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Office of the Chief Actuary

Bureau de l'actuaire en chef



LIVING
to 100

SOCIETY OF ACTUARIES
INTERNATIONAL SYMPOSIUM

Jan. 4–6, 2017
Orlando, FL

Mortality Projections for Social Security Programs in Canada

2017 Living to 100 Symposium, General Session IV

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January 5th, 2017



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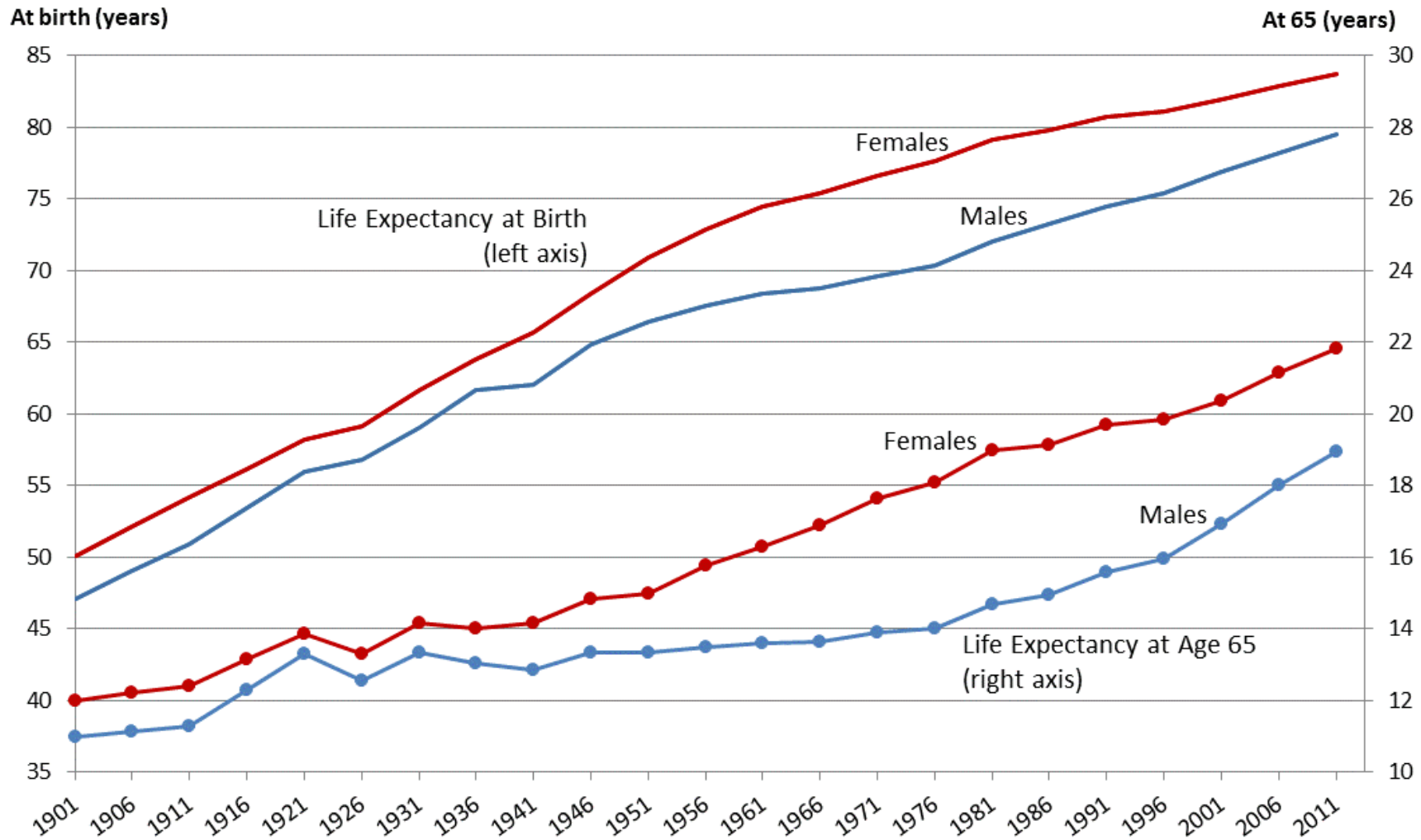
Canada 

Presentation Outline

- **Historical Trends in Canadian Mortality**
- **Recent Slowdown in MIR and Projections**
- **Canada and US Mortality Rates**
- **Can We Live Beyond 100?**
- **Sustainability of the Canada Pension Plan**



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



Source : Canadian human Mortality Database, University of Montreal

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Contribution to increase in life expectancy at birth has gradually shifted to people over age 65

Change attributable to (in years)	Males				Projection
	1931-1951	1951-1971	1971-1991	1991-2011	2011-2031
Infant mortality (<1)	4.1	1.6	0.9	0.1	0.1
Mortality (1-44)	3.3	0.8	1.0	0.8	0.3
Older adult mortality (45-64)	0.0	0.4	1.6	1.2	0.6
Elderly mortality (65+)	0.0	0.4	1.3	2.9	2.2
Total Change in Life Expectancy	7.4	3.2	4.8	5.1	3.2
<i>% attributable to 65+</i>	0%	12%	28%	58%	69%



Source: Canadian Human Mortality Database, University of Montreal and Office of the Chief Actuary calculations
Projections: 27th CPP Actuarial Report

Contribution to increase in life expectancy at birth has gradually shifted to people over age 65

Change attributable to (in years)	Females				Projection
	1931-1951	1951-1971	1971-1991	1991-2011	2011-2031
Infant mortality (<1)	3.2	1.4	0.7	0.1	0.0
Mortality (1-44)	4.3	1.1	0.7	0.3	0.2
Older adult mortality (45-64)	1.1	1.0	0.8	0.6	0.4
Elderly mortality (65+)	0.6	2.2	1.8	1.9	1.8
Total Change in Life Expectancy	9.2	5.8	4.1	3.0	2.3
<i>% attributable to 65+</i>	<i>7%</i>	<i>38%</i>	<i>45%</i>	<i>65%</i>	<i>76%</i>

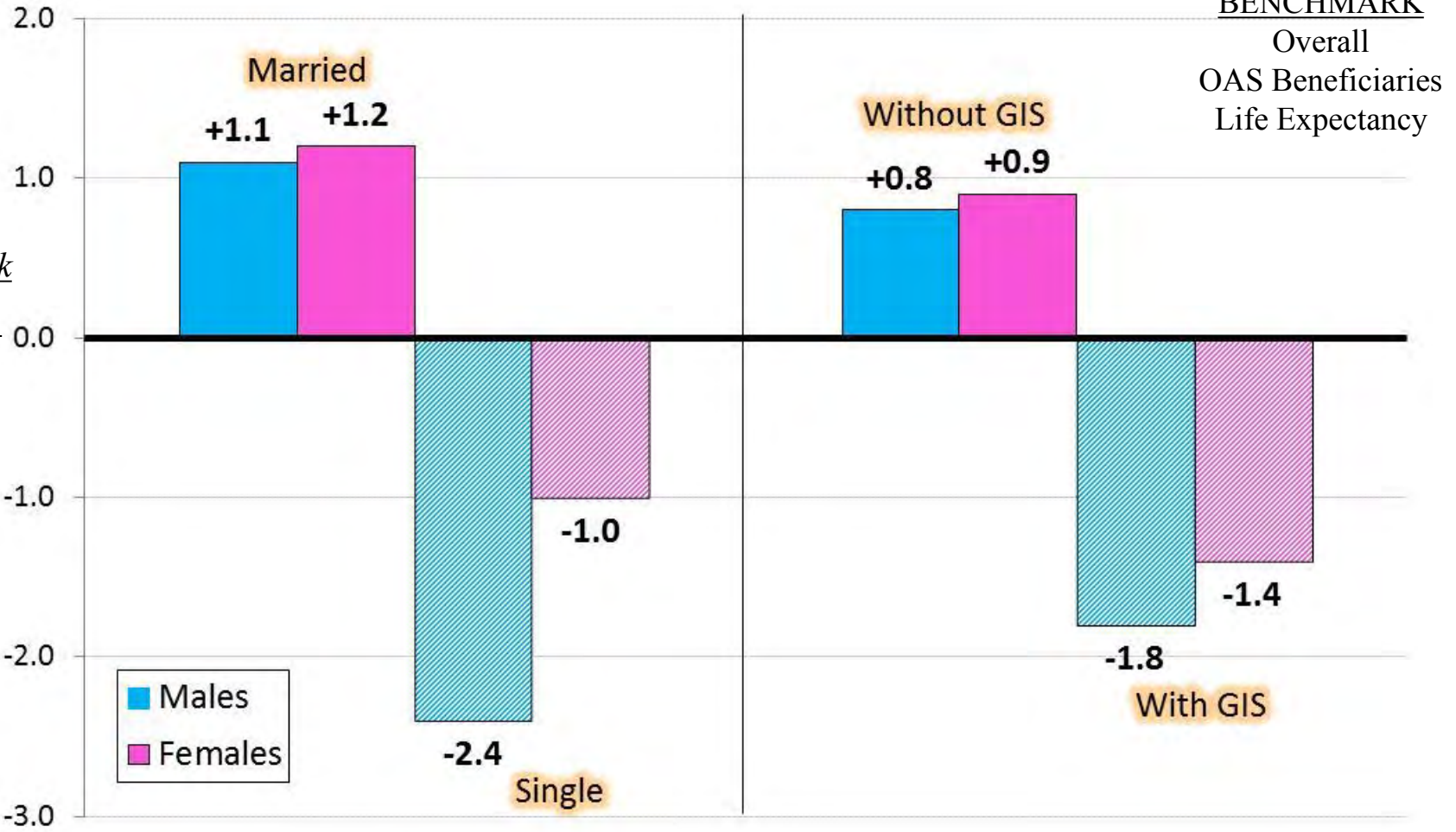


Source: Canadian Human Mortality Database, University of Montreal and Office of the Chief Actuary calculations
Projections: 27th CPP Actuarial Report

Life expectancy is impacted by level of income and marital status

Difference of life expectancy at age 65 (2013)

Years



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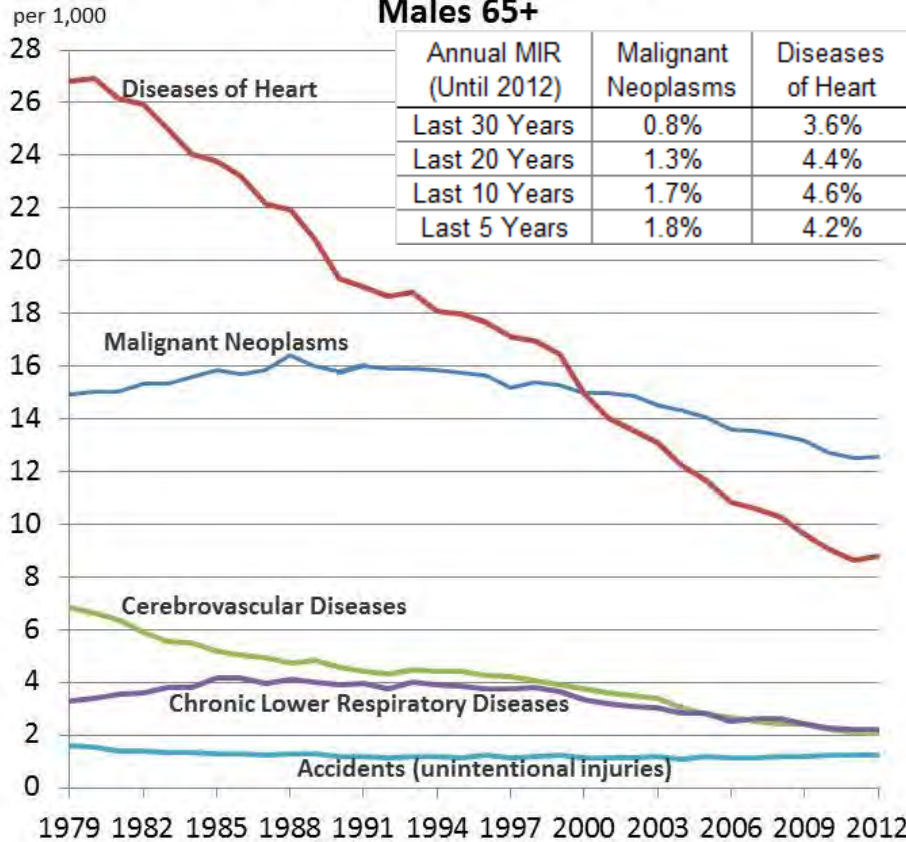
Source: Office of the Chief Actuary, Actuarial Study No. 17: Old Age Security Program Mortality Experience, June 2016

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Improvements in mortality related to heart diseases have been significant over the last 15 years

