



SOCIETY OF ACTUARIES

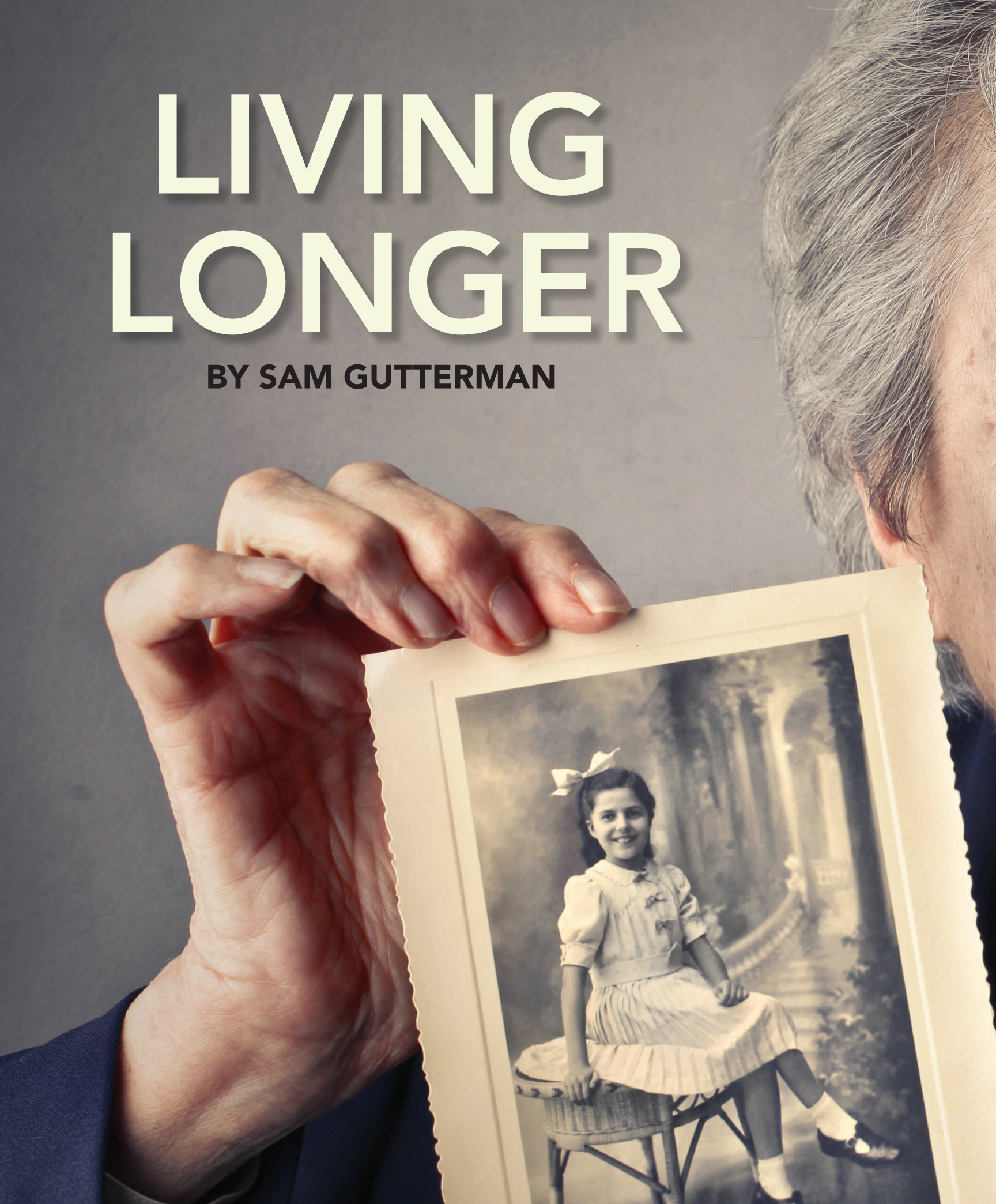
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# LIVING LONGER

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# MORTALITY HAS A BIG ROLE IN SOCIAL SECURITY ACTUARIAL PROJECTIONS. WHAT DOES THAT MEAN FOR A POPULATION THAT IS LIVING LONGER?

**T**oo often professionals become entrapped by practices they have grown accustomed to or developed in intellectual silos. We all benefit by periodically taking a step back to study developments and practice of others. The practice of, insight into, and information used by our peers in other firms, practice areas and countries can provide us fresh ideas and perspectives we can build on further. Yes, North American actuaries, we aren't the font of all the world's wisdom!

Cutting-edge, macro-level insight into mortality projection issues is no exception—this was evident in the 2014 Living to 100 Symposium panel presentations of leading social security actuaries from Canada, the U.K. and the United States.

