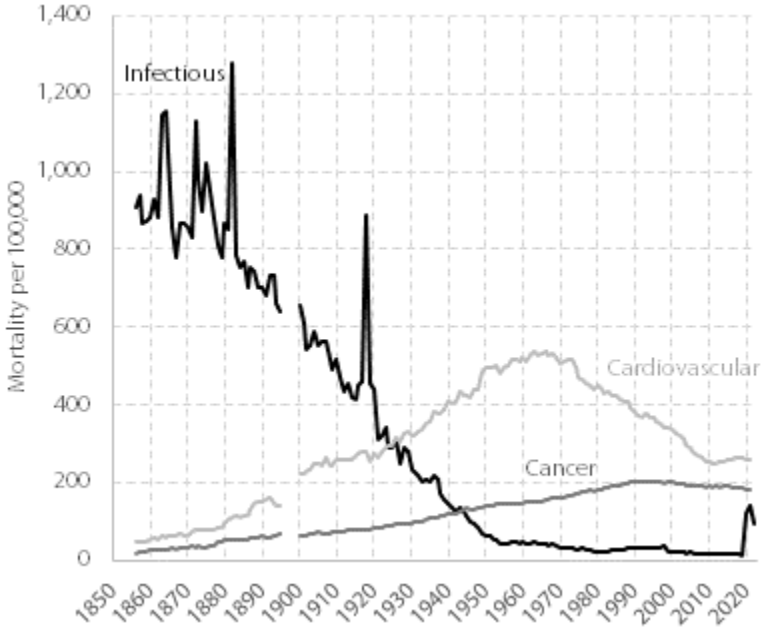
Chronic Diseases

Over recent centuries, the world has gone through a profound transition in terms of what kills us. We have increasingly won the battle against infectious diseases that used to kill most people. As our life expectancies have grown, the leading cause of death worldwide has become noncommunicable diseases, known as chronic diseases or NCDs. Infectious diseases still plague the poorer half of the world, and the chapters on malaria, tuberculosis, and childhood immunization document very efficient policies for these diseases. However, even in low- and lower-middle-income countries, more people now die from chronic diseases, and smart policies to tackle heart disease and the impacts of tobacco and alcohol use turn out to be a very efficient way to save 1.5 million lives annually.

Out of the age of pestilence

Worldwide, the most likely cause of death today is some form of chronic degenerative disease, particularly cancer or heart disease. This shift, known as the epidemiological transition, first hit rich countries and is now moving through poorer ones. We can see the dramatic change in the USA very clearly in Figure 11.1, which shows the mortality rates for infectious and chronic diseases using early data for one of the oldest states, Massachusetts, and then national data from 1900.



Sources: Massachusetts, US 1900-1998, US 1999-2019.[i] US 2020-21, Covid just for 2022.

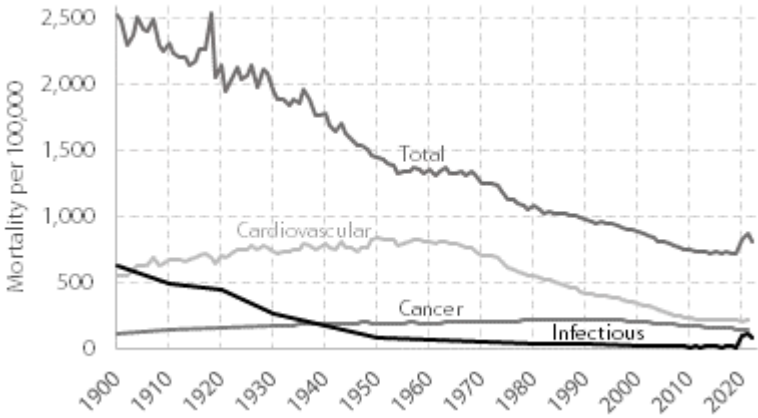
Figure 11.1 Death rate of infectious diseases, cancer, and cardiovascular disease (such as heart attack and stroke), Massachusetts 1856–1895, USA 1900–2022.

In the mid-1800s, the infectious disease burden was immense. Every year, almost 1% of the population (1,000 out of 100,000 people) died from infectious diseases, including smallpox, measles, scarlet fever, diphtheria, typhoid, dysentery, and especially consumption, or as we would know it today, tuberculosis. This meant that infectious diseases caused almost half of the deaths. It's possible that infectious diseases killed even more people than noted here because statistics back then left many deaths unexplained or provided only vague descriptions. In Massachusetts, only about 60% of all deaths were given a cause.

