Canadian Institute of Actuaries Webcast on Mortality Experience and Projections for Social Security Programs in Canada: Living to 100 – Myth or Reality

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Presentation *(Slide2)*

Good Afternoon. Thank you for having us here today to talk about the Canada Pension Plan and Old Age Security mortality experience and the mortality projections for the just released 27th CPP Actuarial Report.

I will cover mortality experience of CPP and OAS beneficiaries as covered under our Actuarial Studies No.16 and 17 and touch on recent trends in mortality improvements for these two programs.

Assia will then present an overview of the 27th CPP Actuarial report mortality projections as well as talk about the reality of living to advanced ages.

CPP Beneficiaries (Actuarial Study No.16) *(Slide 3)*

OCA's Actuarial Study no. 16 provides a detailed historical analysis of the mortality of CPP retirement, survivor and disability beneficiaries.

For retirement beneficiaries over the study period 1990-2013, there were 2.4 million retirement deaths and 69.6 million life-years of exposures.

For the purpose of analysis and comparison, each CPP retirement beneficiary was classified by age, sex, and level of pension expressed as a percentage of the maximum retirement pension applicable to the age and year of commencement of the benefit. Less than 37.5%, 37.5% to 75%, 75% to 99% and 100%.

The large volume of reliable administrative data on deaths and exposures results in highly credible results.

Additional Information:

For survivor beneficiaries over the study period 1990-2013, there were 872,000 deaths and 19.4 million life-years of exposures.

Over the study period 1990-2012, there were 206,000 disability deaths and 7.0 million life-years of exposures.

Distribution of Retirement Deaths (1993 and 2013) *(Slide 4)*

The slide presents the evolution of the distribution deaths for male retirement deaths by age from 1993 to 2013. It clearly illustrates the shift of the distribution towards older ages as men live longer. As a result, the median age at death for males has increased over time by 4 years from 76 years in 1993 to 80 years in 2013.

In 2013, the highest number of male deaths occurred at age 83.

Of the total deaths (males and females), about 9,000 were classified as centenarians (64% females).

Although not shown, the distribution of female retirement deaths by age has also shifted to older ages. The effect is somewhat more pronounced as it reflects the increase participation of females in the Canadian workplace and the CPP. The median age at death for females has increased by 6 years from 77 years in 1993 to 83 years in 2013. The highest number of female deaths occurred at age 88.

Retirement Exposures by Level of Pension (all ages, 2013) ***(Slide 5)***

The slide shows the distribution of exposures by level of pension for males and females for year 2013 all ages combined.

For males, the exposures are more heavily distributed toward the higher levels of pension. In 2013, about 2/3rd of males fell in the category of pensions greater than 75% of the maximum while only 13% had pension below 37.5% of the maximum.

For females, the exposures by level of pension are more heavily distributed towards the lower levels of pension. For example, in 2013, about 30% fell into the 75% and over category while 70% were below 75% of the maximum.

Average retirement benefit in proportion of the maximum (without actuarial adjustment factors): 72 % for males and 56% for females, all ages combined.

Retirement Mortality by Level of Pension (Males, 2013) ***(Slide 6)***

In general, for both sexes, those with higher pensions experience lower mortality, while those with lower pensions experience higher mortality.

In addition, for both sexes, each level of pension mortality exhibits convergence to the all levels of pension mortality as age increases. CPP retirement mortality at ages 60 to 64 must be interpreted with caution as they exclude CPP disability beneficiaries, and as such mortality at those ages is somewhat artificially lower.

Females exhibit the same patterns; however, the level of pension has relatively more impact on male mortality rates.

<u>Additional information:</u>

This slide shows that male retirement beneficiaries receiving a maximum retirement pension have the lowest mortality, 57% of overall mortality at age 65 increasing to 76% at age 70 and 89% at age 80. In comparison, male retirement beneficiaries with the lowest level of pension (i.e., less than 37.5% of the maximum retirement pension) have the highest mortality. 50% higher than overall at age 65 decreasing to 20% higher at age 70 and 10% higher by age 80.