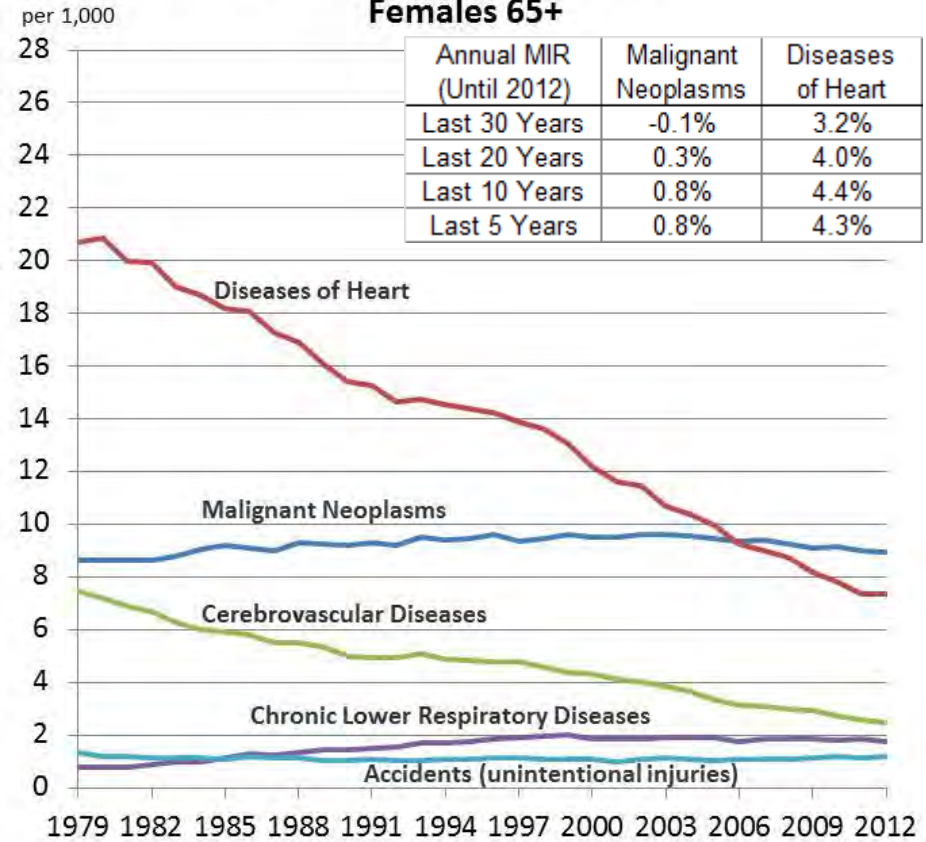
Mortality Rate by Cause

Males 65+



Mortality Rate by Cause

Females 65+

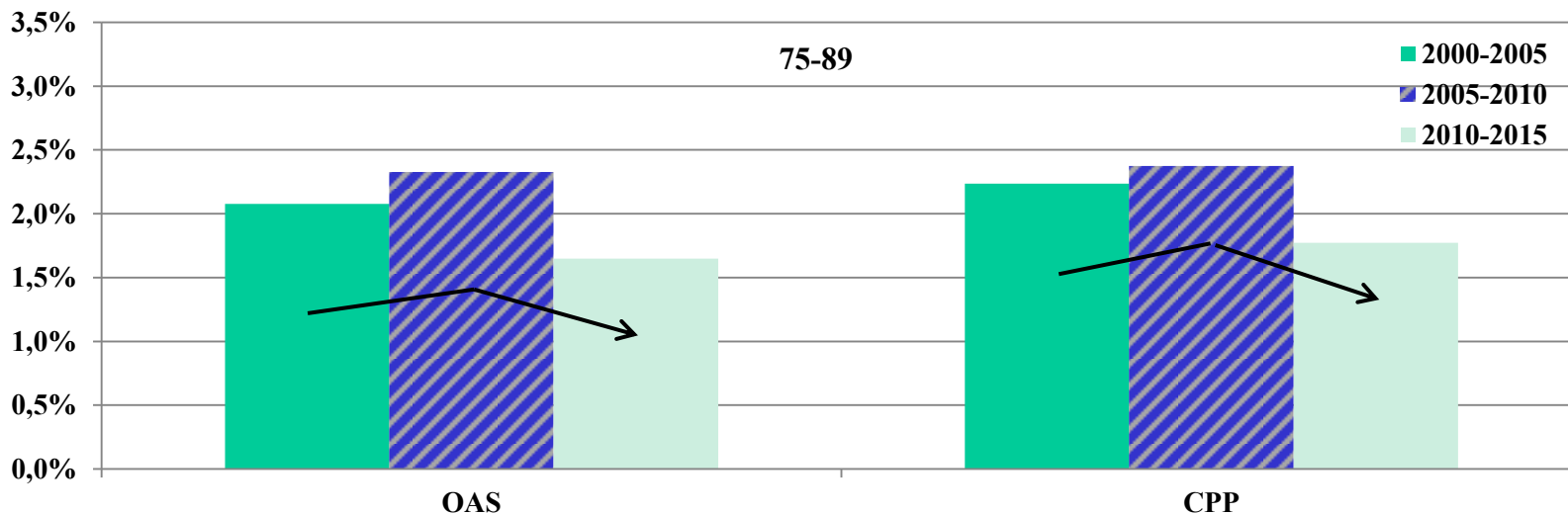
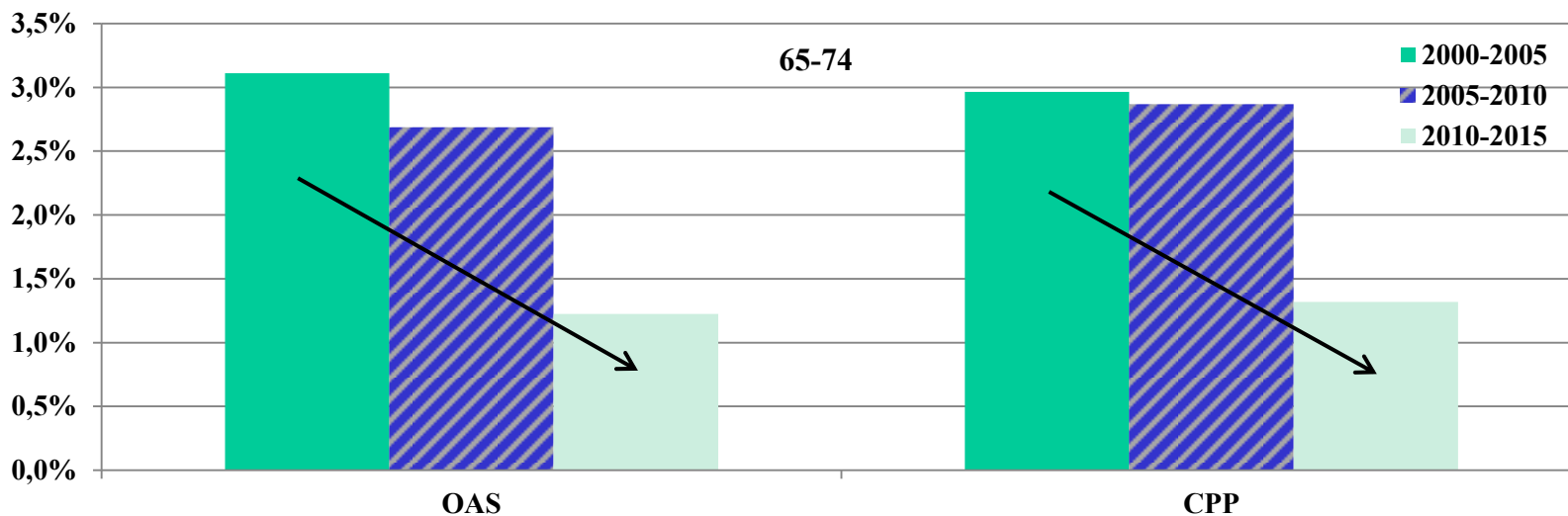


Source: Data from Statistics Canada, Canadian Vital Statistics and OCA Calculations
Standardized Using 2011 Canadian Population

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CPP-OAS Average Annual Mortality Improvement Rates (males)



The ultimate mortality improvement rates are sometimes based on historical averages

Average Historical MIR (%) 1921-2011, Canada

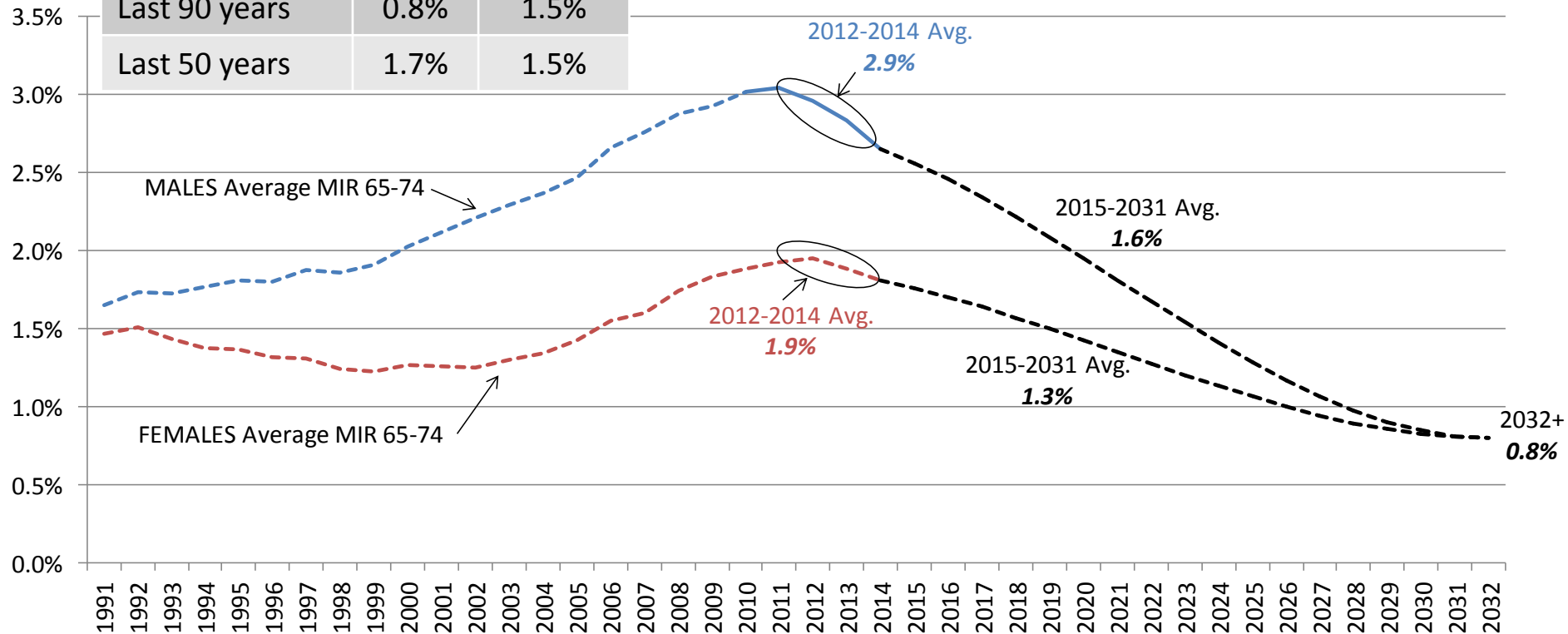
Age Group	Male	Female	Both
65-74	0.8	1.5	1.2
75-84	0.7	1.2	1.0
85-94	0.5	0.8	0.7
95-99	0.2	0.4	0.3
65+	0.7	1.1	0.9
85+	0.4	0.7	0.6



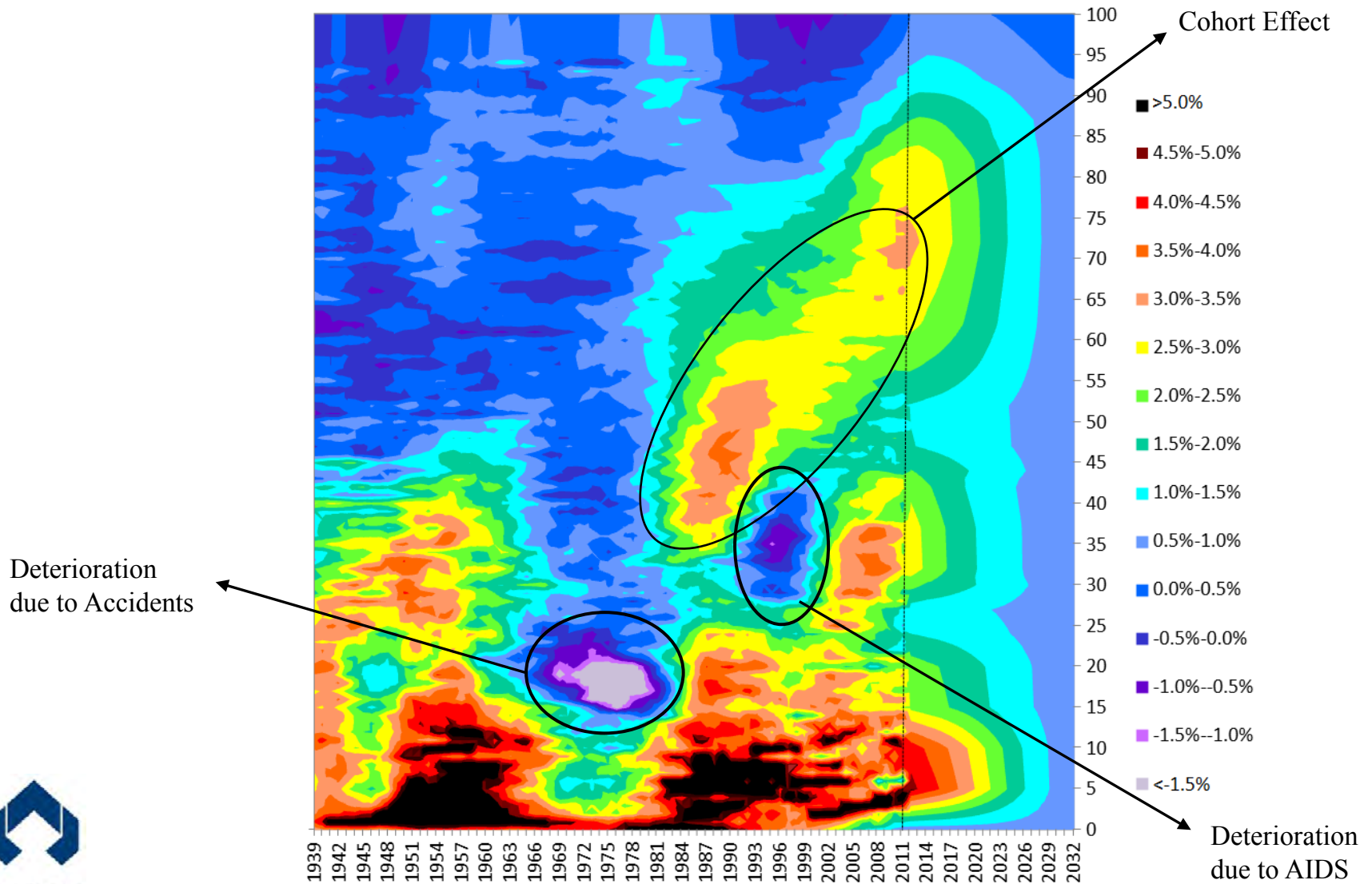
Estimates of MIRs for ages 65+ for 2012-2014 incorporate OAS experience

