Informal Discussion Transcript

General Session V - Mortality Projection from a Social Security Perspective

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Session V - Mortality Projection from a Social Security Perspective

SAM GUTTERMAN: I'd like to welcome you to the session on mortality, the viewpoint of the government, I mean, of actuaries in, working for the government and particularly responsible for mortality projections for their respective government programs. This is an actually a reprise from a panel of six years ago where the same three presenters were here and so I'm very pleased to welcome all of them back. I'm going to be very brief in terms of my introduction. Most of you know the members here of the panel, but I'll give that introduction. Each of them will have no more than 25 minutes to make a presentation; there will not be a formal discussion because we want to optimize the discussion and Q&As from the audience.

Our first presenter will be Adrian Gallop. He is in the Government Actuary's Department in the United Kingdom or, I should say, maybe England and Wales. Well, that's a separate topic. He's in the pension policy, demography and statistics area of the Government Actuary's Department. He's also been very active over the years in U.K. mortality studies and research for the Institute and Faculty of Actuaries, as well as other areas.

Our second presenter will be Jean-Claude Menard. He's the chief actuary of the Canada Pension Plan. He's also chair of the Technical Sub-Committee of the Actuarial and

Technical Committee for the International Social Security Association and I'll have to say that he just told me that he really enjoys what he does.

The third presenter will be Steve Goss. Steve has been a chief actuary of the U.S. Social Security Administration and has presented many times both on Social Security items and in particular his interest in mortality projects, so with that I'll hand it over to Adrian.

ADRIAN GALLOP: Thank you very much, Sam, and thank you very much to the SOA for inviting me to give a presentation. Sam said I was here six years ago and I was also here for the first two symposia as well; I've always found them very interesting and stimulating, and this one has been no exception so far.

In this presentation, I want to provide at a high level some historical trends of mortality in the U.K., go on to talk about the mortality assumptions in the latest 2012 base population projections that were published by the Office for National Statistics in November last year, mention briefly a U.K. government proposal to link state pension age to life expectancy and talk a little bit about life expectancy by socio-economic class, by area as well as looking at some figures on healthy life expectancy.

So just to set the scene, this slide shows the period expectation of life at birth in England and Wales from 1841

to 2011. You can see there's three broad patterns. At the end of the 19th century, there were slow increases in life expectancy and then from about 1900 to 1950, there were rapid increases in life expectancy at birth that has continued throughout the 20th century, but at a slower rate. This is one of the graphs that shows the dangers of extrapolating life expectancy in a straight line. If you had been doing projections in the 1950s, we'd have been looking at projecting much higher life expectancy.

Again with similar figures, these are period life expectancy at birth at age 65, showing again very little improvement occurred in the 19th century. From about 1910, female life expectancy increased more or less linearly but there's very little improvement to male life expectancy at age 65 until about 1980. One of the main explanatory theories relates to smoking patterns in the U.K. where men began smoking much earlier than women and with much higher prevalence of smoking for men that women.

The information on these next two slides shows the difference in life expectancy between males and females; the top line is the difference in period life expectancy at birth and the pink line is the life expectancy at age 65. So here you can see that the difference in life expectancy at birth peaked at about 1971, at just over six years, and this difference has been steadily declining ever since. For

life expectancy at 65, the peak was reached a bit later; there was more of a plateau at about four years during the 1970s and 1980s, but now that's also declining as well, roughly in parallel with the differences seen in life expectancy at birth. To set the U.K. in context, this slide looks at a few other countries. The U.K. part is the dark black line; it was one of the earlier countries to peak and is now leading the charge toward convergence of mortality between males and females. The green line is the USA, so again that's a similar pattern, but the differences are higher and again peaked around about the same time as the U.K. It's also coming down.

There are more interesting countries, such as Japan, where female life expectancy has been increasing much more rapidly than male life expectancy in recent years. They're only just now starting to plateau out.

This next slide shows the age distribution of deaths in the U.K. for males on the left and females on the right, for various years. Looking at the latest year on the graph for 2009, you can see that over 40 percent of the deaths in the U.K. for males are at age 80 and over and around 60 percent of female deaths are at age 80 and over. In 2012, the main causes of death in the U.K. for males were heart disease, 15.6 percent of all deaths; followed by lung cancer, 7 percent; emphysema and bronchitis, 6 percent;

stroke, 5.9 percent; and dementia and Alzheimer's, 5.8 percent. Over the last decade, the percentage of deaths from heart disease for males has fallen by 6.8 percentage points.

For females, the highest cause of death in 2012 was dementia and Alzheimer's disease at 11.5 percent; followed by heart disease, 10.3 percent; stroke, 8.4 percent; flu/pneumonia, 5.8 percent; and emphysema and bronchitis at 5.5 percent. There was a very large increase in the percentage of deaths from dementia and Alzheimer's over the last decade, increased by 7.1 percentage points. That was partly due to changes in the coding of causes of death, which meant that some deaths previously recorded as due to cardiovascular disease are now allocated to dementia and Alzheimer's.

Looking at age groups, for age groups 50-64, the main cause of deaths was heart disease for men and lung cancer for females. For the age group 65-79, it was heart disease for both groups, and for ages 80 and above, the main cause of death for females was dementia and Alzheimer's, followed by heart disease, and, for men, it's the other way round, for whom heart disease was still the main cause for deaths and Alzheimer's was the second highest cause.

The next couple of slides look at the annualized rates of mortality improvement over 20-year periods starting in

1911 and ending in 2011. So the figures on the left-hand side are the overall rates of improvement over the last 100 years. You can see that in the early part of the 20th century, the main rates of improvement were at the young ages, the 25-39 group. But as we move later on into the century, then the older age groups were experiencing the higher rates of improvement and now, in the last 20 years, the group with the highest rate of improvement is the 60- to 79-year-olds. You can also see there's some high rates of improvement now for males aged 80-89, so there's been a gradual movement in improvements in mortality from young ages to older ages.

Again, this slide shows the same figures for females, with a similar pattern, so you've got the higher rates of mortality in the ages at the beginning of the century and then higher rates at older ages in more recent years.

The next couple of slides look at mortality by major cause of death. This slide is for males, showing deaths from respiratory diseases in the pink line; cardiovascular, circulatory disease is in the black line; the blue line is cancers; and the green line is infectious diseases. As you probably already know, deaths from infectious disease have been very low from the middle of the last century. Deaths from cancer have increased slowly over the last century but have now decreased, but the main drivers of overall

mortality have been circulatory diseases, cardiovascular disease and ischemic heart disease. This shows a virtually linear trend downward. If you were to project this onwards, you may conclude by expecting deaths from these causes to be eliminated in the next 20 years or so, which is not what we would expect.

Interestingly, in the last few years, the standardized death rate for cancer has now exceeded the death rate for heart disease. To give some context, over the last decade, there's been a fall in deaths from circulatory disease of about 44 percent, a fall in deaths from cancer of 14 percent and for respiratory diseases of 18 percent. This latter has wiggled up and down due to changes in ICD [International Classification of Diseases] codes and how cause of death was derived from what's on the death certificates. Deaths involving pneumonia were sometimes classified as deaths from pneumonia but sometimes deaths from other causes; changes in the ICD coding is one of the problems in projecting mortality by cause of death.

The next slide shows the same figures but for females and again the patterns are very similar. There's been almost a linear fall in deaths from circulatory diseases, from a peak in the 1950s and 1960s. The death rates from cancers for females has been relatively flat over the whole century and falls in death rates for respiratory diseases

and infectious diseases.

Just looking at more detail at the cause in deaths from heart disease. The left-hand side is falls in deaths from ischemic heart disease and the right-hand side deaths from strokes. As you can see, on the left-hand side, there's quite a big difference between males and females in the 1960s and 1970s. This difference may be one of the causes why we saw stagnation in increase of life expectancy for males at 65 over that period. But since 1980, there's been a large fall in the rates for males. For deaths from stroke, the two have gone down more or less in parallel.

