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CHAPTER 1

Epidemiological Approaches to Population Health

Stephen Bezruchka

INTRODUCTION

Epidemiology is the study of health and its determinants in specified populations, with the often unstated goal of improving health. The root word, "epidemic," derives its origin from a study of the causes of diseases. The word has been so used for over 125 years. Epidemiology as a discipline is mainly concerned with studying illness or disease, rather than health and well-being. This chapter traces the historical roots of epidemiology's evolution and its main concepts and discusses how the way it is practiced limits its potential to improve the health of populations. It considers what health means at various biological and social levels, including the sources of health in populations, and argues that the gap between rich and poor in a society is a key factor in producing health. The gap likely matters most in early life, somewhere between conception and age five. Political economic systems will be seen as the critical elements requiring change that will improve the health of populations. Comparisons of health between the United States and Canada provide a useful case study.

EARLY EPIDEMIOLOGY

The origins of epidemiology and a classic example of its approach come from John Snow, who studied people who succumbed to cholera in London 150 years ago (Gordis, 1996). By plotting the incidence of death on maps, he discovered an association between deaths in various districts and the sources of drinking water. He went door to door, counting deaths and asking about those homes' water sources. He hypothesized that the scourge was spread by contaminated water from evacuations of infected people. Once these sources were identified, Snow removed the offending pumps' handles, even though he did not understand that it was a specific bacterium that spread the disease. Subsequently, deaths declined.

As Snow demonstrated, it's possible to improve health without understanding all the links between the causes and outcomes of disease. When Snow's study is discussed in

standard textbooks, the action he undertook to control the epidemic is rarely mentioned. This lack of concern with improving health once the causes of disease are identified is all too common in the practice of epidemiology today. Asking what is the equivalent of the pump handle now is a very appropriate question. That is, what actions can have profoundly beneficial effects on health outcomes, even though the details of mechanisms of the action are not completely understood?

Epidemiologists mostly conduct studies and report results; action is not usually considered part of the discipline's domain. This reality can be equated with going to the doctor to find out what is wrong with you and then finding someone other than a physician (often a barber in medieval Europe) to provide treatment. We need a more positive and action-oriented approach to producing health.

Another health official during Snow's time, William Farr, the registrar-general in London, recognized that poverty was an important contributor to poor health (Farr, 2000). Others before and since have remarked on this. Veteran public health leader William Foege writes in *The Fears of the Rich, the Needs of the Poor: My Years at the CDC*, "The current corollary to slavery is poverty … It is the single most important determinant of health" (2018, p. 230).

Public health typically posits that the factors responsible for poor health are behaviours and environmental exposures, many of which are associated with poverty. In this chapter, we develop the concept that there is something intrinsic about poverty or deprivation, both material and relative, that is itself unhealthy for humans. This approach is missing from many standard public health texts, as well as curricula in medical schools and specialty training programs. If studies demonstrate the critical importance of relative and absolute deprivation, but there is no action taken, we should wonder about the absence of an equivalent response to removing the pump handle.

Poverty is not a dichotomous relationship but a gradient, meaning that poorer people have poorer health. Although there is increasing recognition of the health impact of relative poverty at the individual, community, or country level, such understanding is still in very early stages among the public as well as among healthcare practitioners. Relative poverty should be considered as an illness and documented in the clinical record as a public health problem. It may be seen as an endemic issue, one that has a constant presence in a society. This recognition could lead to our treating poverty as a cause of illness, which could consist of some kind of cash transfer or other form of providing a sustainable income for inhabitants of a society.

HEALTH DETERMINANTS DIFFER WITH THE LEVEL BEING CONSIDERED

Health can be considered at a cellular level, at the individual human level, and finally at the population level. A discussion of those approaches can help provide a perspective on how health can be produced within a society.

Consider a human being and ask of what an individual consists. In biology classes, we looked at cells under a microscope and saw small structures with nuclei and chromosomes in which DNA resided. There were also cell walls that contained proteins and energy sources. Cells come in many varieties: heart muscle cells, brain cells, lung cells, blood cells, and so on. As a medical student, I spent considerable time learning the different features of those cells and how to identify them.

In one sense, humans are nothing more than a community of different kinds of cells grouped together into various organ systems. These organs include our nervous system, which makes our limbs move when and how we want them to; our digestive system, which extracts and stores nutrients from food; our respiratory system, which extracts oxygen from the atmosphere to allow our cells to breathe; our cardiovascular system, which moves oxygen and energy to various parts of our body, and scavenges waste; our musculoskeletal system, which allows us to maintain our shape and move; and so on. Our bodies consist of cells arranged in these various communities, along with water and some other biochemical and structural material.

Suppose we isolate one of these cells, such as a heart muscle cell, and ask what that cell would need to be healthy. Cell biologists would say that a cell needs nutrients and oxygen. Glucose is the key nutrient or energy substance in our blood that powers cells. Oxygen is necessary, as well as a few trace elements. The same is true for other cells. If your heart cells do not get enough oxygen or glucose because of a faulty nutrient-delivery system, these cells die, and you will have a heart attack. The same is true for any cell in the body. If it is not nourished properly, the cell will not work as it should. Such cells will not be healthy, and premature death may occur. Later, we will review evidence suggesting that cells in poorer people are not as healthy as cells in those with higher incomes and status.

So the argument could be made that since human beings are but an assembly of cells that need oxygen and glucose plus some trace elements, then humans need those same things to be healthy. If cells benefit from oxygen and glucose, then the more food and oxygen we get, the better our health should be. But stuffing ourselves full of food is folly, as our increasing obesity rates demonstrate. Healthy adults breathing high concentrations of oxygen over long periods get lung disease, and babies breathing pure oxygen go blind. The lesson here: The logic of doing what is best for our component parts—our cells—and generalizing this prescription to the community of cells that comprise a human being may not be the best health advice for us as humans.

At the individual level—the community of cells that comprise each of us—our health is improved by following all the oft-preached do's and don'ts, such as eating healthy foods, exercising, not smoking, wearing a seat belt, using a condom, and getting a good night's sleep. That is good health advice for an individual human, but none of those recommendations make any sense to one of your cells. You cannot ask cells to exercise, to not smoke, to wear a seat belt, to get a good night's sleep, and so on. That isn't what cells can choose to do. There are no cellular-relevant versions of health advice for individuals.

What about other levels of organization such as communities, states/provinces, or nations? These locations contain populations of humans. Is it logical to assume that what is the best advice for individuals within that population—you and me—would be the best health advice for that group as a whole? Our health advisers tell us that we should exercise, eat properly, not smoke, wear seat belts, and use condoms, and expect that the population will be healthy. I suggest that approach makes the same mistake I pointed out in applying health advice for a cell to an individual human.

Looking at Japan's population suggests that there may be compelling reasons to rethink our health advice for populations, at least for rich countries. We have all learned how bad cigarette smoking is for our health. However, the Japanese have among the highest levels of smoking for rich nations, and they still lead the world in good health (Bezruchka et al., 2008). This startling observation shows how smoking, although harmful, can be secondary compared to other factors that affect a population's health. It suggests that there are population-level health-producing factors that have no individual-level counterparts, just as health advice for individual cells doesn't work for individual peoples.

Epidemiologists and public health scholars are beginning to understand that if the social and economic factors in a society are right, then what individuals in that population do or don't do for their own health may not matter as much. They will be healthy as a by-product of the way the jurisdiction is organized, just as our cells are healthy if we do what's right for us as individuals. Societies can decide to organize society in such a way as to maximize the health of the population. The task of epidemiologists and others working for health is to make people aware of the critical importance of those factors. It is increasingly apparent that we need also to look for the equivalent of removing a pump handle in modern society.

THE CAUSES OF THE CAUSES

There is an Indian tale—Clifford Geertz, the famous anthropologist, recounts hearing it as a story from India—about an Englishman who, having been told that the world rested on a platform on the back of an elephant, which rested in turn on the back of a turtle, asked what the turtle rested on. Another turtle. And that turtle? "Ah, Sahib, after that it is turtles all the way down."

