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Presentation by Chief Actuary, Jean-Claude Ménard
Office of the Chief Actuary (OCA)
Office of the Superintendent of Financial Institutions Canada (OSFI)
at the
SOA Living to 100 International Symposium
on the topic of: Mortality Projections of Public Pension Plans in Canada and its financial implications

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Good morning. Thank you for inviting me to talk to you today. By way of introduction, I am Jean-Claude Ménard, Chief Actuary of the Canada Pension Plan, the Old Age Security Program and federal public sector pension plans in Canada.

Presentation Outline ***(Slide 2)***
Today I will first discuss the Canadian mortality trends over the past century, and to which degree these trends are projected to impact future mortality rates of the Canadian population.

I will then compare Canadian projections with those of other countries and present different scenarios that illustrate the impact of the uncertainty of mortality projections. Finally, I will try to answer the question: "Can we live beyond 100 years?"

Life Expectancy at Birth (Calendar) ***(Slide 3)***
This slide presents the calendar life expectancy at birth. Calendar year life expectancy, that is calculations based on the mortality rates of a given year, is usually reported by statistical agencies around the world.

Since 1901, life expectancy at birth in Canada has increased by an estimated 33 years with most of the change occurring before 1950. Future increases in life expectancy are expected to take place at older ages as opposed to younger ages, which means that the impact on life expectancy at birth will be limited.

Contribution to increase in life expectancy at birth has gradually shifted to people over age 65 ***(Slide 4)***
This table shows a slowdown in the rate of increase in life expectancy at birth between the first and later parts of the 20th century. Over the 20 years from 1989 to 2009, 59% of the increase in life expectancy for males has come from mortality improvements at ages 65 and over. For females, the proportion is 67% over the same period. This trend is expected to continue in the future.

Improvements in mortality related to heart diseases have been significant over the last 15 years *(Slide 5)*
The significant increases in Canadian life expectancies at age 65 that have been observed over the last few decades can be explained in great part by the improvements in mortality related to heart diseases. These rates were improving at around 5% per year at ages 65 and over for males and 4% per year for females. In the future, we could expect that reductions in mortality from malignant neoplasm may hopefully become an important factor.

Life expectancy at Age 65 (Calendar) *(Slide 6)*
Since the early 1970s, male and female life expectancy at age 65 has increased by about five years to 19 and 22 years, respectively. It represents a pace of increase of more than a year per decade. The gap between female and male life expectancies at age 65 has also narrowed but only more recently.

Life expectancy is impacted by marital status and level of income *(Slide 7)*
Life expectancy varies by population subgroups. For example, the marital status and the level of income are two long-term predictors of mortality. Old Age Security Program in Canada covers virtually all Canadian population. This program mortality study indicates that married beneficiaries tend to live longer than the overall population, while single beneficiaries have a shorter life expectancy, with males affected more than females.

The same study indicates that beneficiaries with higher levels of income (those not entitled to the income-tested GIS benefit) have a higher life expectancy than the overall population. This observation may be explained by the relationship between higher levels of income and improved health and quality of life.

Survivor beneficiaries mortality is significantly higher than that of general population *(Slide 8)*
Another population group that exhibits significantly higher mortality than that of the general population are surviving spouses. The slide shows that females are more affected by the death of their spouse than males, especially at the younger ages. For both males and females, mortality rates converge to the level of the general population mortality at the advanced ages.

Mortality of Disability Beneficiaries is 5 to 6 times higher than the general population's mortality (Ages 55 to 59) *(Slide 9)*
Not surprisingly, disabled people exhibit mortality rates much higher than those of general population. These relationships for other age groups are similar to that

shown on the slide. It should be noted that cancer is the most common cause of death among the disabled population.

Heat map of historical and projected mortality improvement rates for males *(Slide 10)*

One major challenge for actuaries is to make assumptions on how mortality rates will evolve in the future. In other words it is necessary to make assumptions on the future mortality improvement rates. A heat map is a useful tool to analyse the trends in mortality improvement rates.

This slide presents the historical heat map for Canadian males, as well as our projections. As it could be seen, in late 60s – early 70s, the mortality rates among young males increased significantly (purple spot). We believe that this phenomenon was caused by an increase in accidental deaths caused in particular by unsafe driving. Deterioration in male mortality could be observed in mid-90s for males aged between late 20s and early 40s and is related to AIDS.