Another driver of mortality is smoking prevalence, which Sam gave a presentation on in his session yesterday. This is one slide to give some figures on smoking prevalence for Great Britain. In 1974, around 45 percent of adults in Great Britain were cigarette smokers, 51 percent for males and 41 percent for females, but by 2010, this had fallen to 20 percent, with 20 percent for women and 21 percent for men. This kind of chart has a lot of differences, differences by age, differences by area and differences by socio-economic class. To give a couple of examples, in 2010, smoking prevalence was highest in households where the household responsible person was in a routine occupation, such as a manual occupation, and was lowest in households that were headed by someone who was in

a profession. Similarly, smoking was much more common in Wales and Scotland than it was England and it was higher in the north of England than in the south of England. These differentials lead to differentials in life expectancy by area and also by socio-economic class, which I'll come to a bit later on in the presentation.

Following on from the figures on smoking, this slide shows the incidence rates and mortality rates from lung cancer in England and in Scotland with the purple line for England and the red line for Scotland. You can see that for males there's been a decline in both incidence of lung cancer and deaths from lung cancer. It is similar but higher in Scotland; although I haven't put any figures up for Scotland, the life expectancy at birth in Scotland is around two years shorter than life expectancy in the rest of the U.K.

The figures for females haven't really shown much improvement over time and again this is partly due to the fact that females started to smoke in the U.K. later than males.

To go on to mortality projections, which I basically classify as a four-step process, involving estimating where we think we are now, where we think we're going to be in 25 years' time (which we call the target year), how we think we get from where we are now to where we think we're going

to be in 25 years' time and what we think is going to happen after the 25 years' time. To emphasize that in our projections, what we project are rates of improvement in mortality by age and sex and year and we then apply those projected rates of improvement to assumed base rates of mortality in 2012.

I'm going to jump from where we think we are now to where we think we're going to be in 25 years' time first. So with the 2012 projections, the target year is 2037 and we come up with estimates of what we think mortality improvement rates are going to be in 2037 and the various things that we look at to do this. We look at the rates of improvement over past periods in the U.K. to date and if you look over the last century, or from 1910 to 2010, the average standardized rate of improvement was about 1.2 percent per annum both for men and for women. We also consult an expert panel on what they think the main drivers of future mortality are going to be and we asked them to estimate what they think the rates of mortality improvement are going to be in 2037. They came up with a range between 1 percent and 1.5 percent, fortuitously the average of the figures that they gave came to 1.2 percent as well, and most of the experts suggested the same rates of improvement for males and females.

I want to show more about the rates of improvement in

the past. It was noticed that there were cohorts born around about 1931 who are showing very high rates of mortality improvement, but by the time you get to the target year, these people will all be centenarians, so they contribute less to the overall rate of improvement, and as we've heard at this and other symposia, there's considerable debate as to whether future technical, medical and environmental changes will have a greater or lesser impact on mortality improvements than they have in the past.

Our main assumption is that the rate of improvement in 2037 will be 1.2 percent a year for most ages, for males and for females, but for those born between 1925 and 1938, we have kind of a hump in the improvement, so it goes up to around about 2.5 percent for those born in 1931 and then back to 1.2 percent for those born in earlier years. For those born before 1925, we have lower target rates of improvement. These rates of improvement are assumed to apply to the U.K. as a whole and to all the constituent countries in the U.K., because we also do projections, as well as the U.K., for England, Wales, Scotland and Northern Ireland separately.

In terms of the convergence, we assume a convergence from the current rates of improvement to those in 2037 more rapidly for males than for females, but in both cases, the

halfway point is between about 10 to 12 years into the future, so it's slightly nearer than halfway through the 25-year period. Then for those born before 1960, we assume that the convergence applies along a cohort, that is, by the year of birth. So if you were born in 1950, you have a current rate of improvement of 4 percent, assumed to go down to 1.2 percent as you age through time. For people born after 1960, we do it on a period basis.

Then after 2037, we assume the same rates of improvement in future years as were assumed for 2037. As well as a principal projection, we also produce what we call high life and low life expectancy projections. In those cases, we assume a target rate equal to that assumed in the principal rate but plus 1.2 percent for the high life expectancy and minus 1.2 percent for the low life expectancy projections.

One of the things that we do is to look at rates of improvement over past periods and also what that would be over future periods, so this slide looks at the rates of improvements for the last 29, 49 and 79 years, and with the assumptions that we put in the principal projection what the rates of improvement will be over the same period going forward from 2012. Again, you can see that they are roughly equal, so over the last 29 years for males, it was 2.2 percent per annum, and going forward over the next 29

years, we're assuming it will be 1.8 percent per annum.

Now for where we think we are at the moment, again looking at rates of improvement. In order to derive these rates of improvement, we analyzed data for the United Kingdom from 1961 to 2011. We have the deaths data and we have the population estimates and we derive mortality rates by fixing a surface to those, using a p-spline method. Then rather than using the rates of improvement at the edge point, because they can move up and down quite a lot (depending on what happened in the individual years, the data can be quite unstable), we step back a couple of years into that chart and use improvement rates for those years. So for the 2012 projections, we used rates of improvement derived for 2009, assuming that those were kept the same as you age to 2012. The blue figures gives what we think are the trend rates of mortality improvement between 2011 and 2012 for males and the pink line for females. So again you see this is quite wiggly, with quite high rates of improvement at young ages. Around about the age of 40, there are quite low rates of improvement and then there were some troughs and peaks, but the main one is this peak here both for males and females for those born around 1931, as I mentioned earlier.

For the very oldest ages, because the data that we have is quite sparse and gives some rather odd figures, we

don’t take what the data shows but we run this off to 0 percent by age 105.

This chart shows the same standardized improvement to the target rate improvement in 2037, so that’s the central line here. So this is a 1.2 percent with the peak up to 2.5 percent and then back, and then going down. Along the X axis, we have age attained in 2012, so you can think of it for a given age there, we say for this age, this is the current rate of improvement for males and we assume that over the next 25 years, that’s going to fall to the 1.2 percent and then it will stay at 1.2 percent thereafter.

For those people born in 1931, that’s going to fall to 2.5 percent and then stay at that rate thereafter. The one thing you see from this graph is that nearly all the current rates of improvement are higher than 1.2 percent, so we are assuming that the rate of mortality improvement is slowing down in future years.

The next couple of slides attempt to show the rates of mortality improvement. To the left of the black line is past data, smoothed in order to determine current rates of mortality improvement, and to the right, these are projected rates of improvement. So again, along the axis, one of these colors means that the rate of mortality at that age, in that year, was the shown percentage lower than it was at the same age in the previous year. On this chart,

any area that's in blue was a period of when mortality was worsening, so this kind of year for males is partly due to deaths from AIDS and so on; but the main feature of this chart is the cohort. If you extend this back in time, these people who were born around the late 1920s and early 1930s have consistently exhibited higher rates of improvement than people born before or after. Of course, we know there's a cohort effect here, and we project that this will carry on into the future, at least over the short term, and that for this particular cohort, even in the long term, they'll still maintain a comparative advantage in mortality improvement.

This slide shows the same averages for females, and again you see a very similar pattern; the cohort is not quite as pronounced, but it shows the effect at the same years of birth. This slide shows a period life expectancy at birth and also at age 65. I haven't put in the cohort ones here but just to say that the cohort life expectancy at birth in 2012 for males is 90.6 years and for females is 93.9 years and for age 65 it will be 21.2 years for males and 23.9 years for females. So again the dotted line is a period and cohort life expectancy rate for males at age 65 and this is the female period life expectancy and female cohort life expectancy.

You might be asking how sensitive is the choice of

target rate, so this slide uses different target rates though I've kept the same rates of improvement for what we call the golden cohort, so they haven't been changed. But if we'd assumed, say, 0.8 percent instead of 1.2 percent, this alternative would have projected a period life expectancy at birth about 0.5 years lower in 2037 and 2.5 years in 2087.

I've also put on some figures, just as a comparison, if we would have used the long-term assumption of the Canadian Pension Plan that Jean-Claude is going to talk about shortly. If we'd used those figures instead and not kept the hump for the golden cohort, you can see that we'd have something between those figures and the 1.2 percent, which is our principal assumption. We would have a life expectancy of about one year lower for males in 2037 and then three years by 2087.