In any discussion of disease and the causes of disease, we can look at the causes of the causes of the causes—that is, we need to go back to the source of the problem. The idea of an upstream or root cause approach that locates the source has been visually diagrammed by the Department of Health in Hawai'i in Figure 1.1.

Discovering the sources of health can be difficult, since a discussion of disease and its causes is often limited by various societal norms and understandings as to the appropriate way to identify and deal with a problem. The Department of Health in Hawai'i puts political context and governance at the source.

Figure 1.1: Root Causes and Downstream Effects

Source: Pobutsky, A., Bradbury, E., & Wong Tomiyasu, D. (2011). *Chronic disease disparities report 2011: Social determinants*. Honolulu: Hawai'i State Department of Health, Chronic Disease Management and Control Branch.

POPULATION HEALTH EPIDEMIOLOGY

John Snow went door to door in what is called "shoe leather epidemiology" to collect information on water sources and deaths. Such observational data form the backbone of epidemiologic investigations. For a disease-focused approach, one needs to know whether someone has the disease and then obtain a variety of supplemental information to discern other factors that might be relevant. Imagine a study of lung cancer in a population where everyone smoked. It would be very difficult to identify smoking as a cause of lung cancer, since you could not compare the incidence of disease between smokers and non-smokers. The kinds of questions asked to study health in a population depend on a range of characteristics in that population. If you ask wrong or limited questions, or study the wrong population, you can be led astray, as suggested by the smoking and lung cancer example.

Today the term "social epidemiology" reflects the population or societal level of analysis, defined as the branch of epidemiology that studies the social distribution and social determinants of states of health. It looks at the way social, economic, and political structures and relationships influence health. Social determinants of health have been variously conceived as the conditions in which people are born, grow, live, work, and age. These circumstances are shaped by the distribution of money, power, and resources at local, national, and global levels. The social determinants of health are mostly responsible for health inequities—the unfair and avoidable differences in health status seen within and between countries.

Some advocate for a new discipline of political epidemiology that studies the impact of welfare regimes, political institutions, and specific policies on health and health equity. Recognizing the political determinants of health considers the political context as a determinant of "downstream" health outcomes, as graphically depicted by the Department of Health of Hawai'i.

Current concerns in social epidemiology relate to concepts of equity and equality. Health *inequalities* refer to differences in health status or in the distribution of health determinants between different population groups. These are often due to the unequal distribution of the social, economic, and political factors that produce health. Health *inequities* are those health inequalities that are unfair or unjust and can be remedied. A societal state of good health, health equity, is the absence of unfair and avoidable differences in health among population groups. Geoffrey Rose (1992) stated that "there is no known biological reason why every population should not be as healthy as the best." Accepting this idea requires societies to remove political obstacles to good health such as poverty and associated powerlessness. Such practices, once begun, may require generations to demonstrate results. In the United States, the weaker term "health disparity" is mostly used instead of "health inequality." "Disparity" connotes difference and lacks the moral underpinnings of "inequity."

One could ask why "turtles all the way down" is not the focus in epidemiology today. Epidemiologists have graduate training (usually in public health schools), and some work

in public health departments. Many jobs for epidemiologists tend to have a narrow focus, and their projects are short term and focused on behavioural interventions. These foci may not be the most effective in producing health. Epidemiologic research is also done by private businesses or by federal agencies with close ties to private business. Despite the global economic collapse brought about by bankers in the U.S., credence is still given to the business model and so-called free markets in facilitating positive social and health change. The theme is often to create products, drugs, or instruments for a procedure or a communications campaign for individuals or their organs. The outcome is usually an action for individuals to take: Ask your doctor for this drug. Eat that food. Use this exercise appliance. Such a disease focus is severely limited in any ability to affect the factors that produce health in a population (Schwartz, Susser, & Susser, 1999).

Another factor limiting upstream efforts is typified by Upton Sinclair (1935), who wrote, "It is difficult to get a man to understand something, when his salary depends upon his not understanding it!" As an emergency physician, I was paid to diagnose and treat illness and injury, but not to ask why someone had that illness or injury. Most of us have limited areas of expertise and work on downstream issues where basic questions are not being asked.

Another explanation for the type of work done by epidemiologists relates to the emergence of powerful computers that allow analysis of complicated data on individual diseases. The focus on the individual and the ability to process vast amounts of data keep many researchers stuck in the study of individual health risks rather than social factors. This leads to a problem similar to studying lung cancer in a society where everyone smokes. Unless you look at people who are similar in important respects, you won't find what you are looking for. They must have similar incomes or education or wealth or status in society. In the jargon of epidemiology, you have to control for socio-economic status in a study, or you won't find an effect. Socio-economic status measures aspects of poverty, which has been stated to be the most important determinant of health. Controlling means that you factor out the importance of that variable in the analysis. Then you cannot ask questions about the variable. Hence socio-economic status, that is, level of poverty, must be very important in producing health. If it wasn't, then one wouldn't need to control for socio-economic status in studying other factors. How you frame the question profoundly impacts what answer you get.

Defining a disease can be very political (Illich, 1976). Homosexuality used to be labelled a disease in medical textbooks in the U.S., as it still is in some countries. On the other hand, in Canada and the United States same-sex marriages are now legal. Fibromyalgia and chronic fatigue syndrome are conditions that haven't yet appeared on the universally recognized disease stage but are termed "contested illnesses." Some suggest that relative poverty should be considered a disease, as its negative health effects are considerable.

A current global focus considers diseases and their disabilities at the population level by measuring Disability Adjusted Life Years, or DALYs, for various diseases. This approach leads to tallies of the global burden of disease. The Institute for Health Metrics and Evaluation, based in Seattle, has become the key organization aggregating and producing this information. This disease-oriented focus does not consider the social or political factors underlying their distribution,

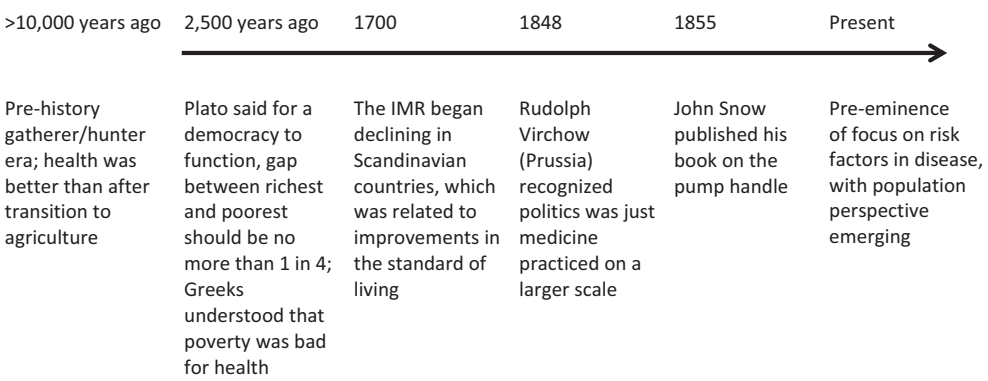

Figure 1.2: Prehistoric to Present Timeline

instead focusing on the diseases that are a downstream manifestation of health. A disease focus may provide much useful information to guide health care in treating individuals, but this schema may not help produce health in populations (Evans, Barer, & Marmor, 1994).

LEARNING FROM HEALTH DATA ON POPULATIONS

To understand what produces health in a population, we need to define health. The World Health Organization (WHO) states that "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." A more measurable definition might be asking individuals how healthy they consider themselves on a scale from very unhealthy to very healthy. This is termed "self-assessed health" (SAH).

For a population, mortality measures allow for comparisons with others. Consider the average length of life (life expectancy) or the infant mortality rate (IMR). Out of 1,000 infants born, the IMR measures how many die in their first year of life. IMR is a more sensitive measure than others, since early life is so critical to adult health considered broadly. These rates can give us numbers, allowing us to ask what may maximize health. SAH measures mirror mortality measures when used in a culturally similar population and are often used to study factors affecting the health of populations that are not rooted in death rates.