Sources Massachusetts 1850-1895[ii], US 1900-2018, 2019, 2020, 2021. Life expectancy in 1900 overlaps almost exactly for Massachusetts and the USA.

Figure 11.2 Life expectancy at birth, Massachusetts 1850–1900, USA 1900–2021.

Meanwhile, there were almost no recorded deaths from cardiovascular disease or cancer in the early decades pictured in Figure 11.1, although today, those are the two leading causes of death worldwide. This may be partially due to that practice of vaguely describing deaths—those attributed to causes like "old age," "senility," or "brain disease" may really have been the result of cancer or heart disease. But the overall trend remains clear, and the data is much more robust after 1900. Americans and other residents of rich countries used to die overwhelmingly from infectious diseases but now rarely do. There are exceptions, such as during the outbreak of the Spanish Flu in 1918 and Covid in 2020-22, but even during Covid, the primary killers in the USA were cardiovascular disease and cancer.



Sources: Heart, cancer, infectious men and women, total, with updates from CDC and CDC. Notice that infectious disease numbers are decadal until 2000, so they are missing the 1918-spike.

Figure 11.3 Death rates of infectious diseases, cancer, and cardiovascular disease and total death per 100,000 for the USA 1900–2022, standardized to the 2000 US population.

As infectious disease has dropped much more than cancer and heart disease has increased we live longer. We can see this in Figure 11.2, which shows the average American life expectancy (using Massachusetts up to 1900). In 1850, it was just over 39 years, reaching 47 years by 1900. Today, even with life expectancy dragged down by 2021 death rates impacted by Covid, the average American is expected to live to 76.1. Even that small decline will likely be regained with

Covid receding. In 1918, when the Spanish Flu hit hardest, the average life expectancy fell almost 12 years from 51 years to 39 years but jumped back to 55 years in 1919.[iii]

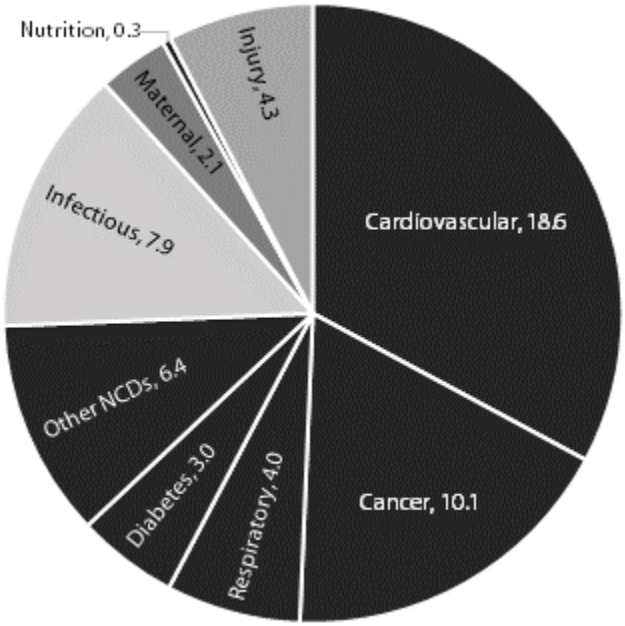
When seeing the massive increase in cancer and heart disease over the 20th century in Figure 11.1, it is easy to become concerned. However, this increase mainly reflects that we are growing older and that cancer and heart diseases afflict older people more. If we keep the age distribution of the population constant at the year 2000 (a relatively older population), we see the death rates in Figure 11.3. This shows that adjusted for age, most of the increase in cancer and heart disease goes away, and indeed, cancer has been declining for decades and heart disease for over half a century.

The slight increase in heart disease in the early part of last century likely has three causes: Better registration, a significant reduction in competing causes of death like infectious and diarrheal diseases, and—most importantly—the dramatic increase in smoking over the 20th century.

Overall, for the world, this is a very positive story. In the rich world, we have been able to conquer most infectious diseases. Even cancer and heart diseases are declining for any given age group. As the poorer half of the world goes through the same transition, there are a set of very efficient policies that could achieve these gains here, too.