The positive cohort effect for males born approximately in the 1930s and 1940s is also well seen. In our projections we assume that this cohort effect will continue for some time and then gradually disappear. In general, mortality is assumed to continue to improve, but at a slower pace than it was seen over the recent decades.

Heat map of historical and projected mortality improvement rates for females *(Slide 11)*

For Canadian females there is no discernible historical cohort effect. A significant calendar year effect is seen for females aged less than 45 in the 1950s and early 1960s with mortality improvement rates close to 5% per year. It is believed to be related to reduction of mortality as a result of giving birth.

The recent historical as well as projected improvement rates are more moderate. It is assumed that the gap between male and female mortality rates will continue to shrink. At the same time, we believe, that male mortality rates will continue to be higher than those of females, that is women will still live longer than men.

Canadian mortality rates at ages 15 to 54 are significantly lower than US rates *(Slide 12)*

The next several slides compare evolution of mortality rates by age groups for Canadians and Americans with more focus on Canada. United States numbers are based on the 2012 OASDI Trustees Report.

For the age group 15 to 54, over the last 40 years, the reduction in Canadian mortality rates was about 57%. This is a little higher than the 50% reduction over the previous 40-year period. However, it is worth noting that mortality rates are now decreasing at a slower pace: decrease of 28% in the last 20 years as opposed to 40% in the previous 20 years. We project a further reduction of 38% over the next 40 years.

Current mortality for this age group is 40% lower than for U.S. mainly due to much lower mortality from accidents, heart diseases and homicides.

Mortality Rates for older age groups have decreased over the last 80 years, more so over the last 40 years for males *(Slide 13)*

For age group 55 to 64, the recent reduction of 57% in mortality rates over the last 40 years was much more dramatic compared to 26% reduction over the previous 40-year period. In addition, male mortality rates for this age group have been decreasing at a much faster pace in the last two decades than in previous decades. A further reduction of 33% is projected. Current mortality for this age group is 27% lower than for U.S. mainly due to much lower mortality caused by diseases of the heart, accidents and diabetes.

For ages 65 to 74, 7 deaths per 1,000 are from cancer, while only 3 deaths per 1,000 are from heart diseases *(Slide 14)*

Age group 65 to 74 has experienced similar pattern and magnitude of reduction in mortality as age group 55 to 64. A further reduction of 40% is projected. Once again, male mortality rates in this age group have been decreasing at a faster pace in the last two decades than in previous decades.

For this age group, cancer is responsible for the vast majority of deaths. Current mortality is 21% lower than for U.S. mainly due to much lower mortality caused by diseases of the heart, lower respiratory diseases and diabetes.

Male mortality rates for ages 75 to 84 for Canada are projected to become lower than US female mortality rates *(Slide 15)*

For the age group 75 to 84, the reduction in mortality rates was about 43% over the last 40 years compared to only 31% over the previous 40-year period. A further reduction of 37% is projected. Current mortality is 17% lower than for U.S. mainly due to lower mortality caused by diseases of the heart and lower respiratory diseases.

Elderly Mortality Rates have decreased over the last 80 years, more so over the last 10 years *(Slide 16)*

U.S. and Canadian mortality rates of the 85 to 89 age group were quite similar prior to 1999. However, since 1999, Canadian rates have been reducing faster than American ones. The reduction over that decade was 21%. Canadian rates are currently 15% lower than for U.S. mainly due to much lower mortality caused by diseases of the heart and Alzheimer's. A further reduction of 30% is projected by 2049.

For ages over 90, heart diseases remains the main cause of death (Slide 17)

The 90 and over age group mortality rates have been decreasing but at a slower pace than for other age groups. A reduction of 26% was experienced over the last 40 years, compared to a reduction of 14% over the previous 40-year period.

For this age group, projections become very uncertain, even for the short and medium terms. As of 2009, Canadian mortality for 90 and over age group is 15% lower than U.S. mortality, due to lower mortality caused by diseases of the heart and Alzheimer's.

Cohort life expectancy at age 65 *(Slide 18)*

A cohort life expectancy differs from the period or calendar life expectancy shown in the beginning of this presentation. It includes future mortality improvements to the calendar year of mortality rates. Canadian life expectancy at age 65 is projected to increase by three years to reach 25 years within the next 50 years. It means that half of Canadian retirees are expected to live past age 90.

This will result in increased costs for pension plans as beneficiaries are expected to receive their benefit for a longer period.

