Mortality in Social Security Actuarial Projections

A Summary of the Social Security Panel at the 2017 Living to 100 Symposium

By Sam Gutterman

Mortality represents one of the most important assumptions in the analysis of the sustainability and the assessment of appropriate contribution rates of social security systems. Because of the importance of this public policy issue (as well as the applicability of long-term mortality assumptions to other actuarial applications), it is important to obtain a broad perspective regarding its methodology and underlying viewpoints.

Cutting-edge, macro-level insight into mortality projection issues were presented at the 2017 Living to 100 Symposium panel presentation[1] by leading social security actuaries from Canada, the United Kingdom and the United States. The three panel members—Jean-Claude Ménard[2], chief actuary of the Canada Pension Plan; Adrian Gallop, of the advice to government team of the Government Actuary's Department in the U.K.; and Steve Goss[3], chief actuary of the U.S. Social Security system—provided mortality intel they have found useful.

As indicated by the panelists, actuarial assessments of a financial security program benefit from a comprehensive understanding of the dynamic demographic drivers and the characteristics of its participants on their mortality. Their projections are not made in isolation—each confers with experts and considers their opinions.

The transparency of the development of the basis of these assumptions invites public and professional scrutiny, facilitating confidence in the objectivity of the developed projections. This has led to the use of sound methodologies and ultimately to a more soundly-based public policy decision-making process, although because of its significance it continues to be subject to criticism and enhancement, sometimes from those with diametrically opposite viewpoints. Almost universally, those involved in social security projections are well respected in their professional communities.

PROJECTION METHODOLOGY

Two overall approaches have been taken to develop mortality projections: (1) statistical projections (that is, relying on time series or regression extrapolation), originally including age setbacks and subsequently involving average (covering periods sometimes spanning more than half a century) mortality improvement rates by age and gender or a more refined modeling approach, and (2) implicit or explicit by-cause projections, at least for up to 75 years. All three social security departments make use of both techniques in one way or another. Nonetheless, all three panelists focused significant attention on their efforts to understand the underlying drivers of long-term mortality experience, considering the significance of and sensitivity to changes in mortality in selecting the projection factors used.

Each actuary follows a rather similar overall projection methodology, incorporating statistical and judgmental elements inherent in both of the above two approaches:

1. Estimate current mortality rates by gender and age (explicitly by cause of death for the United States). This is not simply the mortality experience for the most recently available year—the rates are based on a set of fitted reported rates for the country over several recent years. This is needed partly because of the lag in obtaining current national mortality experience and annual experience fluctuations. In addition, these rates are usually trended until the valuation date.

2. Estimate both current and ultimate mortality improvement factors by gender and age. In the United States, these also vary by major causes of death.

3. Interpolate or converge the mortality improvement factors by gender and age group (and cause for the United States) between the estimated current rates and the ultimate factors (from step 2). The year at which the ultimate improvement rates go fully into effect ranges from 20 years to 25 years.

4. Apply the resulting mortality improvement factors by gender, age and year successively to the assumed current (base) mortality rates.

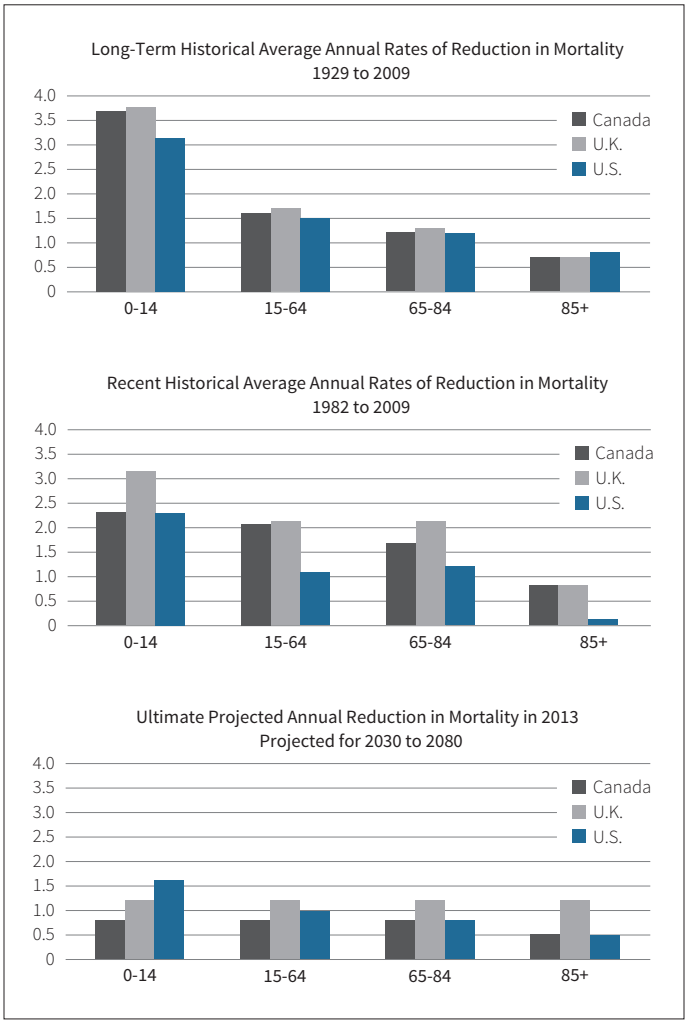
However, different techniques and considerations are applied in each of the first three steps. The views and research of a variety of individuals and technical panels of experts are considered, particularly in the selection of improvement factors. In the end, the last factor applied in each case is professional judgment, and weighting the expected effects of all the factors involved.