Life Expectancy at 65 by Level of Pension (2013) *(Slide 7)*

This slide shows life expectancy at age 65 for retirement beneficiaries by level of pension.

In 2013, males aged 65 with the highest pensions live about 2.0 years longer (20.1 vs. 18.1 years) than those with the lowest pensions. For females the difference is a little less at 1.6 years (23.1 vs. 21.5 years).

Evolution of Life Expectancy at age 65 High vs. Low Retirement Pensions (1990-2013) *(Slide 8)*

This slide presents the evolution of life expectancies at age 65 for those with lowest and highest pensions over the period 1990 to 2013.

Over the past two decades, for both sexes, the difference in life expectancy at age 65 between those with maximum pensions and those with the lowest pensions has been relatively stable at between 2.0 to 2.5 years for males and 1.0 to 1.5 years for females.

Distribution of Survivor Deaths (1993 and 2013) *(Slide 9)*

This slide presents the evolution of the distribution of female survivor deaths by age and from 1993 to 2013.

As for retirement beneficiaries, the slide clearly illustrates the shift of the distribution of deaths towards older ages. As a result, the median age at death for female survivors has increased over time by 8 years from 79 years in 1993 to 87 years in 2013. In 2013, the highest number of female survivor deaths occurred at age 90.

Although not shown, the distribution of male survivor deaths by age has also shifted to older ages. The median age at death for male survivors increased by 7 years from 77 years in 1993 to 84 years in 2013. The highest number of male deaths occurred at age 86.

Of note, about 80% of total exposures come from female survivors. One reason is that CPP participation rates for males have historically been higher than for females, which has resulted in more potential female survivors. A second reason is that male mortality is materially higher than female mortality and thus males are less likely to survive to older ages. This second effect from higher male mortality is augmented by the fact that males are on average older than their female spouses.

Ratios of Survivor to Population Mortality (2011) ***(Slide 10)***

CPP survivor beneficiary mortality is seen to be significantly higher than that of the general population.

One reason might be that survivors are deeply affected by the loss of their spouse, especially at the older ages where the survivor may already be in a weakened physical and emotional condition. Also, in some cases, one could assume that losing part of the primary source of income and social support adds stress to the survivors. At age 65, the excess mortality is about 30% for males and about 35% for females. After age 65, the mortality levels of survivors gradually converge to that of the general population.

In terms of life expectancy at age 65, because CPP survivor mortality is significantly higher than that of retirement beneficiaries, CPP survivor's life expectancy at age 65 in 2013 is about 1 year lower than for retirement beneficiaries for both males (17.9 vs. 19.0 years) and females (21.0 vs. 22.0 years)

Distribution of Disability Deaths by Cause (1991 and 2011) ***(Slide 11)***

This slide shows the distribution of disability deaths in 1991 and 2011 by main causes of disability. Regardless of gender and year, neoplasms are the most prevalent cause of death among CPP disability beneficiaries. For males, the proportion of deaths related to neoplasms was 36% in 1991 and 39% in 2011. In comparison, for females these proportions were much higher at 61% in 1991 and 52% in 2011.

<u>Additional information:</u>

As mental disorders have become a more prominent cause of disability, the proportion of deaths related to this cause has increased the most over the period 1991 to 2011. In 1991, the proportion of male deaths related to mental disorders, was 5% while it was 4% for females. By 2011, the proportions for both sexes increased significantly to 12%.

For both sexes, the significant decrease in cases associated with circulatory diseases between 1991 and 2011 explains why the proportion of deaths related to this cause has decreased the most over the period. The proportion of male disability deaths related to circulatory disorders declined from 22% in 1991 to 11% in 2011. For females, this proportion decreased from 9% to 5% over the same period.

Distribution of Disability Exposures by Cause (1991 and 2011) ***(Slide 12)***

This slide shows the distribution of disability exposures by cause in 1991 and 2011.