Topics covered ranged from age-gender trends to smoking and obesity, and how they are

considered in the development of mortality projections.

Mortality is a crucial ingredient in the estimation of the future course of a social security program, as it is for many financial security programs with which actuaries are involved. The actuarial assessment of a financial security program benefits from a comprehensive understanding of its dynamic demographic drivers and the effects of the characteristics of its participants on their mortality.

The transparency of the assumptions they use facilitates the public and professional scrutiny social security programs are constantly under and provides confidence in the objectively developed projections. This necessarily leads to the use of sound methodologies and ultimately to more soundly based public policy decision-making. Almost universally, those involved in social security projections are well respected in their professional communities.

The three panel members—Jean-Claude Ménard, chief actuary of the Canada Pension Plan; Adrian Gallop, of the insurance and social security area of the Government Actuary's Department in the U.K.; and Steve Goss, chief actuary of the U.S. Social Security Administration—provided mortality intel they have found useful.

## PROJECTION METHODOLOGY

Each of these actuaries follows a rather similar overall projection methodology:

1. Estimate current mortality rates by gender and age (and 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 an average of reported rates for the country over several years. This is needed as there is a lag in obtaining current national mortality experience and fluctuations in year-to-year experience. In addition, these rates are usually trended until the valuation date.
2. Estimate both current and ultimate mortality improvement factors by gender and age group. In the United States, these also vary by major causes of death.
3. Interpolate the mortality improvement factors by gender and age group (and cause for the United States) between the estimated current rates and when the ultimate factors are applied. The year at which the ultimate improvement rates go fully into effect ranges from 20 to 25 years.

However, different techniques and considerations are applied for each individual step. The views and research of a variety of individual and technical panels of experts are considered, particularly in the selection of improvement factors. In the end, the last factor added to the mix of considerations in each case is professional judgment, weighing the expected effect of all of the factors involved.







## Period Life Expectancy at Age 65 at Selected Years

YEAR	CANADA			U.K.			U.S.		
	MALES	FEMALES	FEM-MALE	MALES	FEMALES	FEM-MALE	MALES	FEMALES	FEM-MALE
1941	12.8	14.1	1.3	11.4	13.4	2.0	12.2	13.8	1.6
1951	13.4	15.0	1.6	11.7	14.3	2.6	12.8	15.2	2.3
1961	13.6	16.3	2.7	12.0	15.3	3.3	13.1	16.1	3.0
1971	13.9	17.6	3.7	12.2	16.1	3.9	13.1	17.1	4.0
1981	14.7	19.0	4.3	13.0	16.9	3.9	14.2	18.6	4.3
1991	15.6	19.7	4.1	14.1	17.9	3.8	15.2	19.2	4.0
2001	17.0	20.4	3.4	15.9	19.0	3.1	16.1	19.1	3.0
2011	19.0	21.9	2.9	18.2	20.7	2.5	17.2	19.5	2.3

Two overall approaches have been taken to develop mortality projections: (1) statistical projections (that is, relying on time series or regression extrapolation); and (2) by-cause projections (at least for the next, say, 20 years). It is interesting that 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 expected significance of changes in mortality in the selection of the projection factors used.

Although there are differences in the detailed steps involved and factors considered in the projections for each country, there appears to be a consensus among social security actuaries that future mortality improvement will likely not be as large as it has been in some past periods of exceptional improvement. This is in part because of changes in demographics, prevention activity intensity, health care technologies and medicines, introduction of more extensive public health coverage, supply of services and quality of health care. Nevertheless, the U.K. ultimate

improvement factors are broadly similar to the rate of improvement experienced over the last 70 to 100 years, with American and Canadian ultimate factors decreasing on a percentage basis as attained age increases.

The methods and assumptions used in these projections are subject to regular peer reviews 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, Canada

been shown to be consistent with opinions of independently developed expert opinion of medical staff of likely mortality trends by age and condition conducted at Johns Hopkins University.

### **MORTALITY EXPERIENCE, PROJECTIONS AND OBSERVATIONS**

All three countries have seen significant mortality improvement for more than a century, seemingly with no end in sight. The extent and patterns of future improvement will play a highly significant role in upcoming

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is subject to triennial reviews by a panel of actuaries, and the American projections have been subject to ideas and opinions of quadrennial technical panels consisting of actuaries, demographers and economists. The U.K. regularly convenes a panel of experts to provide input into the demographic aspects of social security projections, while U.S. Social Security mortality projections have recently

debates concerning how best to address financing challenges facing all social security programs, especially as and after the baby boomers retire.

Historical mortality experience of their respective countries was contrasted with those of other countries. Key metrics focused on were primarily life expectancy



at birth and at age 65, as well as mortality rates at key age ranges. For example, the table on page 23 provides life expectancy at age 65 by gender.

