

Technological Advancements and Limitations – Disease

We live in a world fraught with risk from new pandemics. Fortunately, we also now live in an era with the tools to build a global immune system.

—Nathan Wolfe, virologist (born 1970)

Essential Question: How have environmental factors affected human populations since 1900?

As virus specialist Nathan Wolfe pointed out, progress in science and medicine, combined with government-run public health measures, drastically reduced illnesses and deaths from many diseases after 1900. These included **pandemics**, epidemic diseases that spread across national borders. The disease **smallpox**, for example, had plagued the ancient Egyptians and devastated the native population of the Americas and Australia. As recently as the 1960s, it killed millions of people each year. However, the World Health Organization (WHO) conducted a global vaccination campaign to wipe out the disease. In 1979, scientists declared success. Smallpox had been eliminated from the planet, except for the culture kept alive at the Centers for Disease Control in the United States.

Other diseases persisted, especially those related to poverty, including malaria, tuberculosis, and cholera. New epidemics also emerged, such as deadly strains of flu, HIV/AIDS, and Ebola. Other conditions, such as heart disease and Alzheimers, became more common as people began living longer. Each medical problem spurred even more technological and medical advances to try to combat it.

Disease and Poverty

Even when cures exist, some diseases persist because the conditions of poverty are contributing factors. Poor housing or working conditions, contaminated water, and lack of access to health care are commonplace among populations with low incomes, and they all contribute to the spread of disease.

Malaria A parasitic disease spread by mosquitoes in tropical areas, **malaria** killed more than 600,000 people each year in the early 21st century. Most of these were young African children. The international non-governmental

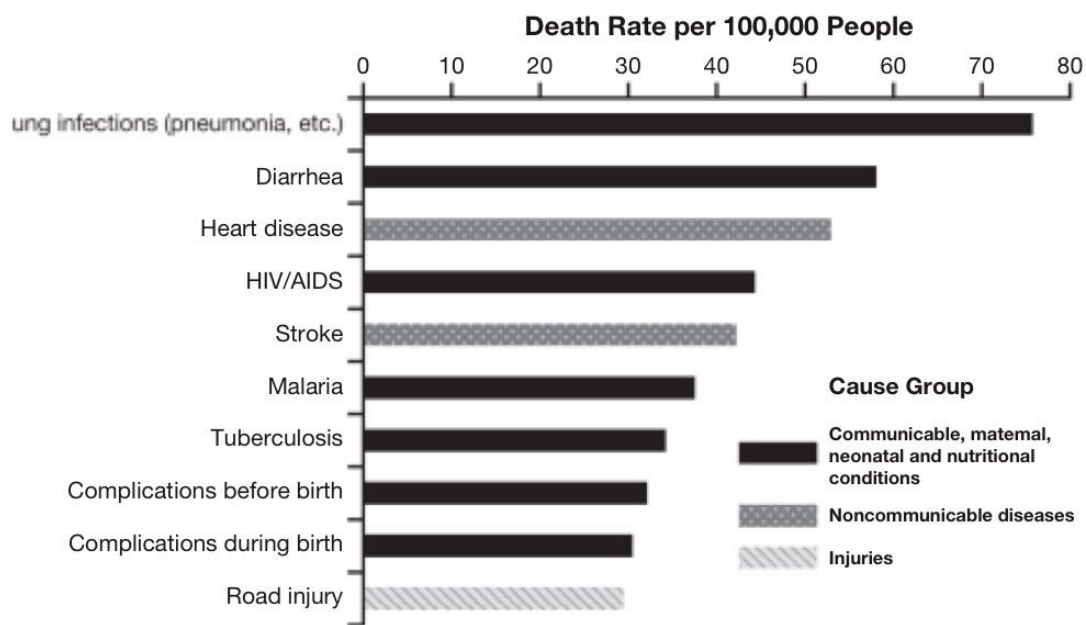


organization (NGO) **Doctors Without Borders** treated about 1.7 million people annually. Experts developed preventive approaches, such as distributing mosquito nets treated with insecticide as cover during sleep. However, people can still become infected during waking hours. A vaccine for malaria has been in development for many years, but one that is effective in most cases is still in trials. Nonetheless, progress has been made. In 2019, the World Health Organization certified Algeria and Argentina as malaria-free. The organization cautioned, however, that some types of mosquitoes were becoming resistant to insecticides.

