YOUR MONEY
OR
YOUR LIFE

STRONG MEDICINE FOR AMERICA'S HEALTH CARE SYSTEM

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THE HEALTH OF THE NATION: A HISTORY

BEFORE WE CONSIDER THE HEALTH care system, we need to agree on what we mean by health. Health is a slippery term—an idea easy to perceive but difficult to define. Good health enables us to live a vigorous and happy life. But what that involves changes over time. When life was spent being chased by saber-toothed tigers, good health meant being able to run and hide. Today, it may involve a positive feeling of self and the ability to use a computer keyboard. These multiple dimensions of health make health measurement difficult.

The easiest part of health to measure is length of life. A population that lives longer is healthier than one that does not live as long. Mortality has declined steadily in the United States since 1900—and likely since at least 1800.[1] The decline in mortality has been continuous, except for a decade or so beginning in the mid-1950s (a period I will discuss shortly).

A more natural metric of health than mortality is life expectancy, the average number of years that a person can expect to live. Given the mortality rates prevailing at the time, the typical baby born in 1900 could expect to live to about age 45.[2] Today, life expectancy is closer to 80, a dramatic improvement by any standard.

The overall trend toward longer life masks important changes in the source of longer life.[3] From 1800 until about 1940, reduced mortality was almost entirely the product of reduced infant and child mortality. In 1900, one in five infants died before age ten. By the

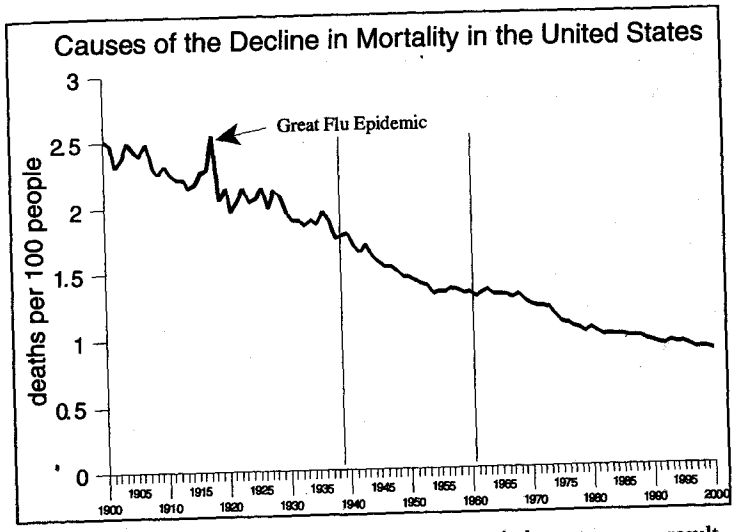
mid-twentieth century, infant and child death was less than half as common. By contrast, life expectancy for those who survived the early years of life increased only slightly in this period.

The tragedy of high infant and child mortality around 1900 was a subject of great concern. Late in the 1800s, a leading French physician lamented: "Is it not humiliating for our country and for our generation that, in spite of public and individual hygiene, the mortality among the newly born is such that one can say, without fear of contradiction, that an infant just born has less chance than a man of ninety of living a week, and than an octogenarian of living a year?"[4]

Infant and child mortality was so high because infectious disease was rampant. The young develop disease antibodies slowly; in combination with their poor nutrition, this makes them particularly susceptible to infection. In an era without effective treatment for infectious disease, these infections were frequently fatal. Over time, several factors combined to reduce infectious disease mortality (see table).[5] Public health improvements, including clean water, sewers, and pasteurized milk, reduced disease exposure. Personal health practices such as hand washing and proper food storage were important too. Combined with better nutrition from improved agricultural output, these improvements limited disease susceptibility and aided recovery. The net effect was a major reduction in infant and child mortality.

Between 1940 and 1960, there was a subtle but important shift in the nature of mortality reduction. Infectious disease mortality continued to decline, but formal medical care began to play a larger role. The development of sulfa drugs in the 1930s and penicillin in the 1940s were the most significant events in medicine. Antibiotics were wonder treatments for infections. By 1960, infectious disease mortality had been substantially eliminated. Antibiotics are valuable for both young and old, and so mortality fell among all age groups. In the mid-twentieth century, we saw the first real increase in life expectancy at older ages.

Observers noting these trends were impressed, but they were grim in their outlook for the future. With infectious disease largely conquered by 1960, the leading killers were cardiovascular disease, cancer, and chronic conditions of old age. There was no experience of



Mortality has declined over the course of the twentieth century as a result of public health and nutritional improvements predominant in the period up to 1940, the development of antibiotics in the next two decades, and medical technology to treat cardiovascular disease and low-birth-weight infants especially since 1960. Mortality is age-adjusted. (United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics)

improvement in any of these conditions. Famed biologist René Dubos expressed the pessimism well: "Modern medicine has little to offer for the prevention or treatment of chronic and degenerative diseases that dominate the pathological picture of technologic societies."[6] Sure enough, mortality rates in the United States stopped declining between the mid-1950s and the late 1960s.

But almost as soon as we began reconciling ourselves to a fixed life span, mortality rates once again started to fall rapidly. That decline continues. What observers in 1960 could not foresee was that chronic disease mortality could change. It could, and it did. Cardiovascular disease mortality led the way. Between 1960 and 2000 it declined as rapidly as infant and child mortality had earlier in the century. Since cardiovascular disease strikes mostly the middle-aged and elderly, mortality improvements since 1960 have increasingly affected older people.

At the other end of life, progress continues on infant mortality, which also fell after 1960. But here, too, the source of the declines is different from what it had been earlier in the century. Where declining infant mortality was formerly associated with reduced infectious disease, today it has much more to do with the survival of low-birth-weight infants. The neonatologist has replaced the hygienist as primary facilitator of infant survival.

Taken together, reduced mortality from cardiovascular disease and from medical advances in treating low-birth-weight infants represent a fundamental change in the nature of health improvements. Call it the medicalization of health. Formal medicine played almost no part in better health in 1900 and only a small part through 1950. Today, it is a major part.

We see this medicalization in the scale of our medical system. In 1950 medical spending was only $500 per person (in today's dollars), and medical care accounted for a mere 4 percent of gross domestic product (GDP). Today, we spend nearly $5,000 per person on medical care, and medical care accounts for almost 15 percent of GDP.