To determine the life expectancy (LE) of a population, the dates of births and deaths are used to calculate age-specific death rates in a given year. The resulting table shows when those in a hypothetical population would die, demonstrating their expected average length of life. Life expectancies are computed for all countries recording vital events, births, and deaths, and estimated for other nations.

Other specific mortality measures include child or under-5 mortality, adult mortality (the probability of a 15-year-old dying before reach age 60), and maternal mortality ratio (number of maternal deaths per 100,000 live births). There are now many sources of these indicators to observe trends among nations.

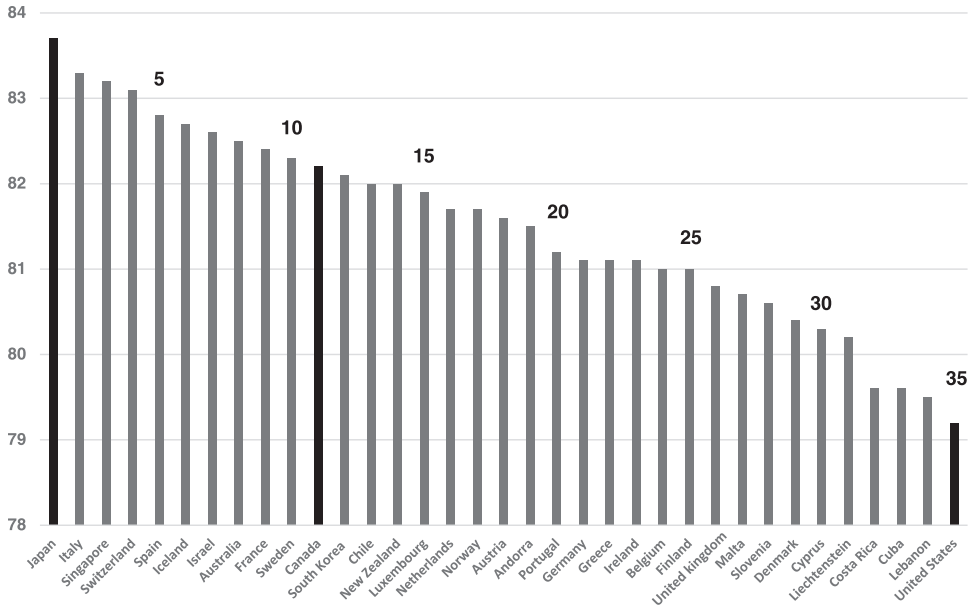

Figure 1.3: Health Olympics, 2015

Source: United Nations Development Program. (2016). *Human development report 2016: Human development for everyone.* Geneva: Author.

The United Nations' annual *Human Development Report* is a convenient data source. Consider health as an Olympic event, with life expectancy as the "race" with a clear finish line. The top 35 countries in this race are shown in Figure 1.3. For all data reported in 2016, estimating life expectancy for 2015, the LE range is from 83.7 years for Japan to 48.9 for Swaziland, the least healthy in a list of 189 countries.

We understand vital signs of individuals, our pulse, blood pressure, and temperature. If those numbers are far from what is considered normal, it may indicate the need to act quickly. If someone told me in the ER that a patient's blood pressure was 60/30 and had a pulse of 200, I'd be there in a heartbeat. If the blood pressure was 120/70 with a pulse of 60 and a temperature of 37°C, I could take my time. Why don't we look at vital signs for populations too?

To get a sense of what small LE differences mean, consider calculating life expectancy in the United States in 2001 with and without the 3,000 deaths of September 11. It would make only a 0.01 year difference for the country as a whole. New York City did this exercise for that jurisdiction alone and found a difference of 0.2 years for men and 0 for women.

Tiny differences in life expectancies can translate to huge inequities in death rates, however. The U.S. is undoubtedly the world's richest and most powerful country, with over a quarter of all billionaires and vast military might, yet it is far from being the healthiest. Canada is much healthier. Japan leads the world in most measures of health. The U.S.

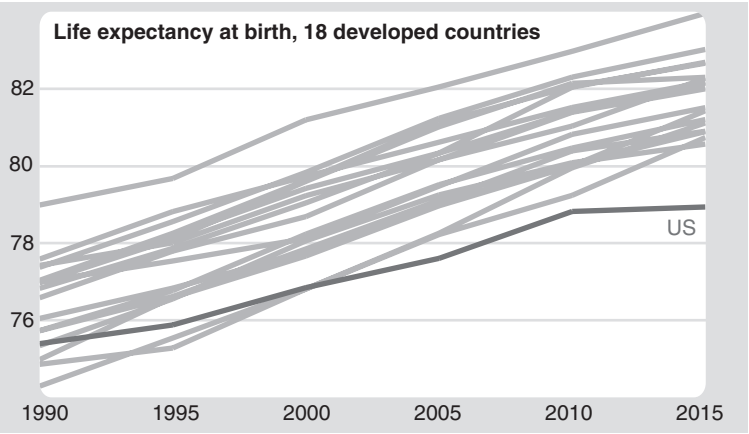

Figure 1.4: Rich Country Life Expectancy Trends, 1990–2015

Source: Ho, J. Y., and Hendi, A. S. (2018). Recent trends in life expectancy across high income countries: Retrospective observational study. *British Medical Journal, 362*(k2562). doi:10.1136/bmj.k2562

is 4.5 years behind Japan in life expectancy, which seems insignificant. But consider: if the U.S. could eliminate heart disease as a cause of death, its number one killer, accounting for one death in four, it still wouldn't be the healthiest country (Arias, Heron, & Tejada-Vera, 2013). The 4.5-year health gap is huge!

Seventy-five years ago, best estimates would put the U.S. in the top five countries for life expectancy. Japan would have been considerably below the 35th ranking enjoyed by the U.S. today, so there has been a profound deterioration in health in the U.S. compared to other countries. U.S. life expectancy has been declining absolutely since 2015, an unprecedented deterioration in health in this century. Figure 1.4 presents life expectancy trends for rich countries from 1990 to 2015, demonstrating how the United States has seen significant deterioration in rates of improvement and then in absolute numbers.

Life expectancy trends comparing Canada, Japan, and the U.S. from 1960 are revealing (Figure 1.5). Canada ranks 11th in the UN list of countries, with a life expectancy of 82.2. It was considerably higher in rank decades ago, although the absolute number of years was less. However, with American life expectancy decreasing recently as noted above, life expectancy elsewhere around the world keeps increasing.

In the "Health Olympics," Canada and the U.S. have more than changed places with Japan. Why? Consider health care. An easy measure is the per-capita expenditure. The U.S. spends about half of the world's healthcare budget, about U.S. $10,348 per person in 2016, comprising a sixth of its GDP, and almost 50% more than that spent by Canada. Underspending on health care is not the reason for the U.S. poor health.

Many mortality indicators other than life expectancy show similar shocking rates for the United States in comparison to other nations. There are no mortality indicators for

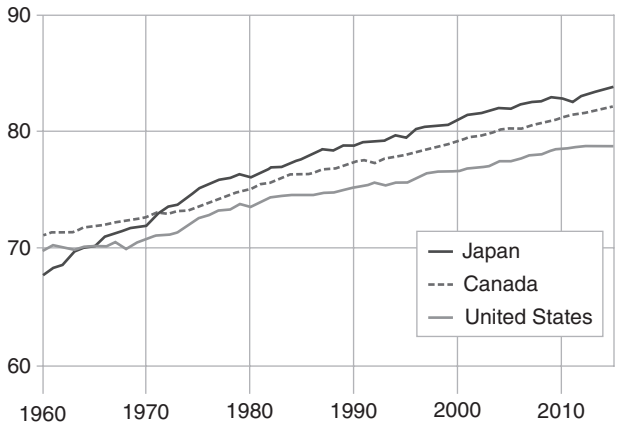

Figure 1.5: Canada, Japan, and United States Life Expectancy Trends, 1960–2015

Source: World Bank. (2015). https://www.google.com/publicdata/explore?ds=d5bncppjof8f9_&ctype=l&strail=false&bcs=d&nselm=h&met_y=sp_dyn_le00_in&scale_y=lin&ind_y=false&rdim=country&idim=country:CAN:JPN:USA&ifdim=country&hl=en&dl=en&ind=false

which the United States ranks in the top 30 nations, until examining survival at much older ages, such as the chance of dying after reaching age 75. Comparisons show that if the U.S. had the under-5 child mortality of Slovenia, which should be an attainable goal, over 40 fewer children would die every day in the United States. For female adult mortality, a 15-year old girl in Sri Lanka has a lower chance of dying before reaching age 60 than a U.S. girl. Similarly, for a 15-year old boy in Tunisia. Even more shameful is the 50% rise in maternal mortality in the United States over the last 15 years. This very rare event has only happened in eight nations. Canada is spared these humiliating results, ranking, for the most part, in the top 20 nations.