In terms of exposures, neoplasms (about 7%) are not as prominent as they are in terms of deaths. This is a result of the high proportion of neoplasm cases with death occurring within two years after benefit uptake (about 70%).

Mental disorders became the most prominent in terms of exposures between 1991 and 2011. Exposures related to muscular disorders decreased the most during the same period.

Additional information:

In 1991, the proportion of exposures related to mental disorders was 11% for males and 15% for females. In 2011, the corresponding proportions more than doubled to 27% for males and 32% for females.

For males, the proportion of exposures related to muscular disorders decreased from 31% in 1991 to 21% in 2011. For females, the corresponding decrease was from 40% in 1991 to 27% in 2011.

Comparison of Disability and Population Mortality (2011) ***(Slide 13)***

As can be expected, since receipt of the CPP disability benefit requires that the disability be severe, long-term and of indefinite duration or is likely to result in death, mortality of disability beneficiaries is much greater than that of the general population.

Mortality rates of disability beneficiaries aged 50 to 64 in 2011 of 35 deaths per thousand for males and 23 deaths per thousand for females, are on average six times higher than that of the general population. For a 50 year old disability beneficiary, such level of mortality is about the same as for an individual aged 75 in the general population.

Probability of 50-Year Old Disabled Reaching Age 65 (males, 2011) ***(Slide 14)***

This slide compares disability beneficiaries and population survival curves to age 65 for a male individual aged 50. The results are based on the observed mortality levels in 2011. The much higher mortality risk associated with those affected by neoplasms is clearly illustrated.

For a male neoplasms beneficiary age 50 there is only a 3% chance of reaching age 65 while this probability increases to 71% for cases other than neoplasm. This compares to a 91% probability in the general population. Similar patterns exist for females but the probabilities of reaching 65 are somewhat higher than for males.

OAS Beneficiaries (Actuarial Study No.17) ***(Slide 15)***

Now, moving to OCA's Actuarial Study no. 17 which provides a detailed historical analysis of the mortality of OAS and GIS beneficiaries.

The longer experience period from 1999 to 2013 of this study, relative to its two predecessors provides for the analysis of changes in trends of mortality within the experience period.

This study accounts for over 64 million life-years of exposure and about 2,753,000 deaths.

Beneficiaries were classified by type of benefit, marital status and place of birth.

Again, the large volume of reliable administrative data on deaths and exposures produces highly credible results.

Evolution of OAS Life Expectancy Age 65 (1999-2013) ***(Slide 16)***

On the left side of the chart we show the evolution of OAS beneficiaries life expectancies at age 65 over the period 1999 to 2013.

In 2013, the life expectancies at age 65 for OAS beneficiaries are 18.9 years for males and 21.8 years for females. These are 2.8 years and 1.9 years higher than the corresponding life expectancies observed in 1999. As such, as shown on the right side, the gap in life expectancies between females and males has decreased from 3.8 years in 1999 to 2.9 years in 2013.

Older Canadians are living longer but the growth in life expectancy of 1.6 months per year over the most recent period from 2010 to 2013 has been lower than the 2 months per year experienced over the previous decade. Similar trends have been observed in the United States and in the United Kingdom, as will be discussed by Assia later today.

OAS Mortality by Type of Benefit (2013) ***(Slide 17)***

Here we show a comparison of OAS beneficiaries mortality by type of benefit received.

Beneficiaries not in receipt of the GIS (those with mid to high) experience lower mortality than that of overall OAS beneficiaries, while those who receive the GIS (Low income) experience higher mortality.

In 2013, GIS beneficiaries aged 65 have experienced mortality that is 54% higher than the overall OAS population and about twice the level of those not receiving the GIS. In comparison, beneficiaries not receiving the GIS, aged 65, experience mortality that is 14% lower than the overall OAS population. In both cases however, there is convergence to the overall OAS program mortality as age increases.

Evolution of OAS Life Expectancies at Age 65 by Type of Benefit (1999-2013) ***(Slide 18)***

On the left side of the chart we show the evolution of life expectancies at age 65 by type of benefit over the period 1999 to 2013.