We also see it in the growing rigor of the system.[7] In 1900, doctors were poorly trained,[8] and infection was rampant, particularly in hospitals. In 1894 there were riots in Milwaukee when an ambulance came to take a child suspected of having smallpox to the hospital. The child had already lost one sibling in the institution, and his mother did not want to lose another. Facing 3,000 people armed with clubs, the ambulance attendants backed away.[9] The system had improved by 1950 but was still not great. Penicillin and sulfa drugs, along with basic sanitary measures, made hospitals a reasonable place to go when sick. Medical school training had improved.

But lack of knowledge was a major limiting factor. Physicians could see older people dying of heart attacks, and low-birth-weight infants dying of respiratory problems, but they did not know what to do. At the time, doctors were generalists. In 1950 there were very few medical specialties. There was a division between medicine and surgery, but little else.[10]

The lack of knowledge was the major factor limiting progress in healthcare. Vannevar Bush, director of the federal office of Scientific Research and Development in the 1940s, wrote a report for President Franklin D. Roosevelt on the prospects for science after World War II.[11] Discussing medical research, Bush noted, "Notwithstanding great progress in prolonging the span of life and relief of suffering, much illness remains for which adequate means of prevention and cure are not yet known. While additional physicians, hospitals, and health programs are needed, their full usefulness cannot be attained unless we enlarge our knowledge of the human organism and the nature of disease. Any extension of medical facilities must be accompanied by an expanded program of medical training and research . . . Further progress requires that the entire front of medicine and the underlying sciences of chemistry, physics, anatomy, biochemistry, physiology, pharmacology, bacteriology, pathology, parasitology, etc., be broadly developed."

Bush's report was instrumental in creating the National Science Foundation and the National Institutes of Health, which pioneered many of the medical innovations of the past half century. Better treatment of heart attack victims and low-birth-weight infants were some of the results. These institutions continue to promote medical advances today.

Health involves quality as well as length of life. A population that lives long but is in poor health is not (much) better off than one with a shorter but healthier life span. Information about changes in quality of life is harder to obtain than information about changes in length of life, since quality of life is so much more difficult to measure. Still, we can see large improvements over time.

Physical health has improved immensely in the past few centuries. A prominent eighteenth-century physician described Italian workers thus: "Starvation and sickness are pictured on the face of the entire laboring class. You recognize it at first sight. And whoever has seen it will certainly not call any one of the people a free man . . . Before sunrise, after having eaten a little and always the same unfermented bread that appeases his hunger only half-way, the farmer gets ready for hard work. With emaciated body under the hot rays of the sun he plows a soil that is not his and cultivates a vine that for him has no reward."[12] Even in 1800 a significant share of the European

population did not have enough food even to wander around the city, let alone work under the demanding conditions of an industrialized workplace.[13]

By 1900 health had improved, though not to modern levels. In a 1905 speech at Johns Hopkins University, the great physician William Osler encouraged retirement at age 60, as people's capacity to do much that was constructive after that age was limited: "As it can be maintained that all the great advances have come from men under forty, so the history of the world shows that a very large proportion of the evils may be traced to the sexagenarians—nearly all the great mistakes politically and socially, all of the worst poems, most of the bad pictures, a majority of the bad novels, and not a few of the bad sermons and speeches."[14] Fortunately (from Osler's vantage point), people rarely lived to those ages.

Medical records show the poor quality of life of older persons a century ago. The best data we have on health early in the twentieth century is from medical examinations of Civil War veterans (young men in the mid-1860s), performed to determine their eligibility for federal pensions.[15] Respiratory disease was three times higher in Civil War veterans than it is among elderly people today. Cardiovascular disease was more prevalent as well, as were joint and back problems. Across the board, modern men are in substantially better health than men of a century ago.

Economic advance is one factor in this change. Manual labor was common around 1900. Manual laborers suffered significant joint and back problems; were exposed to dust, gases, and fumes (leading causes of respiratory disease); and encountered many more infectious diseases. The economic environment is much better than today's elderly experienced when they were working.

There has been more debate about health trends since 1950, the beginning of the era of big medicine. Some argue that medicine is sustaining people who have a very poor quality of life, for whom the benefits of a longer life are not very great. This phenomenon has been termed the "failure of success."

A significant amount of research has examined trends in quality of life in the past few decades to see if it has improved or worsened. Because health impairments are particularly concentrated at older ages, research has focused on the health of the older population. At the upper end, many more seniors are in extremely good health than used to be the case. My favorite statistic, because I myself race, is the age distribution of marathon runners. In 1980 about 5 percent of marathon runners were over the age of 50. Today, the share is double that.[16] This is true even though more people at all ages are running marathons; the elderly have taken up the sport at a greater rate than the young. Even if not running marathons, many more elderly engage in leisure activities such as tennis and golf than used to be the case. Active retirement is a recent and widespread innovation.[17]

The bottom end of the health distribution is, in many ways, more important than the top. Are there many more very sick people than there used to be? Some research analyzing data from the 1960s and 1970s, just at the start of the modern era of medical advance, suggested that quality of life was decreasing—there were increasing numbers of elderly with significant physical impairments.[18] More elderly were reporting themselves unable to work than did just a few years earlier, and diagnosis of chronic disease was much more common. Success did indeed seem to have failed.

But the measures of health employed in these studies were relatively poor. The federal disability program expanded during this time, so one would naturally expect more people to say they were unable to work. The increase in chronic disease might just as easily have resulted from increased diagnosis as from true increases in disease.[19] Some researchers looked at the evidence and concluded that the decrease in quality of life was largely illusory.[20] But in truth, nobody was really sure what was happening. Better data were needed.

Beginning in the early 1980s, efforts were made to collect such data. Researchers developed surveys that measured underlying physical functioning, not report of disease. People are asked about their ability to perform basic activities such as bathing, eating, and walking, and social tasks such as shopping, managing money, and doing light housework. Health surveys with these questions have been administered widely and consistently to large numbers of elderly people since the early 1980s.[21] We now have two decades of such studies, and the results are clear: the elderly are much healthier than they

were two decades ago. There is no "failure of success"; rather, there are more victories.[22]

The change in disability has been large. One in four elderly people had difficulty living independently in the early 1980s. Today, there are fewer than one in five. The nursing home population today is virtually the same as two decades ago, despite a major increase in the elderly population. The health of the population is improving, even as more people live to older ages.

