensure that people have access to healthcare, advocates for sensible healthcare policies and initiatives, and creates strategies for making the healthcare system simpler to use (Stange, 2010). Finding suitable doctors can be a challenge for both individuals and communities. They may lack the knowledge necessary to verify the veracity of medical bills. Health advocacy strives to develop initiatives and resources that can address these problems (Stange, 2010).

Through community-wide initiatives, health advocacy works to address the determinants of health, which are a confluence of social, physical, and environmental elements that affect people's health. A community action plan to address the obstacles preventing African American women from receiving cervical cancer screenings could be one of these, as could a health campaign to reduce binge drinking in university settings (Stange, 2010).

Risk communication

Delivering information regarding the dangers of particular behavior, like skipping vaccinations, is known as risk communication. It entails interacting with audiences to educate them about important health concerns that pose health risks and to answer inquiries from audiences (Bouder, 2015). How health communication specialists construct their communications will depend on how people view a particular health concern. People might, for instance, disregard risky circumstances. In these situations, the communication must arouse more concern. A low-risk circumstance could cause an excessive amount of anxiety (Bouder, 2015). In these situations, communication must focus on managing anxiety levels.

Health Literacy

Understanding basic health concepts is referred to as health literacy. Patients are able to make knowledgeable decisions regarding their health thanks to this. Low levels of knowledge about health are more common in older people and underrepresented groups of the

population. Everyone should have a basic understanding of health issues because they will need to be able to easily find, understand, and use health services at some point in their lives (Andrus & Roth, 2002).

The complex phenomenon known as health literacy involves people, families, communities, and institutions (Andrus & Roth, 2002). The concept of health literacy considers the particular tools, environments, and challenges related to disease prevention and wellness promotion. The capacity to read, comprehend, and analyze information; decipher directions, signs, graphs, and diagrams; weigh risks and rewards; and ultimately make decisions and act are just a few of the many skills that make up health literacy (Andrus & Roth, 2002). A patient's personal health, as well as the public's health, could be harmed by a lack of health literacy (Silva & Santos, 2021). The COVID-19 pandemic has provided a stark example of how crucial these abilities are.

One problem that health communication aims to solve is the gap that has grown between health literacy and its utilization (Ishikawa & Kiuchi, 2010). Health literacy among patients has been hampered by many issues, including the use of cryptic medical language, poorly written messages, and a general educational gap, even though the goal of health communication is to successfully lead to health literacy. Studies that have been conducted specifically among older adults (older than 65) highlight a common audience that is adversely affected by this problem. However, research has revealed that this population finds it challenging to understand written health materials, healthcare coverage, and legislation, and do not understand much medical terminology. Older adults typically have the most chronic health conditions (Ishikawa & Kiuchi, 2010). These communication problems in healthcare may, therefore, result in more hospital admissions, a failure to recognize and treat an illness or medical condition, and a general deterioration in health status.

Professionals in health communication have suggested initiatives to enhance physician-patient communication in order to address these issues. One suggestion is to enhance the education of medical students by including presentations, workshops, and supervised patient encounters to teach communication and interpersonal skills as a core competency (Ishikawa & Kiuchi, 2010). Additionally, it is advised that practicing doctors take part in webinars and in-person specialized training programs to improve their communication abilities. Physicians can lessen the issue of patient healthcare illiteracy and help patients adhere to medical advice more closely if they can enhance their communication abilities.

Some populations now have easier access to health information thanks to websites like WebMD and online support groups like Association for Cancer Online Resources (LaCoursiere et al., 2005). The importance of language in communication, particularly in terms of the language that patients prefer their doctors to use when speaking with them, is another factor. Patients have better health outcomes when they see doctors who speak their native language, according to studies (Molina & Kasper, 2019).

E-Health

The provision of healthcare services through the use of information and communication technologies is known as "e-health" (the "e" in e-health stands for electronic; da Fonseca et al., 2021). E-health is used to characterize the delivery of care when a healthcare pro-

vider and a patient interact via technology rather than face-to-face. For instance, e-health incorporates **telemedicine**, remote vital sign monitoring, and other healthcare services. E-health is utilized for health education, health awareness, and health surveillance, in addition to the delivery of healthcare services (da Fonseca et al., 2021).