This slide shows where the U.K. is compared to some developed countries regarding period expectation of life in 2011. For those countries listed, the U.K. is down toward the bottom in that list, both for males and particularly for females. However, with respect to projections, these figures were taken from the latest published projections for various countries, the applicable national statistics websites in March of 2013, so some of these figures may well have changed since then. The U.K. is now projecting

one of the highest period expectations of life at birth, both for males and for females in 2060.

So although the figures are broadly comparable for various countries, because we've started from a much lower base, the actual overall improvement for the U.K. is much higher than is projected for most of these other countries.

I would like to briefly mention that in last December, the U.K. government announced a proposal to change the state pension age and to link it to life expectancy. These are currently only proposals, so it's not actually certain, but they have proposed a review of the age in each parliament; since parliaments in the U.K. have a fixed term of five years, effectively there would be a review of state pension age every five years. At the same time this review occurs, there would be a report led by a person independent of government on factors relevant to setting state pension age, such as healthy life expectancy and differences by socio-economic class.

The proposed law that was put forward by the government was that people should spend up to a third of their working life drawing state pensions and that would be derived by a formula, which would look at life expectancy at the state pension age (SPA), divided by the life expectancy at the SPA, plus the SPA, so from the start of their working life to the SPA, and the working life

starting age would be age 20. The life expectancy would be based on a cohort unisex life expectancy, so it will be the life expectancy for males weighted by the male numbers at SPA and the females weighted by the female numbers at the SPA. So basically you have to solve for the SPA, which means that this equation is equal to a third.

That was just the proposal so we don't know just yet whether it will be enacted. The proposal is also that people should be given 10 years notice of any change in the SPA. Since it is required primary legislation, it will have to be debated by parliament, so any change in SPA would be fully debated.

There are currently proposed increases in state pension age, which is 60 for females, 65 for males in 2010, which would be equalized at 65 in 2018, 66 in 2020 and 67 in 2028.

Briefly I will look at some of the issues that might be looked at in this independent review. This graph just shows life expectancy at 65 by socio-economic class, the purple one here represents routine manual occupations, the blue line is professionals, which would include actuaries within this top line, so you can see that the gradient by socio-economic class has been maintained over the last 30 years or so, because none of these lines cross over. However, they do move around a bit, with a slight widening

in this gap between the top and the bottom one, although there weren't that many people in this group and these graphs are also affected by changes in the distributions of people moving between classes over time.

Looking at life expectancy by area, the ONS published figures for 350 local authority areas and looking at figures for life expectancy at age 65, these ranged from 15.8 to 20.9 years for males; it's about a five-year gap, with a similar gap for females. This is the gap at the extremes. If you look at the interquartile ranges, the gap is something around about two years. Within a particular area, life expectancies in some areas actually decreased over the last four or five years. If I would decrease the bottom on up to half a year, it increases up to 2.3 years.

The final thing I wanted to mention was healthy life expectancy, again, based on ONS published figures on healthy life expectancy and also the life expectancy in the same area. This table shows that, for the top five areas in England for males and the bottom five areas for males, there is a much wider gap between healthy life expectancy than there is between life expectancy at birth. The inequality in healthy life expectancy is greater for females than males, with a north/south dividing both life expectancy and healthy life expectancy in England. Inequality in healthy life expectancy was greater than life

expectancy for both genders. Although life expectancy was always higher for females than for males, in about 25 percent of the areas, healthy life expectancy was higher for males than it was for females. (APPLAUSE)

JEAN-CLAUDE MENARD: Good morning, everyone. It's a pleasure and I would say a challenge to present our work to such a distinguished audience. Today, I will 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 uncertainly of mortality projection. Finally, I will try to answer the question: Can we live beyond 100 years?

This slide presents the calendar year life expectancy at birth; calendar year life expectancy, that is, the 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.

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, 60 percent of the increase in life expectancy for males has come from mortality improvements at age 65 and over. For females, the proportion is 67 percent over the same period, and this trend is expected to continue in the future.

The same 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 improvement in mortality related to heart diseases. These rates were improving at around 5 percent per year at age 65 and over for men and 4 percent per year for women over the last 15 years. In the future, we could expect that reduction in mortality from cancer may hopefully become an important factor. Since the early '70s, men's and women's 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 expectancies vary by population subgroups, for example, the marital status and the level of income are two long-term predictors of mortality. The old age program in Canada covers virtually all [of the] Canadian population. The mortality study on this program indicates that married beneficiaries tend to

live longer than the overall population, while single beneficiaries have a shorter life expectancy, with men affected more than women.

The same study indicates that beneficiaries with higher levels of income, so those not entitled to the income test GIS benefit, Guaranteed Income Supplement, have a higher life expectancy that the overall population. This observation may be explained by the relationship between higher level of income and improved health and quality of life.

Another population group that exhibits significantly higher mortality than that of the general population are surviving spouses. This slide shows that females are more affected by the death of their spouse than males, especially at the younger ages. For both men and women, mortality rates converge to the level of the general population mortality at the advanced ages.

Not surprisingly, disabled people exhibit mortality rates much higher than those of the general population. These relationships for other age groups are similar to that shown on this slide. It should be noted that cancer is the most common cause of death among the disabled population.

Now one of my favorite graphs. It’s the heat map of historical and projected mortality improvement rates. So it

shows, as it could be seen in this chart or picture, in late ‘60s, early ‘70s, the mortality rates among young males increase significantly and this is the purple spot here, so every section with the dark blue or purple represents an increase in mortality rates and for most of the time, almost all age groups, there was a reduction in mortality rates. And when you see black and red, it means huge reduction in mortality rates. And you could also see the impact of AIDS in the ‘80s.

The positive cohort effect for men born approximately in the ‘30s and ‘40s is also well seen, so this is this one here. 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 has been seen over recent decades. So this cohort effect is very similar to the one observed in U.K., but for women, we don’t have this cohort effect, probably because the mortality rates are already very low for most women in Canada. One thing that could be said here, and I think it’s remarkable that I think it has happened in almost all OECD [Organisation for Economic Co-operation and Development] countries, is that women aged less than 45 in the ‘50s and early ‘60s have had mortality improvement rates close to 5 percent per year. This is believed to be related to the reduction of mortality as a

result of giving birth. So the recent historical as well as projected improvement rates are more moderate for women. It's 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.

Now I'd like to explain a bit of the process we have when we set assumptions. We looked at three factors. The heat map, so the annual reduction of mortality rates, level of mortality rates, is the second aspect. As you know mortality is age related. And the third aspect is to look at the top countries in the world and by age group. So what we have done, we have selected, based on the numbers, the top eight countries in the world with the lowest mortality rates, and, by the way, U.K. and U.S. are not in this category, so it's Sweden, Italy, Switzerland, Australia, Japan, Spain, France and Canada. Now for those who like rounded numbers, if you want to have 10 countries, then you add Netherlands and Israel. We use countries of 8 million and more; we don't want to look at smaller countries because at the end, well, we have only limited resources so we think by looking at these countries, by age group, it gives also interesting information.

For the age group 15-54, Canadian mortality rates are

significantly lower than U.S. rates. Over the last 40 years, the reduction in Canadian mortality rates was about 57 percent; this is a little higher than the 50 percent reduction over the previous 40-year period. However, it's worth nothing that mortality rates are now decreasing at a slower pace, a decrease of 18 percent in the last 20 years, as opposed to 40 percent in the previous 20 years. We project a further reduction of 28 percent over the next 40 years.

Now what you have in this box is the top five causes of death for this age group and you have Canada and U.S. side by side, so in 2009, the standardized death rate is 1.3 deaths per 1,000 for Canada and it's 40 percent lower than the U.S. so it's a significant difference. And the main reasons for that are accidents, heart diseases and homicides. Speaking of homicides, even if it's the fifth cause, the ratio is one to four so the probability of dying from a homicide is four times higher in the U.S. than in Canada. Now, what about the other countries? Well, the leading country, in that age group, is Sweden at one death per 1,000.

Now, 1.3 deaths per 1,000 is already very low, and we are predicting it will move to .8 deaths in 2049. At that level, based on my work with pension plans, it does not really matter.