CPP27 Assumed Annual Mortality Improvement Rates for Canada (65-74)

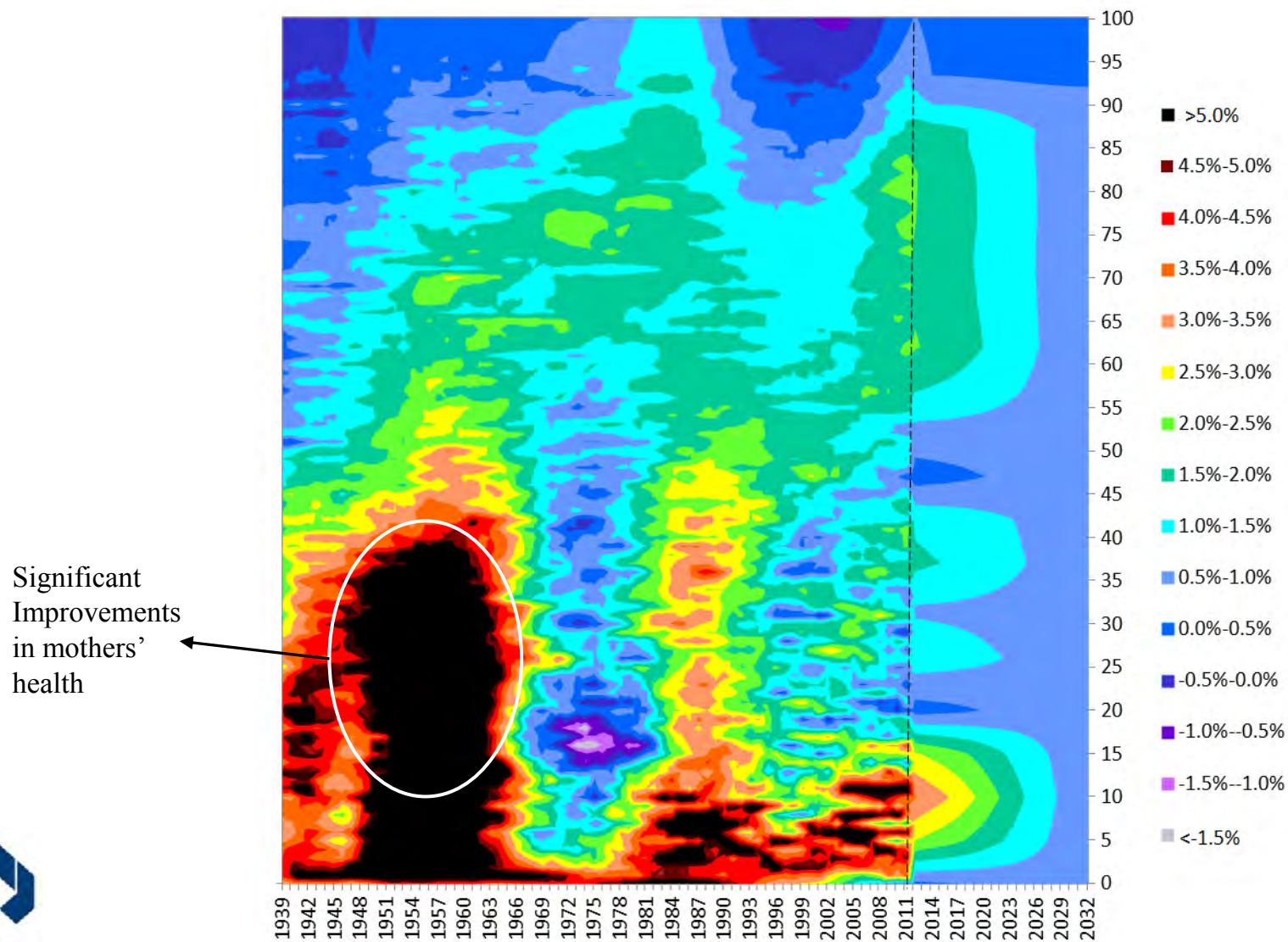
Average MIR	Males	Females
Last 90 years	0.8%	1.5%
Last 50 years	1.7%	1.5%



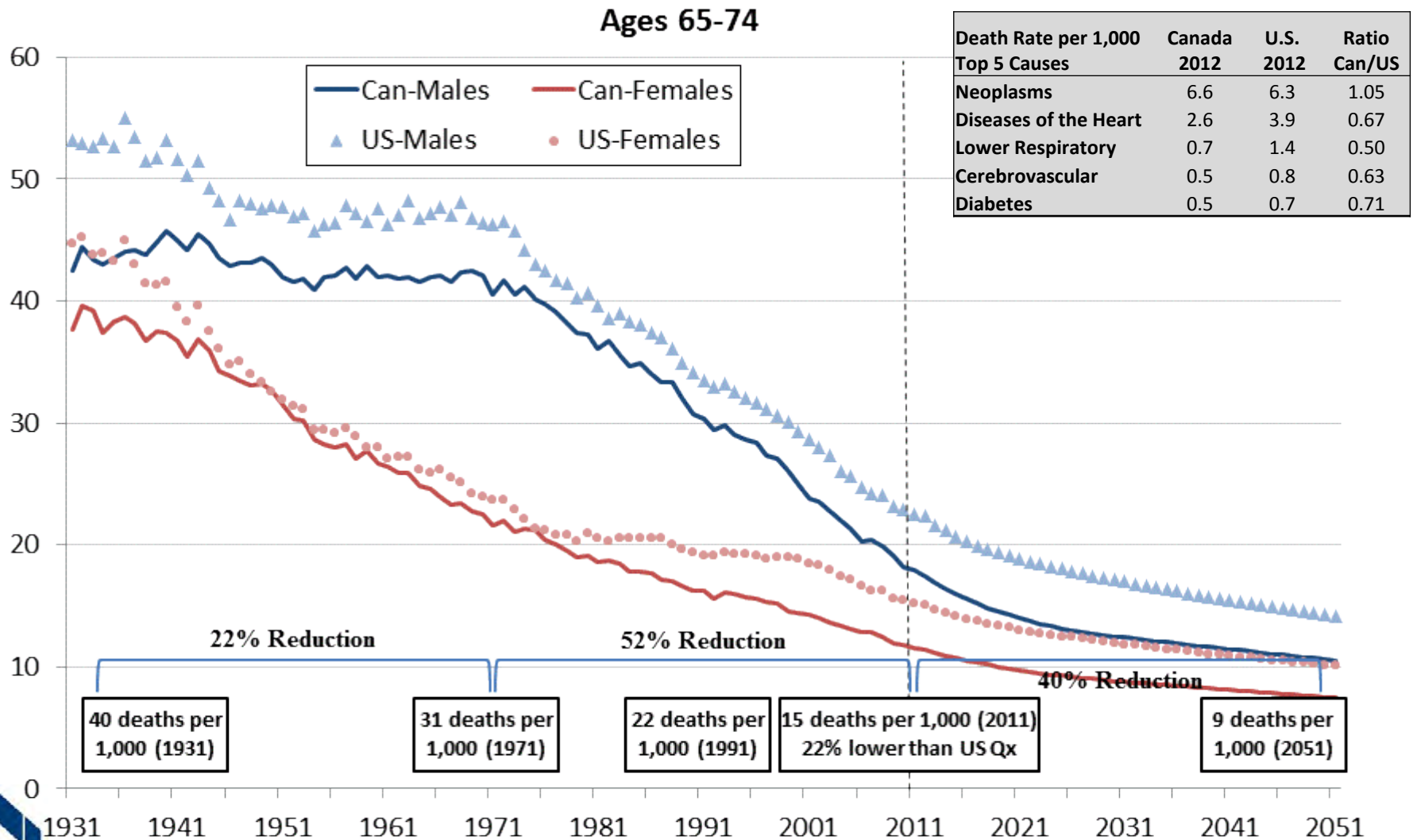
Males Mortality Improvement Rates 15-year Average



Females Mortality Improvement Rates 15-year Average



For ages 65 to 74, 7 deaths per 1,000 are from cancer, while only 3 deaths per 1,000 are from heart diseases



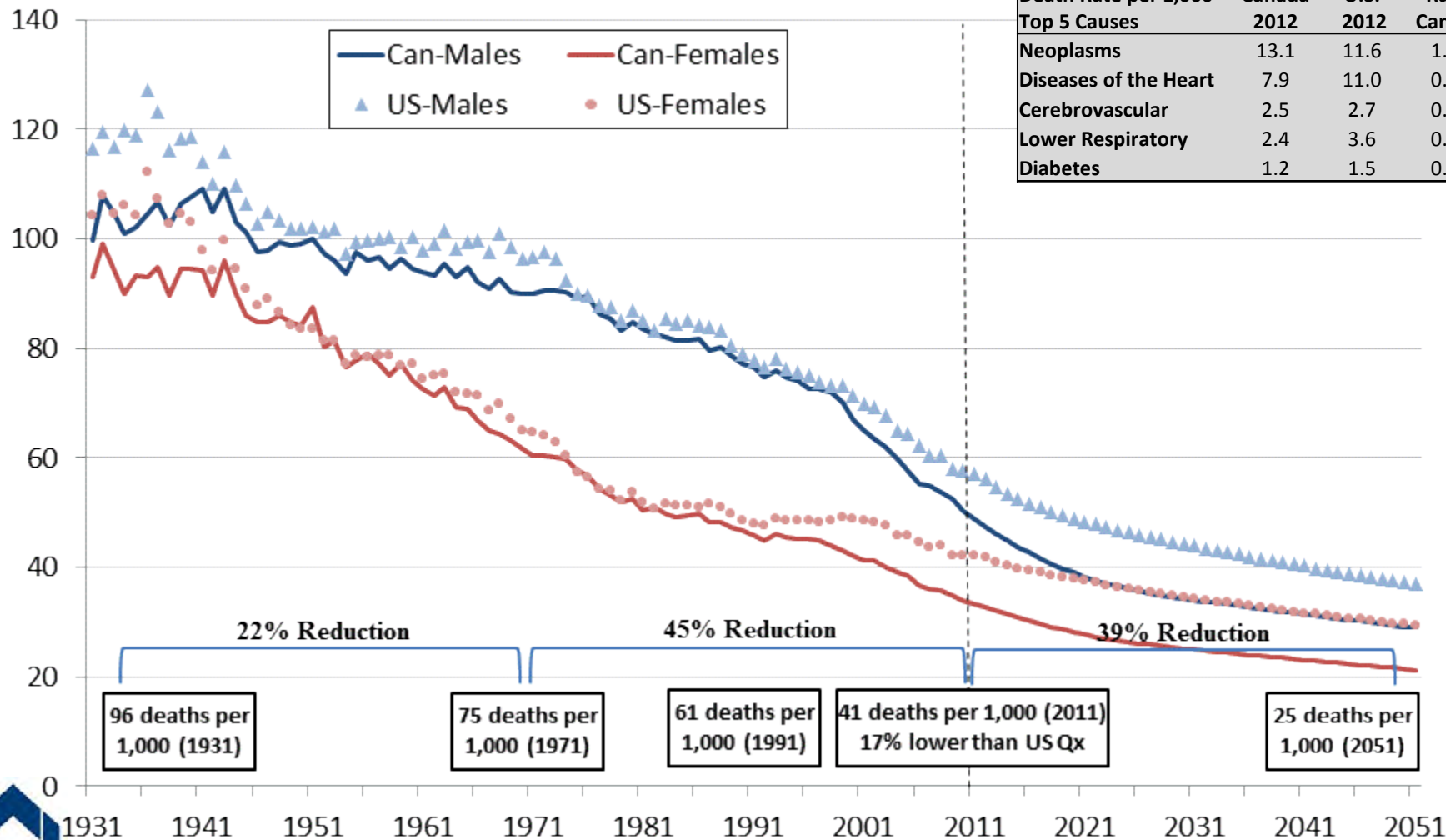
Canada: Office of the Chief Actuary, 27th CPP Actuarial Report and Statistics Canada catalogue 84-215-x

U.S.: 2015 OASDI Trustees Report and National Vital Statistics Report, Volume 63 No.9

All rates are standardized using 2015 Canadian population.