Fighting the last century's battles

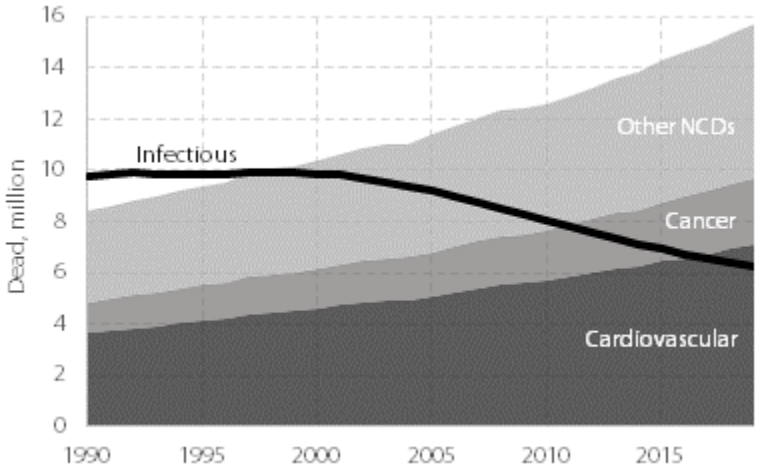
Chronic diseases killed 42 million people worldwide in 2019, accounting for three-quarters of all deaths, as seen in Figure 11.4. A mere 14% are caused by infectious diseases.



Source: Noncommunicable diseases consist of cardiovascular disease (heart), cancer, chronic respiratory diseases, diabetes, and many other NCDs like digestive diseases, musculoskeletal disorders, and neurological disorders. Infectious diseases are often high in the same countries that have high maternal and newborn diseases and deaths from poor nutrition. Injury covers both traffic accidents (1.3 million) and other accidents (1.7 million), suicide (760,000), violence (415,000), and deaths from conflicts and terrorism (71,000).

Figure 11.4 Distribution of the world's 56.5 million deaths in 2019 according to Global Burden of Disease. Injury includes accidents, suicide, violence, conflicts and terrorism.

Even in low- and lower-middle-income countries, chronic disease deaths are now much more frequent than infectious disease deaths. Three decades ago, the total number of infectious disease deaths was larger than all chronic disease deaths, as seen in Figure 11.5. However, this changed after 1997, as infectious disease deaths declined and chronic disease deaths increased. Indeed, after 2011, cancer and cardiovascular disease alone killed more people than infectious diseases. After 2016, infectious disease deaths were outweighed by cardiovascular deaths alone.



Source

Figure 11.5 Number of dead from infectious diseases (line) and noncommunicable diseases for low- and lower-middle-income countries: 1990–2019.

Health spending, however, has not kept up with this transition in causes of death. While there are two-and-a-half times as many chronic disease deaths as infectious disease deaths, the former receives almost none of the external funding. In low-income countries, funding from external sources makes up almost 30% of health spending, but according to the latest WHO estimate, only 5% of it goes toward dealing with chronic diseases.

It's understandable why: Some investments in treating and preventing infectious diseases can be phenomenal, as the malaria, tuberculosis, and childhood immunization chapters in this book shows. But given the overwhelming number of chronic disease deaths in the world, it's worth exploring if *some* additional chronic disease spending options might be worthwhile.

The peer-reviewed paper on which this chapter is based finds that while many of the options for combatting chronic diseases deliver much less value for money than those dealing with infectious diseases, there are some very efficient policies to help people across the world.

The chronic disease SDG—still centuries away

Compared to other SDG promises, the target for chronic disease looks fairly unambitious at first glance. SDG 3.4 reads:

> By 2030 reduce by one-third pre-mature mortality from noncommunicable diseases (NCDs) through prevention and treatment, and promote mental health and wellbeing

It's worded so modestly because, as noted above, the rate of NCD deaths is likely to increase as the world works to eradicate infectious diseases, which the SDGs themselves vow to end. Some chronic diseases can perhaps be almost entirely avoided, but unless we discover immortality, all

we can do is make sure noncommunicable diseases kill people as late in life as possible. Hence, the promise to cut a third of *premature* deaths.

In the SDG promise, this is defined as the death of a person between the ages of 30 and 69 from a chronic disease. Before the SDGs were announced in 2015, that risk was 22.2% for people in low- and lower-middle-income countries. This risk should be down to 14.8% by 2030 if the SDG goal is met.