Now let's move to the 55-64 age group; the recent reduction of 57 percent in mortality rates over the last 40 years was much more dramatic compared to the 26 percent reduction over the previous 40-year period, so you see the slope that is very different here than here. 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 percent is projected. Currently mortality for this age group is 27 percent lower than U.S. so still a significant difference and the main reasons are diseases of the heart, accidents and diabetes. The top country here in this age group is Australia at five deaths per 1,000 and we are projecting four deaths per 1,000 in 2049. Australia is followed by Switzerland, Japan, Italy, Sweden, Spain and Canada; Canada has the seventh spot in that age group.

I will introduce a new notion, the projected death rate. The projected improvement rate for U.K. is much larger than ours; to my knowledge, the U.K. is the most aggressive country with respect to its mortality projections, although they might be right. In this age group, in 2049, we are at the same place, four deaths per 1,000.

Now for the 65-74 group, we start to talk business, in part because there is some uncertainty here. So the 65-74

group has experienced a similar pattern in magnitude of reduction in mortality rates as the previous age group 55-64. A further reduction of 40 percent is projected. Once again, male mortality rates at 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 percent lower than for U.S. mainly due to lower rates of heart diseases, lower respiratory diseases and diabetes.

What about the top countries? Currently, Canada is at 15 deaths per 1,000, with Japan being the leading country at 13 deaths per 1,000; Switzerland, Australia, France, Spain are at 14 deaths per 1,000 and Canada has the eighth spot in that age group.

What about U.K. in 2049? They are projecting nine deaths per 1,000 and here I'm using the 2010 base tables so maybe Adrian has used 2012 experience, that is the most recent, but at least the comparison has been done with the most recent one that we had at the time. Again, in 2049 we are projecting almost the same death rate.

For the 75-84 group, we are currently at 43 deaths per 1,000. So the reduction in mortality rates was about 43 percent over the last 40 years, compared to only 31 percent over the previous 40-year period. A further reduction of 37 percent is projected. The current mortality in Canada is 17

percent lower than for U.S., mainly due to heart diseases and lower respiratory diseases. The leading country, and here we start to have some divergence, as we are at 43 deaths, Japan is the leader at 36 deaths, followed by France at 39, Switzerland 41, Australia 42 and Canada is now fifth at 43 deaths per 1,000. We are projecting 27 deaths per 1,000 in 2049, while the U.K. is projecting 24 deaths per 1,000, so lower than us.

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

We are projecting 65 deaths per 1,000, while the U.K. is projecting 51 deaths per 1,000, so you start to see the difference between the two projections. The leading country in this age group is Japan, with 83. Canada is close to the top in this age group, quite a remarkable achievement and a surprise to me when we looked at the numbers, and there might be a reason for that.

The 90+ age group has been decreasing, but at a slower pace than for other age groups; a reduction of 26 percent was experienced over the last 40 years, compared to a

reduction of 14 percent 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 the 90+ is 15 percent less than U.S. due to heart diseases and Alzheimer's. A further reduction of 20 percent is predicted by 2049; we are projecting 136 deaths per 1,000. The leading country, and we (Canada) at 171 deaths, is Japan is at 168, so we are very close to that top country in this age group. If you separate men and women in this age group, the results are more revealing. Because Japanese men have more difficulty to cope with life at these ages than Japanese women, so to some extent, the difference or the gap between the two in Japan is much higher than in other countries; so if you separate rates by sex, the top country for men is Canada.

When we compare with the U.K., I did not use the 90+ but I used the 90-99 age group. U.S. is at 160 deaths per 1,000. In 2049, Canada is at 131, so lower than 136 (90+) because now I'm looking only at the 90-99 and U.K. at 93 deaths per 1,000, so the difference is important.

So I would like to bring up the difference between a cohort and period life expectancy. A cohort life expectancy differs from the period life expectancy as shown in the beginning of this presentation. Annual mortality rate improvements applied to calendar year of mortality rates to

the future of the cohort. The dotted line is period experience, as reported by statistical agencies, while the solid line is what we use in the valuation model for the applicable cohort. Canadian life expectancy at age 65 is projected to increase by three years to reach 25 years within the next 50 years. It might be sooner than that, but this is our projection, so it means that half of Canadian retirees are expected to live past age 90. When I said that to the members of Parliament, especially the senate members, they didn't believe me. They said, no, we are not living that long. Of course, living that long means that they have to pay more for their pension plan, even if they are members of parliament, but it was an interesting discussion in that suddenly they suggested that I was not underestimating life expectancy but overestimating life expectancy, an interesting perspective when you are a plan member covered by a defined benefit pension plan.

This slide will result in increased costs for pension plans, as beneficiaries are expected to receive their benefits for a longer period of time. This is a comparison. Don't pay attention to the absolutely numbers but look at the relative position of each country instead, because these are period life expectancies, not cohort life expectancies, and the first vertical line is where Canada is in 2010, with only Switzerland at age 65 has a higher

life expectancy. And later on with the projections, Switzerland and U.K., I told you that they were quite aggressive, are projecting higher life expectancy than us. And by the way, I would like to commend all the work done by my U.K. colleagues. We have access to the Continuous Mortality Investigation (CMI) group work and there's a lot of good material in the work they have done.

Now this slide gives the same comparison but for women and you see that in 2030, we seem to lag a bit compared to other countries. U.K., Switzerland, France, Finland and Japan are projecting higher life expectancies than us.

Now let's talk about the uncertainty of results. What you have here is a trajectory of life expectancy at age 65 if you put in the model the reduction in rates of the past 15 years by cause. Because it was so huge for men, if you apply these reductions through 2026, and we would observe, in only 12 years from now, men will live longer than women. You see the differences at the end of the projection period between our projections and just applying the recent improvement rates forever. Indeed, with that kind of projection, male life expectancy would surpass the one of women by over five years in 2075. This scenario serves as a reminder that setting future assumptions only based on the recent experience may lead to unintended results.

The second slide was prepared in response to a request

made by Leonard Hayflick and Jay Olshansky three years ago: What would be the projected life expectancy if we eradicate all deaths because of cancer and heart diseases and after 65? They represent about two-thirds of the deaths. So over the next 75 years in this scenario, nobody dies from heart attack and cancer or heart diseases; for the other cause of deaths, we have used a reduction of mortality rates of 0.35 percent. Now, of course, this is not scientific, because as our speaker yesterday said, if you survive from one cause of death you could be more likely to die from the next one, so it's very perilous and not very robust to still project improvement for other causes while at the same time you are eradicating the two main causes of death. Nevertheless, you see that in 2075, we have not reached an average life expectancy of 100 years old for a population.

Can we live beyond 100 years? I like this slide because it shows exactly where the difference lies between Canada and the U.K., and indeed those who have the highest probability to reach 100 years are those age 99. Then you continue down the road and, because future mortality improvements start to kick in, you can see the difference between the U.K., Canada and U.S. Canada and U.S. are following about the same pattern, but the U.K. is much more aggressive. They may be right, but at least I'm explaining to you the difference. So the main difference in

assumptions comparing ages 90-110 between Canada and the U.K. is the trajectory of mortality rates of the 90-99.

Survival curves for a life expectancy of 100. You see the survival curve. This is a scenario where you have a survival curve representing life expectancy of 80. You can either reduce all mortality rates by 87 percent at each age so you have the dotted blue line and then at 110, there's a tsunami and everybody dies; in this case you will get a life expectancy of 100 years old or you increase the maximum life span to 140 and then this is the red line and then you get life expectancy of 100 years old.

Providing for retirement is expensive and will become even more expensive in the future with improved longevity. Projections of mortality rates after 2030 are highly uncertain, especially for people older than age 90. It is a professional duty of the actuary to examine all available information and, God, there's a lot of information, from the World Health Organization and the OECD. The Internet is good but questionable. At the same time you cannot pretend that you don't have information. Information is there, but it takes time to identify and process all the most important information to get the job done well. So it's a professional duty of the actuary to examine all available information in order to develop best estimate of mortality assumptions. Again, thank you very much for your attention,

as it's always a pleasure to be here with you. (APPLAUSE)

STEPHEN GOSS: Thank you all for being here, and thanks for doing another Living to 100 and for the opportunity to come and talk with you.