Goss pointed out that life expectancy at birth, a widely used indicator of the overall health of population, can be a misleading metric in the assessment of the soundness of a social security program, as well as other systems studied by actuaries. This concern is due to the fact that it is unlikely that the sizable improvements in mortality at younger ages in the first two-thirds of the 20th century that contributed to a large portion of the improvement in life expectancy at birth can be repeated in the future. In addition, the effect of changes in mortality by age on social security projections can differ substantially.

As seen in the table on page 23, over the last few decades each country has seen a reduction in the differential between

male and female life expectancy at most ages, with the historical advantage of females in longevity being reduced since the 1980s when this difference had peaked. This reduction was in part because of the dramatic reduction in smoking and cardiovascular diseases, especially by males over the last several decades. Although each of the three panelists projected some continued reduction in mortality experience between the genders, none projected the differences to be eliminated completely.

All three projected continued mortality improvement in their countries. However, as Goss noted, it is unlikely that several key contributors to reductions in mortality over the recent decades will be able to be matched in the future. The chart below indicates the ultimate improvement factors (weighted by gender) used for the three countries. The improvement rates for the period between 2009 and 2030 are generally between recent historical averages and the ultimate improvement rates.

Ménard developed this comparison of projected annual reduction in mortality rates for the three countries between 2009 and 2049.

AGES	CANADA	U.K.	U.S.
15-54	1.02%	1.35%	0.80%
55-64	1.12	1.43	1.23
65-74	1.21	1.50	1.06
75-84	1.16	1.72	0.92
85-89	0.89	1.83	0.53
90+	0.57	1.61	0.49

Common to all three countries 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—as a result of improvements in prevention and treatment of this family of diseases, as well as more effective control of its direct risk factors. This reduction has driven overall improvement in all economically developed countries. Nevertheless, even if it is believed that this rate of improvement in this cause of death will continue, due to its decreasing share of total mortality, corresponding reductions will not have as significant an effect on overall future mortality improvement, without help from other sources.

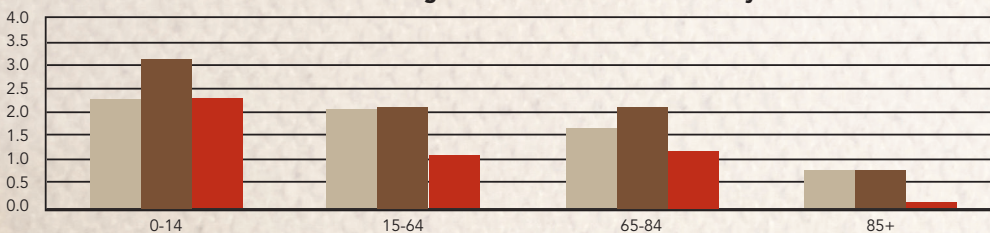
Steve pointed out several factors he has considered in development of mortality projections, all of which are relevant to Canada and the U.K. as well.

- **Smoking.** Smoking prevalence has dropped significantly in many countries, due to higher taxes, regulation and health warnings. Nevertheless, because of the long lag time between smoking inception and consequential death, we have so far

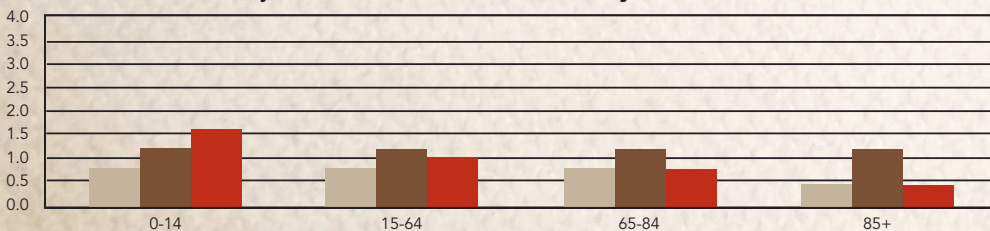
## Rate of Improvement in Annual Mortality Rates



1982-2007 Average Annual Reduction in Mortality



Projected Annual Reduction in Mortality for 2030-2080





only seen improved mortality results in males, with future improvements for female mortality just beginning to be seen.

- **Obesity.** The last 40 years have seen significant increases in obesity for all age groups and both genders. This cannot be good for future mortality levels, particularly with the long lag between obesity exposure and consequential death. The United States has been the leader in having the largest obesity prevalence.
- **Medical technology.** It is not clear how much improvement in mortality will result from the application of future medical technology enhancements.
- **Cost pressure.** Continued cost pressure on health care systems to apply best practice cost control techniques may lead to reductions in lower overall quality of medical care.
- **Medical spending.** As the growth in funding for medical-related research has decelerated, the resulting reduction in new treatments and drugs down the road may have a negative long-term drag on mortality improvement.