While physical impairment is relatively rare in the non-elderly population, many non-elderly contend with mental health problems. There have been concerns that the nation's mental health has suffered in the past few decades, even as our physical health has improved. Life has more stresses, families are less cohesive, and social ties are weaker than they used to be (at least in perception; good data are scarce), all possibly leading to worse mental health.

Data on the mental health of the population are difficult to obtain. Some surveys of mental illness were conducted in the 1950s and 1960s, but they often used particular samples of people that make them nonrepresentative of the United States as a whole (for example, residents of midtown Manhattan). And the definition of mental illness has changed over time. For example, homosexuality was considered a mental illness until 1973. Social phobia and post-traumatic stress disorder were first recognized in 1979. It is difficult to evaluate disease trends when the measures of disease change over time. As a result, the true state of the nation's mental health is not known. But it is safe to say that mental illness is more commonly diagnosed now than it used to be, and we are more aware of the enormous toll that mental illness takes on people. Spending on mental health care is also significantly higher. Because of the particular importance of this issue, I focus on mental health in chapter 4.[23]

Considering all this evidence, it is clear that there has been a revolution in human health dating back more than two centuries and continuing through today. We live longer and better lives than the people who lived before us. Until about 1950 the improvement in health was most significantly a result of improved nutrition, basic public health, and the introduction of effective medications. Infectious disease was the leading killer, and these changes substantially reduced its threat.

Since 1950 the modern medical system has been more important in extending life. A reduction in the number of cases of cardiovascular disease and infant death are most significant in contributing to longer life. Physical disability has decreased as well. In the post-1950 era, health improvements have more directly followed medical advances, as the medical system grew into its modern shape. This post-1950 era is the key period to consider in evaluating modern medicine, and it is on this period that I shall focus. Before doing so, we need to consider how to place a value on health improvements.

2

PRICING THE PRICELESS[1]

"HEALTH IS PRICELESS," THE OLD saying goes. "If you don't have your health, what do you have?" We are willing to do a lot for better health. We spend money on doctors, give up our favorite foods, devote hours to the gym, and seek out the latest medical advances, all in the name of better health.

The importance of health is uncontroversial. But resources are limited, and so we need a way to prioritize. Suppose that doctors invent a wonderful new surgery that will save the lives of some heart attack victims and improve quality of life for others—but the operation costs $10,000. Should we as a society pay for it, for example, by adding it to services paid for by Medicare or private insurance policies? Improving the health of cardiovascular disease sufferers is valuable, but money spent on heart attacks cannot be spent caring for low-birth-weight infants, buying additional textbooks, or cleaning up the environment. How are we to know if heart attack care is worth more than these other uses?

Currently, we do not make these decisions in any systematic way. All medical treatments that improve health are approved for use, generally at the doctor's discretion. As a result, we worry that we spend too much on medical care. In the United Kingdom and Canada, by contrast, limits are placed on what can be done. The government determines how many surgical facilities are available, and doctors can only operate on so many patients. Those judged the highest priority receive operations. Is this type of system better? Valuing health is an integral part of assessing this answer.

Valuing health is among the most difficult of all topics to discuss in polite company. It involves ethical, legal, religious, political, and economic values. There is no way to do it that does not give us at least some discomfort. But we must confront it if we are to make these basic decisions.

Start with the central question: Whose value of health are we considering? Usually, we think about "what would I want if I got sick?" Differences by income are immediately apparent. Rich people are willing and able to pay more for a life-saving medical treatment than the poor. Should we use the value for the rich or the value for the poor (or perhaps a higher value for the rich than the poor)? But this personalized fashion is not right. The health advances we are valuing are not treatments for imminent injury, but rather treatments for potential injuries. How much is it worth now to get to live longer if one has a heart attack? How much is it worth to save a low-birth-weight baby, should one be born in the family? We don't know exactly what we will need; we know only that some will need it.

Consistent with this probabilistic framework, most of these advances are financed by insurance. The rich do not buy heart attack care when they are sick; they buy insurance when they are healthy that allows them access to care when they are sick. Everyone in the same insurance plan is in the same position when they get sick; money is not a (major) deciding factor. So, valuing health is equivalent to asking how much people value an insurance policy that provides access to new medical treatment.

Even in this setting, the rich may value health insurance more than the poor. At the same price, rich people will be more able to buy health insurance than the poor. In practice, though, many of the health advances realized by the poor have been paid for, directly or indirectly, by people with higher incomes. Many of the poor qualify for Medicaid, which is financed from general taxation. Poor people who are uninsured receive "free care"—care given without charging the recipient, but ultimately paid for by passing the costs

along to the insured. In practice, then, the distinction between rich and poor is less consequential than it first seems. Throughout this discussion, therefore, I focus on the value of health for the typical person, not considering variations in income or other attributes.

Religion guides the views of many about life and health. The Bible records that Moses lived to age 120 in reasonably good health ("his eye was not dim, nor his natural force abated").[2] A common Jewish blessing is to wish this for others.

Philosophers have also proposed various criteria to value health, frequently differentiating between more and less valuable health. Ethicist Daniel Callahan has argued that health has a very high value up to the point of premature death—around age 65 or 70—but a lower value after that.[3] Others argue that health has special value insofar as it allows people to live normal human lives, reach their innate potential, and participate meaningfully in society.[4]

Legal analysis has typically framed the value of life in terms of mistakes in punishment: How certain must we be that someone is guilty before we condemn them to death?[5] "Better that ten guilty persons escape than that one innocent suffer,"[6] wrote the famous English jurist William Blackstone. (The Bible makes similar calculations. After God tells Abraham of his intention to destroy Sodom, Abraham convinces God that the city should be saved if there are at least ten righteous men living there. Alas, there were not.) Benjamin Franklin proposed sparing 100 guilty men to save one innocent man, and some jurists have proposed values as high as 1,000. This valuation is done by introspection more than calculation.

Economists have also attempted to place a value on life. The traditional economic analysis values health as the amount that a person will earn over their lifetime. Sir William Petty in 1690 was the first economist to take this approach.[7] Petty calculated the value of life as the amount of income a person would generate over 20 years of work ("The Mass of Mankind being worth Twenty Years purchase"). The implied value of a person in 1690 was about $150 in today's dollars. Many courts use a similar calculation. In litigation, the value of lost life or health impairment is often taken to be the amount a person would have earned over their remaining life span.