Over the last 14 years, for both sexes combined, low income beneficiaries (those receiving GIS) have seen their life expectancy increase by more than two years; about the same pace as those with higher income (those not receiving GIS).

In 2013, the life expectancy at age 65 for males not receiving the GIS benefits is 19.7 years, which compares to 17.1 years for those receiving the GIS. The corresponding life expectancies at age 65 for females are 22.7 years for those not receiving the GIS, compared to 20.4 years for GIS beneficiaries.

The right side of the slide shows the difference in life expectancies at age 65 between beneficiaries not receiving the GIS and those in receipt of the benefit. This difference has shown little variability over the period and has been around 2.5 years for males and 2.1 years for females.

OAS Mortality by Marital Status (2013) ***(Slide 19)***

This slide shows a comparison of mortality by age, sex, and marital status.

The mortality of singles is higher than for married. Singles mortality is about twice the level of married for both sexes at age 65. For both sexes, married and singles, mortality gradually converges to the overall level as age increases.

Additional information:

In 2013, at age 65, married males and females experience mortality that is about 20% to 25% lower than for the overall program. In comparison, at age 65, male singles experience mortality that is 70% higher than for the overall program, and females experience mortality that is 38% higher than the overall program.

Evolution of OAS Life Expectancies at Age 65 by Marital Status (2001-2013) ***(Slide 20)***

On the left side we show the evolution of the life expectancy at age 65 by sex and marital status for the period 2001 to 2013.

In 2013, the life expectancies at age 65 are 20.0 years for married males and 16.5 years for single males. The corresponding life expectancies at age 65 for married and single females are 23.0 years and 20.8 years.

The gap in life expectancies at age 65 between married and single beneficiaries, as shown on the right side of the slide, has remained relatively stable for both sexes over the period 2005 to 2013. In 2005, the differential by marital status was 3.8 years while the differential for females was 2.2 years. In 2013, the differentials between married and single beneficiaries are 3.5 years and 2.1 years for males and females.

In 2013, for both sexes in general, single beneficiaries in receipt of the GIS have the lowest life expectancies while married beneficiaries not receiving the GIS have the highest life expectancies.

Summary OAS Life Expectancy at Age 65 (2013) ***(Slide 21)***

This slide presents a summary of the results in term of life expectancy at age 65 in 2013.

Middle to high income seniors (no GIS), are expected to receive their benefits for about two and a half years more than low-income seniors (GIS).

Married seniors are expected to receive their benefits between two to three and a half years more than single seniors. This difference is more pronounced for males than for females.

Middle to high income single seniors (no GIS) are expected to receive their benefits between two and two and a half years more than low-income single seniors (GIS).

Middle to high income married seniors (no GIS) are expected to receive their benefits for two years more than low-income married seniors (GIS).

Middle to high income married female seniors (no GIS) are expected to receive their benefits for eight years more than low-income single male seniors (GIS), i.e. 15.1 vs. 23.5 years.

Seniors born abroad are expected to receive their benefits for two years more than those born in Canada. Several factors, including medical and employability screening prior to entry to Canada, as well as cultural and lifestyle characteristics, may be used to explain the greater life expectancies of immigrants and their relative better health compared to OAS beneficiaries born in Canada.

CPP-OAS Average Annual Mortality Improvement Rates (males) ***(Slide 22)***

The slide shows OAS and CPP average annual mortality improvement rates for males in age groups 65 to 74 and 75 to 89 for the three periods of 2000-2005, 2005-2010 and 2010-2015. For both OAS and CPP, average annual improvements for males have been lower over the period from 2010-2015.

The OAS and CPP average annual mortality improvement rates for males in the age group 65 to 74 (top part of the slide) have gradually declined steadily over the three periods. Over the period from 2000 to 2005, the OAS and CPP average annual mortality improvement rates were at about 3.0% while over the over the period from 2010 to 2015, the average annual mortality improvement rates were at about 1.3%.