Instead, the risk of premature death from chronic diseases has *increased*.[iv] A new study in *Lancet* laments that "most countries have made little progress" toward hitting the SDG chronic disease target. In the poorer half of the world, even on an optimistic trend, the risk of premature NCD deaths in 2030 will be only a sliver smaller than it was in 2015. That means the poor half of the world would only reach the chronic disease SDG promise by 2203—almost two centuries late. Even if the world returned to its pre-COVID pace and maintained that pace for decades, we would reach the promised one-third reduction only in 2089.

Like so many other SDGs, we are failing. Fortunately, there is a set of NCD-related policies that could make a dramatic difference.

Best healthcare investments for NCDs

The peer-reviewed study for this chapter identifies two categories of effective policies to address chronic diseases. The first group consists of specific solutions for specific NCDs. The second group focuses on regulations designed to limit people's consumption of things that heighten the risk of developing a fatal chronic disease, particularly tobacco, alcohol, and salt.

In the first category, the study finds eight solutions that return more than $15 for each dollar spent. As you can see in Table 11.1, this is a minority of the 25 policies the study investigates, but some of the returns are fantastic.

According to the researchers' benefit-cost analysis, the best policy is a very simple one: Making sure that people on the verge of a heart attack can take aspirin, a medicine that counteracts blood clots. This is cheap (only $0.04 for a pill and 10 minutes of a nurse's time, or about $1 by the study's analysis), and it would save 2,900 lives per year. Unfortunately, that total is quite small. This is because this solution requires that the person having the heart attack is near a health provider at the time.

However, the study also identifies some really efficient policies that have large impacts. In particular, the treatment of chronic heart failure with cheap medication and the primary prevention of heart disease can save many lives at a low cost.

The second-best policy is the treatment of chronic heart failure with 'water pills' (diuretics) to help the kidneys get rid of unneeded water and salt, making it easier for the heart to pump. Along with other relatively cheap pills like beta-blockers provided on an outpatient basis, these can delay death by an average of about six years for almost 350,000 people every year. An annual investment of just over half a billion dollars would yield 41 times as much in return.

One of the main reasons that cardiovascular risk has dropped so much in high-income countries (see Figure 11.3) is because cheap medication that reduces blood pressure is used much more. Achieving a similar drop in the poorer world could deliver huge benefits. Community screenings for high blood pressure cost as little as $1 per person, and the prescription of blood pressure medications often cost only $3-11 per year. In a few instances, the cost can rise to a total of $48,

which includes one annual lab test ($5) and two outpatient visits per year (at $8 each) to adjust medication. The peer-reviewed paper finds that controlling high blood pressure in the poorer half of the world could save almost a million people annually over the rest of this decade. It would cost about $3.5 billion a year, delivering $16 back on each dollar spent.

Table 11.1 Best to worst chronic disease interventions across all low- and lower-middle-income countries with a line separating policies with a BCR higher than 15. Average annual cost and deaths avoided over 2023–2030.

	Cost	BCR	Deaths avoided
Aspirin for suspected heart attack (ACS)	3	63	2,949
Heart failure chronic treatment	551	41	346,556
Treatment of early-stage breast cancer	20	39	7,130
Epilepsy: Acute and chronic treatment	220	32	8,297
Injection drug use harm reduction measures	119	30	3,647
Depression: Chronic treatment	141	23	2,819
Pulmonary rehabilitation	52	21	16,528
Cardiovascular disease: Primary prevention	3,467	16	931,401
Heart failure: Acute treatment	4,096	12	756,387
Management of appendicitis	116	8	5,705
Medical management of heart attack	2,185	7	262,231
Asthma/COPD: Acute treatment	3,641	6	288,465
Cardiovascular disease: Secondary prevention	6,864	6	640,195
Repair of gastrointestinal perforations	35	4.4	1,744
Cervical cancer screening and treatment	1,522	4.2	57,989
Management of bowel obstruction	1,488	3.1	38,304
Treatment of early-stage colorectal cancer	160	3.0	5,855
Alcohol use screening/brief intervention	1,314	1.8	8,340
Management of acute ventilatory failure	147	1.6	3,217
Schizophrenia: Chronic treatment	763	1.4	23
Asthma/COPD: Chronic treatment	1,659	1.2	18,032
Repair of hernias	6,797	1.0	25,559
Unclogging heart arteries	1,474	1.0	19,132
Bipolar disorder: Chronic treatment	2,425	0.8	84
Diabetes: Screening and treatment	20,124	0.6	103,882

Source: Costs are in a million 2023 US dollars, and both costs and deaths avoided are yearly averages across the eight years from 2023 to 2030. Detailed descriptions of the different interventions can be found in the online appendix of the Lancet NCD article.