This methodology is not very appealing. It implies that there is no value to keeping older people alive, for example, because they are not working. Similarly, it implies that health to the rich is worth more than health to the poor, because the rich will produce goods of greater dollar value. Both of these implications violate our basic sense of fairness. The values underlying the religious and ethical views, reflecting the preciousness of human beings, are closer to what we want. People value longer, higher-quality life because health itself is a valuable goal. But how can we turn these values into practical equations?

The place to start is to quantify the health associated with different medical conditions. We all have a good sense of what it means to be healthy or sick, but we rarely make this explicit. Being more precise is the first step in valuing health. Consider the following hypothetical person:

> Tom is a 62-year-old white male with a high school education. Last year, he suffered a heart attack. Even after receiving medical care, he has a number of physical impairments. He has difficulty walking more than a quarter mile, is out of breath after climbing a flight of stairs, and cannot play for a long time with his grandchildren. Tom's doctor tells him he will probably live another ten years, and the condition will not improve in that time. His mental functioning is fine, however, and he is able to socialize with friends and relatives. His health does not limit his weekly poker game with friends.

We all agree that Tom is in less than perfect health. But how much worse?

One way to quantify Tom's health is by considering a trade-off: Suppose you are in Tom's position. Rather than living your remaining years with these limitations, however, you can choose to give up some of those years to live without the disability. How many of the ten years would you be willing to give up to be in better health?

This question is called a time trade-off. It is a way of converting quality of life into years of good health. There is no right answer to

the time trade-off. Some people are unwilling to give up even a day of life for improved quality; others value quality a great deal. Everyone has a different scale. To determine a value for the population as a whole, it helps to think about how the average person would respond.[8] Because heart attacks affect a wide cross section of the population, the average person's views on them can represent those of society as a whole.

Suppose that the typical person would be willing to live eight years in good health instead of ten years in Tom's condition. We can say that Tom has eight years of "quality-adjusted life" that he can expect to live. The concept of quality-adjusted life years (QALYs) is commonly used in the medical field as a way to quantify the effect of different health states.[9] An entire branch of medicine has sprung up to measure the QALYs of different conditions.

The QALY measure can be used to determine the effect of medical interventions on health. Suppose that Tom is a candidate for a new heart attack surgery that costs $10,000. If he receives the surgery, he will be able to engage in more physical activities and play with his grandchildren. Suppose that Tom's life after surgery would be the equivalent of nine quality-adjusted years instead of eight. The surgery would thus generate one additional year of quality-adjusted life, at a cost of $10,000.

We can then compare the benefits of the new heart attack surgery with other medical interventions. If the alternative to treating heart attacks is providing more psychotherapy for depressed younger people, we would figure out how many quality-adjusted life years the depression care would bring. If $10,000 spent treating depressed teens would improve quality-adjusted life by four years, one could argue that the money would be better spent on that. If the benefits were only half a year, the heart attack care would be more valuable.

If the only choice we faced was how to allocate the resources we have now, we could stop at this point. The quality-of-life improvement of different interventions tells us which treatments are most valuable. But we often have to make other trade-offs. Is one year of quality-adjusted life to older people worth more or less than a year to teenagers? There are also trade-offs outside the medical sector. Is it better to spend the $10,000 on heart attacks or on building additional public parks? To answer this question, we need to be able to express the quality-of-life improvement in monetary terms.

Measuring health states is difficult; valuing them is even harder. How can we possibly value additional years of survival? Fortunately, the situation is not as hopeless as it first seems. When contemplating the value of life, we think first of the extremes. What would we give up to save a friend in desperate need? Most people would give as much as they could afford. The insurance setting we are considering makes things easier, however. The question in this case becomes instead: Are we willing to pay more throughout our lives so that if we have a heart attack we can receive a new therapy? The need is not immediate and the cost will not bankrupt us, so we can consider the situation more rationally.

If the cost of guaranteeing access to the heart attack care were $5 per year, almost everyone would want it. Fewer would sign up if the cost were $5,000 per year, not because people could not afford it—most could—but because other goods are valued too. The value for the typical person is probably between these two figures.

Rather than considering hypotheticals, economists prefer to look at the choices that people make. What do the insurance policies that people actually choose imply about how people value better health? The difficulty of unraveling exactly what is in insurance policies makes using this information difficult to interpret however. Fortunately, there are more clear-cut examples. Consider peoples' willingness to pay for an air bag in a car. Air bags are now standard on new cars, but they did not use to be. When air bags were optional, people had the choice of buying one at a cost of about $300, or not. Many people wanted an air bag at that price; enough did so that we did not protest when the government made them mandatory. It turns out that air bags save the life of one driver in 10,000.[10] Paying $300 to save one person in 10,000 is equivalent to paying $3 million for each life saved. Thus, the air bag suggests that most people value a life at at least $3 million.[11]

There are various examples like that of the air bag: whether one buys a fire alarm for a house, the choice between working in a riskier

or safer job, and so on. A number of economic studies have inferred the value of additional life from these examples. The $3 million estimated above is relatively typical. Across a range of studies, a common conclusion is that the implied value of remaining life ranges from $3 million on the low side to $7 million on the high side, with an average of perhaps $5 million.[12] Most health economists use a number like this.

For our purposes, we care about years of life more than life as a whole, because medical interventions are frequently evaluated that way. The new heart attack treatment extends Tom's life by one year. The value of a year is what is needed. We can translate values of remaining life into a year of life by dividing by the number of years remaining. For example, a person who values their remaining life at $4 million and has a remaining life expectancy of 40 years implicitly values each year at $100,000. Such a value is typical. Most studies value a year of life at $75,000 to $150,000. I use $100,000 as the value of a year in good health, which is approximately in the middle.

There is another way, presented by economist William Nordhaus, to reach this conclusion.[13] Suppose you are offered a choice between all the consumption gains that occurred between 1950 and today—better cars, computers, televisions, and so on—or all the health improvements that have been made—nine years of life and better health while alive. Which would you choose? Informal surveys suggest that people find this choice difficult to make. The two are of roughly equal value. Adjusted for inflation, annual income has increased by about $25,000 per person since 1950, or perhaps $750,000 over a person's lifetime. If that value is equivalent to nine years of life, the implied value for each year is just under $100,000.

