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# The Drivers of Future Mortality: An underwriter's perspective

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## EXECUTIVE SUMMARY

Presented in a breakout session at the 2015 Canadian Reinsurance Conference in Toronto, this article discusses how mortality and longevity have evolved over time, what were the major determinants of past mortality improvements, and the most significant drivers of future mortality.

## INTRODUCTION

Globally mortality has improved over time, though most of the reduction has been attained over the last 150 years. This decline in mortality rates resulted in life expectancies at birth increasing by 30 to 40 years, up to 80 to 85 years in developed countries. From the beginning of human history, life expectancy at birth has been estimated at about 25 years, and little progress was made through the Roman Empire. By the 1700's, life expectancy at birth reached 37 years in England, rising to about 41 by circa 1820. It remained stable during the period of the Industrial Revolution (1820 to 1870) and by the dawn of the 20th Century, life expectancy had reached 50 years.

## HISTORICAL DETERMINANTS OF MORTALITY IMPROVEMENTS

Complex and intermingled factors contributed to these past mortality improvements. They appeared in sequence, building on the improvement provided by each previous factor:

- **Nutrition:** In the 18th Century, agricultural quality and yields increased with the mechanization of the farming industry. British physician and demographer Thomas McKeown argued that better nutrition improved the population's health. This was later evidenced by Robert Fogel between 1977 and 2004. Opponents to the "Nutrition" theory argue that the disease burden changed mostly as a result of strong public health interventions.
- **Public health:** Samuel Preston made the case that the reduction in mortality occurred because of improved public health in the context of increases in income. Major macroeconomic projects had taken place over several decades—e.g., filtering and chlorination of water, sanitation systems, swamp drainage, milk pasteurization, and mass vac-

inations. Microeconomic efforts also contributed—better food conservation and protection from insects, promotion of better hygiene, ventilation of homes and preventative medicine programs. It is estimated that about 50 percent of the mortality gains occurred early in the 20th century, mostly due to better water sanitation. Developments of new therapeutics to treat people with diseases—such as antibiotics developed in the 1930 and 40s—also contributed to the early steep mortality improvements. Advances in medicine regarding cardiovascular disease were a fairly recent development in the 1960s and it is only by 1970 that water and foodborne diseases were quasi-eliminated from North America.

- **Urbanization:** Initially, large-scale urbanization had a negative effect on health and overall mortality due to the effects of unsanitary living conditions, which facilitated the spread of diseases in more crowded cities. Gradually, the situation improved as urban sanitation (running water, sewage, and garbage collection), housing and access to health care improved.
- **Socio-economic changes:** Growing evidence suggests that reducing economic and social inequality has a positive effect on a population's health. Even in countries that have income inequality, overall mortality has improved, as the less fortunate of today are much more prosperous than their peers a century ago. In effect, while income inequality may actually increase, prosperity (and hence mortality) still improves as the entire scale moves up.
- **Behavioral and lifestyle factors:** Research indicates that non-smokers have had greater mortality improvement than smokers. In general, people who engage in "healthy habits," such as regular medical check-ups, may be more likely to engage in other positive habits (wearing seat belts, teeth cleaning, etc.) and tend to exhibit better mortality than those who do not. Other lifestyle risk factors, such as moderate drinking, regular physical activity, healthy eating choices, and the use of preventative care (mammograms, prostate examination, colonoscopies, etc.) have all a positive correlation to improving long-term mortality.

## DRIVERS OF FUTURE MORTALITY IMPROVEMENTS, SPECIFICALLY IN NORTH AMERICA

According to S. Jay Olshansky, the future mortality improvement rate may be slowing down, since some of the reductions obtained in the 20th century may not be reproducible. With mortality at younger ages already low, it has become more difficult to raise life expectancies at birth. According to Olshansky, the focus is on improving the mortality for the middle and older

ages, where the impact may be less, and hence his argument for an improvement-rate slowdown. Other renowned experts, most notably Prof. James Vaupel, dispute this perspective.