I'd like to start by providing some perspective. I don't know about you all, but when we talk to people about aging in our society, the first thing everybody thinks about is that death rates are going down, life expectancy is going up. But for our social insurance programs, I mean when we get down to the bottom line, what we really worry about regarding aging is what are the implications for the cost of these programs and the cost of the programs relative to our tax space, relative to the people who can pay for it. I suggest it's not just for the pay-as-you-go social insurance programs, but for any funded system you have to worry about that too. But why? Because even if you may have funding, and you may have all these nice securities in your funds, but when it comes time to cash them in, who are you going to sell them to? You're going to sell them to the younger generations. So it is the overall age structure of the population, what we refer to as the macro aging of the population, that really matters. This is the shift toward there being more elders in the population, which occurs, and it's occurring in all the OECD, all the developed nations, because we're having slower growth in

the number of people at younger ages for various reasons and faster growth in the number of people at older ages. Now we'll get a little bit more into that in a minute.

What we're really talking about here in this conference is just a chunk of what's happening in the aging process and that's micro aging. Micro aging is just people living longer, increased life expectancy because of declining death rates. Well, these different kinds of aging create different challenges for us. Just for a moment, on the macro aging, a really big reason that we're seeing macro aging going on in all of our countries right now isn't because of mortality improvement, it's because of the drop in fertility rates that we have all experienced, after the baby boom generation. And you can see here for instance in the U.S., the little dashed line, is the actual total fertility rate (I assume everybody knows the definition of that, similar to period life expectancy). We have made a little adaptation of that total fertility rate and call it the adjusted total fertility rate, which counts only those births that survive to age 10, roughly approaching adulthood. You can see that we have had pretty much an average 3.0, three children per woman over a normal lifetime up until the mid 1960s, when it dropped down to about 2.0, which is where we're at now and we've stabilized. Now, hey, talk about best nations, you know of

all the OECD nations, the U.S. is the best in that. So in terms of aging, that really matters for financing our programs where fertility rates are probably being the key driving variable. The U.S. actually has an edge, not that this is a competition. (LAUGHTER)

So on to the implications, the implications of macro aging that really is a shifting age structure. This is one of my favorite slides. This little slide shows that, below the purplish line is our adult pre-retirement age population, roughly between 25-64, so you can see how the adult age population has been shifting between young adults and older adults, which is important for disability benefits. We've had an awful lot of discussion in the U.S. about disability costs going up, which should not be a shock when you look at this graph about the area between the green and the purple lines. Look at how that's expanded over the last 20 years. Well, those are the ages where adults tend to be disabled, not so much from ages 25-44.

OK, skipping forward to what we're really about here today and this week, micro aging, which is really looking at it from a life expectancy basis, and what's happening to death rates per se. In the U.S., here's our age-sex adjusted death rate, taking all you know through the use of a standard population in the year 2000. You can see how the age-sex adjusted death rate has been going down and what

we're projecting: continued declines in our intermediate central forecast going forward into the future. What would we expect?

The implications for life expectancy include some increases in life expectancy, just as Adrian and Jean-Claude have shown. You see how the gap between males and females has narrowed. We're projecting it to stay relatively stable in the future. Could it re-expand with the females taking the lead to a greater extent in the future? Absolutely, and we'll get into that a little bit more as we go on.

But I want to make a comment about the use of life expectancy versus age-sex adjusted death rates. I think there's a real peril of misguiding ourselves and misleading others by focusing too much on life expectancy that's really an outcome variable, and not a driving variable for what's going on. A simple example is the use of life expectancy at birth, something that a lot of people like to focus on. They like to look at the past trend and put a ruler on it, using a linear extrapolation concept. Of course, you can do that. But if in the past most of our life expectancy improvement, which has been dramatic, was the result of big reductions in the youngest age for the life expectancy we're talking about, to achieve the same type of life expectancy improvements, we have to have

dramatic improvements in deaths at older ages, for which it is much, much harder to have similar improvement in life expectancy at birth.

For example, if we eliminate one death at infancy, that could add another 80 years of life or 90 years of life. If we eliminate one death at age 90, how many years does that add that factors into the life expectancy at birth? So going forward, even with continued strong rates of improvement in death rates, we'll have a deceleration in the rate of increase in life expectancy at birth. I think Adrian and Jean-Claude have both shown this in their graphs, so it's important to avoid the peril of trying to extrapolate on death rates themselves.

Now I would like to share with you something from two Living to 100 Conferences ago, which was the last one I attended, at some of the numbers that were presented for the U.K., Canada and the U.S. You see in the top panel what were historical average rates of improvement, which were age-sex adjusted across these narrow age bands. You can see that for all three countries, the fastest improvements were at the youngest ages, slowest at the oldest ages. These are over very, very long periods of time, but it was what we had presented then. You can see in the bottom panel what everybody was projecting six years ago, probably 2007 projections. I think the U.S. was the only one that

maintained a significant age gradient. Jean-Claude and Canada had a little bit slower rate of improvement at age 85+ compared to the other ages and the U.K. had exactly the same rate of improvement at all ages going forward. This was really quite a sea change from the historical period.

Now let me share with you where we are now. Three panels, a little more of a challenge to take a peek at. The top panel is similar to the old one, but these are long-term periods and at least we've got the same time period, we're looking at average annual rates of improvement from 1929-2009 across the three countries. You can see the strong age gradient where the age reductions are strongest at the youngest ages and they get much smaller at the oldest age.

When we jump to the middle panel, this is a more recent period, for 1982-2009, you can see that there's still an age gradient for each of the countries, although not quite as strong. We'll get, in a couple of moments, to the interesting age 65-84 group, where it looks like it's doing about as well as the 15-64 age group. Now when we look at the projection in the bottom panel, it's a little bit like we had six years ago. We still have some age gradient for the U.S. and none for Canada or for the U.K., but we have some age gradient for Canada at the 85 and over category. I suggest that one observation is that

historically there's been a rather strong age gradient over time, and as I think Jean-Claude and Adrian both pointed out, we can probably do a lot to eliminate deaths, maybe nearly completely at young ages, but since we're all going to die sometime and if we have an 85 and over category, everybody, even everybody who survives to 85, will die sometime in the 85 and over category. So we can have improvement there, but will it improve at the same rate as at the younger ages? We suspect not.

As Jean-Claude pointed out, maybe U.K. has got it right and we'll have exactly the same rates of improvement at all ages. Nevertheless, we just don't see that in the data yet, there's been some convergence, but nothing quite as strong as that. So going forward, we are projecting a continued age gradient. This is really, really critical for the cost of the programs that we're dealing with, because remember, for young ages, a reduction in mortality results in more workers coming to the system and creates a younger age profile for your population. Death rates that are dropping at older ages contributes to more people living in retirement, which has very, very different effects on the cost of the systems, which is really the bottom line of what we're really looking at here, more than just the total amount of our population. I don't know if anybody is here from the U.S. Bureau of Census, but the census obviously

focuses primarily at the population headcount. We focus much more on the age distribution, because that's what's really critical for projecting the costs of the programs we're working with.

Now let me address the age gradient in the U.S. and how this has varied over time. We've got two time periods here and you can see one is 1900-1936 and then 1936-1954, for which there is quite a difference. That was a pretty good time, 1936 to '54. You might wonder why on earth was the rates of reduction, at all age groups, so much better in that period? Factors contributing to this include the use of penicillin and antibiotics, a big increase in the standard of living, as well as better access to primary health care, just a remarkable change at all ages. There was still an age gradient that was quite strong in the 1936 to '54 period, but much, much stronger improvement in overall mortality.

Now let's skip ahead a slide and we see what happens when we add two more periods. For the 1954-1968 period, we drop back to a much lower level of rate of improvement, generally, for the different age groups, but during the 1968-82 period, we hop back up again. Again, another really good period. What happened there was that in 1965, we introduced Medicare and about the same time we had Medicaid coming in, which brought primary health care readily

available to aged, disabled and poor folks, folks who are responsible for a lot of the deaths in our population, especially at younger ages, so they had a major impact. So we have two periods of really, really strong improvement when penicillin and increased standard of living happened, also when we had Medicare and Medicaid come online in the U.S.