The $100,000 estimate is not the same for everyone. Some people value health more than others, just as some find particular conditions more disabling than others. For policy purposes, however, the average valuation is what we care about most. It captures the views of the typical person.[14] Clearly, this value of a year of life is an estimate, not an exact figure. It is a bit like asking someone what the weather is like outside—they can give a reasonable idea, but not an exact temperature. In working with the value of health, I pay particular attention to uncertainty about the true value. It would be a mistake to draw sharp conclusions based on an estimate.

One hundred thousand dollars is a lot of money. It is more than the typical person will earn in a year. This is especially noticeable since the benefit is not cash income that will show up in someone's bank account. Rather, it is the pleasure people get by living longer, healthier lives. How can a year of life be worth more than a person will earn in that year?

While this seems contradictory, in fact it is not. One point to note is that in these settings, people are spreading health care payments over their entire life. Someone who is willing to pay $2,000 each year so that they can have access to the new heart attack care is likely to pay $100,000 over the course of their lifetime ($2,000 for 50 years). Because it is spread out, the burden is smaller in any year. More fundamentally, people are willing to give up more than their annual income to be in better health. The only constraint is that they can't give up more than they could ever earn.

Consider the analogy with vacations. Most people spend more on a week's vacation than they could afford to spend if they were on vacation permanently—even if they still earned their regular salary. People are willing to cut back on their consumption at home to enjoy vacation more. The problem occurs if vacations get so extended that there is little money available for anything else. At that point, people have to be more frugal on vacations.

The same is true of health. We are willing to pay a lot for some improvements in health. That is fine, provided our income is high enough to pay for other goods as well. We would have a problem however, if we spent too much on health, and thus had little for everything else. At some point, the trade-off would no longer be worth it, and the value of health improvements would be low.

We are not at that point now. The value of health that people express in their choices about air bags, fire alarms, and the like show that health is still valued very highly relative to other things we can buy. In the future, we might run up against this constraint, although I suspect we will not.

The value of life we have calculated to this point is the value to the person affected and to his or her family. This is implicit in the choice about whether to buy an air bag or take other safety precautions.

There is another component to health improvements, however: the impact of health changes for one person on the financial status of everyone else.

Let's return to Tom. Suppose that Tom wanted to continue working, but his heart condition kept him from doing so. As a disabled nonworker, Tom would receive disability support of perhaps $20,000 per year. Further, he would not be earning income and thus not be paying taxes. All told, the cost to society of Tom's being ill is about $30,000 a year. If the new therapy allows Tom to return to work, the rest of us would be $30,000 richer. This $30,000 is an additional benefit of the heart attack care, beyond the value of better health to Tom.

Economists term this effect an externality: When one person does something that influences the economic circumstances of others, the costs and benefits of that action for other people need to be taken into account. Externalities may be positive or negative. Allowing Tom to leave disability and return to work is a positive externality. Extending life among nonworkers, as would occur by enabling Tom to live to increasingly older ages, is a negative externality, since retired people collect public transfers (Social Security, Medicare, and sometimes Medicaid), but do not pay as much in taxes as they collect.

The average elderly person receives about $10,000 in transfer income annually. Thus, the net value of a year of quality-adjusted life to the elderly is roughly $90,000—$100,000 of improved health to the individual less the $10,000 of additional support costs. Fortunately, this value is still positive; society is better off having older people alive than not. I include both the direct benefits and the financial effects on others when I evaluate medical advances. The direct benefits are generally far larger, however.

Many of the costs and benefits of medical interventions come in the future. Treating someone who is sick today may extend their life, but it does so several years down the road. Like all values in the future, the costs and benefits of medical innovation need to be discounted to the present. Economists use a range of discount rates to make this adjustment. Three percent, roughly the inflation-adjusted yield on fairly safe investments such as U.S. Treasury bonds, is a common value. I discount the costs and benefits of future medical interventions at this rate.

The methodology for evaluating medical care is complex in detail but simple in concept. Medical advance has a cost and a benefit. The cost is the money spent, which cannot be used for other goods that we want. The benefits are the value of a longer and higher-quality life to the person receiving the care, plus the effects of those health changes on others. Conceptually, that is all there is to it.

The framework I have presented is used by many health care experts, but not all.[15] It is worth laying out the objections to make clear what is happening. One objection is the difficulty of actually performing the calculations. Determining QALY weights requires that individuals value health states that they may know little about. How many people can really imagine what their life would be like if they were paralyzed? Those without use of their limbs, on the other hand, may be sufficiently adapted to the condition that they are unable to appreciate what a newly paralyzed person would experience. There is also uncertainty in how to value a life. How many people really know the effect of air bags on mortality or the risks of their job? While this critique is important, any method for valuing health requires assumptions. The key is to make certain that the results are not too dependent on any one particular set of results.

Even if we can solicit preferences accurately, peoples' preferences may not be the same at all times. For example, teenagers might not care about years lived beyond age 70, but those same teens will start to care about late-life health as they near middle age. Which set of preferences should count—the teenager's or the adult's? There is no theoretically correct answer to this. Some people believe that individual autonomy reigns supreme and we should take preferences as they are. Others argue for using the adult's preferences, as a more mature person. Implicitly, the approach outlined here uses the adult's preferences. Most of the studies of the value of health are based on adults. Thus, their preferences are weighted more than those of children and teens. I find this to be the right decision, but some do not agree.

Most fundamentally, some people object to the very idea of valuing health based on what individuals perceive, rather than on a broader social conception of what health means in society. Health

is a special good, and it may reflect values beyond individual perception. Good health may be essential to functioning in a democracy, to living a decent life, or to reaching one's innate potential. Individual valuations do not necessarily consider this. To take just one example, we may feel that the elderly have earned the most advanced medical care possible, even if quality-of-life considerations do not suggest providing a lot of care to them.

Health does have a special role in society, and we all feel the tug for this broader valuation. One of the questions to consider as we see the results is how the quality-of-life answers compare to our innate sense of medical care priorities. Of course, there are multiple innate views. But I believe that the results seem to be reasonable guides to our social conception, for reasons that will be made clearer in the analysis.

