# Articulating the Case for the Longevity Dividend

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The benefits of most public-health interventions that are now well established, as well as the recognized harmful health consequences of some behavioral risk factors, were rarely considered as accepted doctrine when first identified. In fact, some unassailable public-health interventions are still rejected by some, and almost every major discovery in the history of public health initially faced disbelief, vehement skepticism, and even scorn. The scientific study of aging is leading researchers in the direction of a major breakthrough that has the potential to revolutionize public health in our aging world—but obstacles once again stand in the way.

In this essay, I describe the Longevity Dividend Initiative—a contemporary effort to extend the period of healthy life by slowing the biological processes of aging (Olshansky, Perry, Miller, & Butler, 2006)—and some of the obstacles that stand in the way of what many consider to be one of the most exciting breakthroughs in the history of science and public health.

## Healthy Life Extension

The most precious of all commodities is life itself, and if there is one attribute most of us share, it is the desire to remain alive. The yearning for healthy life is equally important—perhaps even more so—especially for those struggling to regain health that has been lost. One would think, therefore, that the case for extending our healthy years would be universally accepted and easy to make, regardless of how it is achieved. Sadly, this is not the case.

In public health, examples of interventions that in the past had a profound influence on the length and quality of life include the development and dissemination of clean water, sanitation, indoor living and working environments, and refrigeration (although there is still plenty of room for lessening disparities in health and longevity and the factors that contribute to them). During the last century, epidemiologists raised public awareness of the life-shortening effects of smoking and other harmful risk factors, as well as the life-extending effects of proper diet and exercise, among other lifestyle choices.

In the modern world of medicine and medical technology, a trip to the doctor, dentist, or other health professional is justified as a form of primary prevention. When a health issue arises—such as a serious infection, cancer, or heart disease—the routine for most is to seek out and trust modern medical treatment as the best approach to regaining one's health. In fact, a strong endorsement for the efficacy of medicine's ability to extend healthy life comes from its validation by the insurance industry.

These three pillars of healthy life extension have earned people's trust, and deservedly so, but concerns are being raised about how much more healthy life can be manufactured using these approaches. The reason is the biological aging of our bodies.

In the last half-century, a combination of public health and medicine enabled most people born in the developed world to live past age 65, and for them, a large percentage live past age 85. As appealing as this scenario is, the problem that arises with extended survival is that a less tractable risk factor has emerged—the biological aging of our bodies. Public health can manufacture only so much survival time through lifestyle modification, after which medical technology has an important life-extending impact, but even these methods of life extension eventually leave the survivors facing biological aging.

Think of the effect of aging on the body as the same as the effect of miles on an automobile. Very few things go wrong with most cars during the first 3 years and 36,000 miles, and for some automobiles the warranty period has been extended to 10 years and 100,000 miles. Operate these cars beyond their warranty period, and a cluster of problems emerges. These problems are an inevitable by-product of the passage of time and the accumulation of damage that arises from operating the machine—they are not programmed to occur at a set time by the auto manufacturers. Although planned obsolescence is part of the manufacturing ethos for some companies, what I mean here is that automobile manufacturers do not build a specific death time into a car.

The same principles hold true for human bodies. Once we operate our bodies beyond the equivalent of their biological warranty period, a large number of health issues begin to emerge and cluster tightly into later regions of the life span. Among scientists who track these events, this phenomenon is known as competing causes, which is another way of saying that a large number of lethal and disabling conditions accumulate in aging bodies. Ameliorating any one lethal condition independent of all others leaves the person with a high risk from all other remaining conditions. With time (and age), the treatments

devised through medicine (which tend to focus on one disease at a time) and risk factor modification then become progressively less effective as survivors move further into older age windows where aging-related diseases cluster ever more tightly together. Keep in mind that, just like automobiles, our bodies are not programmed with aging or death genes that are set off at a predetermined age. Aging is best thought of as an inadvertent by-product of fixed genetic programs that evolved under the direct force of natural selection for early-life developmental events; aging is a product of evolutionary neglect, not evolutionary intent.

**Science has now demonstrated that aging is inherently modifiable.**

Recognizing the fact that competing causes places a damper on the future effectiveness of disease-oriented medical interventions, scientists in the field of aging have proposed that the next big step in public health and healthy life extension is to attack the seeds of aging rather than just its consequences. The idea is to slow the aging of our bodies such that 1 year of clock time is matched by less than 1 year of biological time. This approach would allow people to retain their youthful vigor for a longer time period and, if delayed-aging interventions work the way researchers hope they do, compress the infirmities of old age into a shorter time frame at the end of life. Delaying biological aging is the only viable approach to addressing the increasing importance of competing causes and the rise of aging as an ever more important risk factor for disease. This effort to transform aging science into a new paradigm for combating disease and extending the period of healthy life is referred to as the Longevity Dividend Initiative.