One other measure that stands out in Table 11.1 is the treatment of chronic depression. The SDGs only mention mental health once in the NDC target mentioned above, which uses very vague terms. But it's an increasingly serious problem. Unlike declining risks from most diseases, mental health risks are increasing globally, including in low- and lower-middle-income countries. Although, statistically, mental illness leads to deaths relatively rarely, the disease mars

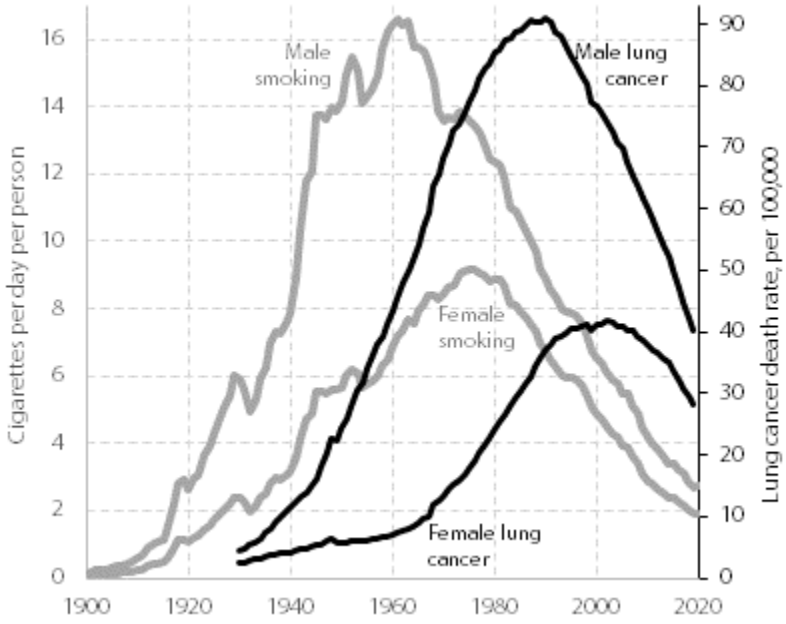
the quality of life for many—globally, depressed people constitute 5% of the burden of disease and 4% in low- and lower-income countries.

Happily, there are new, cheap medications available that can substantially relieve depression. In addition to improving patients' quality of life, such medications make it much easier for people to work productively and function in society. With an investment of little over $140 million annually, the use of this medication in poorer parts of the world could generate an excellent social benefit-cost ratio of 23.

Low- and lower-middle-income countries should consider investing in all the effective policies listed in the upper part of Table 11.1. However, they should also weigh employing regulatory approaches that turn out to be enormously efficient.

A tobacco tax can smoke lung cancer

At least since the 1960s, people have known that smoking kills. The data in Figure 11.6 most convincingly shows how the dramatic increase and then decrease in smoking in the USA is matched by an increase and decrease in lung cancer three decades later.



Source: Update of figure 120, with new cancer rates from NCHS and updated statistics on cigarette consumption.

Figure 11.6 Number of cigarettes smoked per adult man and woman in the USA, 1900–2020, lung cancer death rate for men and women in the USA, 1930–2019, age-adjusted to 2000 population.

Prior to the early 20th century, very few people smoked, and lung cancer was a rare disease. The USA had perhaps 140 annual cases. However, starting in the early 1900s, the number of American men who smoked began to rise quickly, helped by the free cigarettes distributed to soldiers during both World Wars. Later in the century, the number of female smokers also began to rise, although less substantially.

A massive rise in lung cancer deaths followed. By the time male rates peaked in 1991, it was by far the biggest cancer killer for men, taking the lives of 90 of every 100,000. When female lung cancer deaths peaked in 2004, it was similarly the most deadly cancer for women. As smoking

decreased, cancer rates began declining some three decades later, but today lung cancer still kills 136,000 Americans each year.

In addition, smoking causes a variety of other health problems, including other cancers, heart diseases, strokes, lung diseases, diabetes, and chronic obstructive pulmonary diseases, along with increased risk for tuberculosis and rheumatoid arthritis. In total, tobacco causes about 550,000 deaths in the USA each year. Worldwide, it kills 8.7 million people annually, mostly claiming the lives of smokers but also 1.3 million people who simply inhaled the smoke secondhand. In low-income countries, tobacco kills half a million people, and in lower-middle-income countries, it causes 2.6 million annual deaths.