#### MEDICAL ADVANCES IN DIAGNOSTICS, TREATMENT AND OTHER LIFE-SUSTAINING METHODS

When can we expect the next major breakthrough that will push the average life expectancy from 80 to 85 today to 100 or higher? Even today, numerous medical advancements in the areas of cancer, heart and circulatory diseases make it possible for individuals to survive the initial disease onset. Olshansky notes that even if we discovered an intervention that effectively eliminates a major mortality factor, the possibility exists for nature to replace this gain with another human killer. We have seen some of this already as the mortality improvement from smoking reduction is gradually being replaced by increased incidence in obesity, diabetes, and other metabolic diseases.

What could the next breakthrough in medical advancements be? Presently, many people are living longer and better due to pacemakers, beta-blockers, statin drugs, or HIV combined therapies, etc. Though current biomedical research is generating much knowledge about the genetic basis for diseases, their practical and large-scale implementation remains challenging. So, will future improvements be subtler in the sense of “one person at a time” versus an entire segment of a population? Will the past and current public health philosophy of “the greatest good for the greatest number” be broken?

#### BEHAVIORAL AND LIFESTYLE CHANGES

What is the impact of social inequality and access to health care on mortality? Some research indicates a very high correlation of longevity between level of education, income and overall wealth, as well as early-life and childhood living conditions, social conditions in adulthood, and family genealogy. Other behavioral and lifestyle factors need to include further reduction in smoking, safer driving standards, better nutritional knowledge and exercise, higher occupational safety standards and improved work conditions. The list is almost endless, and does not even encompass natural disasters!

Forecasting is an inexact science, and behaviors are very complex to predict. It would be an unfortunate setback if the increase in obesity in North America became so significant that it could wipe out the mortality improvements obtained:

- Less smoking (one third reduction since the 1960s),
- Less excess drinking (20 percent decline since the 1980s), and
- Overall improved risk factor control and treatment for cardiovascular diseases?



Could further improvement be achieved by improving our education about preventative medicine and compliance to the recommended medication, dosage and physician follow-ups?

#### INFECTIOUS DISEASES

Animals and non-living sites (soil, water) are reservoirs for disease. Stronger regulations may need to be implemented to protect the public from infectious diseases, by eliminating the pathogen from its natural reservoir or interrupting its route of transmission. Past measures like creating a safe water supply, effective sewage treatment and disposal, education about food safety, animal control, and mass vaccination and education programs have helped reduce and even eliminate some of the most dangerous and common infectious diseases. On the other hand, resistance to anti-microbial treatments—in particular to malaria and tuberculosis—is rising at an accelerating rate. New infectious diseases have appeared in the last few decades such as AIDS, Legionnaire’s disease, Hantaviruses, Lyme disease, prions, West-Nile virus, Ebola, and the new Zika virus, just to name a few. Most emerging infections appear to be caused by “sleeping” pathogens. They are “activated” when there is a change in the pathogen’s natural environment, such as ecological changes due to agriculture, economic development or anomalies to the climate, human demographic changes and behavior, travel and commerce, microbial adaptation, resistance and mutation, and breakdown in public health measures.

#### CONCLUSION

How mortality improvement will emerge in the future remains uncertain, but two main schools of thought have evolved:

- a. Mortality improvement will continue indefinitely and follow a linear trend, with people living to age 150 and beyond (e.g., James Vaupel); and
- b. Humans have, by design, a limited life span, and future mortality gains will be smaller because of real and observable natural limitations (e.g., S. Jay Olshansky).

Reliable projections are complex due to the large number of past determinants and future drivers. If mortality rates improved at the same rate as in the last 15 years or so, then a life expectancy of 100 could be reached by the turn of the 21st century in Canada. However, some populations in North America are experiencing a slowdown in the rate of improvement and it appears that future gains in mortality may be measured in years, rather than decades. Changes of health patterns (smoking, obesity, diabetes, etc.), economic and social disturbances (recessions, downturns, fiscal restraints and austerity measures), or the (re)emergence of old and new infectious diseases may temporarily influence future longevity gains.

Does the prospect of ever-longer life remain the holy grail of societal achievement, and is an extra year of life expectancy worth the economic efforts required? These and other ethical questions will be the next area of debate, as isolated public health care providers begin to shift their focus on improving the quality of end-of-life years. How this trend will affect mortality improvement rates going forward from an actuarial standpoint will need to be determined.

Note: *The views expressed herein are those of the author and do not necessarily reflect the views of SCOR Global Life.* ■



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