The embarrassing health status of the United States gets little attention in that country despite the undeniable evidence. In 2013, the Institute of Medicine there produced a report titled *U.S. Health in International Perspective: Shorter Lives, Poorer Health*. It highlighted that even the privileged few, who are white-skinned, earn substantial incomes, and practice all the health promoting behaviours, die younger than their counterparts in other rich nations. The report advised informing the public and looking at healthier nations to see what they do that could be of use in the U.S. Sadly, this advice has not been followed.

The U.S. is clearly not buying health with its healthcare dollars. We naturally assume that health and health care are synonymous, but they are not. In the United States, people speak of accessing health, paying for health, insuring health, and getting health when they are really speaking of health care in those phrases. We might ask: "Do you want health or health care?"

Similar analyses demonstrate that none of the usual factors explain why the U.S. is so unhealthy. Out of all the countries presented in Figure 1.3, Japanese men smoke the most,

while the U.S. has the lowest prevalence of male smoking (World Health Organization, 2015). You could conclude that smoking is what makes Japan so healthy. Another interpretation is that although smoking is not good for your health, other factors are worse, and they supersede the bad effects of smoking. We must look beyond individual behaviours for understanding population health outcomes.

Inequality in Society Is Bad for Your (Our) Health

Richard Wilkinson is an economic historian and epidemiologist who has been studying the health of countries for decades, trying to determine the factors related to their health. He has demonstrated that the usual factors do not offer satisfactory explanations. By 1986, he had found that the gap between the rich and poor in a country appeared to be correlated with the population's health. This was not something commonly recognized, but in 1992, his findings were published in the *British Medical Journal*. This paper helped spawn the study of population health today.

Wilkinson and Kate Pickett went on to create an index of health and social problems for 23 rich nations and looked at the impact of income inequality on this measure. The index comprised life expectancy, infant mortality rate, teenage births, obesity, mental illness, homicides, imprisonment rates, mistrust, social mobility, and education. The graph shows the remarkably clear association of the United States having the highest income gap and scoring very poorly on the indicators. Their bestselling book, *The Spirit Level: Why Greater Equality Makes Societies Stronger*, has had a profound impact on recognizing the importance of economic inequality on producing undesirable outcomes.

This relationship between income inequality and worse health and social problems is causal, using the accepted epidemiologic criteria for inferring causality (Pickett & Wilkinson, 2015). In the 40 years since the first study associating income inequality and mortality appeared, a scientific revolution has occurred. The concept has undergone fierce criticism, scrutiny, and now increasing acceptance. Social inequalities, such as income inequality, can be considered a fundamental cause of health inequities and lie near the source in the upstream metaphor.

Research has shown that this relationship is not found in small areas where people of similar economic means reside (Wilkinson & Pickett, 2009). The strength of the association can also depend on social spending policies that modify the effect of income, so that beneficial goods such as health care do not need to be purchased out of the paycheque. There are often lag effects when health impacts are seen some time after inequality changes. Context matters, such as in Canada where the association is not seen among new immigrants, but for long-term immigrants it approaches that seen in the Canadian-born (Auger, Hamel, Martinez, & Ross, 2012).

Explanations for the impact of income inequality on health rest on three observations. One is that there are diminishing returns for the effect of increasing income and increased health. The income health curve is concave downward; that is, additional income

Figure 1.6: Health and Social Problems Related to Income Inequality

Source: Wilkinson, R. G., & Pickett, K. E. (2009). *The spirit level: Why more equal societies almost always do better.* London: Allen Lane.

results in very small health gains. Redistributing income from the very rich to the very poor results in an increase in average health.

A second mechanism relates to the psychosocial impacts of stress produced by social comparisons among and between economic classes in society. Stress has been termed the 21st-century tobacco. When people are aware of economic inequities or relative deprivation, they respond in various ways. Road rage is commonly experienced, and air rage has been observed in passenger planes that have first-class cabins. Mass shootings in the United States have been linked to county income inequality. The highest global level of opioid use is in the United States. It may be that the ten-fold increase in opioid mortality since 1980 demonstrates one way of trying to cope with the stress of inequality.

Finally, in what is termed a contextual effect of income inequality on health, with a large income gap in society, the rich pay directly for many services they receive. These include private education, concierge health care, security guards, and gated communities. They do not want to be taxed to pay for others to receive services that they pay for directly. Using their economic and political power, they push for further tax cuts for the rich, leading to less social spending for the rest of the population, a phenomenon termed "austerity." Fewer services are available to fill the gaps in income, health care, and other services. The $1.5 trillion-dollar tax cut passed in 2018 in the U.S. represents an example of this third contextual effect.

How is inequality measured? The most commonly used measure in rich countries is that of income differences, data that are collected regularly in the census and from other sources.

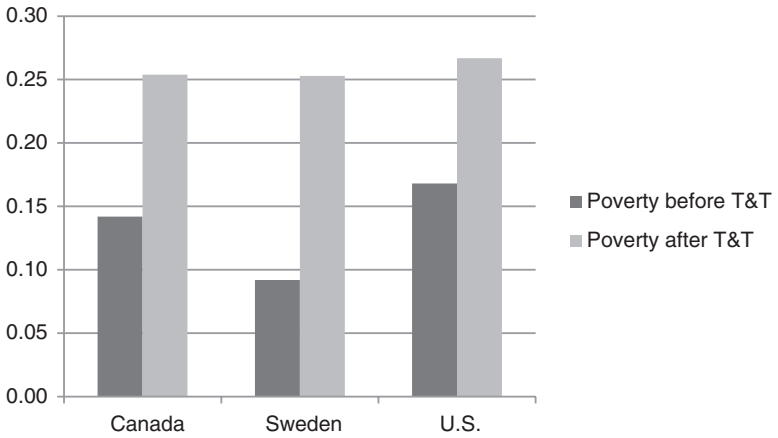

Figure 1.7: Poverty Rates Before and After Taxes and Transfers (T and T)

Source: Based on Bourgeault, I. L., Labonté, R., Packer, C., & Runnels, V. (Eds.). (2017). *Population health in Canada: Issues, research, and action* (Figure 24.1). Toronto: Canadian Scholars' Press.

Income is a flawed measure—especially at the country level—because there are a variety of behind-the-scenes redistribution mechanisms that mitigate the effects of differences. Using Organisation for Economic Co-operation and Development (OECD) data in 2015, through taxes, transfers, and other payments, Sweden reduced its poverty rate based on income over 63%, in comparison to about 44% for Canada and only 37% for the U.S. (author calculations from OECD, 2015). Some countries, such as Sweden, provide health care, education, and other benefits that people in countries like the U.S. must purchase directly.

There is a stronger relationship between income inequality and mortality in the United States than in Canada, which provides more social services that are not paid for by individuals directly. Besides universal health care in Canada, the government supports education, housing, transportation, and other social services (Ross et al., 2000; Sanmartin et al., 2003).