The research paper finds two very effective ways to reduce the death toll from smoking. One is through a simple tobacco tax. The other is tobacco regulation, which can include bans on advertising and smoking in public places. Both produce excellent benefits for their costs.

The World Health Organization recommends a tobacco tax that makes cigarettes at least four times costlier than their production costs. This has two benefits, although the research paper ignores the second. First, a tobacco tax makes smoking more expensive, which means that more young people will never start, more smokers will stop or reduce their consumption, and there will be fewer secondhand smoking deaths. Second, a tobacco tax raises large and reliable funds for the government (even as some smokers give up), something that many governments in the global South struggle to secure.[1]

We know from many real-world examples that higher taxes reduce tobacco consumption. Between 2006 and 2011, for example, Brazil hiked its cigarette excise tax rate, which led to a 34% rise in the cost of a pack of cigarettes. Tobacco use among adults dropped by around 19%. In 2012, Brazil followed this up with further tax increases; by 2016, real cigarette prices had risen by another 33%, and adult tobacco consumption had dropped by almost half again.

Surprisingly, the evidence suggests that higher cigarette taxes do not lead to much of a rise in the trade of illicit cigarettes.[v] Even with slightly more smuggling, most of the benefits remain, and they are immense.

The cost of implementing a tobacco tax, meanwhile, is quite small–it only constitutes the cost of the legal change, administration, and enforcement.

Table 11.2 Overview of tobacco, alcohol, fat, and salt regulations and taxes for all low- and lower-middle-income countries. Average annual cost and deadweight loss in million dollars, and avoided deaths over 2023–2030.

	Cost	Loss	BCR	Deaths avoided
Tobacco tax	10	113	101	194,193
Tobacco regulations	5	24	92	41,167
Alcohol regulations	6	14	76	19,091
Alcohol tax	7	6	53	9,032
Trans fat regulations	57	3	40	38,937
Salt regulations	94	4	36	58,664

[1] Often funding for crucial government programs comes from more volatile sources, which makes it harder to run an efficient state. These are frequently much more distorting taxes such as taxes on imports.

Raising the tobacco tax across low- and lower-middle-income countries to four times the production cost is estimated to have a total price tag of just $10 million per year, as seen in Table 11.2.

However, dramatically increasing the taxation on smokers has additional costs. The full cost of the tax is not a cost from a welfare point of view: the money is not used; it is a straight transfer and could be compensated with a reduction in other, more distortionary, taxes.

However, taxation incurs what economists call a *deadweight loss*. This is the social loss that occurs when the increased tobacco tax makes smokers lose more than the public coffers gain. In other words, it essentially measures the loss of enjoyment when some smokers are forced by price rises to smoke less or give up. We can measure this loss because it is the number of cigarettes that used to be sold at the lower price but not at the higher price—the loss of enjoyment for each cigarette is, therefore, somewhere between the lower and higher prices.[2]

In total, this cost turns out to amount to over $110 million per year over the rest of the decade, as can be seen in Table 11.2.

However, the benefits from a tobacco tax are vastly higher than this cost, averting more than 194,000 deaths each year. The benefit-cost ratio is spectacular for each dollar of loss and cost of regulation: The return is $101 for social benefits.

Although tobacco regulations save fewer lives (only 41,000), they carry a lower total cost and still have a very strong benefit-cost ratio. Regulation only takes $5 million in administrative costs and $24 million in deadweight loss per year. The total benefits vastly outweigh these costs, resulting, overall, in a spectacular benefit-cost ratio of 92.

Cutting problem drinking

Alcohol consumption takes the lives of around 3 million people each year, and three-quarters of those killed are men.[vi] In low-income countries, alcohol kills 300,000 people annually, and in lower-middle-income countries, it kills 1.6 million.[vii] It contributes to a large number of diseases and globally causes almost 700,000 accidental deaths as well as 250,000 intentional deaths.[viii]

Alcohol also increases the risks of sexually transmitted infections and clearly affects non-drinkers, including victims of alcohol-related homicides, spousal and child abuse, traffic accidents, and assaults.

The researchers estimate that regulating alcohol availability at a fairly low cost, including the deadweight losses to drinkers, can reduce alcohol consumption and avert 19,000 deaths annually. Each dollar spent will deliver $76 of social benefits, mostly by averting deaths. An alcohol tax similarly can generate large, if lower, benefits at $53 back on the dollar.