By 2030, Canada is projected to be behind UK and Switzerland for males *(Slide 19)*

Canada enjoys one of the top positions on longevity in the world and this is expected to continue. Based on the available projections, by 2030, British and Swiss men are expected to live longer than Canadian men. The Canadian calendar male life expectancy at age 65 is projected to reach more than 21 years by 2030.

Japanese, British, Swiss and Finnish women are all projected to live longer than Canadian women by 2030 ***(Slide 20)***

By 2030, Japanese, British, Swiss, French and Finnish women are all projected to live longer than Canadian women. The Canadian female life expectancy is projected to reach almost 24 years by 2030.

Uncertainty of Results: Life Expectancies at age 65 if MIRs by cause are sustained ***(Slide 21)***

Future mortality projections are very uncertain. As such, it is useful to consider alternative projection scenarios. This chart presents the life expectancies at age 65 under a scenario where the annual MIRs of the last 15 years (1994-2009) by cause are assumed to remain constant over the entire projection period.

Due to the higher recent mortality improvement rates for males, this scenario leads to a narrowing of the gap between male and female life expectancies at age 65 and, eventually, higher life expectancy for males than for females by 2026 and thereafter. In 2075, male life expectancy would surpass the one of females by over 5 years. This scenario serves as a reminder that setting future assumptions only on recent experience may lead to unintended results.

Uncertainty of Results: Life Expectancies at age 65 if heart diseases and cancer gradually removed over 75 years ***(Slide 22)***

Next, let's consider a scenario where mortality related to heart diseases and malignant neoplasms is gradually eliminated over the next 75 years. It is also assumed that mortality from all other causes is gradually reduced by 2030 to half the rate observed for females over the last 15 years.

This scenario results in cohort life expectancies at age 65 that will surpass those projected under the latest Canada Pension Plan actuarial report by 2017 for female and by 2024 for males. By 2075, cohort life expectancies will be about 3 years higher for females and about 4 years higher for males than under CPP26.

Uncertainty of Results: mixed stochastic/deterministic approach produces wide range of life expectancies ***(Slide 23)***

To create low- and high-cost mortality tests for the 26th CPP Report we have used a mixed stochastic-deterministic model. Higher and lower ultimate mortality improvements are defined deterministically. Stochastic simulations were then performed to determine future morality rates.

The low-cost scenario corresponds to the lower end of the 80% probability range under the alternative of reducing the improvement rate assumption, and the high-cost scenario corresponds to the higher end of the 80% probability range under the alternative of increasing the improvement rate assumption. These scenarios produce life expectancies at age 65 in 2050 of about 2 years lower and higher as compared to the best-estimate assumptions. As it could be seen, the financial impact on the Canada Pension Plan is quite substantial.

Can We Live Beyond 100 Years? Probability of living to 100 for Canada, the U.S. and the U.K. ***(Slide 24)***

So, can we live beyond age 100? This slide presents the probability of surviving to age 100 from a given age in 2012 for Canada, UK and US. It is interesting to look at the shape of the curves. The probability is higher for younger ages due to the projected decreases in mortality rates. On the other hand, for older age groups, the probabilities of living to 100 increase since only individuals who have already reached older ages are considered.

UK has the highest probabilities of living to 100 of the three countries at all ages between 0 and 85 due to higher assumed future mortality improvement rates.

Survival Curves for a Life Expectancy of 100 (Males) ***(Slide 25)***

What could happen to mortality rates in order for Canadians to have a life expectancy at birth of 100?

We came up with two alternatives. This chart presents a comparison of the current survival curve and two alternative ones. Under the first scenario, current mortality rates at each age are reduced by 87% (dotted blue survival curve). Under the second alternative, the life-span is increased to 140 (red survival curve), and the current mortality rates are redistributed across ages 0 to 140.

To live beyond 100… ***(Slide 26)***

If mortality rates decrease at the same pace as observed over the past 15 years, a life expectancy of 100 could be attained in 85 years (2094) for males and in 112 years (2121) for females. If we wish to live to 100 today, we either need to reduce current mortality rates dramatically or increase our life span. In our view, both routes are not very likely.

Conclusions *(Slide 27)*
To conclude, retirement is expensive and will become even more expensive in the future with improved longevity. Projection of mortality rates is a difficult exercise, since future mortality rates are highly uncertain, especially for people older than age 90.

It is a professional duty of the actuary to examine all available information in order to develop best-estimate mortality assumptions.

Thank you. I will be pleased to answer any questions you might have