The OAS and CPP average annual mortality improvement rates for males in the age group 75 to 89 (bottom part of the slide) have increased between the period from 2000-2005 to the period from 2005-2010 and then decreased from 2005-2010 to 2010-2015. Over the period from 2000 to 2005, the OAS and CPP average annual mortality improvement rates were at about 2.0% while over the over the period from 2010 to 2015, the average annual mortality improvement rates were at about 1.7%.

Although not shown, for each of these two age groups, female mortality annual improvement rates have generally been more stable and lower than the comparable male mortality annual improvement rates. Females have experienced higher mortality improvement rates in the period 2005-2010 and similarly to males, have experienced lower mortality improvement rates in the period 2010-2015.

Assia which comes up next, will touch more on this issue from an international perspective.

This concludes my part of the presentation, I would like to thank all those at the Office who worked on these two studies.

Life Expectancy at Birth and at Age 65 (by calendar year) ***(Slide 23)***

Over the next several slides I will discuss how we develop the population mortality projections that serve as a basis of the population projection for the actuarial valuations of the CPP and OAS. To project future mortality we need to examine the past, and estimate which past trends could continue into the future. We also need to look at emerging trends and not only in Canada, but in peer countries.

This slide presents the calendar year life expectancy at birth (two lines in the upper part of the chart associated with the left axis) and at age 65 (two lines in the lower part of the chart associated with the right axis).

Please note that this slide presents so called calendar life expectancy. It means that the calculations are based on the mortality rates of a given year and mortality improvements after the given year are not considered. Calendar year life expectancy is usually reported by statistical agencies around the world.

Life expectancy at birth has increased steadily since the beginning of the 20th century. However, we can observe that the slope becomes flatter. In the first half of the 20th century, life expectancy at birth increases by 19 years for males, it represents an average pace of increase of around 4 years per decade. In the second half of the 20th century, life expectancy at birth for males increases by 10 years, representing an average pace of increase of 2 years per decade.

Notes:

Males LE at birth

1901-1951 -> increase from 47.1 to 66.4 years (+19.3 years, annual average of 0.39)

1951-2001 -> increase from 66.4 to 76.9 years (+10.4 years, annual average of 0.21)

2001-2011 -> increase from 76.9 to 79.5 years (+2.7 years, annual average of 0.27)

Females LE at birth

1901-1951 -> increase from 50.1 to 70.9 years (+20.8 years, annual average of 0.42)

1951-2001 -> increase from 70.9 to 81.9 years (+11.1 years, annual average of 0.22)

2001-2011 -> increase from 81.9 to 83.7 years (+1.8 years, annual average of 0.18)

Contribution to increase in life expectancy at birth has gradually shifted to people over age 65 *(Slide 24)*

We just saw that there is a slowdown in the rate of increase of life expectancies at birth between the first and later parts of the 20th century, while the growth in the rate of increase of life expectancies at age 65 is more recently observed.

This table provides more details on the change in life expectancy over the past 80 years broken down by 20-year periods.

It shows the total increase in life expectancy for males for each 20-year periods and from which age category the change comes from.

We can observe that the proportion of the increase in life expectancy coming from the reduction of mortality rates at ages 65 and over is more and more important through time.

Over the last 20-year period, from 1991 to 2011, 58% of the increase in life expectancy for males came from the reduction of mortality rates at ages 65 and over.

This trend is expected to continue in the future.

Additional Notes:

In the most recent CPP mortality study released in June 2015, we analyzed the source of increases in life expectancy for those 65 and older. Over the past 10 years, a greater share of the increase in life expectancy comes from seniors aged 75 and over.

Males CPP beneficiaries: 72% or 1.3 out of 1.8 years

Females: 79% or 1.1 out of 1.4 years

Improvements in mortality related to heart diseases have been significant over the last 15 years *(Slide 25)*

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.