Although the detailed steps taken and factors considered in the projections differ by country, there appears to be a consensus among social security actuaries that future mortality improvement will likely not be as large as the exceptional improvement of the first decade of this century. This is, in part, because of

differences in national experience and changes in demographics, the effectiveness of prevention activity, health care technologies and medicines, introduction of more extensive public health coverage, supply of services and quality of health care. That said, U.S. and Canadian ultimate improvement factors that decrease on a percentage basis as attained age increases, contrast with U.K. projections of a level ultimate-mortality improvement, independent of age.

The methods and assumptions used in these projections are subject to regular peer review and adjustment based on new data, the objective of which is to maintain their high quality and to incorporate, as much as practical, the best possible approaches and information sources. For example, the Canadian projections are subject to triennial reviews by a panel of actuaries, and the U.S. projections have been subject to ideas and opinions of

Figure 1 – Comparable rates of mortality improvement by age category and country



Source: U.S. Social Security Administration

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quadrennial technical panels consisting of actuaries, demographers and economists. The U.K. regularly convenes a panel of experts to provide perspectives into the demographic aspects of its social security projections, while U.S. Social Security mortality projections have recently been shown to be consistent with opinions of independently developed views of likely mortality trends by age and medical condition developed by the medical staff of Johns Hopkins University.

MORTALITY EXPERIENCE, PROJECTIONS AND OBSERVATIONS

All three countries have seen significant mortality improvement for more than a century. The extent and patterns of future improvement play a significant role in debates concerning how best to address financing challenges facing all social security programs, especially as the baby boomers retire and beyond.

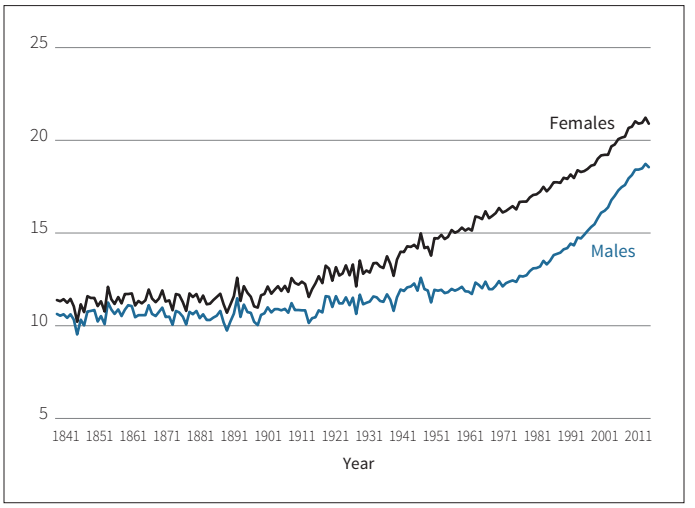
Historical mortality experience among their respective countries is gathered, with a focus on mortality improvements at key age ranges. For example, Figure 1 compares annual rates of reduction in mortality for two historical periods and age categories and projections for years between 2030 and 2080.

Goss pointed out that life expectancy at birth, a widely-used indicator of the overall health of the population, can be a misleading metric for use in assessing long-term trends. This concern is due to the sizable improvements in mortality at younger ages, particularly at infancy, in the first two-thirds of the 20th century that led to a substantial portion of the improvement in life expectancy at birth over this period.

As shown in Figure 2 (shown for the U.K., with similar patterns for Canada and the U.S.), the last few decades have seen a reduction in the differential between male and female period life expectancy at age 65, with the historical advantage of females in longevity being reduced since the 1980s when it was at its peak. This is partly because of the dramatic reduction in smoking that was more significant for males and in cardiovascular diseases. Although each of the three panelists projected some continued reduction in this difference between the genders, none projected the differences would be eliminated completely.

One historical experience improvement pattern that seems consistent in all three countries is an age-gradient, that is, a

Figure 2 – Period life expectancy at age 65 (U.K.)