It is at this juncture where one of the main problems occurs. The contemporary proposal to slow aging as a means to extend healthy life has historical linkages to medical deception, charlatanism, and greed (Gruman, 1966). Historically, the quest for immortality was couched within a prolongevity message suggesting that ingesting or injecting substances with alleged antiaging properties could manufacture youth. One of the most famous among these is the alchemist's dream of transmuting lead into gold, a process thought to confer immortality to those who ingested minute quantities.

In the late 19th century, French physiologist Charles-Edouard Brown-Sequard claimed to have discovered the secret to rejuvenation. Brown-Sequard crushed the testicles of domesticated animals, extracted what he called vital substances from them, and then inoculated older people against what he termed the aging disease. Modern versions of these ancient antiaging potions have been described as posing the "potential for physical and economic harm" (United States Government Accounting Office, 2001).

Finally, some scientists in the field of aging have formed companies designed to attract outside investors interested in cashing in on a possible breakthrough in the field of aging (Anton, 2013). Although this approach enables some aging science to occur that would not otherwise be funded, it can and has led to exaggerated claims and unproven interventions that reach the marketplace before they are fully evaluated using the tools of science. This, too, creates suspicion among members of the public, who already have a difficult time distinguishing between medical fraud and genuine public-health interventions.

Taken together, these historical and contemporary roadblocks to legitimacy have delayed the entrance of aging science into the realm of accepted discourse as a legitimate and, quite frankly, valuable and needed public-health intervention. However, these aren't the only roadblocks.

## Religious Arguments

Religious objections are sometimes posed in response to proposals to enhance public health by modulation of aging. The objection usually starts from the assertion that tampering with aging is equivalent to tampering with God's plan for us—an effort that should not be pursued. However, this argument loses its power when those proposing it admit that both they and their children have been vaccinated against lethal childhood diseases. It is hard to imagine that God's plan is to kill most children from communicable diseases before they reach the age of 10, but up until the 19th century that was humanity's fate. Most people who make this argument also admit that they would seek medical attention if they (or their loved ones) experience heart disease or cancer. Why is one form of disease prevention acceptable while another is not?

## Population Growth

When delayed aging was first proposed as a public-health intervention in the 1950s, rapid population growth was a concern because the growth rate in the post–World War II era was about 3 percent (see Table 1). To place this growth rate into perspective, consider that, at 3 percent growth, the population would double in 26 years. Thus, both demographers and environmentalists, among others, were for good reason alarmed about the population growth rate during most of the last half of the 20th century. Although the rate of population growth has attenuated considerably since 1950, the momentum for population growth will remain through the middle of this century, and

environmental concerns have escalated considerably. Population growth and resource depletion definitely should be on our minds, and these issues are appropriate to raise when discussing healthy-life extension.

The thing is, those making this argument believe that delayed aging will dramatically accelerate population growth, wipe out the reductions in the growth rate achieved in recent decades, further challenge resource depletion, and generate a new set of population and environmental headaches. As it turns out, none of these concerns are valid.

With regard to population growth, I have estimated how the growth rate (GR) would change with the hypothetical extreme scenario of immortality (i.e., no more deaths). The data in Table 1 demonstrate that under the extreme scenario of immortality, the GR would be about 1.5 percent (i.e., the GR would be defined by the birth rate because the death rate would be zero)—which is three times faster than the current GR of about 0.5 percent. However, longer lives tend to be accompanied by lower fertility, so I estimate a GR under conditions of hypothetical immortality of about 0.9 percent—still twice the current GR. Because immortality is not likely to happen anytime soon, and because the longevity dividend associated with delayed aging would yield only marginal increases in life expectancy, the actual population GR would rise only slightly if the longevity dividend is achieved.

In fact, the population GR would also rise marginally with a hypothetical cure for cancer or heart disease. I have yet to hear anyone argue that cures for these diseases should not be pursued because success would be accompanied by accelerated population growth and resource depletion. The bottom line is that the Longevity Dividend Initiative will have a negligible effect on population growth and the environment, but it will have a dramatically positive impact on work, retirement, health care financing and costs, and physical and psychological well-being.