After age 85, Canada along with Japan and France has the lowest mortality rates *(Slide 26)*

This slide shows mortality rates for Canada (red bars) as well as for 7 other countries that have population more than 8 million and have the highest life expectancies in the world. As you can see, while there is not much difference in mortality rates among countries for age groups from 65 to 84, Canada has still some room to further reduce mortality rates and close the gap with the top countries for ages under 85.

As we move to older age groups, Canada becomes one of the top three countries with the lowest mortality rates along with Japan (light red bars) and France (dark blue bars).

The question is then: Will Canadian seniors ever reach the level of mortality of Japanese, or diet and lifestyle differences will always result in some gaps in mortality?

<u>Additional information</u>

Conference Board Study: Canada got a grade of A for reducing mortality rates because of heart diseases, but a C for cancer. Japan got an A for both causes. Main causes of death after age 65 are heart diseases and cancer (2/3 of deaths)

Top three causes of death for 90+

Canada and France: Heart diseases, cancer, cerebrovascular diseases

Japan: Heart diseases, pneumonia, cancer

65-74: too optimistic in the reduction of the mortality rates

85-89: not enough reduction of mortality rates

long-term MIR

0 to 89 -> 0.8% p.a.

it corresponds to the geometric average observed

over the last 90 years for both sexes

Mortality Rates by Cause *(Slide 27)*

Mortality rates by cause of death for the age group 75-84 are shown here for 9 countries (Italy is the extra one compared to the previous slide).

Where can we further reduce Canadian mortality rates?

For heart diseases, only France and Japan have lower mortality rates than Canada. *[Also, as discussed previously Canada has experience a significant decrease, between 1979 and 2012, in mortality rates associated with heart diseases.]*

For stroke, Canada has the lowest mortality rate.

However, the mortality rate associated with cancer is higher in Canada than in all other countries, except UK. As mentioned earlier, in the future, we could hope that reductions in mortality from cancer may become an important factor.

Males Mortality Improvement Rates based on HMD 15-year Average *(Slide 28)*

Heat map is a useful tool to analyze the trends in mortality improvement rates. This analysis is usually performed on smoothed mortality improvement rates. Different colours correspond to the different level of improvement rates.

Mortality improvement rates for any given age, sex, and calendar year may be regarded as a combination of age, year, and cohort components or effects. Age effects are seen as horizontal bands or patterns on heat maps, calendar year effects as vertical patterns, and cohort effects as diagonal ones.

This one is the historical heat map for Canadian males. It is based on 15-year moving average based on CHMD data, for all ages and several past decades.

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 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.

Another interesting phenomenon that could be seen on this slide is the cohort effect for males born approximately in the 1930s and 1940s. These cohorts experienced higher mortality improvement rates than those born before or after.

Males and Female Mortality Improvement Rates 10-year Average *(Slide 29)*

This one is kind of a zoom of the previous slide based on the last 3 decades, for ages 65 and over only. The mortality improvement rates are based on a 10-year average, showing the volatility better than the previous slide. The part on the right of the dotted line represents the estimated rates based on OAS. It shows the recent decreasing trends observed that I described a few slides earlier.

The red represents high improvements (between 3% and 3.5%); the light orange represents smaller improvements, in the next 0.5% range; then comes the yellow, followed by the green, blue, etc.

We can thus observe that the improvement rates were generally increasing between 2000 and 2011, but the light orange area is now closing and is being replaced by the yellow area.

Slowdown in mortality improvements in recent years: a blip or a new trend?
(Slide 30)

The slowdown in mortality improvements was also observed in UK and USA over the last few years.

For UK, in CMI working paper No. 83, it is stated that the average annual improvement rate for ages 65+ is as low as 0.1% for 2011-2015.

For US, the SOA recently released an updated mortality improvement scale based on experience of 2010 and 2011. The impact is that the immediate annuity factors were reduced.