Telemedicine
The internet, electronic information, and technology are used to deliver health remotely (Craig & Petterson, 2005).

Today's healthcare providers rely heavily on technology to help them with extremely challenging tasks related to the delivery of health services and goods. These tools are used to improve patient outcomes, cut expenses, and increase output (Sheikh et al., 2021). E-health can also facilitate decision-making; enable automated pharmaceutical prescription, dispensing, and administration; make it simpler to store organized patient data; automate supply chain management; and provide tools for evaluating the efficacy and safety based on previously prescribed medications (Kampmeijer et al., 2016; Sheikh et al., 2021).

The Effects of Social Media on Health

The media has the ability to influence how people feel about their health (Institute of Medicine [US] Committee on Assuring the Health of the Public in the 21st Century, 2003). Our opinions, attitudes, and perceptions of social norms can all be impacted by the volume and nature of information we get from the media. It is also possible that the media has an unintended impact on beliefs.

Given these implications, it is critical to understand the messages that both mainstream media (such as TV, radio, and newspapers) and **social media** (such as Facebook, Twitter, TikTok, and Instagram) are conveying regarding certain health issues (Montag & Hegelich, 2020). How are people who have a certain ailment portrayed in the media? How are professionals in relevant medical systems and health services portrayed in the media? Is the representation more positive or negative than shown by scientific research? Is a certain ailment shown in the media as more or less prevalent than it actually is? Are the types and intensity of sickness shown comparable to those observed in reality? What effects do these media messages have on our cognition, emotions, bodies, and attitudes?

Social media
These are websites and applications that place a strong emphasis on collaboration, content sharing, interaction, and crowd sourced input (Greenwood et al., 2016). People communicate and interact with their loved ones and other communities using social media.

The health of both individuals and populations can be significantly impacted by the media, especially social media. Furthermore, social media exposure, particularly among young people, may have a positive or negative impact on sexual behavior, dietary patterns, and substance use (Bozzola et al., 2022).

Positive effect

Social media may be used in healthcare and public health in a variety of beneficial and positive ways, such as to spread correct health information and raise awareness. Social media may provide people with access to a platform that transcends time and place restrictions, enabling them to interact and reconnect with others, as well as deepen and widen their interpersonal networks and interaction (Ventola, 2014). This, in turn, will improve their social and overall health. Additionally, social media for healthcare has several advantages, including the following (Schiavo, 2013; Venegas-Vera et al., 2020; Ventola, 2014; Wang et al., 2019):

- increasing societal awareness for health-related issues, such as smoking
- fighting false information, such as that related to safety of vaccines, like the COVID-19 and **measles, mumps, and rubella (MMR) vaccines**
- communication in an emergency, such as a disease outbreak
- increasing the reach of current resources and recruiting initiatives for healthcare providers
- addressing typical inquiries, such as health-related questions
- increasing commitment to health-related causes, such as fighting breast and prostate cancer
- assisting medical services to prioritize serious cases
- increasing accountability

Measles, mumps, and rubella (MMR) vaccines This offers defense against measles, mumps, and rubella. With a minimum of four weeks passing between each treatment, children normally take the first dose between the ages of nine and fifteen months and the second dose between the age of fifteen months and six years (Geier et al., 2019).

Consequently, due to issues with traditional internet connectivity, smartphone use has surpassed computer use in low- and middle-income countries (Roessler, 2018). According to reports, there are more than four billion mobile phone subscribers worldwide, with two-thirds of them living in low- and middle-income countries, with Africa experiencing the fastest growth (Roessler, 2018). This means that people in developing regions of the world frequently have access to social media at a similar level to those in industrialized countries and have greater reasons to utilize it (e.g., to overcome geographic isolation).

People can share information on social media about symptoms, therapies, and healthy living topics, as well as moral support for other people who are going through treatment or afflicted with a certain condition (Srivastava et al., 2018). When people share their experiences with others in similar situations and feel accountable to other forum participants, it has been found that people who desire to lose weight, stop smoking, or abstain from other substances adhere to their health regimens more faithfully. Additionally, a sizable number of people have utilized social media platforms to back causes linked to health, whether by joining petitions against harmful pharmaceuticals or giving money for research or the care of someone in need (Chen & Wang, 2021). From the perspective of a healthcare provider, sharing information online can save a doctor's time because there are numerous situations in which consumers only need certain information and don't need to see a doctor in person (Chen & Wang, 2021).