Male mortality rates for ages 75 to 84 for Canada are projected to become similar to US female mortality rates

Ages 75-84



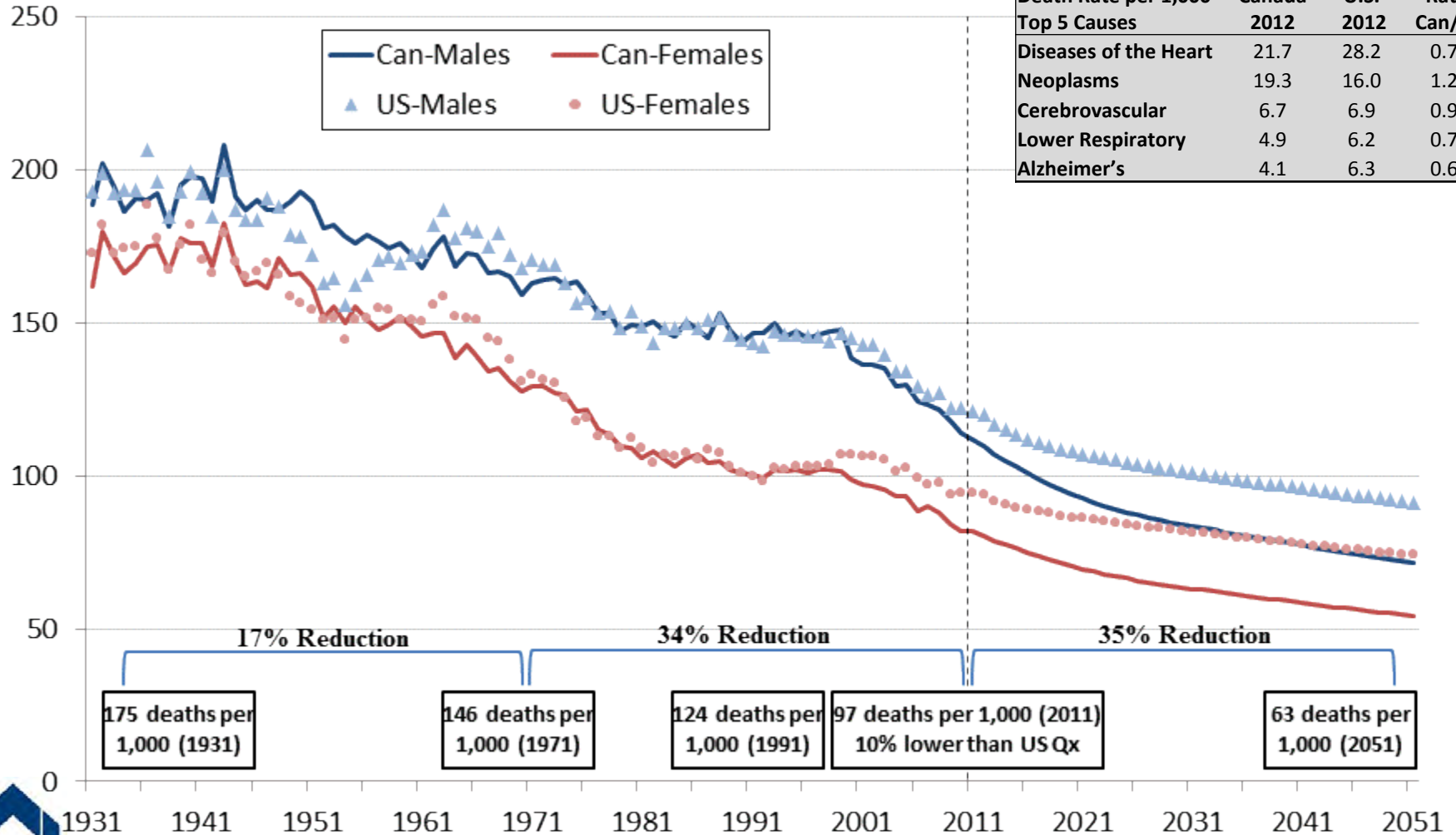
Canada: Office of the Chief Actuary, 27th CPP Actuarial Report and Statistics Canada catalogue 84-215-x

U.S.: 2015 OASDI Trustees Report and National Vital Statistics Report, Volume 63 No.9

All rates are standardized using 2015 Canadian population.

Elderly mortality has decreased over the last 80 years, more so over the last 10 years

Ages 85-89



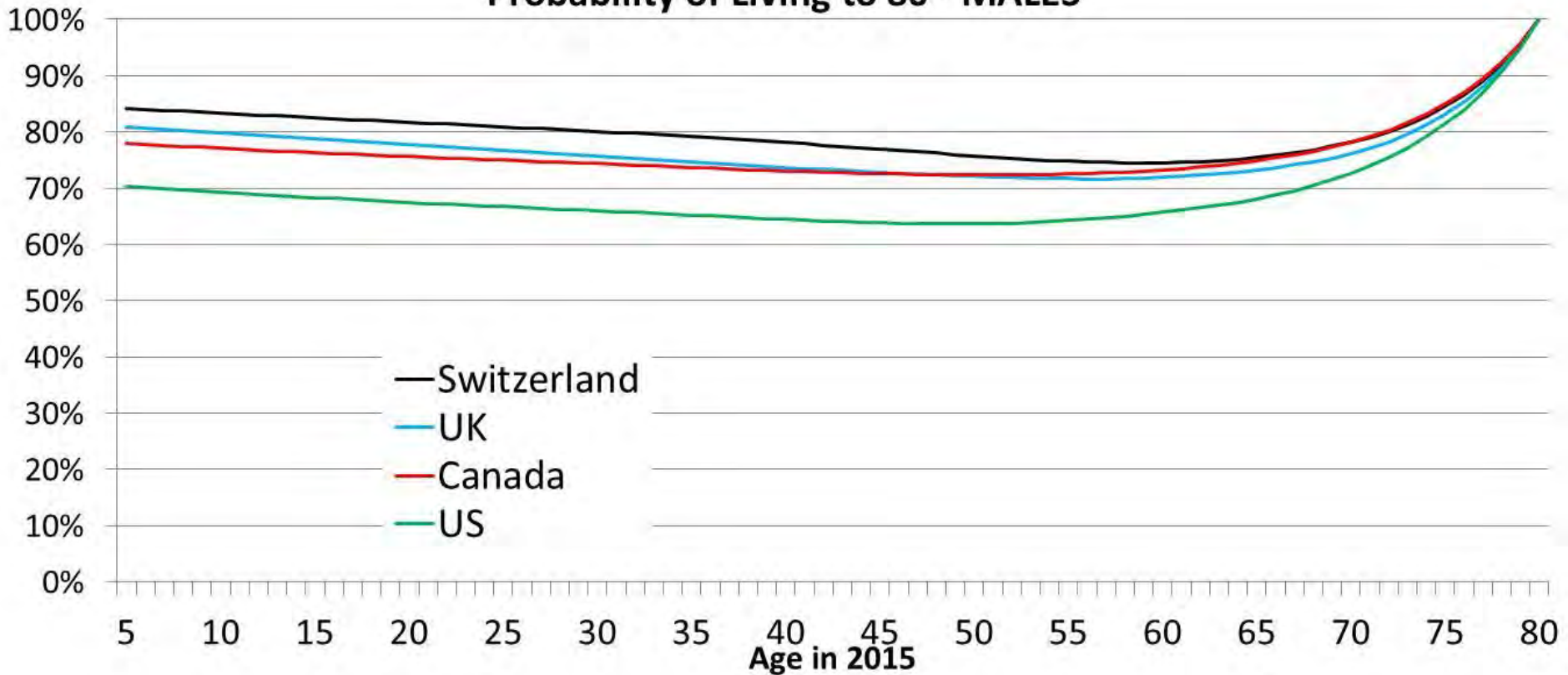
Canada: Office of the Chief Actuary, 27th CPP Actuarial Report and Statistics Canada catalogue 84-215-x

U.S.: 2015 OASDI Trustees Report and National Vital Statistics Report, Volume 63 No.9

All rates are standardized using 2015 Canadian population.

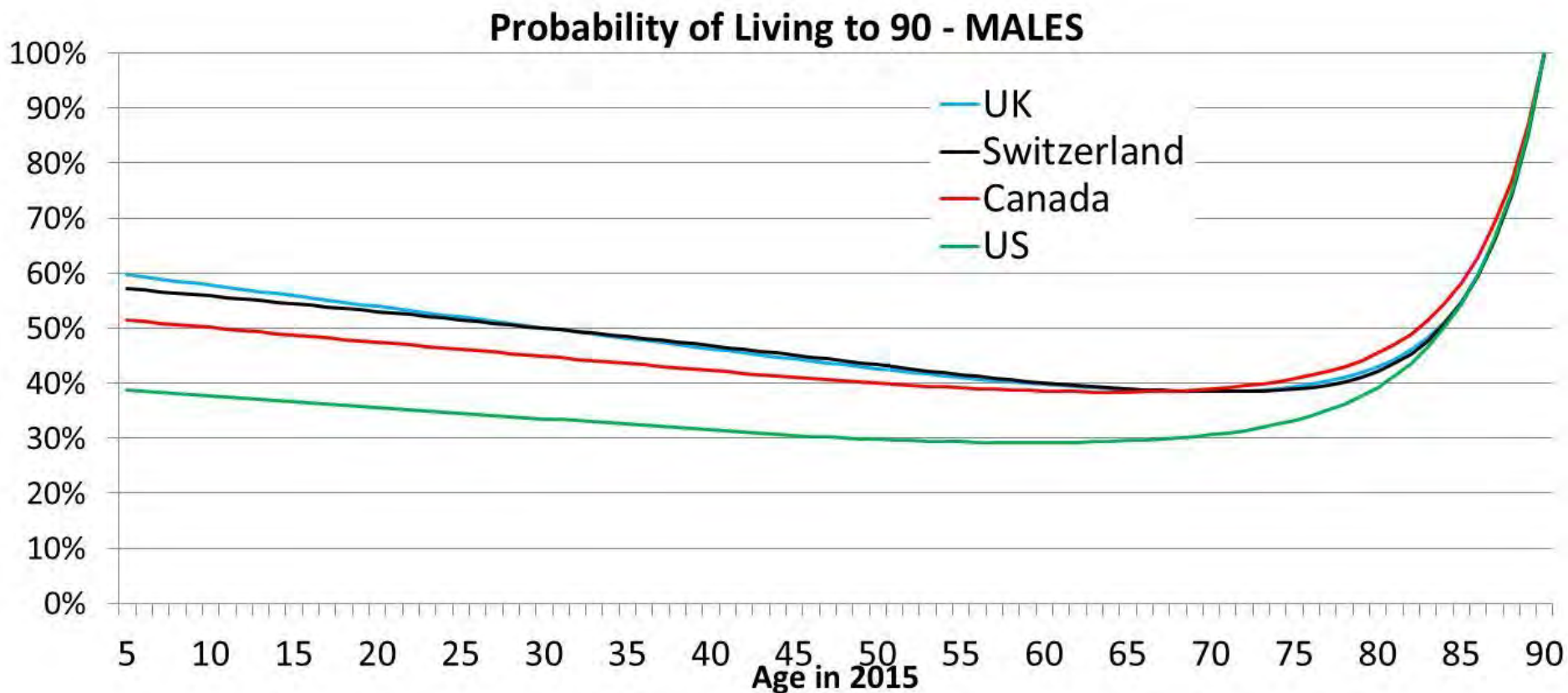
Three-quarters of Canadian men aged 20 today are expected to live to age 80 (82% of women)

Probability of Living to 80 - MALES



Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report, 2015 OASDI Trustees Report

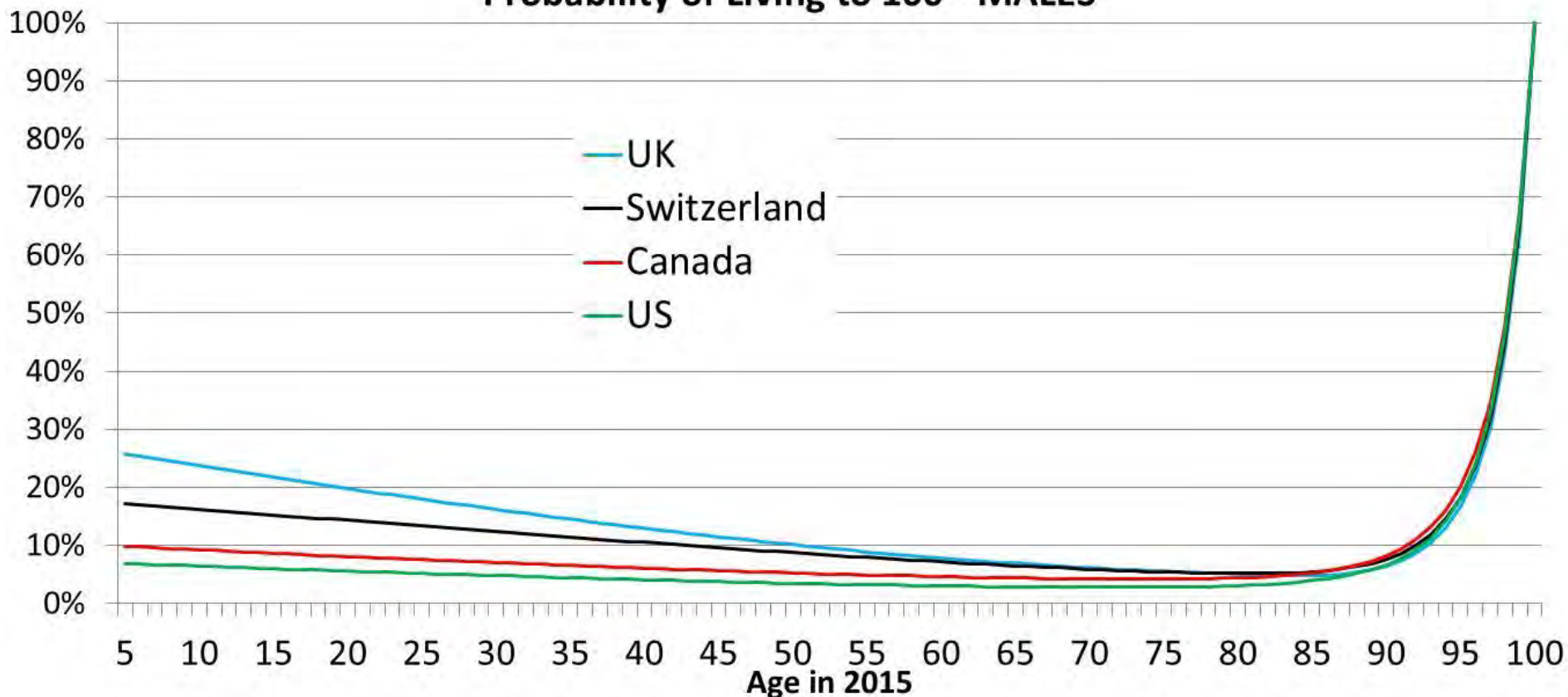
Near half of Canadian men aged 20 today are expected to live to age 90 (58% of women)



Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report, 2015 OASDI Trustees Report

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

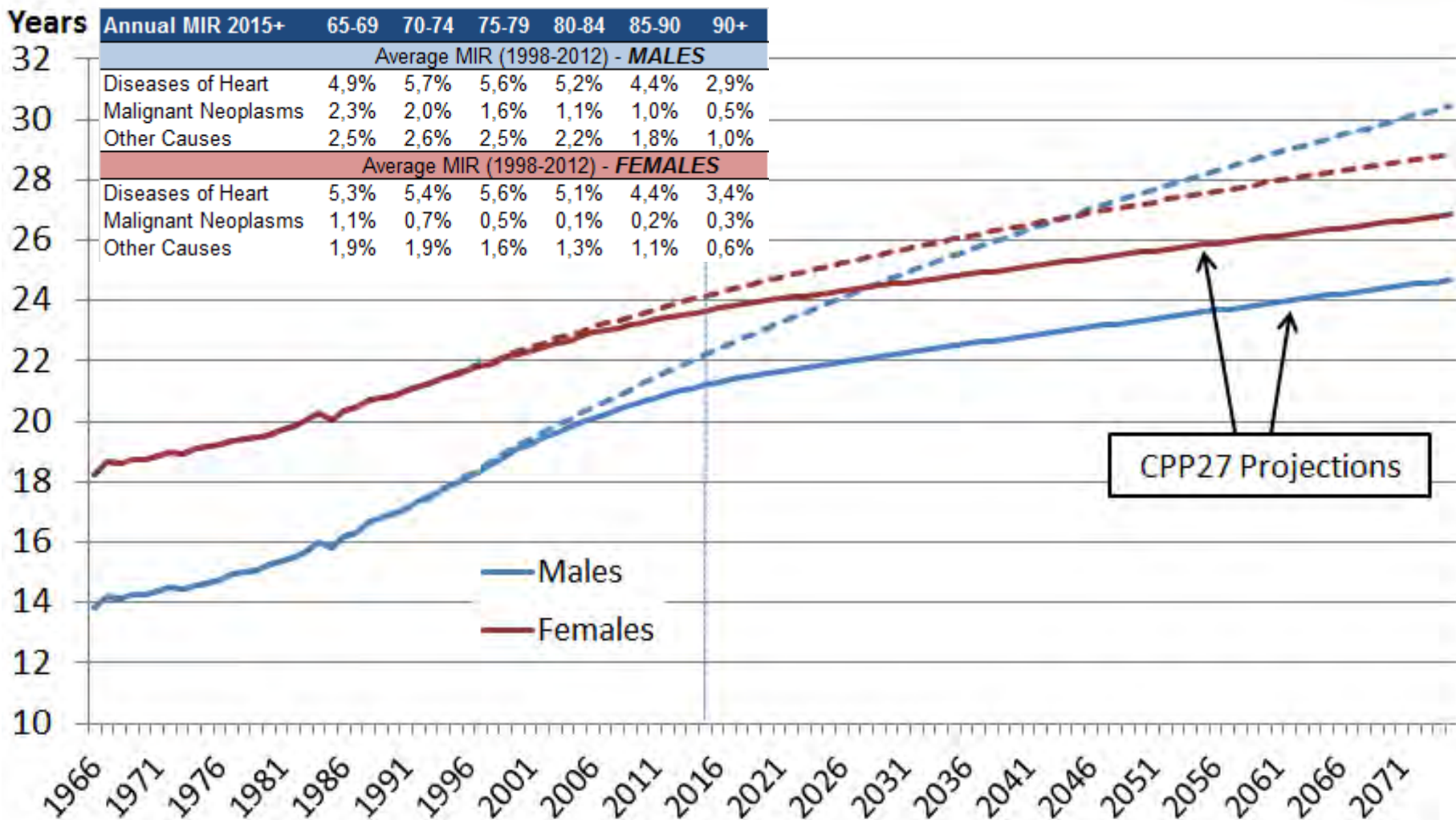
Probability of Living to 100 - MALES



Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report, 2015 OASDI Trustees Report

Uncertainty of Results

Life Expectancies at age 65 if MIRs by cause are sustained

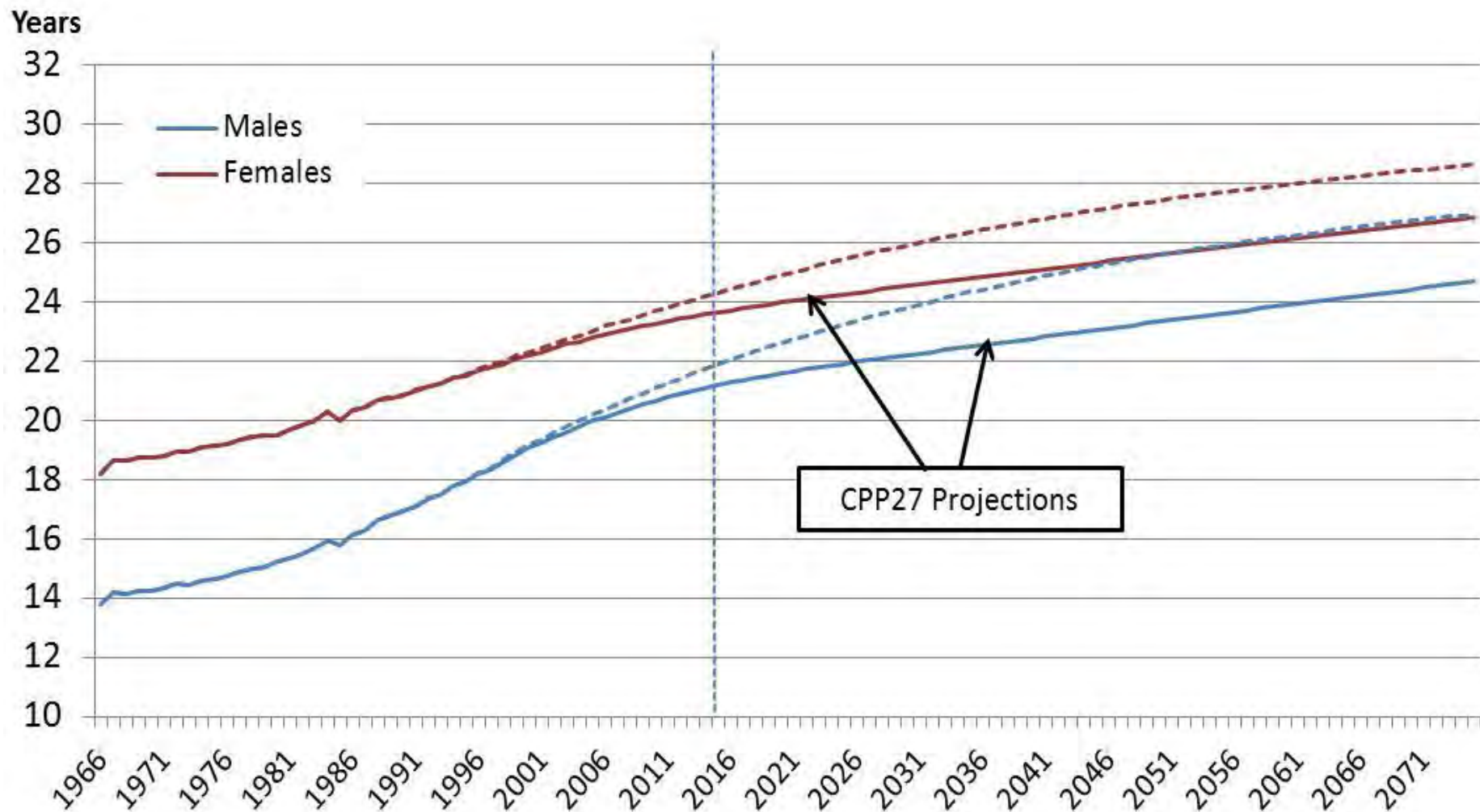


Source for MIR by cause of death: Statistics Canada, Office of the Chief Actuary calculations

Source for projections: 27th CPP Actuarial Report

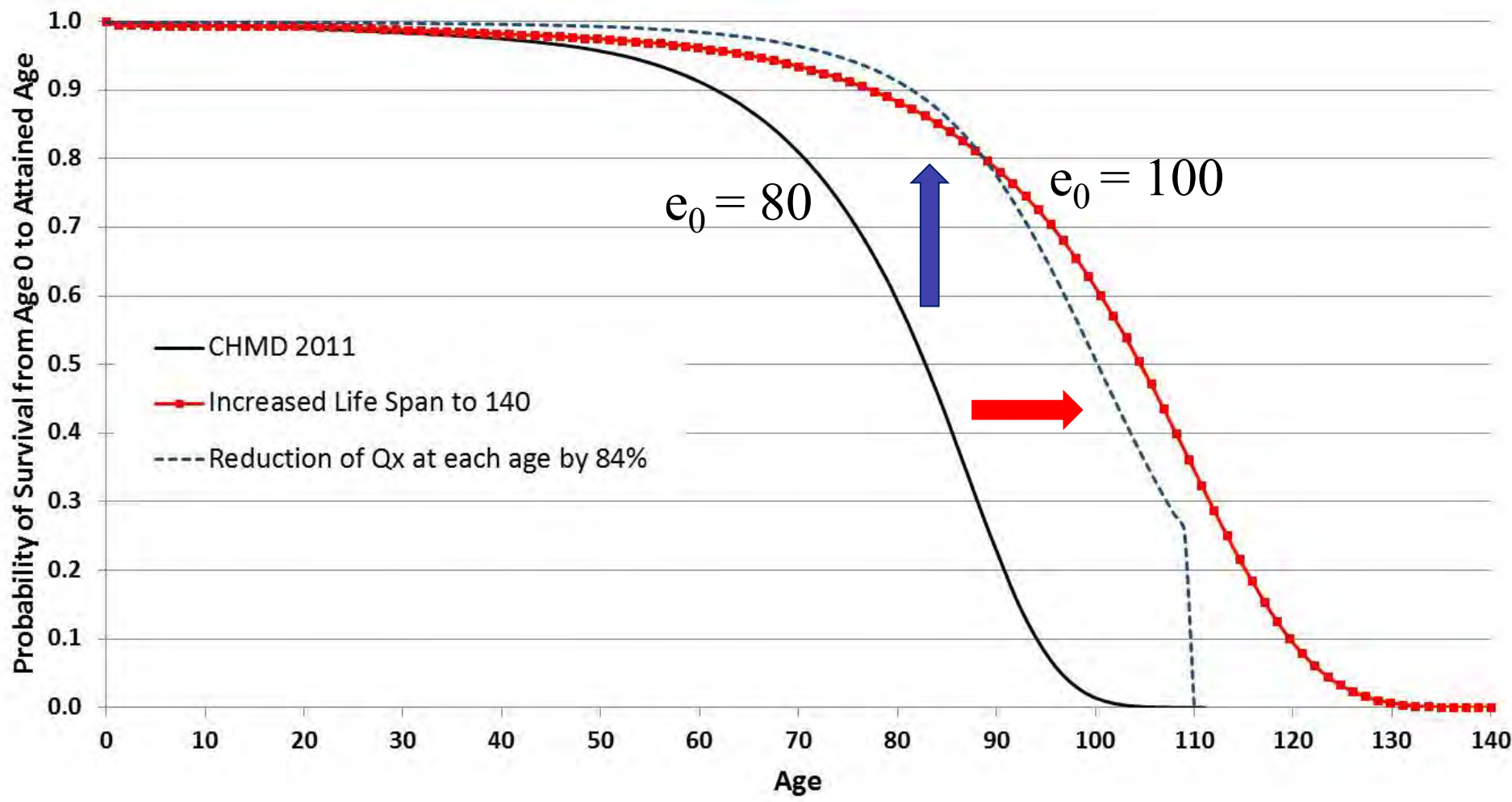
Uncertainty of Results

Life Expectancies at age 65 if mortality from cancer is wiped out



Source for MIR by cause of death: Statistics Canada, Office of the Chief Actuary calculations
Source for projections: 27th CPP Actuarial Report

Survival Curves for a Life Expectancy of 100 (Males)



To live beyond 100...

- A calendar year life expectancy at birth of **100** in 2011 is achievable if:
 - Q_x at each age are reduced by 84% for males (80% for females).
 - Q_x below age 97 are zero, followed by current Q_x from ages 97 to 120.
 - The maximum life span increases to 140 years for males (132 years for females) and mortality rates are changed accordingly.
- ✓ If Q_x at each age decrease at the same pace as observed over the past 15 years, a calendar year life expectancy of 100 at birth would be attained after 2200.
- ✓ If Q_x at each age decrease at twice the pace observed over the past 15 years, a calendar year life expectancy of 100 at birth would be attained in about a century.



So, what is the impact of living longer on the CPP?

	Cohort Life Expectancy at Age 65 in 2050		Minimum Contribution Rate
	MALES	FEMALES	
Best-Estimate	23.3	25.6	9.79%
Low Cost Scenario	20.9	23.2	9.46%
High Cost Scenario	25.8	27.9	10.10%
<i>If no mortality improvements at all after 2011</i>			8.99%



Source: 27th CPP Actuarial Report as at 31 December 2015

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Conclusion

- It is projected that 69% of increase in life expectancy at birth for men (76% for women) will come from the reduction of mortality rates past age 65.
- Projected mortality rates are highly uncertain, especially for people older than age 90.
- Despite increased longevity of Canadian population, the CPP is expected to be sustainable over the long term based on the most recent Actuarial Report tabled before Parliament on Sept. 27, 2016.





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Thank you

Questions?