Future drivers of mortality *(Slide 31)*

The ultimate mortality improvement rates are sometimes based on historic averages *(Slide 32)*

Estimates of MIRs for ages 65+ for 2012-2014 incorporate OAS experience *(Slide 33)*

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 34)*

Male mortality rates for ages 75 to 84 for Canada are projected to become similar to US female mortality rates *(Slide 35)*

This chart shows the resulting projected mortality rates for the age group 75-84 by applying the MIR assumptions of this age group. A 40% reduction in mortality rates is projected for the next 40 years.

Significant reduction in age-specific mortality rates has contributed to the aging of the population. For the age group 75-84, you can observe that mortality rates have continually decreased over the last 80 years. The reduction was about 45% over the last 40 years ([41–75]/75) compared to only 22% over the previous 40-year period ([75–96]/96). A further reduction of 39% is projected ([25 – 41]/41).

It's worth noting that elderly mortality rates are decreasing at a faster pace: their rates decreased more in the last decade than in previous decades, especially for males.

Elderly mortality have decreased over the last 80 years, more so over the last 10 years *(Slide 36)*

Projected Life Expectancy at 65 ***(Slide 37)***

- The significant reduction in age-specific mortality rates can be best measured by the increase in life expectancy at age 65, which directly affects how long retirement benefits will be paid to beneficiaries.
- Since the inception of the Plan in 1966, life expectancy at age 65 has increased by almost 5 years for each sex.
- Further improvements in mortality are projected in the future, thus resulting in higher life expectancies and increased Plan costs. By 2050, it is projected that life expectancy at age 65 will be 22.5 years for males and 24.7 years for females (or 3 more years than today).
- Over the long term, the life expectancies at age 65 for males and females are 0.3 years and 0.3 years higher than in the previous report.

<u>Additional Information</u>

1. Male life expectancy at age 65 increased 39% between 1966 and 2011, rising from 13.6 to 18.9 years. For women, life expectancy at age 65 increased 29%, from 16.9 to 21.8 years over the same period. Although the overall gains in life expectancy at age 65 since 1966 are similar for males and females (about 5 years), about 60% of the increase occurred after 1991 for males, while for females, about 60% of the increase occurred by 1991.
2. On a cohort basis, male life expectancy at age 65 is expected to be 21.2 in 2015 increasing to 24.7 years by the end of the projection period. Female life expectancy at age 65 is expected to increase from 23.7 in 2015 to 26.8 years by the end of the projection period.
3. This follows increases of 0.4 years for males and 0.6 years for females from the previous report. Over two consecutive actuarial reports, the projected life expectancies have increased by approximately a year for both males and females.

International Comparisons – Males *(Slide 38)*

Now, let's look at international comparison of life expectancy. 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 year male life expectancy at age 65 is projected to reach more than 21 years by 2030.

Quiz question (2015) – before showing the slide

			LE @ birth	
2015	Population (million)	LE@birth	> 80 M	> 84 F
Japan	127	83.7	5th	1st
Switzerland	8	83.4	1st	5th
Australia	24	82.8	2nd	6th
Spain	46	82.8	8th	2nd
Italy	60	82.7	6th	7th
Israel	8	82.5	4th	8th
Sweden	10	82.4	3rd	10th
France	64	82.4		4th
South Korea	50	82.3		3rd
Canada	36	82.2	7th	9th
Netherlands	17	81.9		

International Comparisons – Females *(Slide 39)*

For females, projected life expectancy at age 65 for Canada in 2030 is about the same as Austria in 2030. Japan, France, Switzerland, Italy, Finland and UK project higher life expectancy. The Canadian female life expectancy is projected to reach almost 24 years by 2030.

Three-quarters of Canadian men aged 20 today are expected to live to age 80 (82% of women) ***(Slide 40)***

This slide presents the probability of surviving to age 80 from a given age in 2015 for Canada (in red), Switzerland (in black), the U.K. (in blue) and the U.S.A. (in green).

It is interesting to look at the shape of the curves. It will be even more pronounced on the next slide showing the probability of living to 90. The probability is slightly 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 80 increases since only individuals who have already reached older ages are considered.

As it could be seen, for all four countries and for all ages, chances to survive to age 80 are quite high.