The geographic level at which income distribution is measured affects its association with health. In a small neighbourhood, most people are similar economically, so it would be unlikely that a small income gap there would be related to health. In the U.S., the relationship is seen at the city and state level throughout the country, but not at the county level within states. Other studies have demonstrated that even the rich in the United States are not as healthy as counterparts in Europe (Avendano, Glymour, Banks, & Mackenbach, 2009).

Epidemiologists speak of the ecological fallacy for population findings that may be misleading when applied to individuals (Berkman, Kawachi, & Glymour, 2014). For example, the finding that populations with more poverty have worse health than populations with less poverty implies that poorer people have poorer health. But this conclusion must be demonstrated by other means. It could reflect the opposite reality, for example,

such as if it were the rich individuals that had worse health in a high-poverty population. However, numerous studies, including some using self-assessed health estimates, refute the ecological fallacy limitation: The poor are much more impacted by inequality than the rich. Nonetheless, even those who are economically advantaged would likely be healthier in a more equal society.

To summarize the findings, relative poverty is bad for your health. That is, being lower on the socio-economic ladder is a disadvantage in most measures of health. The steepness of the ladder or gradient reflects the severity of economic inequality, and a steeper gradient in more unequal societies is associated with worse health. The gap between the rich and poor in society represents how much the society cares for and shares with its members.

Canada has a better inequality profile than the U.S., but fares worse than do many European nations (see Chapters 6 and 9, this volume). A top CEO in the U.S. makes close to 500 times what an average worker does (Pizzigati, 2018). The figure used to be 20 times for Canada, although it is now higher. The rate used to be around 10 for Japan, but this has also risen today. Back in 1980, when the U.S. was considerably healthier compared to other countries, the pay gap was about 40 to 1. As Thomas Piketty (2014) points out in *Capital in the Twenty-First Century*, the phenomenal increases in top executive compensation in the United States represent something other than market forces at work.

Role of Health Care in Producing Health

While universal health care is a human right and an important indicator of progress, the United States remains the only rich nation not taking this step. How important is health care in improving health and reducing health inequities? The best published study looking at the impact of healthcare services in advancing health was done in Winnipeg, Manitoba, by looking at mortality outcomes related to cuts in healthcare services (Roos, Brownell, & Menec, 2006). The more that was cut, the better the improvements in mortality. The study's last paragraph stated, "To conclude, a universal health care system is definitely the right policy tool for delivering care to those in need, and for this it must be respected and supported. However, investments in health care should never be confused with, or sold as, policies whose primary intent is to improve population health or to reduce inequalities in health. Claims to that effect are misleading at best, dangerous and highly wasteful at worst" (Roos et al., 2006, p. 125).

As many nations transitioned to universal health care, it was expected that the socio-economic gradient in health, namely poorer people having poorer health outcomes, would decline or perhaps disappear. That hasn't happened, which remains a concern, especially for European nations.

Medical care treats illnesses and injuries, but the lack of medical care is not the cause of illness and injury. To compound the issue, whenever medical care has been studied, it has been found to be a leading cause of death. One study in the U.S. (Makary & Daniel, 2016) suggested it was the third-leading cause of death.

Whereas health care definitely helps some, it harms others, and for populations, whenever it has been studied, there appears to be little or no net benefit for population mortality measures. Medical care can improve quality of life and health, but its impact is often limited. I write this as someone who was an emergency physician for 30 years: Consider medical services as necessary for a society, but not sufficient, to produce good health. Recognizing this is very difficult for most people.

Consider the argument presented earlier regarding the health of cells/organs, individuals, and populations. Does medical care treat individuals or populations? No, for the most part it treats cells and organs. You take aspirin to treat platelets, proton pump inhibitors to treat gastric mucosa cells, statins to treat hepatocytes, and sildenafil to treat smooth muscle cells in the corpora cavernosa. Surgery and coronary stenting work on organs. A different kind of political or upstream medicine is needed to treat populations. Rudolf Virchow, the founder of modern cellular pathology, stated in 1848 that "medicine is a social science and politics nothing more than medicine on a larger scale." This has been called public health's biggest idea.

Studies in rich nations have shown that a focus on primary as opposed to specialty care does influence health. In Europe, the strength of primary care system mitigates some of the adverse effect of income inequality on health (Detollenaere, Desmarest, Boeckxstaens, & Willems, 2018). Strong primary care can be defined as accessible services that provide a comprehensive scope, meeting the population's healthcare needs, coordinating care across different healthcare levels, and providing a continuous provider-patient relationship over time and different disease and illness episodes. With almost four times as many generalists as the U.S., Canada has a strong primary healthcare system.

What does produce health for a society are specific forms of social spending. Comparing social spending to healthcare expenditures among rich nations demonstrates that healthier nations privilege the former over the latter. Social expenditures have been shown to lead to better outcomes for infant mortality, life expectancy, and other measures of health (Bradley, Elkins, Herrin, & Elbel, 2011). In the U.S., states with higher expenditures on education, income support, transportation housing, and the environment have better outcomes compared to those that spend less.

Basic Needs

Better caring and sharing in a society, along with less inequality, determines its health. Can we generalize this from what we know of rich countries? For the poorest nations, providing food, water, shelter, and basic needs for everyone takes priority. For countries with a low gross domestic product (GDP), a few hundred dollars up to $5,000 to $10,000 per person per year, life expectancy estimates tend to increase with increasing GDP (Wilkinson & Pickett, 2009). This seems to indicate that most are getting the basic necessities of life and living standards are improving. But economic growth, as measured by increasing per capita GDP, must be shared to be beneficial. A critical threshold relates more economic growth to further improvements in population health and other measures of

Box 1.1: What Produces Health in a Population

- Provision of basic needs (food, water, shelter, security)
- Provision of caring and sharing, especially in early life, which is typically measured by the distribution of wealth, resources, income, political power, and the status of women
- Access to basic healthcare services
- Cultural elements of reciprocity, social harmony, and vigilant sharing
- Focus on early life: early life lasts a lifetime

well-being. The threshold is reached at about $10,000 per capita GDP. Above that level, more economic growth does not by itself lead to longer lives, increases in happiness or well-being, or other measures of a good society. Once countries exceed that threshold, levels of inequality matter more in producing health.

Increasingly inequality is an upstream factor strongly related to infant and maternal health outcomes around the world. Income itself is difficult to measure in poorer countries, but inequality of household wealth, or assets, has been found to impact child health in low- and middle-income countries. Most low- and middle-income nations have not seen equitable economic growth to benefit their societies. Hunger and poverty remain common in both sub-Saharan Africa and South Asia. Yet, in 2010, India had more of the 10 richest people in the world than any other country.

What is needed is more global caring and sharing—providing the basics of food, water, and shelter—to address today's immense global inequities, as well as those within countries.

Early Life Lasts a Lifetime

If we ask how much of our health as adults is determined during the first years of life, the answer is a great deal. Research shows that by age two or three, as much as half of our health as adults is already programmed. The first thousand days after conception matter the most for our health outcomes as adults—long before we make any conscious choices about behaviours to make us healthy. This perspective is known as the developmental origins of health and disease (DOHaD; Bezruchka, 2015).

How can such life-course issues be studied epidemiologically? Ideally, a cohort study would follow a group of people from conditions during their gestation until they died. Major challenges in such research include the need to follow people for longer than the lifespan of the investigator, as well as the huge costs involved. However, some countries have kept detailed records at birth for individuals who can be followed over time. Studies of these groups have found that in the trajectory from the womb to the tomb, the

womb may be more important than the subsequent home as far as chronic diseases in adulthood are concerned. David Barker's (1998, 2012) initial studies on low birth weight affecting adult health, termed the fetal origins hypothesis, have spawned much understanding of the importance of early life conditions. The life history of a woman before she becomes pregnant also matters for the health of her baby, as much as or more than the prenatal period.