Tuberculosis Another disease associated with poverty is **tuberculosis (TB)**, an airborne infection that spreads through coughs and sneezes and affects the lungs. Before 1946, no effective drug treatment was available for this deadly disease. Then a cure was developed involving antibiotics and a long period of rest. In countries where TB is common, vaccines are administered to children. In the early 21st century, a strain of tuberculosis resistant to the usual antibiotics appeared. The number of infected patients increased, especially in prisons, where people live in close quarters. The WHO began a worldwide campaign against tuberculosis in the 2010s.

Cholera A bacterial disease that spreads through contaminated water, **cholera** causes about 95,000 deaths per year. Like tuberculosis and malaria, cholera affects mainly poor people in developing countries. Methods to counter cholera include boiling or chlorinating drinking water and washing hands. Although cholera vaccines are available, they do not reduce the need to follow these preventive measures. A severe cholera infection can kill within a few hours, but quickly rehydrating an exposed person can effectively eliminate the risk of death.

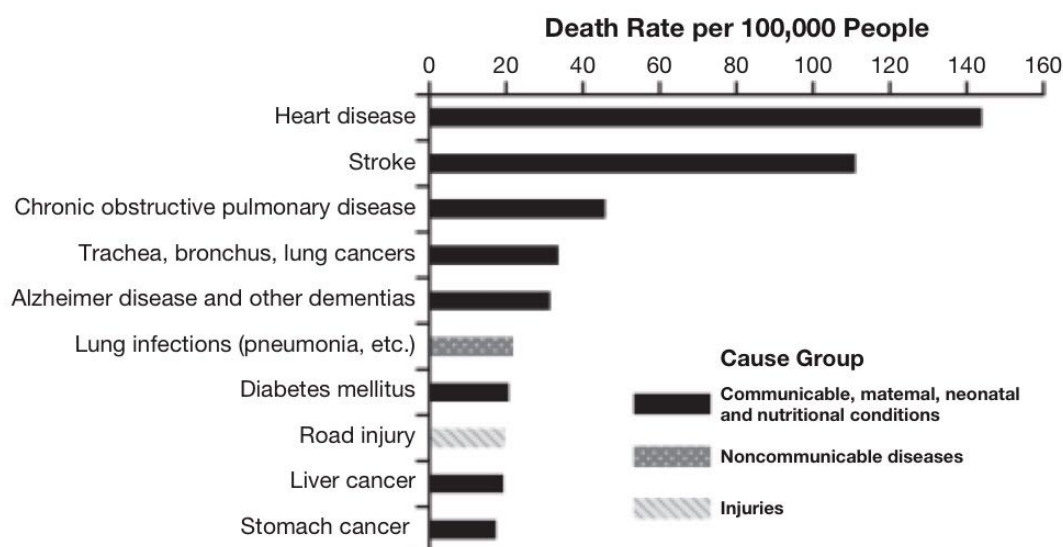
Top 10 Causes of Deaths in Low-income Countries in 2016



Source: Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization; 2018. World Bank list of economics (June 2017). Washington, DC: The World Bank Group; 2017 (<https://datahelpdesk.worldbank.org/knowledgebase/articles/905319-worl-d-bank-country-and-lending-groups>).



Top 10 Causes of Deaths in Upper-middle-income Countries in 2016



Source: Adapted from Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization; 2018. World Bank list of economies (June 2017). Washington, DC: The World Bank Group; 2017 (<https://datahelp-desk.worldbank.org/knowledgebase/articles/905319-world-bank-country-and-lending-groups>).

Polio Another disease caused by water contaminated by a virus transmitted in fecal matter, **polio** once infected 100,000 new people per year. It could result in paralysis and sometimes death. The world cheered when an American researcher, **Jonas Salk**, announced on April 12, 1955, that an injectable vaccine against polio had proven effective. Six years later, an oral vaccine, developed by **Albert Sabin**, became available.

Vaccines became the centerpiece of a global public health campaign to eliminate polio. A joint effort by governments, private organizations, and United Nations agencies began in 1988. In less than 30 years, polio was eliminated in all but a few countries. In places where it still exists, such as Pakistan and Afghanistan, war makes administering the vaccine difficult. Political unrest and religious fundamentalism make people fearful of programs advocated by outsiders. Still, the success of the campaign showed that coordinated global efforts could help solve global problems. (Connect: Compare the effects of diseases during the Age of Exploration to those in the 20th century. See Topic 4.3.)