Now let's fast forward to the next period, which is 1982-2009, which you know was not such a great period. Well, we didn't have anything new like Medicare and we didn't have any other amazing breakthroughs. We did pretty well in a lot of areas, but you can see there two outstanding periods that we had, in 1936-65 and the 1968-82. The reason I want to point this out is because this is the way we analyze the historical record of the rate of improvement in mortality. We really want to understand the reasons in any given period why mortality improved fast or improved slow. If we can understand the causes of the improvement at different periods of time and we think forward about what we expect conditions will be in the future, that will give us an edge in trying to guess what kind of rates of improvement we should be expecting. We don't just want to apply a formula and just apply by extrapolating to some long period in the past, unless we think that the conditions in the future are going to

replicate the average conditions of the past.

Now we add our projected period. Our projected period for all the different age groups still has an age gradient as pointed out earlier and reflects something better than the bad periods during the last century. But not as good as the extreme good periods, probably a little closer to the not as good periods. Now let me just explain why we have come to this conclusion. When we're thinking about the conditions of the past and conditions in the future, we have focused a lot on smoking, which does explain a lot of the difference between male and female mortality improvement. As a result, we expect females will be catching up a bit in the rate of improvement in the future, but obesity is another factor. I know Sam has talked at this symposium and at others about obesity, which I will address in a slide coming up.

Another factor that really affects us is medical technology and the cost of applying new developments to everybody in the population. I point this out because over the last 30 or 40 years, we've gone from spending 3 percent (another areas where the U.S. is the world leader) of GDP to 18 percent of GDP on health expenditures. Now can we continue that rate of increase? Well, of course not, and everybody is talking about trying to slow that growth down, but to the degree that health services have any affect at

all on bringing down death rates, if we decelerate our spending on health services, that suggests we should not necessarily expect to have the same kind of mortality improvement rates we've had in the past, especially during periods when we were dramatically increasing our expenditures.

Speaking of obesity, here's a slide that I just love. Sam Preston, from the University of Pennsylvania, showed this to us back in 2010. This just leapt off the page to me and to a number of others because what this shows is, in the U.S., the prevalence of obesity across all age groups dramatically rose simultaneously from back in the mid 1970s up to 2005 or 2006. We don't have numbers going beyond that. Sam Preston described a paradox about why it is that on average it doesn't appear as though aged folks who are obese now don't look like they're having that much of an adverse effect on mortality from being obese compared to the effect of obesity back 20 years ago. After we talked about it, it seems rather evident that if obesity, like smoking, hurts you most if you've been obese for a long time, there's a cumulative effect. So if you look at the cohorts that are obese in the 2005 and '06 period, these will experience excess mortality in the future. If you follow them back in earlier times, the prevalence of those cohorts being obese in earlier years was much, much lower

so the adverse effect should not be great yet.

Now if we stabilize these rates by age going forward another 20 or 30 years, the aged who were obese at the earlier time and will have been obese for a much longer period, we have that unfortunately to look forward to.

We consider in our projections not just the age gradient and gender, but also by cause-of-death category. We think this is really important and on the next slide you'll get a hint as to why. Adrian and Jean-Claude have both shown you quite a bit of material about different levels and different rates of improvement in death by cause. Given such dramatic differences across the cause groups, we think it's really important to project them separately and not just to take all mortality rates and project it out as a singular feature.

Now here's the wonderful story. We just love cardiovascular. I think Jean-Claude and Adrian have both had this same kind of experience. We can see the rate of improvements in the cardiovascular cause of death similar to what Jim Vaupel has been predicting for a long time, 2 percent plus annual rates of improvement in mortality, which we have achieved over the last 20 to 25 years. The thing to note here is to look at the dramatically high rates of improvement at age 50-84, which is not a surprise. You know all of the things that have been done to help

people from high blood pressure, hypertension, coronary bypasses and everything else, the statins, has really, really made a big difference. We have made dramatic improvements in mortality from cardiovascular at these middle ages. This helps explain why at middle to upper middle ages, overall mortality has done so well, even compared to mortality rates at younger ages in this period. Of course, we're kind of running out of gas on lowering cardiovascular deaths, so we shouldn't extrapolate this tendency for the middle ages to that at the very youngest stages into the future.

Now let's take a look at cancer. Cancer is unfortunately not quite as great a story. Under age 64, we've been doing pretty well for men and women, while above 64, both at ages 65-85 and 85+, we've not been doing very well at all historically over this historical period. Let's take a look another one, violence. Violence is not a pretty picture either. We've done quite well in terms of improvement rates at the very youngest ages but with no strong reductions in violence, suicide, homicide and other forms of death by violence.

Respiratory disease is an even worse story, especially for women and, of course, this is where cessation of smoking is related. I'm sure everybody knows that women started smoking heavily later in time than men did, at

least in the U.S., and they stopped smoking or started reducing their smoking at a later point in time, so we haven't yet seen the beneficial effects as much for women. This can be seen in this recent 30-year period, where the death rates from respiratory causes have been going up for women at all ages above 15. For men, it's been relatively flat.

We have done pretty well at other causes, including diabetes, which for under 15 we have done pretty well at, while at higher ages we have not done quite so well.

Now putting them all together, the total of all causes has experienced a strong age gradient over this 30-year period. Again, I want to point out that the 50-84 age group looks relatively good, beating out the 15-49 age category. However, remember how mortality due to cardiovascular reasons looked. That's really the explanation as to why these middle age groups have really done so well during this period.

When we're developing our projections, we consider the possibility of a repeat of some of the items we have mentioned, to anticipate what's going to happen, including developments in the areas such as smoking, obesity, medical technology and others, because just developing technology doesn't help unless people like Bill Gates, those behind Google and the rest of those in Silicon Valley aren't the

only ones who get it. It has to be disseminated to our broad population to really make a difference. But just how fast things will improve in the future is really a matter of judgment.

Now, taking a look here on what's going on in the cardiovascular area. You already saw what we had experienced, now let's patch in what we're projecting. The two bars on the right indicate that we're still projecting pretty strong rates of improvement in cardiovascular. In fact, we are extrapolating a continued pretty strong improvement in cardiovascular for ages 50 to 64. For cancer, remember historically we have not been doing very well. In the very most recent period, that has been turning around somewhat and we're projecting some improvement in the future, but again with an age gradient. More improvement at the younger ages than the low. I do this with some care. Johns Hopkins University staff, who I don't think is represented here, at the SOA meeting in San Diego recently, has done some great, so far unpublished work in projecting mortality trends using expert opinions. With no knowledge of our projections, Bob Berlein at AIG asked their clinicians, and researchers came up with very similar expectations, by cause and by age. I'm only showing you cancer projections here because we received dispensation from them to show this, but you can see their rates of

improvement. If anything, there the clinicians and researchers, who are actually in the medical trenches developing new technologies, are less optimistic than we are on improvements. You can see the strong age gradient that they have on their expectations for cancer improvement in the future.

You can see our projections of deaths due to violence and age gradient, but returning to improvements at all ages. Respiratory, horrible experience in the past, as I pointed out before, seem to be moving toward some level of improvement in the future, but not dramatic. The other category, which includes everything else and anything new that we don't know about now, such as if we were to miraculously eliminate some causes lock stock and barrel, which we're getting close to perhaps with cardiovascular or with infectious diseases. Again, remember we're all going to die someday, so something else is going to probably turn up that will take us out.

Finally, you can see the age gradient for the total for all causes, male and female, for our projections. We do have a relatively strong 50-64 category, again because we have a projection that cardiovascular will continue to improve for those in that age range. So death rates are going to continue to decline.

The orange curve for age 65 and over, which is an

alternative assumption of 1 percent across the board compared with our current assumption of about a 0.6 or 0.7 annual rate of decline in mortality rates at the highest ages, you can see what happens to the life expectancies at 65, they drop somewhat faster.