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Appendix

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Future drivers of mortality are not easy to quantify

“Easy” gains have been somewhat achieved:

- Previous improvement in heart disease mortality will be tough to duplicate
- Favorable effects of decreasing smoking prevalence should continue for awhile but will diminish in 20-30 years.

Other factors: obesity, income inequality, aging, marital status

Future drivers of mortality could be:

FAVORABLE

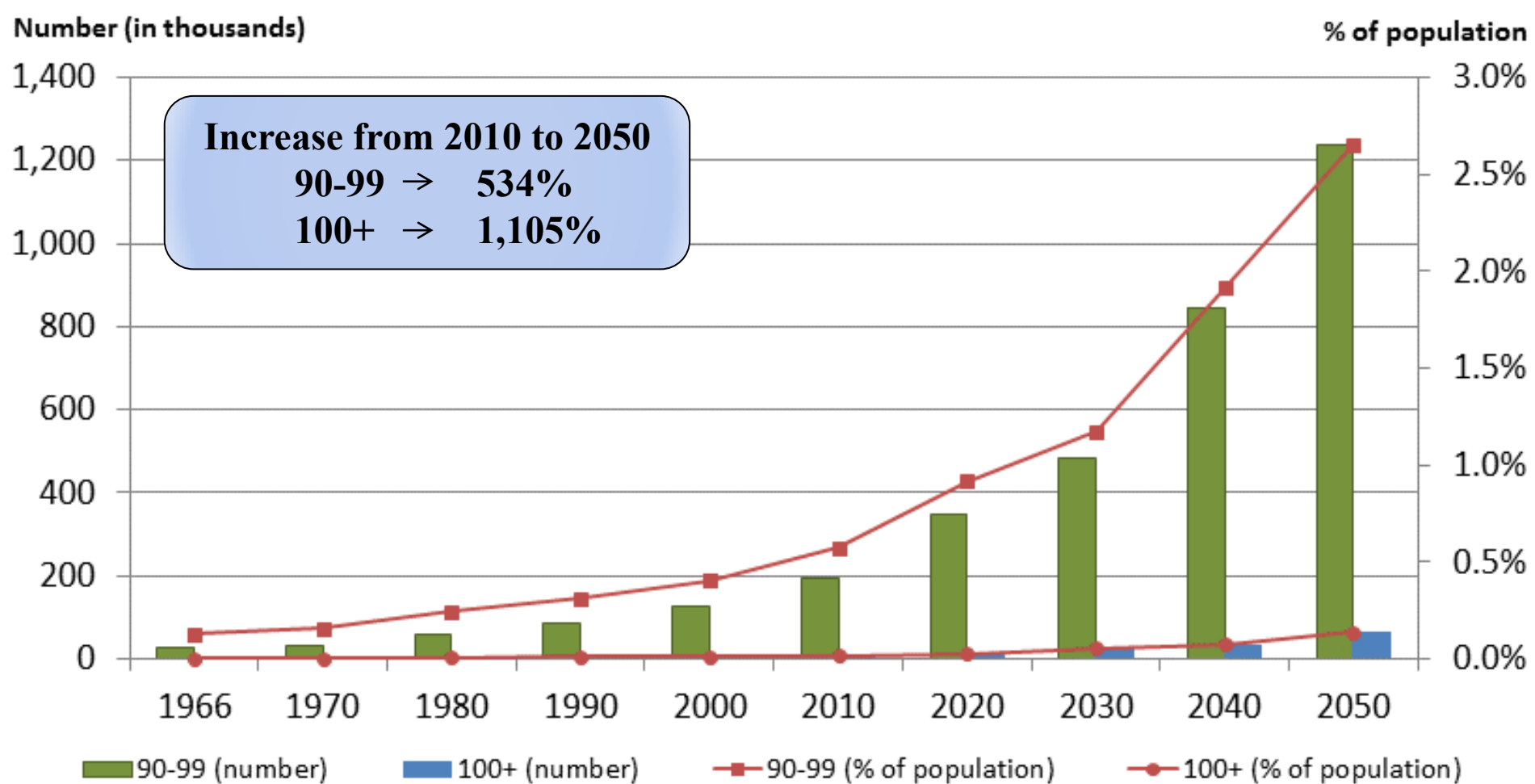
- ✓ Enhanced medical treatment
- ✓ Pharmaceuticals
- ✓ Technology Breakthroughs
- ✓ Self-driving cars

UNFAVORABLE

- ✓ Pandemics
- ✓ Increasing drug resistance
- ✓ Natural and man-made disasters (increasing with future climate change)



The number of people aged 90 and over increases dramatically



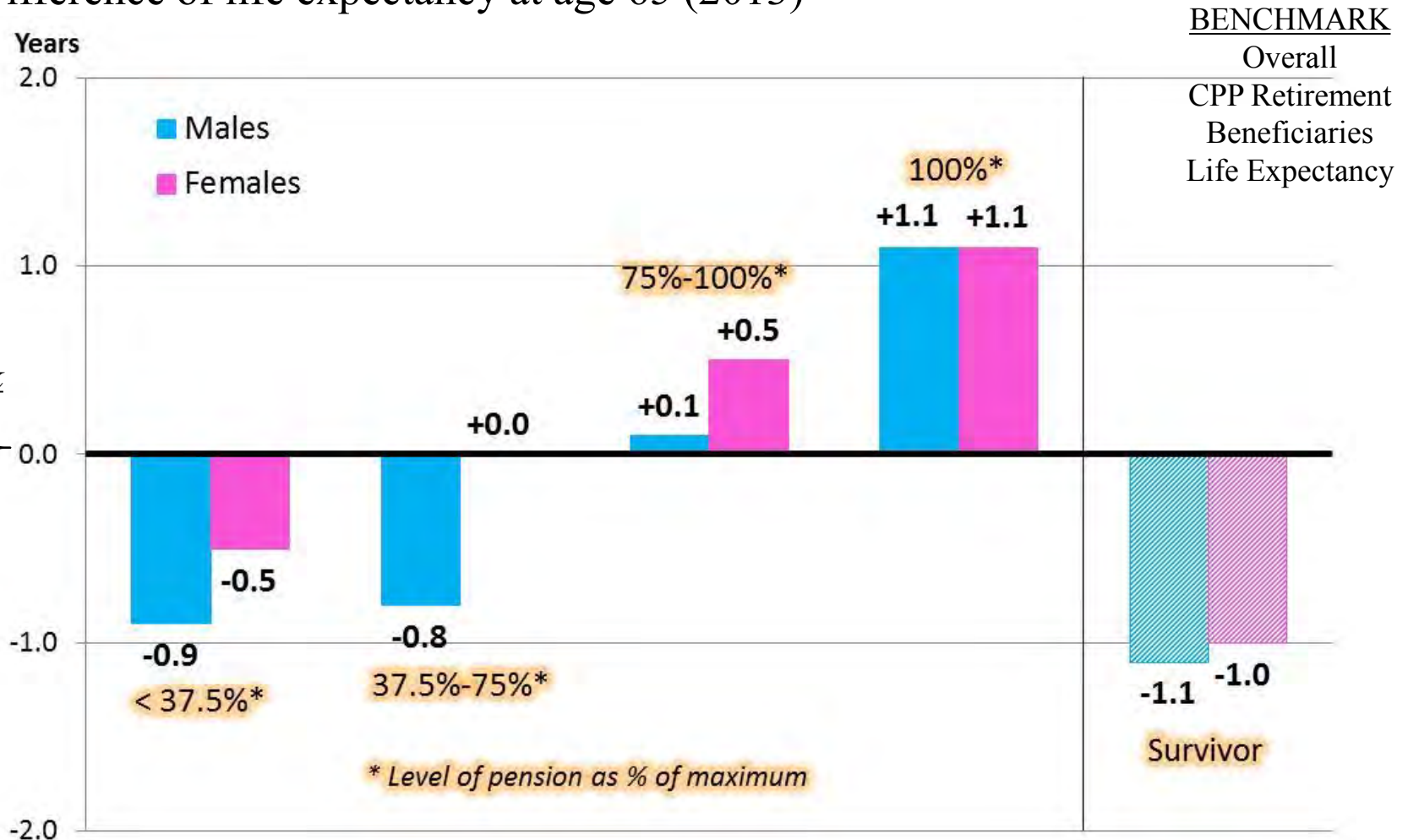
Source for projections: 27th CPP Actuarial Report

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Life expectancy is impacted by level of income

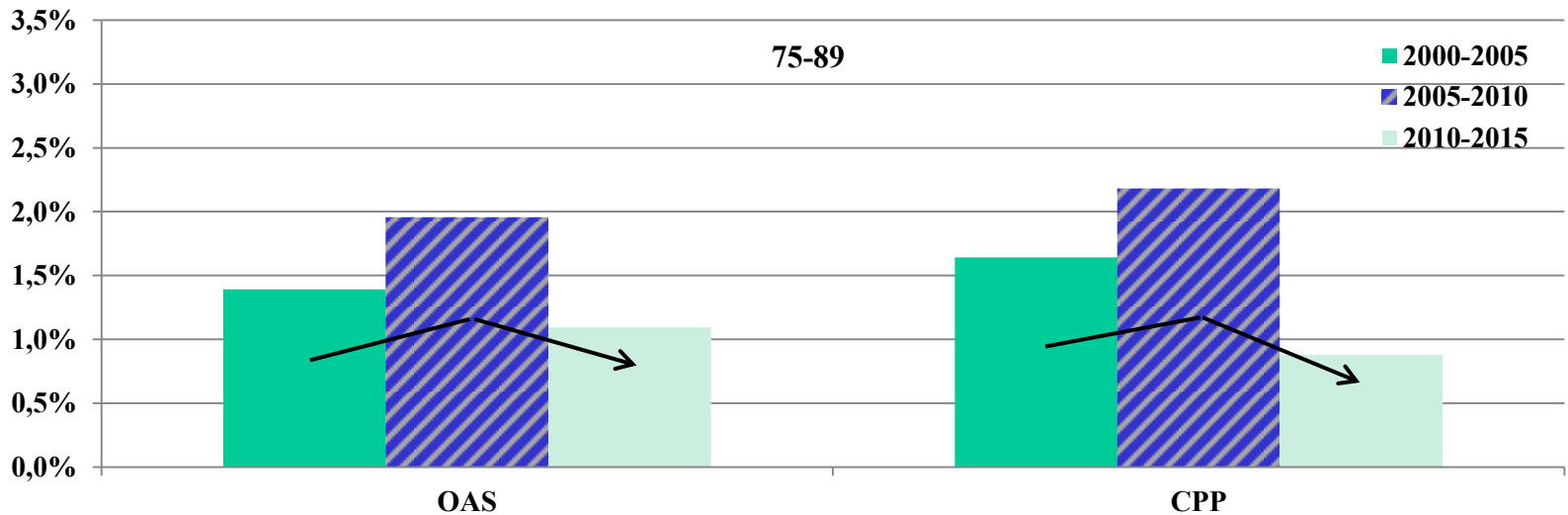
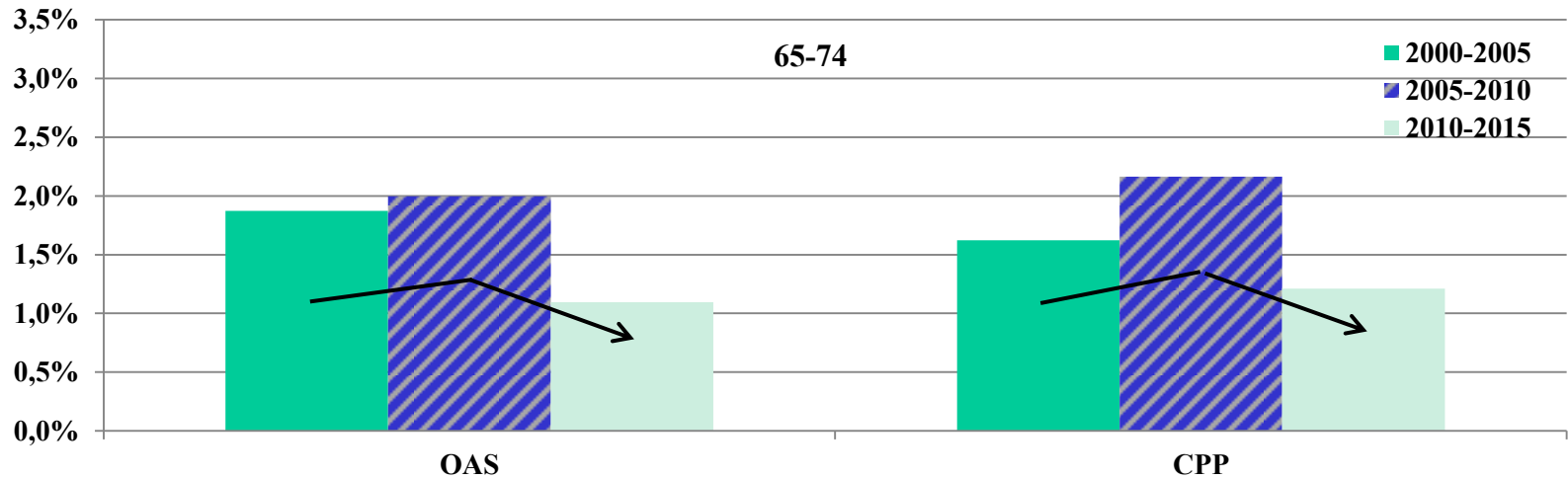
Difference of life expectancy at age 65 (2013)



Source: Office of the Chief Actuary, Actuarial Study No. 16: Canada Pension Plan Retirement, Survivor and Disability Beneficiaries Mortality Study, June 2015

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CPP-OAS Average Annual Mortality Improvement Rates (females)