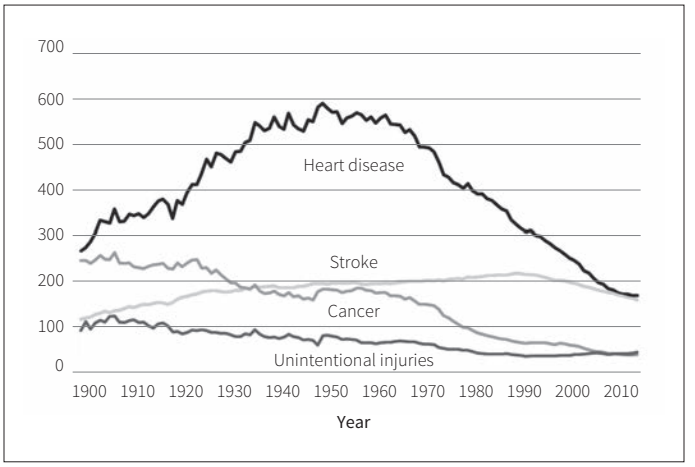


Source: Office for National Statistics

smaller percentage improvement at ages 85 and older compared to that of younger ages. The projections made in Canada and the United States have reflected a continuation of this age-related pattern, while those of the U.K. are the same for all ages, expressing an aggregate historical average instead. Over time, differences in this pattern by age can contribute to significant differences in overall social security projections.

Each panelist discussed trends in the leading causes of death in their country, which overall are cardiovascular (heart) diseases and malignant neoplasms (cancers). An example of major causes of death on an age-adjusted basis is shown in Figure 3 for the United States.

Figure 3 – Age-adjusted death rates for heart disease, cancer, stroke and unintentional injuries: United States, 1900-2015 (rates per 100,000 standard population)



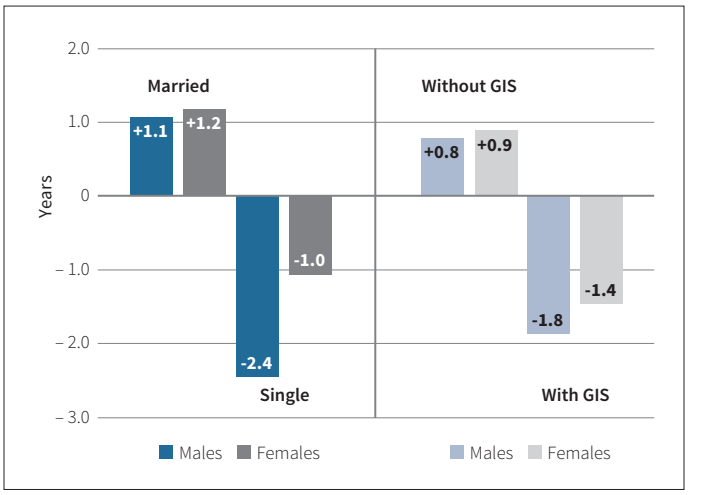
Source: Robert Anderson, National Center for Health Statistics (U.S.)

Common to all three country projections and contributing most to the mortality improvements of the last 30 years has been a drastic reduction in deaths due to cardiovascular and related diseases—resulting from enhancements in prevention and treatment of these diseases, as well as from more effective control of their direct risk factors. This reduction has driven overall improvement in all economically developed countries. Nevertheless, even if this improvement continues, due to cardiovascular's decreasing share of total mortality, corresponding reductions will not have as large an effect on overall future mortality improvement.

In addition, an increasingly important reported cause of death at older ages has been dementia (including Alzheimer's disease). Note that this increase is partly because of an increasing attribution of deaths to this cause. An example of the importance of dementia can be seen in the U.K., where the two leading causes of death for males of all ages in the U.K. in 2013 were heart disease (14.3 percent of total) and dementia (7.3 percent), while for females they were dementia (15.2 percent) and heart disease (8.8 percent). Dementia and Alzheimer's disease are the leading cause of deaths for both males and females aged 80 and over (at 13.7 percent for males and 21.2 percent for females). A reason why the percentage of dementia is higher for females is that the average age of females over age 65 is older than that for males.

Those with lower income experience a shorter life expectancy at age 65 than those with higher income—this is illustrated in the right side of Figure 4 (Canadian experience) by comparing those provided with GIS (Guaranteed Income Supplement—in

Figure 4 – Differences in life expectancy at age 65 (2013) between those who are married and single, and of those collecting Old Age Security benefits between those collecting GIS benefits and those who are not (Canada)



Source: Office of the Chief Actuary, Actuarial Study No. 17: Old Age Security Program Mortality Experience, June 2016

Canada, those who receive monthly benefits from the Old Age Security pension program due to their lower income). The left side of Figure 4 shows that those who were married in 2013 at age 65 experience longer longevity than those who were single.