We can use this methodology to evaluate the hypothetical heart attack treatment we have been considering for Tom. The cost of the therapy is $10,000 per person. The benefit is one year of quality-adjusted life. Valued at $90,000 per year (assuming that Tom would be retired anyway and collecting $10,000 in Social Security and Medicare), the treatment yields a value of $90,000. Accounting for the fact that some of the health benefits are not realized until the future lowers this value in today's terms, but not by a great deal. The net is about $80,000 of benefits. This is substantially greater than the cost. Thus, the technological advance is worth the money.

Tom's case was presented as a hypothetical, but in fact it is not. The story behind it is integral to my views about the medical system. I noted earlier the year I spent working on the Clinton administration's health plan. When I returned to academic life, I wanted to research the value of the medical system. When we spend more on medical care, are we getting enough to justify it? To address these questions, I decided to focus on one particular condition, so that I could really learn what medical spending was buying. After discussions with colleagues, I decided that heart attack care was a good starting point. Spending on heart attacks has increased rapidly over time, as treatments have become more sophisticated. Further, there are good data on health outcomes. I formed a research group with three other people to consider the heart attack case: Mark McClellan of the Food and Drug Administration, Joseph Newhouse of Harvard, and Dahlia Remler of Columbia.

The four of us gathered data from the mid-1980s through the late 1990s, the lengthiest period for which statistics were available.[16] The average heart attack cost about $12,000 to treat in the mid-1980s; costs increased by about $10,000 through the late 1990s. Along with the costs, though, came clear benefits. In that decade and a half, life expectancy after a heart attack rose by about one year. We suspected that quality of life for heart attack survivors was improving as well, but we did not have good data on quality, so we considered only the length of life.

The trade-off was thus $10,000 of increased spending for one additional year of life. At the time, we assumed a very low value for a year of life—$25,000, rather than the $100,000 noted previously. The value was low to reflect the fact that the quality of that additional year was not always so high. Even with such a low value, however, the benefits of medical advances were more than twice the costs. With a higher value of life—the $90,000 used here, for example—the ratio would be even greater. The conclusion is clear: We spend a lot more on heart attack care than we used to, but we get even more in return.

We were startled by the starkness of these conclusions and quickly published our results.[17] To our great pleasure, other people found our results as enlightening as we did. From my biased vantage point, I believe it has caused people to back off from the reflexive view that more medical spending is necessarily bad.

The clarity of these results spurred me on. If heart attack care was worth it, what about other areas of medicine in which spending has increased just as rapidly? Has that spending been worth it too? In the time since the heart attack study, I have looked at a wide range of medical technologies, examining the costs and benefits associated with them. The next few chapters summarize my findings. The conclusions generally bear out the heart attack study: We spend a lot on medicine, but we get more in return. That is not to say that everything is good. There is a good deal of waste. But a central feature of the medical system is the increasing value it provides over time.

3

SUCCESS AND FAILURE AT THE BEGINNING OF LIFE

Baby Noelle was born at the edge of viability.[1] She emerged at 25 weeks, weighing a mere 1 lb., 13 oz. Very few babies born at this weight survive; many of Noelle's contemporaries did not.

Noelle's mother was in her early forties when Noelle was born (in 2000). She had had three previous miscarriages, and so was watched carefully. After an uneventful pregnancy, Noelle's mother went into labor in the twenty-fourth week. She was immediately admitted to a good Boston hospital, restricted to bed, and given drugs to delay birth and speed up the infant's development. Several days later, Noelle was born by emergency cesarean section.

Noelle's most immediate problem was breathing. Her lungs, on the verge of collapse, were incapable of transporting enough oxygen into the blood stream. Respiratory distress syndrome, as it is called, is a leading cause of infant death. Noelle was treated with bovine surfactant, a chemical taken from cows that keeps the lungs open. She made it through her first day.

Too young to eat on her own, Noelle was fed intravenously at first and later through a feeding tube. Throughout her first few weeks of life, she received phototherapy to prevent jaundice and had ultrasounds to check for bleeding in the brain. Despite her small size, Noelle progressed well. Nineteen days after birth, however, she suffered a setback, developing necrotizing entercolitis, an inflammation of the lining of the bowel that can prevent the absorption of nourishment and the elimination of waste. Untreated, entercolitis can lead to infection and death. Fortunately, the problem was spotted in time. Doctors operated and gave her antibiotics. By 36 days old, Noelle had improved sufficiently to resume tube feeding.

After more improvement in the hospital, she was at last allowed to go home, to the great pleasure and relief of her parents and doctors. Several months later, she continued to do well. Noelle is one of a growing number of medical miracles.

Noelle's first few months were miraculous, and also very expensive. The total cost was $192,634. This is above average for babies of her size (a typical cost is about $100,000; Noelle was more expensive because of the various surgeries), but not unusually so.

Is it worth it to spend so much on babies like Noelle? Could we have done better? If not spent on Noelle, the money could have bought health insurance for 40 poor families, or textbooks for several hundred children. These are very valuable as well.

Progress in infant survival has been profound. In 1900, one in every ten babies died in the first year of life. Today, fewer than one in a hundred do. Knowing a family in which an infant died was once commonplace; now it is rare.[2] The conquest of infectious disease was the major factor in infant mortality declines in the first half of the twentieth century. A combination of public health advances such as improved sanitation and clean water, increased nutrition, and antibiotics led to dramatically fewer infant deaths.

By 1950 infectious disease mortality was low for infants. Infant mortality remained high, however, because of the substantial number of low-birth-weight infants. Low birth weight is generally defined as less than 2,500 grams, or around five and a half pounds. Most such babies are born prematurely and are at risk for a variety of complications, most importantly respiratory distress. Premature infants typically have difficulty breathing, which can often be fatal.

In 1950 there was little that medicine could do for premature infants. There were some incubators (an offshoot of the technology used for baby chickens), and primitive attempts to provide enough oxygen and warmth. But the overall state of science was poor. Noted

physician Clement Smith remarked in 1955, "Most of us who work in neonatal pediatrics are distressingly familiar with the sight of a small infant surrounded by a fog of vapor within a closed tent or incubator. The situation perhaps symbolizes the present state of my subject which is essentially a very small body of facts enveloped in a misty atmosphere of speculation which is walled off from its surroundings by a rigid container of prejudices."[3]

Infants like Noelle rarely survived. In 1963, for example, First Lady Jackie Kennedy gave birth to a baby boy, born at 32 weeks and weighing four and a half pounds (four times larger than Noelle). He too had respiratory distress syndrome, for which there were few treatments. Patrick Bouvier Kennedy died a day and a half later.