Salt reduction

Salt is the most used condiment globally, and most of us consume unhealthy amounts.

According to the WHO, we should consume a little less than one teaspoon of salt each day (5 grams or about one-sixth of an ounce). Almost everywhere in the world, people consume much

[2] If the value were lower than the low price, the cigarette wouldn't have been bought even at the lower price. Similarly, if the enjoyment were higher than the new price, the cigarette would (albeit grudgingly) still be bought.

more. Globally, we consume, on average, about twice as much, and our intake has likely gone up slightly over recent decades.

This excessive salt intake leads to high blood pressure, heart disease, and stroke and likely causes almost two million deaths each year.

Most of our salt intake comes from processed foods. Unlike when we prepare our own meals, we are often unaware of how much salt processed food contains and have no opportunity to simply add less. In the USA, 70% of the salt people eat comes from food prepared outside their homes.

One of the most effective salt reduction programs in the world has been in the United Kingdom. It gradually changed the salt content of more than 80 food categories produced by the food industry. Over four years, this strategy successfully lowered salt intake by at least 16%, yet consumers did not notice the difference. In Finland and Poland, similar salt reduction campaigns have reduced the prevalence of stroke by 10% and 23%, respectively.

This chapter's paper estimates that the costs of enforcing these changes will be quite substantial at more than $90 million per year (with very small deadweight losses), but this approach could avoid almost 60,000 deaths per year, delivering $36 of social benefits for each dollar spent.

Reaching the SDG target *completely* would be very expensive

All the above efficient chronic disease policies should be implemented, but this will only get us about halfway to fulfilling the chronic disease promise in the SDGs.[ix]

Interestingly, the paper gives us an opportunity to see how much it would cost to fully achieve the promise. It would require a much broader set of policies, and all of them would be less cost-efficient than the ones recommended here. Some of the resources would be spent on acute heart failure treatment, which still delivers $12 back on the dollar (see Table 11.1). But some would be spent on diabetes treatment, which inefficiently delivers only 60 cents in benefits per dollar spent at a yearly cost of over $20 billion.

The combined, efficient chronic disease policies described above deliver 1.5 million saved lives for $4.4 billion. Forcing the world to achieve the full SDG promise would provide about the same number of saved lives again but at more than 12 times the cost. Not surprisingly, this is a much less attractive policy.

The additional policy will deliver less than $3 back on the dollar, yet cost almost twice as much as *all* the policies recommended in this book, which deliver $52 back on the dollar. Each dollar spent here first would forego benefits of $49 for humanity. It shows how important it is to not spend too much on any one policy before we have completed all the most efficient policies.

However, we should implement all the efficient policies this chapter's paper finds to have a benefit-cost ratio of $15 or more. This will cost $4.4 billion annually but allow us to make a significant impact on chronic diseases, save 1.5 million lives each year, and deliver a remarkable $23 back on each dollar spent.

The academic paper is entitled "Best investments in chronic, noncommunicable disease prevention and control in low- and lower-middle-income countries" It is authored by

David Watkins, University of Washington
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The data and texts in this manuscript are not finalized. Intended use is for finding references, links and sources for the finalized text of the book Best Things First.

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[i] There is a drop in definition of pneumonia/influenza from ICD9-10 1999-2000, also see here.
[ii] p. 56, https://fraser.stlouisfed.org/files/docs/publications/histstatus/hstat1970_cen_1975_v1.pdf
[iii] p. 55, https://fraser.stlouisfed.org/files/docs/publications/histstatus/hstat1970_cen_1975_v1.pdf
[iv] Figure 2 in the best investment paper
[v] Fig 15, http://bit.ly/2VcpIG9, https://www.bloomberg.org/public-health/building-public-health-coalitions/task-force-on-fiscal-policy-for-health/
[vi] P. xv, https://www.who.int/publications/i/item/9789241565639
[vii] p. 82, https://www.who.int/publications/i/item/9789241565639, https://data.worldbank.org/indicator/SP.POP.TOTL?locations=XM-XN, 42.1/100,000*750 million is 316,000 and 46.2/100,000 * 3.4 billion is 1.57 million.
[viii] Using 8 billion global inhabitants, and 8.3 and 3.1 risk factors, p. 82, https://www.who.int/publications/i/item/9789241565639,
[ix] Interpreted as halving the low- and lower-middle-income country NCD-specific 40q30 percentage by 2030.