Several factors expected to affect future longevity may prove either beneficial or detrimental. Some of the issues involved include the following questions:

- In view of budget and cost pressures, will investments in and effects of health care infrastructure and financing, new medical treatments, medical technology and drugs continue at their recent pace?
- What will be the effect of behavioural changes, including smoking prevalence, lifestyles, physical activity/sedentary living and obesity?
- What will be the effect of possible new diseases (e.g., HIV, SARS) or re-emergence of old diseases (e.g., tuberculosis and yellow fever), either on a gradual or pandemic basis?
- Will antibiotic resistance become a widespread issue?
- What environmental changes, disasters or wars will take place?
- What changes in population composition will arise, including cohort effects and migration between countries.

It will be difficult to match the effect of the various and wide-ranging sources of historical mortality improvement that included the introduction of antibiotics, increases in standard of living, expanded education, public health programs such as improved sanitation, and vast spending on medical technology, medical care and drugs.

As shown in Figure 1, all three panelists projected continued mortality improvement. However, Goss expressed an opinion that it is likely that the combined effects of several key contributors to reductions in mortality over recent decades will not have matching effects in the future.

In fact, a significant development so far in the early 2010s has been the larger than expected decline in rates of mortality improvement in all three countries. Although there is a great deal of speculation regarding the causes for this emerging pattern change, there is, as yet, no definitive consensus regarding the primary cause of this change, or, indeed, whether it is a temporary blip or represents a structural change in mortality improvement.

Some country-specific observations that were made included:

- Canadian mortality experience, although at a middle-of-the-OECD (a group of 30 economically developed countries) level at middle attained ages, has recently been more favorable than most of these countries at the oldest ages. Over the last few decades, Canadian mortality levels have generally been significantly better than both that of the U.K. and the United States.
- Mortality for the disabled has been significantly greater than for the non-disabled. For example, for Canadians 55 to 59 years of age, mortality experience for the disabled has been five or six times greater than for those who are not disabled.
- Mortality rates of Americans and Canadians with larger retirement income are better than that of those with lower income. The U.S. white population has recently experienced an increase in mortality in middle ages.
- Based on heat map analyses, certain cohorts in the U.K., especially those born during the period between 1925 and 1938, and Canadian males born in that period have experienced significantly better mortality improvement than those born both before and after that period, although it is uncertain whether these cohort effects will continue.
- U.S. mortality experience is likely to continue to be affected by both smoking and obesity levels, with somewhat offsetting mortality results—mortality increases due to increased obesity may partly offset the favorable results from decreases in smoking.

There is a great deal of uncertainty associated with future longevity. Mortality projections remain controversial and will continue to be discussed and debated by demographers, economists and actuaries. For instance, the recent slowdown in mortality improvement compared with the extraordinary last half of the 20th century will challenge all of these professionals in the years to come.

CONSIDER THESE RESULTS, BUT USE WITH CAUTION

The projection methods and results used by Social Security actuaries have proven to be of value to actuaries in other fields. For instance, I am aware of actuaries practicing in life insurance, annuities, pensions and long-term care insurance who have based their mortality improvement assumptions on corresponding projections made for the national population.

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Although the estimated mortality rates of the overall population and their improvement are appropriate for projections of social security, they may not be appropriate, without adjustment, for applications other than those intended. This is due, in large part, to differences between the overall population and a segment of the population. Social security programs cover almost all of a country's population, while the characteristics of a population segment that most actuaries address are much different.

Actuaries who develop or rely on mortality estimates should keep up-to-date with developments in this area, while, at the same time, recognizing the limitations in applying these methodologies and projections.

A key takeaway from this panel is that the study of mortality from many sources remains important for both social security projections and also for other applications. The size and shape of mortality projections will likely remain dynamic and controversial. Special care is needed if the population to which experience is to be applied is not the population from which experience is available. Join us. ■

Special thanks to the panelists who also reviewed and helped finalize this article for publication: Jean-Claude Ménard, chief actuary of the Canada Pension Plan, jean-claude.menard@osfi-bsif.gc.ca*; Adrian Gallop, of the advice to government team of the Government Actuary's Department in the U.K.*, adrian.gallop@gad.gov.uk*; and Steve Goss, chief actuary of the U.S. Social Security Administration*, stephen.c.goss@ssa.gov.

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ENDNOTES

1 Presentations available at *https://livingto100.soa.org/sym-agenda-Day3.aspx* (Concurrent Panel IV)

2 Jean-Claude Ménard shared the floor with Annie St-Jacques during his presentation.

3 Steve Goss shared the floor with Mark Bye during his presentation.