Since then, medicine has progressed to include the vast array of technologies available today. Incubator design has improved continuously and is now situated in neonatal intensive care units. Ventilators providing oxygen at the right pressure and phototherapy preventing jaundice both date from the 1970s. Corticosteroids to speed up infant development and tocolytics to delay labor were developed in the 1980s. The late 1980s and 1990s saw the widespread use of surfactant to prevent respiratory distress syndrome, and drugs to substitute for surgery for certain heart abnormalities.

The armamentarium of medicine is much greater than it used to be, but also more expensive. I have evaluated the costs and benefits of care for low-birth-weight infants along with Ellen Meara, a professor at Harvard Medical School.[4] In 1950 there were few costs for low-birth-weight infants: When little can be done, little is spent. Today, the costs are much higher. Noelle is not typical, but she is not out of the ballpark either—families can rack up bills of hundreds of thousands of dollars. Fortunately, bills of this magnitude usually occur in only the very smallest of babies. For low-birth-weight infants as a whole, medical costs in the neonatal period average about $30,000.

In addition, there are long-term medical costs of caring for low-birth-weight infants who suffer complications.[5] Up to a third of infants born at the edge of viability will suffer severe impairments, ranging from cerebral palsy to blindness to mental retardation.[6] A high-end estimate is that the additional lifetime costs of medical care needed for low-birth-weight infants is about $40,000 (roughly $1,000 per year). In total, therefore, we spend perhaps $70,000 more on medical expenses per low-birth-weight infant than we did in 1950.

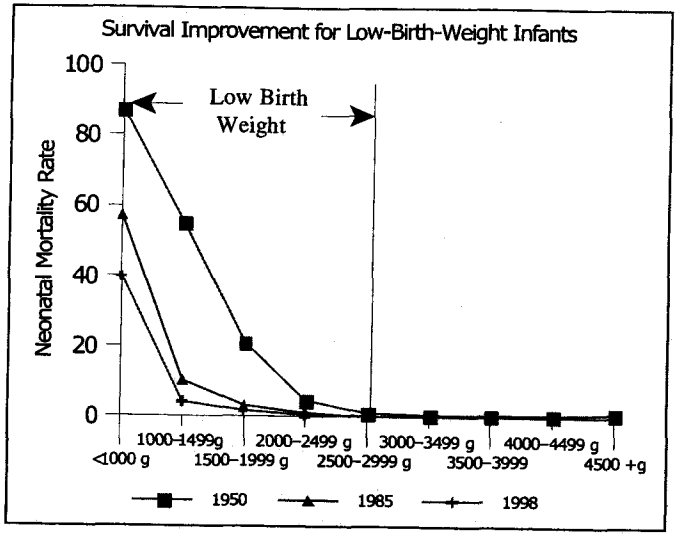
Are the benefits enough to justify these costs? Low-birth-weight infants live significantly longer than they used to. Mortality for low-birth-weight infants has fallen by three-quarters since 1950, from 18 per hundred to 5 per hundred. Although only 7 percent of infants are born at a low birth weight, survival improvements for low-birth-weight infants account for two-thirds of overall infant survival.

We can measure the medical contribution to the change in low-birth-weight survival by looking at survival within birth-weight categories. Factors such as whether the mother smoked or drank during pregnancy, the environment in which the family lives, and the nature of previous pregnancies influence the gestational age and birth weight of infants, but once the baby is born, medical care is almost the only factor that is known to influence survival. Medical technology's effect on survival is particularly important in the first month of life, a period of time termed neonatal mortality. It is this component of mortality that I examine.

There has been remarkable improvement in birth-weight-specific neonatal survival since 1950 (see table).[7] Mortality rates for the smallest infants, those under 1,000 grams, or roughly two pounds, fell from 90 percent in 1950 to about 40 percent today. Mortality for the next largest infants (1,000 to 1,500 grams), about two to three pounds, fell from 55 percent to 5 percent.

To place a value on this medical advance, beyond the hours of happiness it has brought to parents and families, we need to translate it into additional years of life lived. Even today, babies born with low birth weight tend to live fewer years than normal-birth-weight babies, about 20 percent fewer, according to recent estimates.[8] Still, a typical low-birth-weight survivor can expect to live about 70 years on average. Since 1950, the average low-birth-weight infant lives about 15 years longer now because of medical advances than he or she did previously.

But what about the quality of those years? Physicians and ethicists have raised concerns about the quality of life of low-birth-weight infants, and with good reason. At the margin of viability, about



Mortality rates for low weight babies in most weight categories have fallen by over 50 percent. (United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics)

one-third of infants have severe developmental problems, including cerebral palsy, mental retardation, and blindness. Another third have minor problems, such as minor learning impairments or slow development. Even with such problems, however, quality of life can still be high. One study showed that nearly three-quarters of low-birth-weight adolescents (or their parents) rated the adolescents' health as excellent or nearly so, just below the share for normal-birth-weight adolescents.[9] Increased survival of very low-birth-weight infants results in a greater share of infants with complications. On the other hand, infants at the higher end of the low-birth-weight range face very high rates of complications, but medical advances have reduced these complications.

These two effects roughly offset each other. Quality of life for the average low-birth-weight survivor is about the same as it was in 1950. Including quality and length of life, quality-adjusted life expectancy for the average low-birth-weight infant increased about 13 years between 1950 and today, only two years less than the increase in the number of years lived.

In total, therefore, $70,000 of increased spending bought 13 years of quality-adjusted life. Is this a good deal? I estimated in the previous chapter that the value of additional life years is about $100,000 per year. From this we need to subtract the additional nonmedical costs of caring for low-birth-weight infants, including special education, and sometimes disability. For the severely impaired, therefore, the benefits of life extension are only $75,000. Adding up the additional years with this value yields a benefit of $350,000 per low-birth-weight infant.[10]

The $350,000 in benefits is substantially greater than the $70,000 in additional costs. In investment terms, every dollar invested has yielded $5 in better health. Technology for low-birth-weight infants is costly, but it is clearly worth the cost.