So, bottom line, we believe mortality reductions will continue. Our sense is that it's going to be hard to match the effects of the past. We're not going to be able to start up Medicaid and Medicare again. We are going to have the Affordable Care Act kicking in and providing insurance to a lot of people at younger ages. But these are not the same kinds of people that were so positively affected when Medicare and Medicaid came in, so we think and hope it will have some positive effect, but the vast increase in spending and health research and services in the past is something we won't be able to replicate and, if anything, we are likely to be decelerating.

Now can we get way smarter about every dollar we spend? If we knew how to get way smarter, why wouldn't we have already done it? OK, we're going to get smarter, but will it be enough to offset the deceleration in spending we're going to have in the future? The other point is that we expect the age gradient, for which we have identified the causes and has been so prevalent in the past, will continue into the future.

My last slide is really just a listing of the websites for the material that we at the Social Security Administration have developed, which covers everything that I've been talking about here, which I can take almost no credit for. The people on the very first slide who are responsible, one of whom is here, Mark Bye, I hope you get a chance during this conference—because aging does happen. Some of us are getting older and we need the next generation to come up and pick up the baton and do even better.

These websites have all of our projections and all of the background and basis for the projections for what we've talked about today. Thank you very much for listening and again I wish Jim Vaupel were here so we could discuss and debate this issue further. (APPLAUSE)

DOUG ANDREWS: Doug Andrews, University of Waterloo. The panelists have done a great job in their presentations; it was very informative. I have a couple of comments and questions. First of all, Sam, you teased Adrian that Scotland might no longer be part of the U.K. and his job may change; I'd like to tease Jean-Claude in that I noticed in his list of countries, he has Quebec as a country. Does that indicate that Quebec is not going to be part of Canada?

In the analysis of the different causes of death,

alcohol and alcohol-related diseases don't show up as a separate cause. I'm sure they're mixed into a lot of different causes, but I'm wondering if our approach to the effect of alcohol has changed significantly and how that might impact the various death rates. Has anyone done analysis on that?

Also I can't leave without challenging Steve's statement about how the reduction in health care spending slows down the improvements in life expectancy. The work that I've done shows that there's no direct tie between how much money you spend on health care and how long life expectancy is. Japan, for example, spends far less on health care than the U.S. does and has far longer life expectancy, so I think it matters how you organize the expenditures, not just how much you spend.

STEPHEN GOSS: I guess I would respond by asking Doug about alcohol. Which way do you think we're going? I mean, I remember some years ago at the National Academies, a researcher from Harvard had a wonderful graph that showed death rates on the Y axis crossed with average daily alcohol consumption, with the minimum being 1.5 ounces, that is the minimum death rate was for 1.5 ounces of alcohol consumption. I don't know if you're suggesting that we're moving toward more alcoholism or maybe more marijuana or what. (LAUGHTER)

DOUG ANDREWS: Well, I did think about marijuana because that's certainly something that's happening in the United States in a couple of states, but I was thinking about the question when Adrian started talking about the U.K. and the possible splitting off of Scotland, because Scotland certainly is a heavy drinking country and their life expectancy was two years less at birth and alcohol may be one factor involved, which is what got me thinking about the question. I was thinking about alcohol reduction.

STEPHEN GOSS: Regarding Doug's point about the relation between health care spending and longevity, I think the evidence in our periods where we've had these two really remarkable periods of improvement in mortality. Doug is right, it's not really just how much you spend but who you spend it on and what you spend it for. If we spent a whole lot more money just on having Bill Gates getting all kinds of replacement organs, that's not going to do much for mortality. But when we spend money on distributing antibiotics to our entire populations or spend money on Medicare and Medicaid getting primary health care to a broad group of people in the population who are at high risk and had not had good access before, that makes a huge difference. I suggest those are the kind of applications, with whatever money we spend, we're going to have to make and be able to replicate those kinds of remarkable changes

in the future. I think that will be an immense challenge.

MICHAEL PFALZER: I have a question for Stephen. I noticed you're projecting decreased mortality from violence, despite recent experience. I was wondering if you'd talk to the reasons for this. As I look at it, this mortality could decrease from improved medical skill of preventing death due to the frequency and severity for several types of violence we might experience. What I seem to pay attention to and notice is an increasing toxicity of the brain and a lot of technology leading to a deterioration of the neurological system, which would seem to increase violence frequency and severity. This would not improve mortality. What are your thoughts on why you're projecting a decrease?

STEPHEN GOSS: Well, I guess we're generally optimistic, but I was just thinking about the doctor who about 20 years ago was doing a lot of euthanasia in Oregon, and I was wondering whether my generation might be more open to that going into the future and we might have more deaths from suicide. Now, is that part of what's going on at the age 85 and over group? I was talking with somebody on the plane yesterday and they raised that issue. It's something we're going to go back and look at.

Going forward, it's entirely possible that, especially from suicide, self-choice on deaths from what we include as violence could increase in the future. We also suspect part

of what's going on at the higher ages is that with more people not being with family members in their last days of life, but being with other care givers, that may have some effect, and not positive. So, you know, we don't have a perfect explanation, but we are optimistic and hopeful.

ROB BROWN: I have a comment and I'm hoping you will comment on my comment. I'm becoming increasingly convinced that one of the strong drivers of life expectancy is financial security. We don't study that, it's not listed as a cause of death, because financial insecurity is not listed as a cause of death. Socio-economic factors, Adrian shows, have strong correlations, but a socio-economic factor is not something you can control and society can't do much about. You didn't get enough education, you had a lousy job. What can we do about that? But financial security is something you can provide and I would suggest that one of the reasons that Canada starts to look pretty good in some of these statistics is, I'm going to say with some humility, we do a pretty good job at providing financial security, especially to the elderly, and we do it especially with a program called Old Age Security, which includes a Guaranteed Income Supplement and that costs us less than 3 percent of gross national product. For less than 3 percent of gross national product, you can provide financial security. Steve, I would suggest to you that if you pulled 3 percent of gross

national product out of U.S. health care and used it to provide financial security, the life expectancy in the U.S. would go up; in fact, I will guarantee it. (LAUGHTER, APPLAUSE) It's really easy to guarantee it, because I know you're not going to do it. (LAUGHTER) So I can stand here, it's no problem at all. Now in the U.S., you will want to do things in the private sector. Now, who do we look to, what profession is the expert profession in the provision of financial security? It's the actuarial profession, that's our focus. But I would say right at the moment, we've got a private sector failure.

People aren't buying annuities and we're not marketing annuities or even pricing them appropriately. Right now in the U.S., a blue collar worker would be an absolute idiot to buy an annuity the way they're priced today. What we need is risk classification. It happens in the U.K., a huge profitable market, but it isn't happening here.

The second product we need for financial security are deeply deferred annuities starting at, say, age 85, so that somebody coming out of a DC world only has to take care of a known set period of time and the longevity risk is gone. Those products aren't being marketed and sold and yet that's a problem for which society is demanding a solution. I think that comes back to us as a profession, so I'll send you home with that friendly message.

STEPHEN GOSS: Rob, you are right that if we had less dispersion of income and wealth in this country, we probably would have a positive effect, but I would suggest that while more emphasis on annuitization would be a wonderful thing, if you reach retirement with no assets, you've got nothing to annuitize. Probably the biggest issue in this country is that over the last 30 years, the dispersion of the earnings distribution, which has happened much more I suspect here than many, many other countries. Jean-Claude was talking about how some other nations were doing better in terms of mortality compared with the U.S. Some countries, certainly the U.S. and to some degree the U.K., are a much more heterogeneous society, and certainly in terms of earnings levels. But in some ways we are trying, such as what's going on with the minimum wage. But Rob, although you've got some great ideas, we've got 535 people we want you to talk to, because they're the ones we have to influence if you want to get a change in this country.

SAM GUTTERMAN: Rob, annuities with a start date of, say, age 85, are increasingly popular in the U.S.

GARY MOONEY: I'm from Canada and in the various sessions at this symposium, with the exception of this one, there's been very little reference to statistics from Canada in presentations that have compared various OECD countries.

I'd like to encourage researchers to pay some attention to Canada because we're not just 10 percent of the U.S.