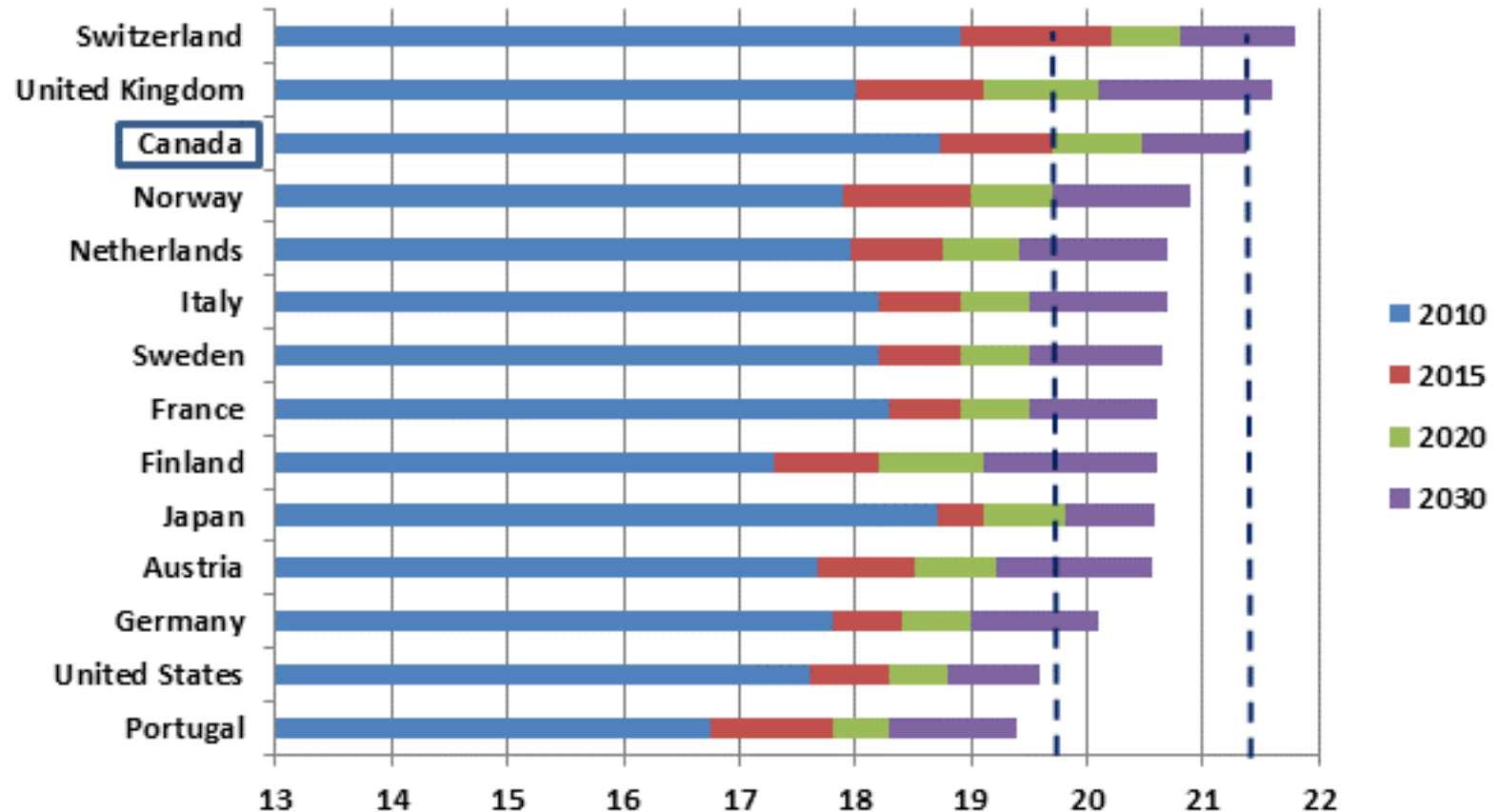


Source: Office of the Chief Actuary calculations.



International Comparisons - Males

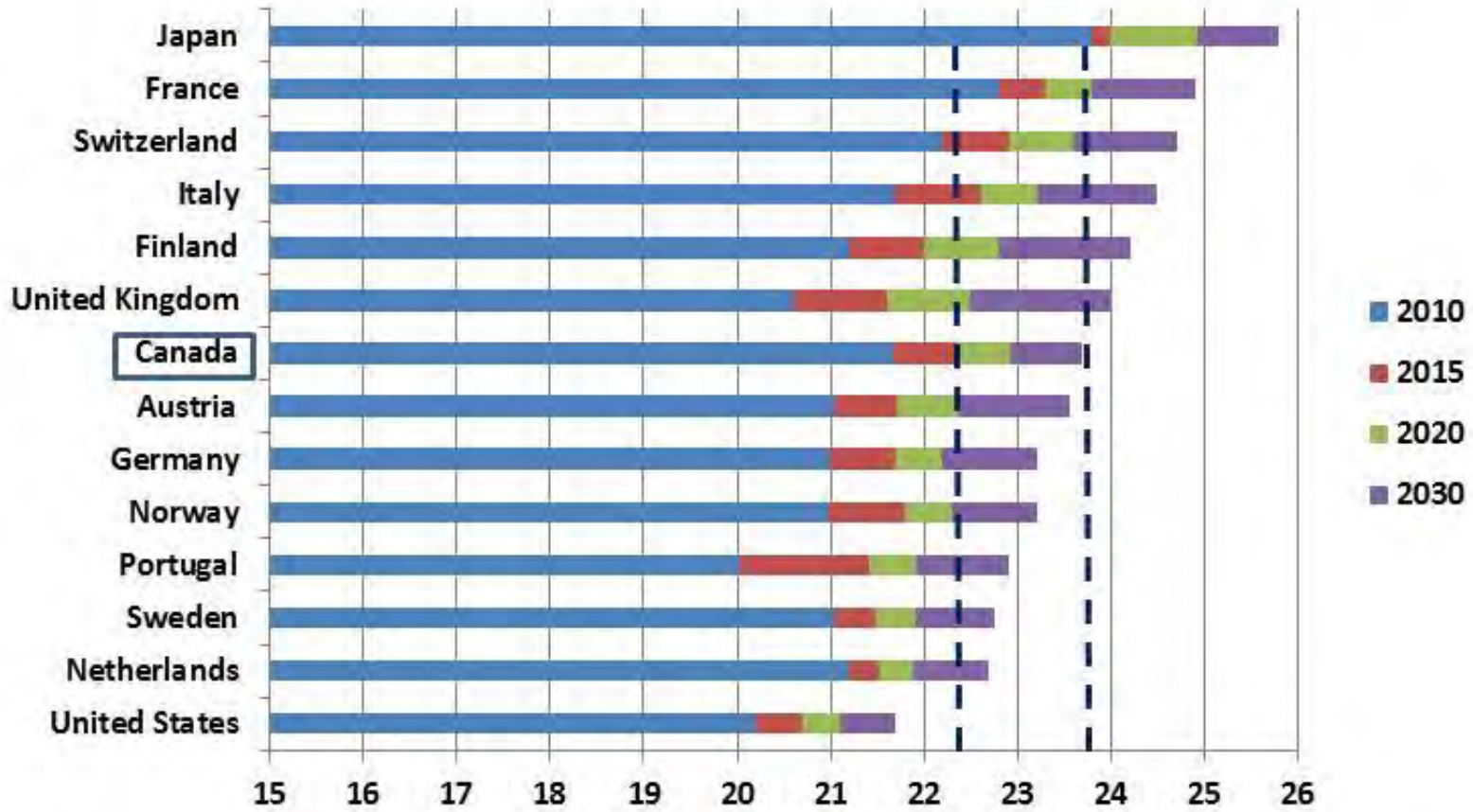
Projected period life expectancy at age 65 - males



Source: 18th International Conference of Social Security Actuaries and Statisticians presentations and reports. Data for Canada are produced by the Office of the Chief Actuary, based on CPP27th preliminary assumptions. Data for Japan are from National Institute of Population and Social Security Research (Sept. 2013).

International Comparisons - Females

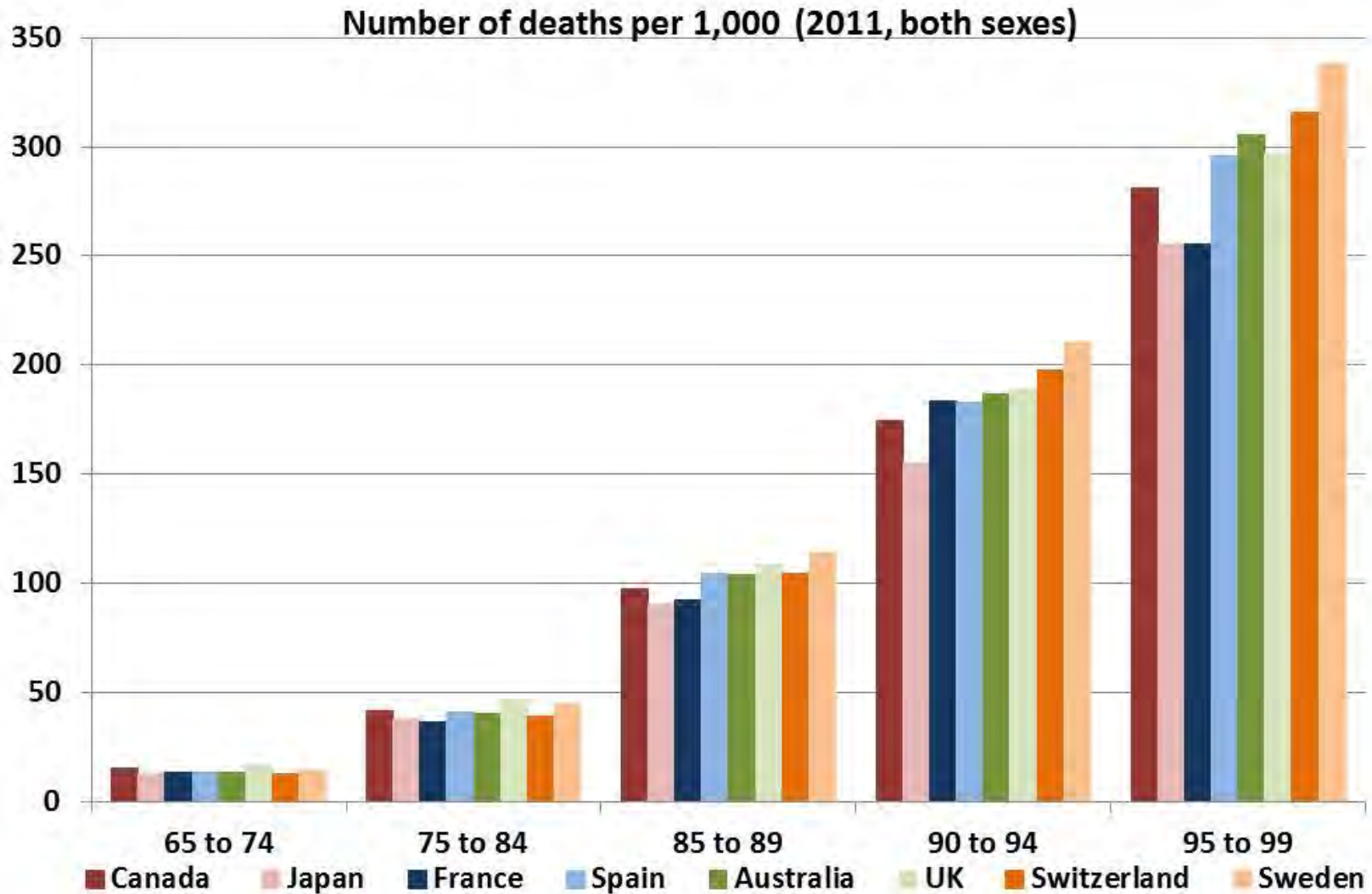
Projected period life expectancy at age 65 - females



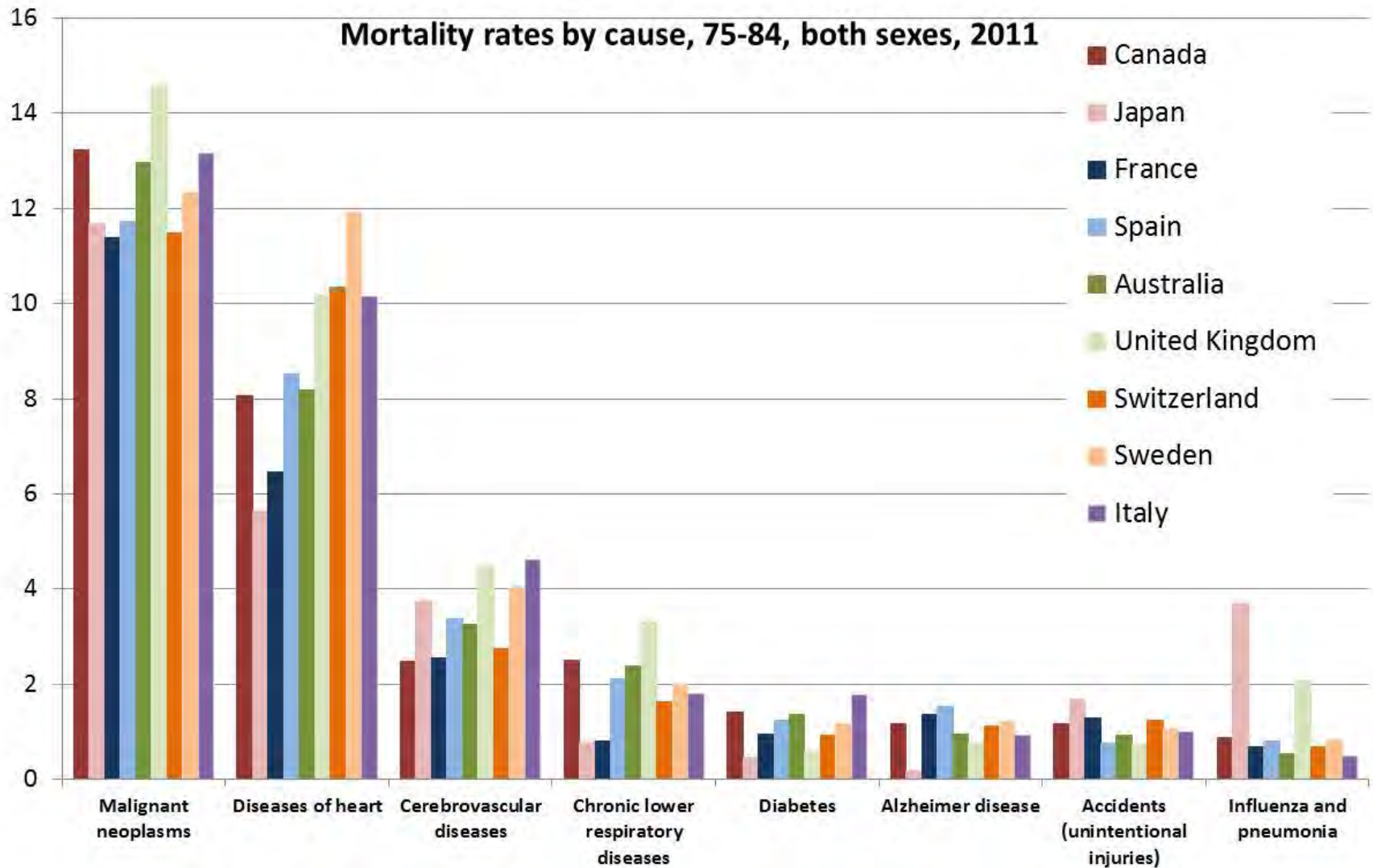
Source: 18th International Conference of Social Security Actuaries and Statisticians presentations and reports. Data for Canada are produced by the Office of the Chief Actuary, based on CPP27th preliminary assumptions. Data for Japan are from National Institute of Population and Social Security Research (Sept. 2013).