For example, according to the CPP27 projections, 75% of Canadian men and 82% of Canadian women aged 20 today are expected to live to at least age 80.

Additional information

Due to higher assumed mortality improvements, these probabilities are higher in the U.K. for ages lower than 70. However, Canadians fare better for older ages, due to the lower current mortality rates.

Nearly half of Canadian men aged 20 today are expected to live to age 90 (58% of women) ***(Slide 41)***

Living to 90 on average is also quite a realistic perspective. Again, this slide presents the probability of surviving to age 90 from a given age in 2015 for Canada, the U.K., Switzerland and the U.S.A.

According to the CPP27 projections, almost half of Canadian men and 60% of Canadian women aged 20 today are expected to live to at least age 90.

Additional information

Due to higher assumed mortality improvements, these probabilities are higher in the U.K. for ages lower than 70. However, Canadians fare better for older ages, due to the lower current mortality rates.

8% of Canadian men aged 20 today are expected to live to age 100 (14% of women) ***(Slide 42)***

Now… can we live beyond 100?

According to the CPP27 projections, 8% of Canadian men and 14% of Canadian women aged 20 today are expected to live to age 100.

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

Uncertainty of Results Life Expectancies at age 65 if MIRs by cause are sustained *(Slide 43)*

Let's try to see what will happen if it is assumed that the annual MIRs of the last 15 years (1998-2012) by cause are to remain constant over the entire projection period.

Due to the higher recent mortality improvement rates for males, especially for death related to cancer, this scenario leads to a narrowing of the gap between male and female cohort life expectancies at age 65 and, eventually, higher life expectancy for males than for females by 2043 and thereafter. In 2075, male life expectancy would surpass the one of females by 1.6 years. This situation is quite unprecedented for mammals. This scenario serves as a reminder that setting future assumptions only on recent experience may lead to unintended results.

Additional information

For this graph, MIRs are the ones experienced in average for each age group over 1998-2012.

Survival Curves for a Life Expectancy of 100 (Males) *(Slide 44)*

What should 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 86% (dotted blue survival curve). Under the second alternative, the life-span is increased to 140 (red survival curves), and the current mortality rates are redistributed across ages 0 to 140.

Additional information

For increasing life-span, we use the technique called "age-mapping" to redistribute current mortality rates across ages 0 to 140.

A third alternative is to assume $q_x = 0$ for $x \in [0, 96]$ and $q_x = CMHD_{2009}$ for $x >= 97$

MALES

Age 65 is the new 57 -> back in 1961

Age 75 is the new 68, some 50 years ago (2011 -> 1961)

In other words, the probability of living to age 75 is equal to the probability of living to age 68 some 50 years ago (difference of 7 years)

Age 80 is the new 74

Age 85 is the new 80

To live beyond 100… *(Slide 45)*

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.

If mortality rates decrease at the same pace as observed over the past 15 years, a life expectancy at birth of 100 would be attained only after 2200.

If mortality rates decrease at twice the pace observed over the past 15 years, a life expectancy of 100 would be attained in about a century.

Additional information

Cohort LE of 100 (if Qx same pace as 15 years ending in 2011) -> 2165 (estimation)

Cohort LE of 100 (if Qx twice the pace of 15 years ending in 2011) -> 2050 (estimation)

Conclusion *(Slide 46)*

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.

Further questions to the audience

i) Premature mortality (at what age?)

ii) What is the age with the highest probability to reach age 100?

Living to 100 – Myth or Reality *(Slide 47)*

(APPENDICE)

CPP-OAS Average Annual Mortality Improvement Rates (females) *(Slide 48)*

Contribution to increase in life expectancies at birth has gradually shifted to people over age 65 *(Slide 49)*

Similarly, this table shows the total increase in life expectancy at birth for females for each 20-years periods, along with the change attributable to each age category through time.

Over the 20 years from 1991 to 2011, 65% of the increase in life expectancy for females came from reduction of mortality rates at ages 65 and over.