Secondly, there was a comment about obesity. It just occurred to me that the problem of obesity may be similar to the problem of smoking in that is cumulative over time, so that some of us who are a little older and may be a little bit heavy don't have to worry so much if we put on the weight recently, but the big problem is the younger people who put on weight quite early and I see Steve is nodding his head.

STEPHEN GOSS: They have strong thumbs on their electronic devices.

GARY MOONEY: And I just have one more thing for Adrian. Two questions about Alzheimer's as a cause of death, two questions. First, does this include Alzheimer's as well as other types of dementia?

ADRIAN GALLOP: Yes.

GARY MOONEY: That seems to be to me more of an indirect cause of death. In other words, the direct cause of death might be something more physically obvious. How do you establish a cause as being Alzheimer's or dementia?

ADRIAN GALLOP: That's done by those who produce the statistics. On the death certificate, you can have several causes of death and they'll then decide from what's written on the death certificate how you identify the final cause

of death. They're following the rules and they would determine that this was caused by Alzheimer's dementia, even though it may be something else that was the initial contributing cause. It has to do with things like you may have fallen, gone to the hospital then died of some virus from the hospital. What was the cause of the death? Was it the fact that you were in the hospital or was it the fact that you fell to start off with? So there are problems in many cases. That's one of the problems of trying to project things by cause of death. As I said in my presentation, one of the reasons why Alzheimer's is now recorded as a high percentage of female deaths was a change in how these things are written on the death certificates. Before it would have been called something like a vascular disease, so it would have been included in the cardiovascular category, but now it is classified as being a death from Alzheimer's, not just as a result of a rule change.

STEPHEN GOSS: It may be that the U.K. is somewhat ahead of other countries in looking to Alzheimer's and dementia as the underlying cause.

SAM GUTTERMAN: I'd like to put Adrian on the spot regarding older age mortality assumptions. Jean-Claude and Steve referred to the differential in projections between the two countries and I'm sure you've done some thinking about it. Do you have any thoughts about why the U.K. actuarial

projections regarding older age mortality improvement is more optimistic?

ADRIAN GALLOP: One of the main reasons is the effects of what is termed the golden cohort, because those people who were born in 1930 and who are now in their 80s, as you move further into the next 25 years or so, they're moving into the older age category. Because we're projecting that they will keep experiencing high rates of mortality improvement relative to those who are younger and older, effectively the people that come along after that are assumed to gain from this improvement as well, so it's kind of an artifact of the way we do the projections. If we were to assume that the cohort effects fell as these people got older, then we would have less improvement at the older stages.

STEPHEN GOSS: So U.K.'s cohort effects?

ADRIAN GALLOP: That's my theory. Also I should point out that although it's called a cohort effect, it may not necessarily be because of something intrinsic with those people themselves. It may be that these people were young during the Second World War, they have had a good diet, they may have benefited from calorie restriction or, alternatively, it could be that they've benefited from a series of effects, such as the introduction of the National Health Service in 1948. Possibly they were the beneficiaries of medical research, the type of things that

these people died of were the things that money was being invested to reduce, so it's not known why these people have maintained high rates of mortality improvement, it's just that we know that if we hadn't in previous projections projected them to continue, our projections would have been worse than they are at the moment.

STEPHEN GOSS: One comment on that, Adrian. If there was this cohort effect and one cohort had a surge of improvement in their mortality, then later your cohorts after that might experience a level shift. But what you've got, though, for ages 85 and over, you've got a 1.2 percent average annual rate of decline in the future. Ultimately the U.S. and Canada are both projecting for 85 and over 0.5 percent per annum improvement; you've got more than twice the rate of improvement at age 85 and over and that's almost breathtaking. Note that I sure hope you're right, because as I approach that age, I'm hoping it will be true here in the U.S. as well.

JEAN-CLAUDE MENARD: A study of cohort effects is definitely top on our to-do list for the next actuarial report, so for the next three years we will investigate and read more on the papers produced by the U.K.'s Continuous Mortality Investigation group. We want to understand better why we have such a difference.

One thing, I would respond to one of Gary Mooney's

questions. In comparison with other countries, I think it's extremely important and there are two indicators that I did not present today that are related also to what Rob Brown said. It's the poverty rate among seniors and to some extent the Gini coefficient that there might be a stronger correlation with these two indicators about where life expectancy could go for each country.

TOM SHELBY: My question is addressed to Adrian. I'm interested in the U.K.'s determination of the SPA, which I believe is somewhat similar to the technique used in Denmark, that you came up with a result of one-third being the ratio of retired versus life expectancy. It has also been suggested that doing this would be a possibility for the U.S., but my calculations show that it was more like a quarter at base, for example, in 1935, and it has risen to about 29 percent currently. I was curious how you arrived at that one-third. By the way, I calculated it starting at working age 20, so I appreciate your further comment on it.

ADRIAN GALLOP: I'll first say this isn't a figure we've come up with; this is a figure first proposed by the Department for Work and Pensions who are the policy government department in terms of pensions. They said they thought the figure should be one-third. Also, it is based on cohort life expectancy, so this would be based on the life expectancies from the latest population projections.

However, you have to solve for the state pension age in any future year so you assume that people start work at age 20 and they will all live to whatever the state pension age is that you solve for. Then when you add on the life expectancy from that age, the cohort life expectancy at that state pension age would be no more than a third. That was the top percentage and then once it ticked above a third, you would then increase the state pension age by one year from what it was, although it's not a cliff edge at the moment. When the state pension age is up for review in the U.K., they usually have a two-year phasing-in period.

JAY SIEGEL: Two matters, one a technical detail, another a broad social issue. First, I'm formerly from the Census Bureau and Georgetown University. The technical detail is that I'm glad that Steve Goss pointed out that the long-term primary factor in aging has been the decline in the birth rate or fertility, but a few decades ago that changed. As a paper by Sam Preston pointed out, just as others have, around 1980, the decline in death rates at older ages became the dominant driver and has exceeded the role of fertility in determining age distribution.

The broader question is that lots of thought has gone on, or lots of thought should be going on, about the fact that, with the declining death rates and increasing longevity, perhaps we ought to change or link the Social

Security age of official full retirement benefits to changing life expectancy. My question is then whether you have had to deal with your legal people or your congressional or legislative people on this question, and what do you think about doing that? Now I know there are many problems associated with this approach, but I'll let you folks comment on that.

STEPHEN GOSS: On the issue of changing the retirement age, as you know in the U.S., back in 1983, we enacted an increase from 65 to 67, and every commission, including the Simpson-Bowles' Commission, always address this as a possibility. The biggest sticking point has been the heterogeneity of the U.S. population. Folks at the lower income levels have not been experiencing as much improvement in earnings, which may be part of the reason that they have been not experiencing as much improvement in their standard of living, their health status and their life expectancy. Therefore, it becomes difficult to convince everybody that raising the retirement age further ought to be done. There are other approaches like changing our benefit formula that would affect people with the highest earnings and therefore the highest life expectancy, more than those with the lowest levels. That's a real possibility.

To the point about the Sam Preston issue, you are

absolutely right that since 1980 the fertility rate in the U.S. rose from what was a little bit of a dip back up to 2.0. So certainly changes in fertility since 1980 have actually gone in the direction of improving the financial status of social security, where changes in mortality we've continued to have declines. However, the changing of the actual age distribution of the population with respect to over 65 and under 65, we are only just now starting to see the effects of the drop in birth rates that occurred well before 1980 and that's the critical point for the cost of our social insurance systems. When the drop in the fertility rate actually starts to affect this distribution and giving us fewer folks at working age and more folks at retirement age, we're just starting to see that around the year 2010.

JEAN-CLAUDE MENARD: About the retirement age, amongst the 34 OECD countries, more than half have or will have a normal retirement age higher than 65, some going to 68. In Canada, the current retirement age of the Old Age Security program is 65 and will increase to 67 in 2023. And the Canada Pension Plan, the normal retirement age is still 65. It remains to be seen if the two programs will be aligned in the future.

SAM GUTTERMAN: Thanks to our panel members and please join me in expressing our appreciation.

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