## Delayed Aging Means Increased Infirmity

Perhaps the most common misconception and fear about aging science and the Longevity Dividend Initiative is the belief that delayed aging will extend the period of infirmity at the end of life—the fear that most people have as they approach older ages. This view is ironic because although the scientists involved may disagree on exactly how to accomplish the goals we researchers have set, the one thing we all have in common is the final and most important goal of extending the period of healthy life. An intervention that does not meet the test of extending the health and functionality of both body and mind together would not be pursued—in fact, such an intervention would be seen as harmful.

## Articulating the Case for the Longevity Dividend

The case for the longevity dividend is extremely compelling and, in theory, should be easy to make to funders, public-health professionals, and the general public. Here is the line of reasoning:

1. Treating diseases worked well in the past to extend healthy life, but aging has emerged as the primary risk factor for the most common fatal and disabling diseases.

**Table 1. Population Growth Rates With and Without Immortality**

| Year | Birth rate (per thousand) | Death rate (per thousand) | Growth rate (percent) | Population doubling time (years) |
|---|---|---|---|---|
| 1000* | ~ 70 | ~ 69.5 | ~ 0.1 | ~ 800–1,000 |
| 1900 | 50 | 30 | 2.0 | 35 |
| 1950 | 45 | 15 | 3.0 | 26 |
| 2000 | 15 | 10 | 0.5 | 140 |
| Immortality | ~ 15 | 0 | 1.5 | ~ 53 |
| Immortality** | ~ 10 | ~ 0.1 | ~ 0.9 | ~ 80 |

* The birth rate and death rate in the year 1000 cannot be known with certainty. These numbers are used to illustrate that vital rates were extremely high by comparison with today, and that the birth rate throughout most of human history hovered, on average, just above the death rate.
** Birth rates would likely decline if immortality was achieved. The estimated birth rate of 10 per thousand is speculation, and perhaps even an overestimate. A death rate of zero is impossible to achieve in the real world, where accidents, homicide, and suicide are present. The difference between the vital rates under the more realistic demographic conditions that might occur in the presence of immortality would lead to a growth rate of less than 1 percent and a population doubling time of approximately 80 years.

2. The longer individuals live, the greater the influence of aging on disease expression.
3. Aging science offers medicine and public health a new and potentially far more effective weapon for preventing disease, extending healthy life, and avoiding the infirmities associated with old age (Butler et al., 2008).
4. Failing to take this new approach could leave people who reach older ages in the future even more vulnerable to rising disability than they are now.
5. Aging science represents a new paradigm of public health that has the potential to yield more effective methods of delaying most fatal and disabling diseases, extending healthy life, and reducing the prevalence of infirmities more commonly experienced at older ages (Sierra, Hadley, Suzman, & Hodes, 2009).

**Reductions in the infirmities of old age and increased economic value to individuals and societies would accrue from the extension of healthy life.**

The language of the longevity dividend must be unambiguous. Much like the introduction of antibiotics in the mid–20th century and the broad dissemination of basic measures of public health a century ago, humanity is once again fortunate enough to witness the rise of a new paradigm in human health. Aging science has successfully turned the spotlight on the origins of the aging of people's bodies and minds and the fatal and disabling diseases that accompany us in our later years. What the scientific study of aging reveals shakes up a long-held assumption that aging is an inevitable and immutable by-product of the passage of time (Miller, 2002), and these new discoveries fundamentally challenge the fatalistic view that aging and death are nature's way of removing the old to make way for the young.

Science has now demonstrated that aging is inherently modifiable. Furthermore, there is now reason to believe that aging science can be translated into new, more effective medical and public-health interventions that will be able to combat fatal and disabling diseases far more effectively than any intervention available today—yielding an extension of the period of healthy life in ways that could not even be imagined just a few years ago.

Although people who benefit from advances in aging science will probably live longer, the extension of healthy life is the primary goal. In addition, reductions in the infirmities of old age and increased economic value to individuals and societies would accrue from the extension of healthy life.

It is only a matter of time before aging science acquires the same level of prestige and confidence that medicine and public health now enjoy, and when that time comes, a new era in human health will emerge. An abundance of formidable obstacles are standing in the way, including strongly held views of how to proceed, a history of association with dubious aging interventions, and misconceptions about the goals in mind and the impact of success on population growth and the environment. Once the air clears and aging science is translated into effective and safe interventions that can be measured and documented to extend our healthy years, the 21st century will bear witness to one of the most important new developments in the history of medicine.

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