In sum, it may be difficult to match the effect of sources of historical mortality improvement that have included the introduction of antibiotics, increases in standards of living and education, public health programs such as improved sanitation, and vast spending on medical technology, medical care and drugs. 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 other countries at the oldest ages. This age advantage is wonderful, although if recent favorable trends continue it may prove costly for both Canada's social security and private pension programs. Canadian mortality rates have for the most part been better than those of the United States. Over the last few decades, Canadian mortality levels have, except for the very young, been significantly better than both the U.K. and the United States.
- Mortality for those disabled has been significantly greater than the non-disabled. For example, for Canadians 55 to 59 years of age, experience has been five or six times that of those who are not disabled.
  - Ménard observed that marital status is an important variable affecting mortality, although it is more significant for males than for females. This is consistent with experience in most countries.
  - Mortality rates of Canadians with larger retirement income are better than corresponding mortality of those with lower income. This mortality relativity is consistent with observations in the other two countries.
  - Certain cohorts in the U.K., especially those born during the period between 1925 and 1938, have experienced significantly better mortality compared to those born both before and after



- that period. This type of cohort effect has not been observed to nearly as great an extent in the other countries. Although Canadian experience appears to suggest some cohort effects for males, none has been evident in the United States or for Canadian females.
- U.S. mortality experience is likely to continue to be affected by smoking and obesity, with somewhat offsetting mortality results (increases due to increased obesity may be offsetting in part the favorable results from the decrease in smoking). Goss pointed out that it was quite difficult to project improvement for "other" specific causes, as new issues affecting mortality are bound to arise, although not all are currently evident.

In spite of the in-depth insights of our social security actuaries, mortality projections remain controversial and will continue to be discussed and debated by demographers, economists and other actuaries.

### CONSIDER THESE RESULTS, BUT USE WITH CAUTION

At times over the last couple of decades, many actuaries have focused their attention on investment returns, with scant attention paid to mortality, as it seemed to be stable and predictable. Many are now awakening to the importance and issues associated with this demographic assumption.





Not only are the methods and resulting projections used by social security actuaries in developing their social security projections, they have also been of value

mortality of Canadians of older ages. In addition, American pension actuaries are looking at new mortality tables, and U.K. actuaries are now

also affect expected benefits for private financial security systems.

## Especial care is needed if the population to which experience is to be applied is not the population from which experience is available.

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 improvement assumptions on the mortality projections published by social security actuaries. All actuaries who rely on mortality estimates should keep up-to-date with developments in this area, while at the same time recognizing the limitations they need to keep in mind in applying these methodologies and projections for their own use.

Examples of applications include:

- **Life insurance.** Mortality improvement is being considered, not only for pricing and reserving for payout annuities, but also for pricing and reserving of life insurance. In addition, refinements in risk classification for new issues continue to be important in competitive positioning.
- **Long-term care insurance.** Some of the largest sources of reserve strengthening for long-term care insurance have arisen from switches to more current mortality tables.
- **Pensions and annuities.** Canadian pension and annuity actuaries are experiencing challenges associated with significant improvement in

updating their mortality projections on a regular basis to stay on top of mortality improvements.

Although the mortality rates of the overall population and their projection are appropriate for projections of social security, they may not be appropriate to be applied without adjustment for areas other than those intended. The primary reason is because of difference in the segments of the population covered. It has to be remembered that social security programs cover almost all of a country's population, while those of most actuaries address programs or programs with selected sub-population groups.

It is clear that mortality can differ substantially by segment, whether as a result of selection by means of underwriting of life or long-term care insurance, self-selected by industry employed or anti-selected by insured or annuitant/pensioner, particularly if they are given choices between options (including opting out of the program) that are not financially equivalent. Each panel member indicated that mortality in their country has varied by socioeconomic characteristics—in social security programs this implies that those receiving higher periodic benefits will likely also receive them for a longer period of time. This differential by size of benefit may

Even mortality improvement can vary. For example, although a population of non-smokers may experience at a far lower level than current smokers, their rate of mortality improvement may not be as significant, because they won't benefit from smoking cessation. Gallop indicated that large differentials existed within regions of the U.K.—a fact that may be ignored by many actuaries if the population segment being assessed is not nationally representative.

### TAKEAWAYS

Takeaways from the panel include recognition that the study of mortality from many sources remains important for both social security projections and many other applications; and the size and shape of mortality projections will likely remain dynamic and controversial. Especial care is needed if the population to which experience is to be applied is not the population from which experience is available. ▣

For more information on the presentations from the 2014 Living to 100 Symposium, visit the online monograph at [livingto100.soa.org](http://livingto100.soa.org).

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