Furthermore, the dissemination of all this information has had the positive effect of increasing the amount of health-related data that researchers have access to, including patient experiences, medication responses, and more qualitative lifestyle data than are frequently available through conventional healthcare consultations (Bujnowska-Fedak & Węgierek, 2020).

Negative effect

Little research has been done to determine whether utilizing social media might have good or adverse long-term implications because of its recent technological development, but multiple studies have discovered a clear association between using social media regularly and a higher likelihood of depressive symptoms, anxiety, alienation, self-harm, and even suicidal ideation (Karim et al., 2020).

Another negative aspect of social media is that more inaccurate and deceptive health information has been spread in recent years. For instance, false information during the COVID-19 pandemic led to the use of untested treatments, mitigation measures being ignored, and elevated levels of vaccine hesitancy (Mheidly & Fares, 2020). In addition, researchers discovered that posts on social media about marijuana, painkillers, and smoking frequently contained medically incorrect information. Incorrect medical information about vaccines, notably the HPV vaccine, was also frequently posted on social media (Vanderpool et al., 2020).

Participants in the study who used social media frequently had higher levels of C-reactive protein (CRP), a physiological indicator of chronic inflammation, which predicts chronic conditions like diabetes, a number of cancers, and heart disease. This is similar to how use of social media also has an impact on mental health (Lee & Way, 2021). According to the findings, more frequent trips to doctors and medical facilities for illness treatment, as well as higher CRP levels, were linked to increased social media use. These somatic complaints included headaches, chest discomfort, and back pain. Moreover, using social media can result in lower amounts of physical activity. This is because users of social media frequently sit still when using social media, which can also contribute to eating disorders. For instance, someone might crave the same meal more often if they see someone post a picture of what looks like a delectable dinner (Lee & Way, 2021). More negative effects of social media on physical and mental health include the following (Rook, 2015; Siddiqui & Singh, 2016):

- comparing ourselves to other people: Regularly perusing other people's "highlights" online causes us to subconsciously judge our own situation as better or worse, which is linked to jealousy and more severe depression symptoms.
- sedentary lifestyle: It is not surprising that spending a lot of time looking at your phone or sitting at a computer can lead to a sedentary life, which can be bad for your overall physical health.
- increased sadness: Because of feelings of social isolation, Facebook has been related to lower overall life satisfaction. It has also been proven that spending more time on social media sites like Facebook and Instagram makes these emotions stronger.
- addictive: According to studies, those who use social media frequently may develop addictive habits and exhibit psychological withdrawal symptoms whenever deprived of access to the platform.
- cyberbullying: According to a study, 52 percent of social media users reported having encountered it, with Facebook accounting for 84 percent of the abuse (Cassidy et al., 2014).

SUMMARY

Community health focuses on the physical and mental well-being of the inhabitants of a specific geographic area. It deals with a population or group of people, whereas individual health focuses on the individual. The three categories of community health are primary, secondary, and tertiary. Community health employs three methods: health promotion, health protection, and provision of health services.

Public health's division of environmental health focuses on promoting healthy and safe communities and the interplay of people with their environment. It is a vital component of any comprehensive public health system. The five fields that frequently contribute to it are environmental epidemiology, toxicology, exposure science, environmental engineering, and environmental policy.

Occupational health and safety is a multidisciplinary field that focuses on the welfare, safety, and health of people in a workplace. Its goal is to assist employees in treating any present health issues and foresee any health-related difficulties at work. A variety of workplace hazards are threats to people's health and safety at work, including physical, biohazards, chemical, and psychosocial hazards.

With regards to the essential nutrients needed to promote human health, the study of nutrition focuses on how food and drink affect health. Therefore, it is essential to have adequate food available that is both safe and sufficient to sustain life and encourage good health. Over 200 diseases are brought on by contaminated food that contains dangerous ingredients.

Health communication via traditional and social media is one way that public health disseminates awareness, health messages, etc. using public health campaigns, educational initiatives, etc. By improving health literacy (ability to comprehend fundamental health ideas), the purpose of disseminating health information is to influence personal health decisions. This can be done via social media, which both has positive and negative impacts on health.

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