Emerging Epidemics

Some diseases have emerged that caused major social disruption. In the fall of 1918, as World War I was drawing to a close, a new fight erupted. The issue of the *Journal of the American Medical Association* published on December 12, 1918, described the battle this way: “Medical science for four and one-half years devoted itself to putting men on the firing line and keeping them there. Now it must turn with its whole might to combating the greatest enemy of all—infectious disease.” In fact, more soldiers died from the flu than from

battle. One quarter of all Americans and one-fifth of the world's population became infected with this particularly virulent strain of the flu, which killed 20 million people worldwide. Its victims tended to be between the ages of 20 and 40. The effects of the flu were so disastrous that longevity in the United States fell by 10 years. More people died from the flu in 1918–1919 than had died in four years of the Bubonic Plague (1347–1351). Like the plague, the flu spread along trade routes and with military troops.

HIV/AIDS Another disease outbreak causing social disruption occurred between 1981 and 2014. **Acquired immunodeficiency syndrome (AIDS)**, which is caused by the **human immunodeficiency virus (HIV)**, killed more than 25 million people around the world. HIV weakens the immune system, so people more easily succumb to other illnesses. The virus is contracted through the exchange of bodily fluids, usually through unprotected sex, blood transfusions, or sharing intravenous needles. Funding for the research on the disease, which was associated in its early days with homosexual men and drug addicts, was difficult to come by, and a high percentage of its first victims died.

By the mid-1990s, however, medical researchers had developed ways to treat the disease but not to cure it. **Antiretroviral drugs** could stop HIV from weakening the immune system, thus allowing a patient to live with the virus for many years. However, the drugs were very expensive, so access to treatment was difficult, particularly for patients in poor countries. Brazil is a notable exception. In 1996 it established a policy of providing free antiretroviral drugs to any person who needed them. Deaths have declined dramatically, and the program has actually saved the government money by lowering the number of hospitalizations, medical leaves, and early retirements.

After 2000, the WHO, the United States government, and private groups increased funding for AIDS prevention and treatment, but the disease remains a serious problem. In 2018, about 40 million people globally were living with HIV, the majority in developing countries or low-income neighborhoods of developed countries. Each week, more than 600 young women between the ages of 15 and 24 become infected with HIV, and many lack access to healthcare.

Ebola Another recent and frightening epidemic is Ebola. Discovered in the Congo in 1976, **Ebola** is a deadly disease caused by a virus that infects the African fruit bat, humans, and other primates. Humans get the virus from exposure to fluids of infected people or animals. The disease causes extensive bleeding, organ failure, and, for the majority of infected people, death. In 2014, a massive outbreak in West Africa caused fear around the world. However, a coordinated, intensive public health effort contained and then ended the outbreak. As with polio, countries demonstrated their ability to work together to confront a danger. The WHO took a leading role in this public health response, issuing emergency warnings and implementing a “road map” for handling the outbreaks.



Diseases Associated with Longevity

Heart Disease As longevity increases, diseases that typically do not develop until later in life began to assert themselves. **Heart disease**, for example, is associated with lifestyle, genetics, and increased longevity. One of the major discoveries in fighting heart disease was the **heart transplant**, first performed by the South African **Christiaan Barnard** in 1967. **Robert Jarvik** led a team that designed an **artificial heart**, used as a temporary device while the patient waited for a compatible human heart. Other researchers developed less invasive procedures: replacing valves, installing stents in arteries, replacing the vessels leading to the heart, and developing medications to reduce blood conditions that led to heart disease. In the 2000s, people with heart disease lived longer than similarly affected people did in the 1970s.

Alzheimer’s Disease As people lived longer, a form of dementia known as **Alzheimer’s disease** that affects elderly and some middle-aged people also became an increasing concern. Alzheimer’s patients progressively lose their memory, eventually leading to a stage in which they do not recognize their loved ones. Since the disease undermines bodily functions, it leads to death. Researchers continue to search for a cure.

KEY TERMS BY THEME		
<p>ENVIRONMENT: Epidemics pandemic smallpox malaria Doctors Without Borders tuberculosis cholera smallpox Jonas Salk</p>	<p>Albert Sabin polio Acquired Immunodeficiency Syndrome (AIDS) Human Immunodeficiency Virus (HIV) Ebola SOCIETY: Disease heart disease Alzheimer’s disease</p>	<p>TECHNOLOGY: Medical Advances antiretroviral drugs heart transplant Christiaan Barnard Robert Jarvik artificial heart</p>