Significant stress during the mother's pregnancy can be linked to worse health later in a child's life. Research on this topic looks at surrogate markers, such as inflammation and other biological parameters in adulthood, to gauge later health outcomes. It has been found that susceptibility to lung cancer may depend on various conditions in the uterus, independent of smoking cigarettes. One source of such studies is the Helsinki birth cohort, a population for which birth data and long-term follow-up information were recorded from 1924 to 1944 (Barker, 2012).

Care during early life is immensely important for future development of the child. John Bowlby, studying orphans after the Second World War, demonstrated the importance of having a single caregiver present soon after birth and for the first year of a child's life. Such conditions were more likely to lead to secure attachment, meaning the infant felt more comfortable among strangers and in exploring surroundings. Better mental health, physical health, and healthy behaviours are more likely to result than when the newborn is unattended or cared for by several different individuals for much of the early part of their life, at least in Western societies.

Subsequent studies have demonstrated the impact of early life, especially conditions of poverty and socio-economic circumstances, on adult health. Societies that provide support for pregnant women and early life parenting, including economic support, have better health outcomes than countries that neglect that period. The United States stands with Papua-New Guinea as only two populous countries without a paid parental leave law.

Various forms of abuse or maltreatment in early life also cause great problems later in life. Adverse childhood experiences, or ACEs, are categorized as emotional, physical, and contact sexual abuse, as well as various forms of household dysfunction and neglect. The original studies followed people in San Diego enrolled in Kaiser, a health maintenance organization (Bezruchka, 2015). They found that higher ACE scores were associated with various forms of later impairments, unhealthy risk behaviours, chronic diseases, and early death. Such toxic stress in early life has permanent effects. Various forms of supportive care in later life can help but not eradicate that initial adversity.

ACEs are more common among those who are poorer and in more unequal U.S. states (Eckenrode, Smith, McCarthy, & Dineen, 2014; Halfon, Larson, Son, Lu, & Bethell, 2017). At present, there are few studies on this topic in Canada. The WHO is developing an international study to validate the concept in other parts of the world, which would include exposure to community, collective, and war violence. Many dysfunctions in adulthood, including criminal behaviours and recidivism, poor school performance, and various disabilities and chronic conditions have their origins in early life abuse.

Adverse childhood socio-economic circumstances add to the impact of ACEs. There is need to merge DOHaD material with ACEs to gain wider awareness.

Denmark is a country that serves as a case study of the complexities of the inequality-health relationships. It is the only more egalitarian and rich country that has relatively poor health outcomes, comparable to those of the United States. In 1994, the Danish government published a report mentioning that for the past two decades, life expectancy had been stagnating there, rather than growing as in all the other OECD nations (Bjerregaard & Hermann, 1994). Historically, life expectancies of both Danish men and women were far higher than in the United States in the 1970s, and close to those of Norway and Sweden. However, by 1990, they were equal for U.S. and Danish men, with U.S. women outliving Danish women.

The report noted that Danish women entered the labour market in large numbers during the period 1960–1968, which was earlier than women in other neighbouring countries such as Norway and Sweden, and that they typically began working when they had young children. Their jobs were mostly temporary, unskilled, and low-paying. In the 1970s and 1980s, many women were laid off and unemployment soared, especially in comparison to other nearby nations. Women's mortality increased as a result, while the welfare practices typical of other Scandinavian countries were not as comprehensive in Denmark. The resultant stresses led to high rates of women smoking, and later these women developed the highest lung cancer mortality of all European nations.

Adult mortality improvements stagnated from about 1970 to 1990, and child mortality from 1980 to 1990. Female adult mortality, which is the probability of a 15-year-old dying before reaching age 60, demonstrated rapid declines in Denmark after 1990, suggesting that the conditions producing worse outcomes have abated to some extent. Denmark has learned from the conditions producing health deprivation. Life expectancy is again increasing.

Bakah and Raphael (2017) reviewed the health paradox in Denmark and suggested that neo-liberal policies leading to high unemployment, wealth (not income) inequality, and the country's flexi-security policies were important antecedents to its health outcomes. Unlike other Scandinavian nations, the government is more invested in modifying personal behaviours rather than focusing on more upstream political policies.

Biology of Inequality

Most of us go through life with a rudimentary understanding of biology and specific physiology and pathology. Our previous discussion of cells, organs, individuals, and populations leads us to consider what it would mean to have a biological explanation of health impacts on large human groups. Understanding proceeds from hypotheses that are tested by experiments and further refined and elaborated in different settings. Cells can be studied in cultures, and their components can be extracted and measured. Organs can be perfused in an artificial environment.

Experiments on populations are rarely carried out on humans for ethical reasons, but various natural experiments occur throughout history. Early life issues have been studied extensively in rats and sheep. Dog labs have been settings for much understanding of human physiology. Primate labs and alfresco experiments help understanding of our closer relatives.

But we do know quite a lot about inequality in human societies and its impact on health. Many aspects of the early environment matter tremendously in producing the health of offspring. Growth in the uterus is determined by many factors, and early child development has a profound effect on adult health. Stresses during pregnancy will affect the health of children and the adults they become. Generally, those lower in socio-economic positions in society have worse health outcomes that are independent of personal behaviours, to the extent that poverty in infancy can be considered a brain toxin, from which complete recovery is difficult (Bezruchka, 2015).

The social environment in early life is determined to a significant degree by the economic and political environment. The acute stress response, activated when one is faced with a threat or danger, allows energy to be mobilized and directed to the organs that will save one's life (Bezruchka, 2015). But chronic stress in pregnancy, such as that of economic insecurity, has a negative impact on the biological responsiveness of inflammatory cells that lasts through to adulthood. It's observable in adults in their 20s who appear to be otherwise healthy and predicts the development of more chronic illnesses as they age.

Cortisol and adrenaline are key effectors. Turning the fight-or-flight response on for a few minutes to get out of the path of a car has a marked survival benefit, but if it is turned on all the time—for example, when stuck in traffic and late for an appointment or worrying about being evicted or fearing a significant other will be violent at the next encounter—it may not have death-avoiding advantages. Overworking the stress system, a concept termed allostatic load, appears to be maladaptive and have lasting repercussions on the ability to mount a swift survival response when it is needed.

Those lower down the socio-economic ladder tend to be more affected by chronic stress in measured ways. This includes a greater likelihood of obesity, adult-onset diabetes, and cardiovascular disease. Mechanisms that produce chronic stress in society have received considerable research attention (Sapolsky, 2004). The production of cortisol from the adrenal gland, which is regulated by the hippocampus in the brain, is an important pathway leading to worse health when higher cortisol levels are sustained. Levels of cortisol in scalp hair provide a time-concentration integral of stress exposure. Increasing cortisol in recent hair growth is related to events such as a heart attack, and higher elevations afterwards have a worse prognosis. In addition to many individual studies, there are population data that demonstrate different stress responses (Kristenson et al., 1998).

At the same time, organs and bodies must continue with growth, tissue repair, and fighting potentially hazardous infectious invaders. Markers of the inflammatory response to infection and other illnesses suggest that those lower down the socio-economic hierarchy are working harder to combat contagion. They have higher allostatic loads measured

by blood pressure, BMI, and various blood biomarkers such as cholesterol, and they also have worse health outcomes (Geronimus, Hicken, Keene, & Bound, 2006).

The nervous system turns out to be very plastic—that is, it is capable of remodelling depending on various social and environmental stimuli. It is the major conductor of the body's response to the physical, social, economic, and political environment. Mother Nurture facilitates Mother Nature, meaning that early life circumstances and both biological programming (before birth) and biological embedding (which relates to issues after birth) are heritable. Epigenetic mechanisms, which are heritable changes that are not due to alternations in the DNA, can transmit biology intergenerationally without genetic changes (Bezruchka, 2015).

Poorer people have poorer-functioning organs. This is easily demonstrated for the lungs by measuring how much individuals can blow out in one second (the medical term is FEV1). The lower someone is in the socio-economic hierarchy, the less air they can blow out. This observation is independent of the usual factors hypothesized to be responsible (Hegewald & Crapo, 2007). It's important to remember that the sociobiology described here does not imply that those lower down the hierarchy are inferior beings in the sense of Thomas Malthus. Rather, psychosocial and other mechanisms that are a *result of living in unequal societies* have profound and lasting biological effects on our health.