What is most impressive about this number is how large it is. A private company would be happy with a benefit of $1.20 per dollar spent. Governments are usually happy with a return of $1.10. The return here is an order of larger magnitude. These returns are so large that the uncertainties inherent in the calculation do not seem very important. For example, a year of life could be worth only half what the literature suggests and the spending would still be overwhelmingly worth it.

Finding that medical advance is worth the cost does not imply that relying on medical technology was the best approach we could have taken. Treating low-birth-weight infants when they are born is an expensive way to extend life. Are there cheaper ways to accomplish the same goal? The answer is yes, which we can see by focusing on the sources of low birth weight.

The most important risk factor for low birth weight is maternal smoking. Women who smoke while pregnant are twice as likely to have a low-birth-weight baby as those who do not. Rather than focusing on saving lives through neonatal care, suppose we instead invested more in smoking cessation programs—providing self-help materials to help women quit, following-up regularly to address problems, and paying for cessation aids? A number of programs like

this has been tried experimentally.[11] The cost of these programs is modest, about $50 per woman. The benefits are large; significant numbers of women stop smoking in the programs. In the typical program, enough women stop smoking that the smoking intervention programs are more cost-effective than neonatal intensive care. Per life saved, smoking cessation programs cost only one-third as much as neonatal intensive care.

Added to these lower costs are potential savings in the costs of neonatal care. Avoiding low-birth-weight births results in lower use of neonatal intensive care. Some researchers argue that the savings are sufficiently large that smoking cessation programs could actually save money, even as they improve health.[12]

And yet, such programs are used only sparingly. Most doctors counsel pregnant women to quit smoking, but the advice is rarely followed up systematically. Few health plans pay for smoking cessation programs or help women enroll in them. There is little nurse or physician follow-up to make sure women quit. For many people, quitting an addictive habit requires more than just exhortation. But exhortation is all that most women get.

A medical intervention that was shown in clinical trials to save lives and improve quality of life would be adopted right away. A social program that does the same is not. We shall encounter this problem time and again in looking at the medical system. High-tech medical intervention is routine; less intensive programs struggle to be accepted.

Smoking cessation is not the only intervention that could reduce costs. Regular prenatal care could as well, by spotting problems early on and intervening to correct them. A 1985 report by the Institute of Medicine argued this case.[13] The Institute of Medicine estimated that every dollar spent on prenatal care could save $3.38 in caring for high-need babies. Prenatal care, according to the report, was the ultimate free lunch.

The Institute of Medicine report was a bombshell. A distinguished group of scientists had concluded that we could improve health and save money at the same time. The report led to a major change in public policy. In the decade following the report, the Medicaid program was expanded to allow more women in working-poor families to qualify for Medicaid to take advantage of these possible savings. Nearly half of all women giving birth in the United States today are eligible for Medicaid coverage when they are pregnant. Very few women giving birth are without insurance.

Nearly two decades later, we can evaluate the impact of this program. Did it improve outcomes? Were costs saved? The bottom line is that infant health improved somewhat, but money was not saved.[14] The "free" lunch turned out to come with a multibillion dollar price tag.

The reasons that the program failed to live up to expectations are revealing. One reason is that the program wasn't able to enroll only women who were previously uninsured. Among the working-poor population, a substantial share of women already had private insurance coverage. Some of these women responded to the Medicaid expansion by switching from private coverage to Medicaid, or becoming uninsured with the knowledge that Medicaid was available when needed.[15] When women substitute public insurance for private insurance, Medicaid spending rises, but there are no health benefits.

More importantly, the program didn't work as intended because use of prenatal care did not increase as envisioned. Nearly a third of the women who obtained coverage as a result of the Medicaid expansions enrolled in the last month of pregnancy—many after admission to the hospital to give birth.[16] Many women who received care earlier did not get care regularly enough. Care received this late or sporadically has few health benefits.

The government is partly to blame for this failure, as it did not alert enough women to the opportunities of the program. But government is not the sole problem; the medical system deserves blame as well. The medical system is so difficult to use that even determined women have trouble accessing it. A task as simple as scheduling an appointment and arranging baby-sitting can be prohibitive for many poor women; their lives are too chaotic to meet the rigidities of the medical world. The behavioral changes they need to make—dietary changes, reduced smoking and alcohol intake—are also difficult, and

they receive no help with those changes. The premise of the Medicaid expansions was that giving women health insurance was enough. That is not the case.

A better health care system would recognize the need for outreach and provide it. Scheduling and follow-up would be easy. Coordination across providers, to deal with complications as they arise, would be seamless. Behavioral changes such as smoking cessation and diet modification would be promoted through physician and nurse outreach. Reconfiguring the system in this way would make it vastly more effective. The system doesn't do this, and we pay the price.

When asked why they do not provide these services, physicians have a uniform answer: They are not paid to provide them, and so cannot afford to invest in them. Physicians counsel patients in their office and encourage appropriate behavioral change. Harassed by insurers and pressed for time, however, that is all that the typical doctor can afford; they cannot do for patients what they know needs to be done. This just pushes the puzzle back a step, though. Insurers could pay doctors for these services, reimbursing them for outreach and rewarding successful follow-up. Why don't they? Again, the answer is money. Insurers are paid to cut spending, not improve health. Thus, they focus on managing the services provided, not encouraging more care. The financial incentives are perverse, creating a medical system that does not work as well as it might.

Private insurance and Medicaid are equivalent on this score. Each pays for medical care for pregnant women, but neither does so in the right way. Both government and the private sector will have to change to make the system work better.

Of course, even partly effective programs can still be worth the expense. That appears to be the case here. More babies survived the neonatal period as a result of the Medicaid expansions—not an enormous number, but some. Because life is valued so highly, the benefits of saving additional babies justify the added cost.[17] We didn't save money, but it was still the right thing to do. Government, to its credit, has virtually eliminated the problem of lack of insurance among women giving birth.

Still, considering infant mortality shows the strengths and weaknesses of the medical system. On the one hand, we have invested a lot in a set of intensive technologies that have brought significant benefits. On the other hand, we could do better by investing in lower-tech care and a system that works better. Saving Noelle was good, but preventing more low-birth-weight cases would be even better.