NATURAL EXPERIMENTS IN POPULATION HEALTH EPIDEMIOLOGY

Just as John Snow could observe the decline in deaths from cholera after he removed the pump handle, which boosted his belief in the hypothesis that there was something in the water that caused the disease, we can be reassured by experiments that change the factors producing population health.

Agriculture

There is ample evidence that human health was better before the advent of agriculture than after domestication of crops and animals began (Cohen, 1991). In early hunter-gatherer societies, vigilant sharing was a critical social value. They had few, if any, possessions, and

Box 1.2: Some Methods Used in Epidemiology

- Observational ecological studies
- Cohort studies
- Cross-sectional study
- Multi-level modelling (requiring powerful computers)

the key resource that was shared with everyone, whether they were related or not, was meat from an occasional big game kill. Given food, shelter, and safety sufficient to sustain health, everyone had the same level of resources. But with the development of agriculture, a food surplus could be produced. Some individuals proclaimed themselves lord or master and coerced others to produce food for them, build castles, and protect them. As a result, caring and sharing declined, exploitation of the weaker by the stronger became the norm, poverty appeared, diets changed, and food variety declined (Larsen, 1995, 2006). Famines began.

Living in close proximity to domestic animals also resulted in many infectious organisms jumping to new hosts to produce human disease. The nature of human relationships changed as exploitation began. Throughout recorded history until the 19th century, the health of human populations has been less than that of primitive societies.

Most of the increases in life expectancy beginning in the 19th century came from reductions in early life mortality. The more recent improvements in health affect older people and depend on forms of societal redistribution that favour poorer people, along with technological changes that have an impact on improved living standards. Much of the redistribution has been done by governments through taxation. Piketty (2014), in *Capital in the 21st Century*, presents a graph of tax revenues as a percentage of national income from 1870 to 2010 for Sweden, France, the United Kingdom, and the U.S. They were relatively stable until early last century, when Sweden rose to command the most tax revenue at almost 55% of income, and the U.S. plateaued at 30%. The Swedish government prioritizes social spending, which is considerably greater than in the U.S. They provide generous paid family leave and spend more government funds on the first year of life than in any subsequent year. In the United States, government funds go to remedial processes in later childhood that are less effective. Better health can result more from early life government policies favouring social justice directed at populations than from individual or non-governmental actions.

Japan at the End of the Second World War

Japan became the healthiest country in the world in part because of economic policies resulting from the U.S. occupation of that country after the end of the Second World War (Bezruchka, Namekata, & Sistrom, 2008). The post-war "medicine" was administered by perhaps the world's greatest population health doctor, General Douglas MacArthur. It had three ingredients. The first was demilitarization: Japan was forbidden to have an army and had to resolve disputes peacefully, as specified in the constitution that MacArthur wrote. The second ingredient was democratization. Everyone got the vote, and labour unions obtained the right to organize and bargain collectively. A public health clause in the constitution required the government to do all it could to improve health. MacArthur legislated a maximum wage of 65,000 yen per year. The final ingredient was decentralization. The concentration of wealth and power that existed in pre-war Japan was broken up, and the most successful land-reform program in history was carried out.

With the dismantling of Japan's hierarchy, the resulting improvement in health was unequalled in any country in the world in history in a comparable period. Japan's health is better than that of many other nations with comparable income gaps. An important factor that allowed the "medicine" to work was the underlying culture of *wa,* or social harmony. Collectivist cultures with less inequality and a Confucian dynamism will have better health than more individualistic ones with greater social distance among society members that is accepted by the people (Hofstede & Hofstede, 2005).

We have already discussed Japan's good health status despite its having a high proportion of men smoking cigarettes. High prevalence of smoking is also found in many Western European nations that, nevertheless, have favourable mortality results. This is an example of the importance of context for behaviours and other health outcomes. One cohort study has compared civil service workers in the United Kingdom with those in France and examined early life circumstances affecting adult mortality outcomes. The patterning of health-related behaviours and association with the socio-economic gradient demonstrated that the steeper the gradient (as in the U.K. compared to France), the more smoking, physical inactivity, and diet impacted health, especially for those of lower socio-economic status. One recent study contrasted the impact of smoking on health in the United States with Finland. Death risks from smoking were 50% higher in U.S. women compared to those in Finland (Mehta et al., 2017). Such research challenges the concept that risk factors such as smoking are the same in different populations.

Japan represents a case study where rapidly decreasing inequality had profound good effects on population health. What happens when inequality increases rapidly?

The Former Soviet Union

Countries of the former Soviet Union demonstrate what can happen when huge hierarchies are created overnight (Wilkinson, 2005). Russia was a very hierarchical society during the tsarist period and lagged about 25 life-expectancy years behind the U.S. in 1900. The centrally controlled, or command, economy in Russia dismantled the extreme wealth gap, and by 1960, the two countries had comparable female life expectancy. Health gains in Russia faltered in the 1970s and 1980s as its people felt deprived of the apparent wealth of the West, as depicted by outside media. Infant mortality began increasing in parts of the Soviet Union in the 1970s. This observation prompted Emmanual Todd (1976) to predict the collapse of the Soviet Union. With the dismantling of the former Soviet Union in 1991, fabulous wealth was created so that Russia now has the fourth-largest number of billionaires in the world (behind the U.S., China, and India), while 25 years ago it had none.

As the gap between rich and poor grew astronomically, health in Russia declined, something that had been unprecedented in the modern world (Parsons, 2014). Life expectancy in Russia had dropped about seven years for men and somewhat less for women. The decline then abated and reached pre-breakup levels, but the carnage has resulted in 20 million deaths that would not have occurred if health had remained at pre-dissolution levels. The gap between rich and poor in Russia today is greater than it was during the tsarist period.

Box 1.3: Health Care and the Public's Health

Whenever it has been studied, medical care is always one of the leading causes of death (Starfield, 2000). In studies of doctors' strikes, the common finding is that mortality does not increase. In fact, it tends to go down (Cunningham, Mitchell, Narayan, & Yusuf, 2008). The public believes that postmodernism doesn't apply to medical science. Perhaps half of what is believed to be true in medicine is not. Primary care may be the best part of medical care. Countries that have less of a specialist focus on healthcare services tend to have better health. Always ask: "Do you want health or health care?"

Canada–U.S. Health Divergence

Canada is considerably healthier than the United States, although it is less wealthy and spends much less on medical care. Comparisons of the two nations' population health allow us to demonstrate the political situations that have created inequalities responsible for this difference. In the 1950s, life expectancies in the two nations were almost the same (Figure 1.5). Health in Canada then improved more rapidly than health in the United States. For working-age men today, for example, mortality rates in Canada are almost half of what they are in the United States.

Most American medical students are unaware of the extent to which health in the U.S. lags behind that of other wealthy countries (Agrawal et al., 2005). It is astonishing that citizens in the world's wealthiest and most powerful nation seem to accept dying much younger than they should. Remarkably, the U.S.'s inferior performance in many international comparative measures, such as teen birth rates, youth homicides, incarceration, child poverty, and poor educational performance, does not inspire their citizens' desire to do better. The United States was founded on a weak form of government, so individuals must rely on one another for support. The U.S.'s form of government was, by design, with its separation of powers and lack of a parliamentary system, not very responsive to the popular will (Kingdon, 1999).

Canada's government was more receptive to public opinion and engineered a social compact with more generous welfare provisions. Social expenditures have been higher in Canada and performance on many social indicators much better than in the U.S.

The United States undertook redistribution programs after the Great Depression to reduce the wealth of the richest 1% of Americans by 1975 to be roughly half of what it was in the Gilded Age. However, the rich and powerful have regained their wealth share through mechanisms such as limiting worker wage increases. The result has been requiring the citizenry to borrow their salaries from home equity and credit cards. The rich have also gained massive government support for their financial interests, and public welfare programs have been eroded. The result has been huge increases in inequality and the global economic collapse of 2008.

Canada, on the other hand, has continued to provide many social-welfare services as a part of government responsibility. These included low-cost education, subsidized housing, efficient public transportation systems, and universal medical care. Canada remained one of the world's healthiest nations until this century, when eroding government policies began to favour the rich. Income inequality increased in Canada in the 1990s, after which that trend levelled off and is now considerably below that of the United States. Canada stands in the middle of the collective–individual divide represented by Western Europe and the United States. Trends in the health differences between the U.S. and Canada in the coming years will depend to a large extent on how responsive governments are to the needs of their populations as they grapple with neo-liberal economic issues and their long-term global repercussions (Siddiqi, Kawachi, Keating, & Hertzman, 2013).

Racism remains a major barrier to achieving full health in Canada, the United States, and elsewhere. Indigenous populations almost always have higher mortality than settlers, and Aboriginal peoples in both Canada and the U.S. face stark health inequities. Race, which is essentially a social construct, leads to many forms of racism that have been given more critical attention in recent years. The negative effects of racism are likely programmed in early life. For example, black infant mortality rates are almost 2.5 times higher than that of whites in the United States, and black women have four times the maternal mortality of whites there. The stress of racism is likely a major contributing factor. Immigration has its own stresses that affect health. Minority Canadians, whether native-born or immigrants, have lower incomes and vastly lower wealth than whites, a trend that remains true for minorities globally. While Canada prides itself on fostering multiculturalism, systemic racism has yet to be fully addressed.

Box 1.4: Power, Inequality, and the Physical Environment

Cross-sectional studies among U.S. states find that shared political power, less income inequality, strong environmental regulations, and better quality of the environment are associated with better health outcomes. Political power is measured by voting rates, tax fairness, Medicaid accessibility (meaning healthcare services for the more impoverished), and educational attainment (Boyce, Klemer, Templet, & Willis, 1999). Green space exposure in England has been linked to income inequality and mortality differences. Those living in greener environments have less inequality in health outcomes. Economic inequalities translate to less healthy physical environments, just as they do to disadvantaged social ones (Mitchell & Popham, 2008). Recovery in hospitals has been linked to a patient's window providing a bucolic view. This suggests that psychosocial factors team up with physical ones to produce health. Increasing economic growth above $5,000–$10,000 per capita increases the ecological footprint, indicating further strain on the environment, with no health benefits (Rainham, 2007).

The current global migrant and refugee crisis will continue to test governing systems as long as global inequality continues to increase. Populism is leading to strong-men leaders who garner popular support by trying to keep immigrants out and by suppressing dissent as well as creating conditions for an endless term in office. Rising inequality is the upstream factor as countries of birth determine economic prospects.

CONCLUSIONS

Producing health in populations requires attention to the upstream determinants of health. To achieve population health, policies and practices that promote caring and sharing need to be operationalized and will need to transcend state boundaries. Such systems must prioritize early life.

A positive and action-oriented approach to producing health would be to publicize and act upon what is known regarding the poor health status of countries such as the U.S., which have large gaps between the rich and poor, relative to other rich countries. These gaps result from political policies that do not promote economic justice. Canadian policies that result in increases in the gap between rich and poor will move Canada toward U.S. outcomes. If Canadians want a healthier population, the government can take policy steps that further social and economic justice. The first step is to create awareness of what conditions produce health in populations, and then promote policies to ameliorate those conditions (Bezruchka, 2009).

CRITICAL THINKING QUESTIONS

1. What can you do personally to engage communities to help them understand population health issues concerned with histories of exploitation, current economic inequality, and adversity in early life to foster better health?
2. A recent threat to Canada's social compact has eased, but voter turnout has declined from the levels seen in the 1960s. What can be done to maintain a well-functioning democracy that works for improving health?
3. How can societies distinguish health and health care to foster understanding of the limited role of health care in producing health? Why is producing health so focused on changing individual behaviours?
4. Given the importance of poverty, inequality, and racism in affected population health, how can one maintain a focus upstream while working at a downstream job?
5. How does economic inequality affect you?

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Wilkinson, R. G., & Pickett, K. E. (2009). *The spirit level: Why more equal societies almost always do better.* London: Allen Lane.
A paradigm-shifting book on how more equal societies do better for people and the planet.

Wilkinson, R. G., & Pickett, K. E. (2018). *The inner level: How more equal societies reduce stress, restore sanity and improve everybody's wellbeing*. London: Allen Lane.
A companion to *The Spirit Level*, this volume explores diverse psychosocial impacts of inequality. The authors start out stating this is not a self-help book but one to galvanize required changes in societies.

RELEVANT WEBSITES

Black Doll White Doll
https://www.youtube.com/watch?v=tkpUyB2xgTM
https://www.youtube.com/watch?v=QRZPw-9sJtQ
A telling depiction of skin colour preferences in early life in both the USA (first) and Italy (second).

Conference Board of Canada—How Canada Performs
https://www.conferenceboard.ca/hcp/
Comparisons of health and inequality outcomes for Canada with nations and among Canadian provinces.

Equality Trust
https://www.equalitytrust.org.uk

Primarily focused on inequality in the United Kingdom, but very relevant for other parts of the world.

Gapminder
https://www.gapminder.org

A treasure trove of data, charts, and animations on inequalities around the world.

Innocenti Research Group publications
http://www.unicef-irc.org/

This branch of UNICEF presents a host of research compilations that includes report card comparisons of child indicators among rich nations. Search their publications and Publications Series for the Innocenti Report Card.

Institute for Health Metrics and Evaluation
http://www.healthdata.org/results/data-visualizations

A continually evolving treasure trove of data depicting trends and outcomes for various health and healthcare measures. With the mortality visualization, one can make comparisons of child and adult mortality for various countries and among regions within some countries.

UCLA: John Snow
http://www.ph.ucla.edu/epi/snow.html

A look at the profound influence this man has had on the subject of epidemiology.

Population Health Forum
http://depts.washington.edu/eqhlth/

The Population Health Forum's mission is to raise awareness and initiate dialogue about the ways in which political, economic, and social inequalities interact to affect the overall health status of our society. Ranking of countries in the health Olympics are depicted, as well as links to various studies, readings, and broadcasts.

Primary Care Interventions in Poverty
https://ocfp.on.ca/cpd/povertytool

An Ontario family medicine site that looks at what physicians can do about poverty.

Public Health Agency of Canada
https://www.canada.ca/en/public-health/services/health-promotion/population-health/what-determines-health/what-makes-canadians-healthy-unhealthy.html

Much useful material on determinants of health that stands in stark contrast to U.S. government information.

Public Health Sudbury and Districts
https://www.phsd.ca/health-topics-programs/health-equity/health-equity-resources

An example of a public health jurisdiction communicating the difference between health and health care.

Raising of America
http://www.raisingofamerica.org/

A documentary series looking at early life issues concerning the United States but with relevant, actionable material for the rest of the world.

The Last Straw Board Game on the Social Determinants of Health
http://www.thelaststraw.ca/

Designed by a McMaster University medical student and a University of Toronto graduate student, this board game provides an entertaining way to consider concepts in this chapter. Available in English, French, and Spanish.

GLOSSARY

Controlling for a factor: Statistically adjusting in the analysis for a variable (factor) so that this factor has no impact on the outcome one is studying.

Infant mortality rate: The proportion of infants born that die in their first year of life, usually expressed per 1,000.

Life expectancy: The average number of years lived by a population if the age-specific mortality rates in place when the calculation was done continued until everyone had died.

Population health: A term that distinguishes what makes populations healthy as opposed to public health, which tends to mean a select group of interventions, such as immunizations, disease screening, prenatal care, and health education for behaviour change.

Social determinants of health: Variously defined as the conditions under which people are born, grow, live, work, and age. Determinants of health would add effects of health care.

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