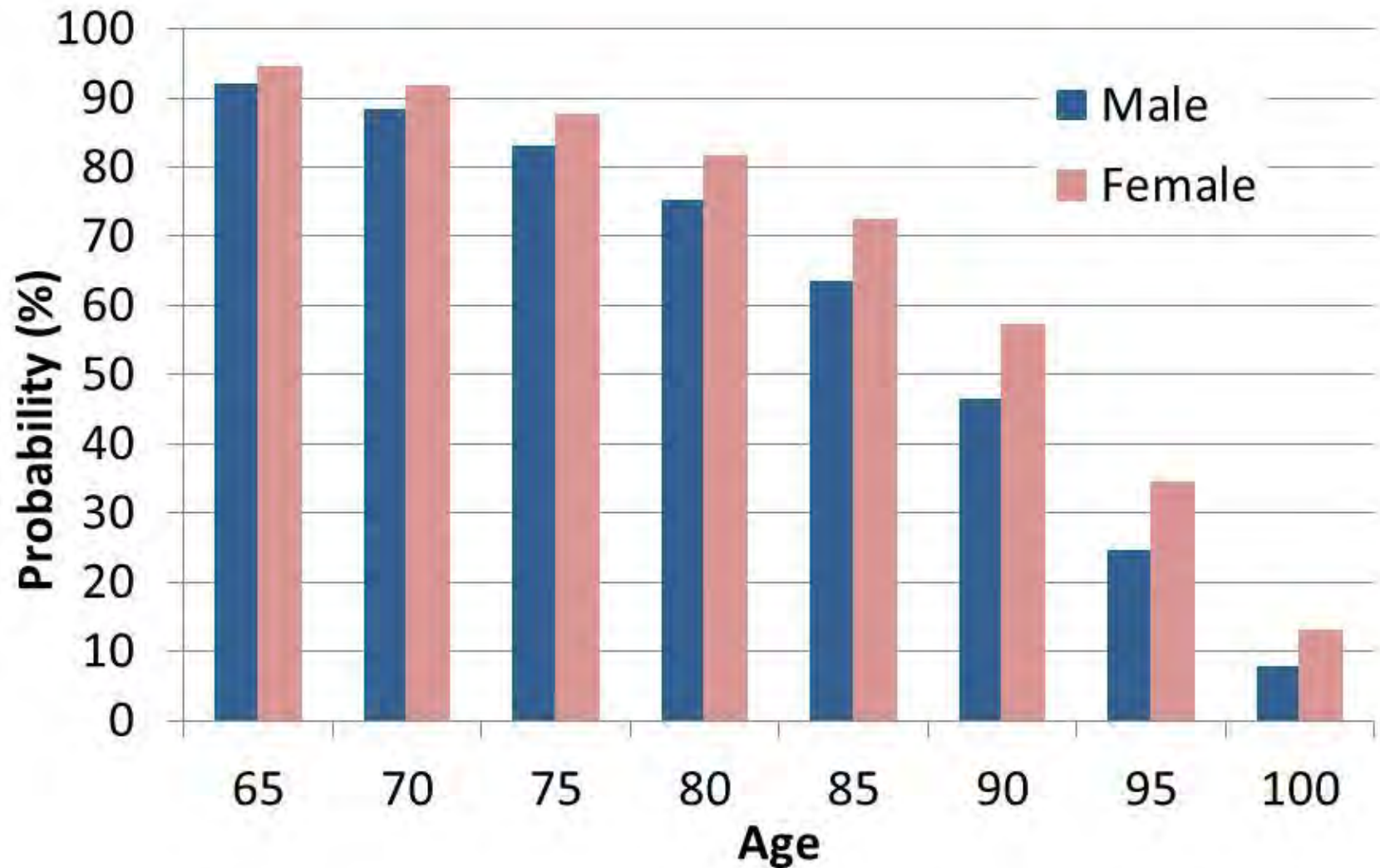
After age 85, Canada along with Japan and France has the lowest mortality rates



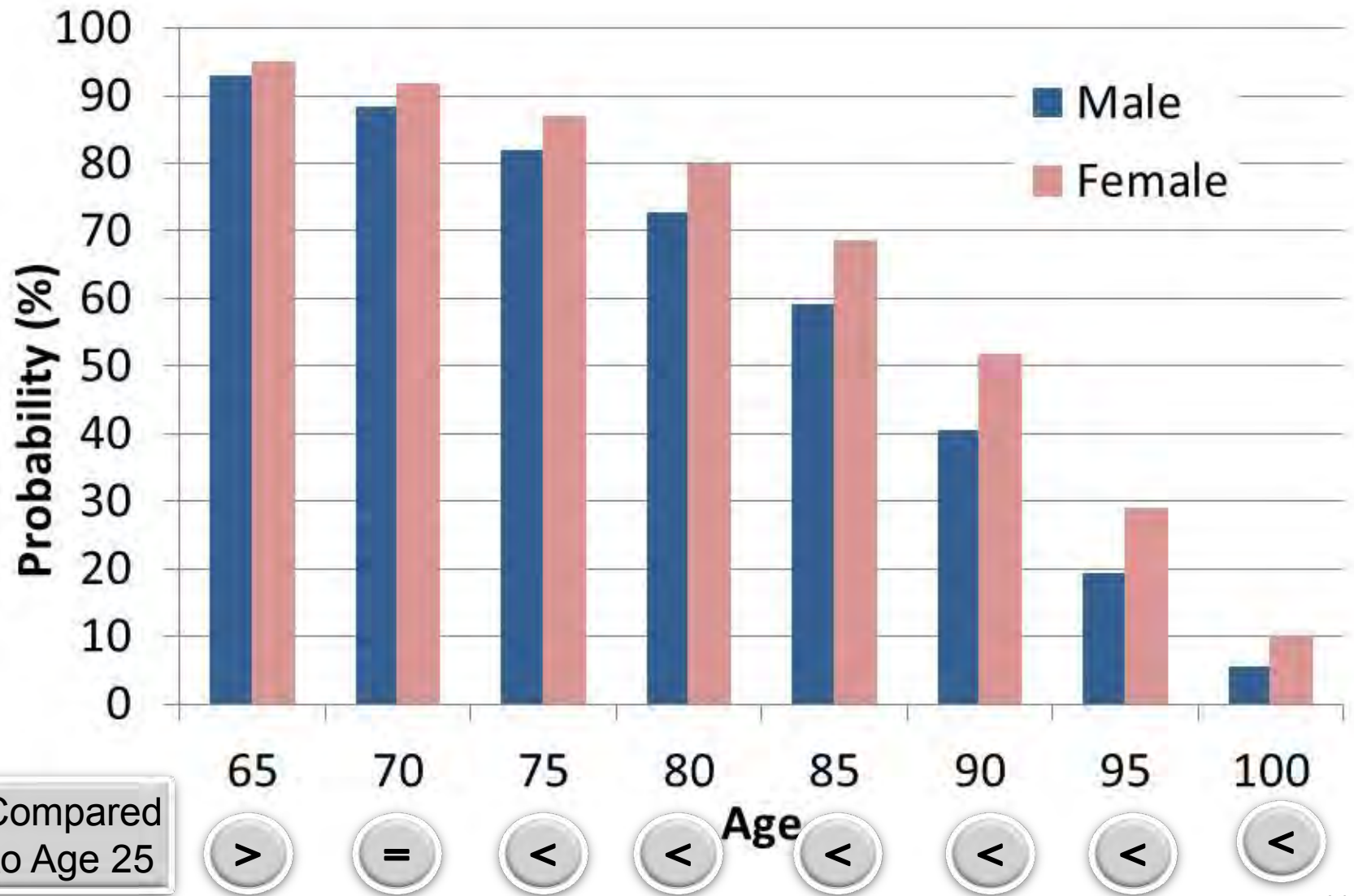
Mortality Rates by Cause



Probability of living to a certain age for men/women aged 25 today



Probability of living to a certain age for men/women aged 50 today



Compared to Age 25



Age



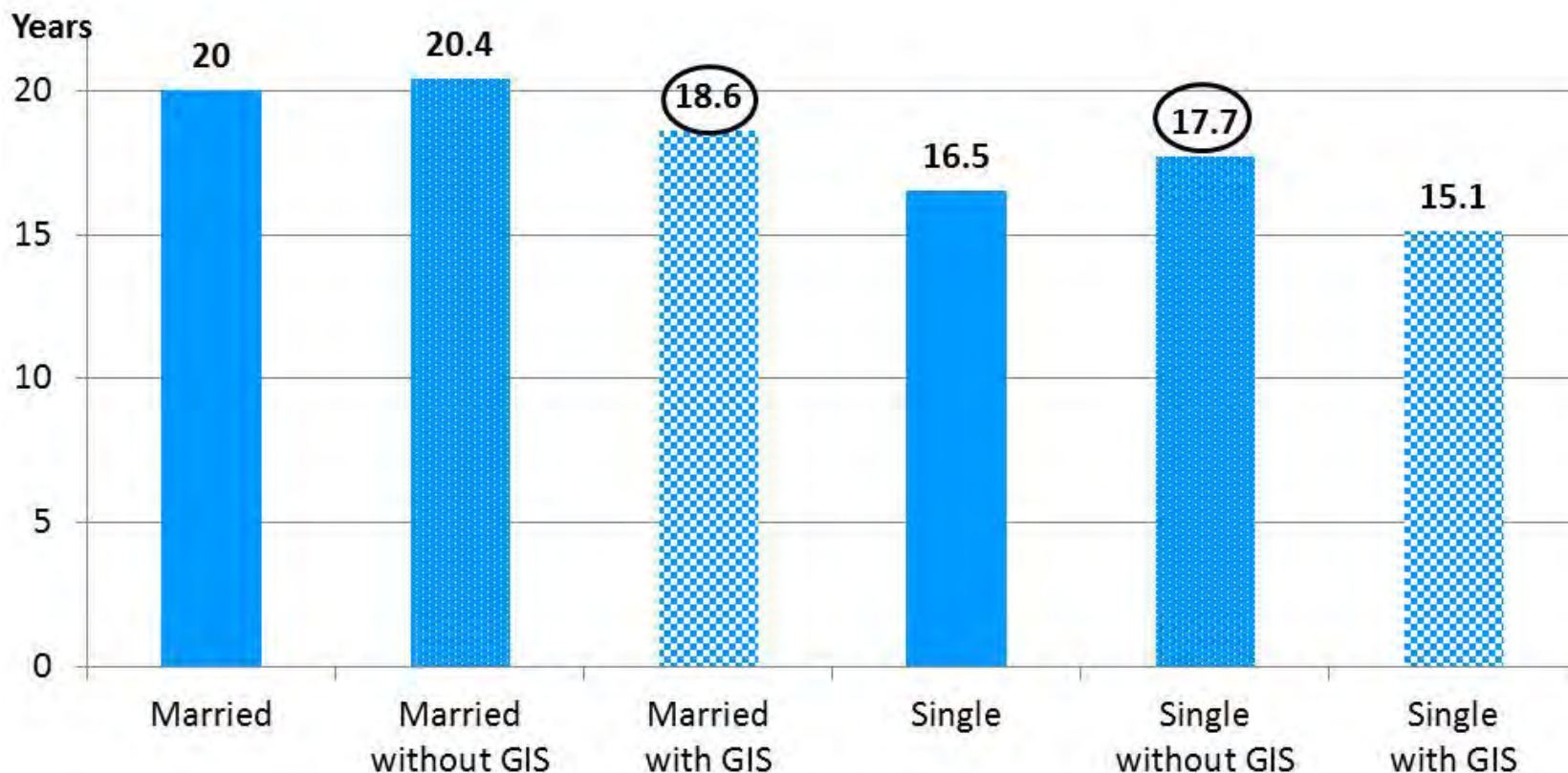
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Source: 27th CPP Actuarial Report

Marital Status has more Impact than Level of Income for Men

Life Expectancy at age 65 is **HIGHER** for Married with GIS than Single without GIS



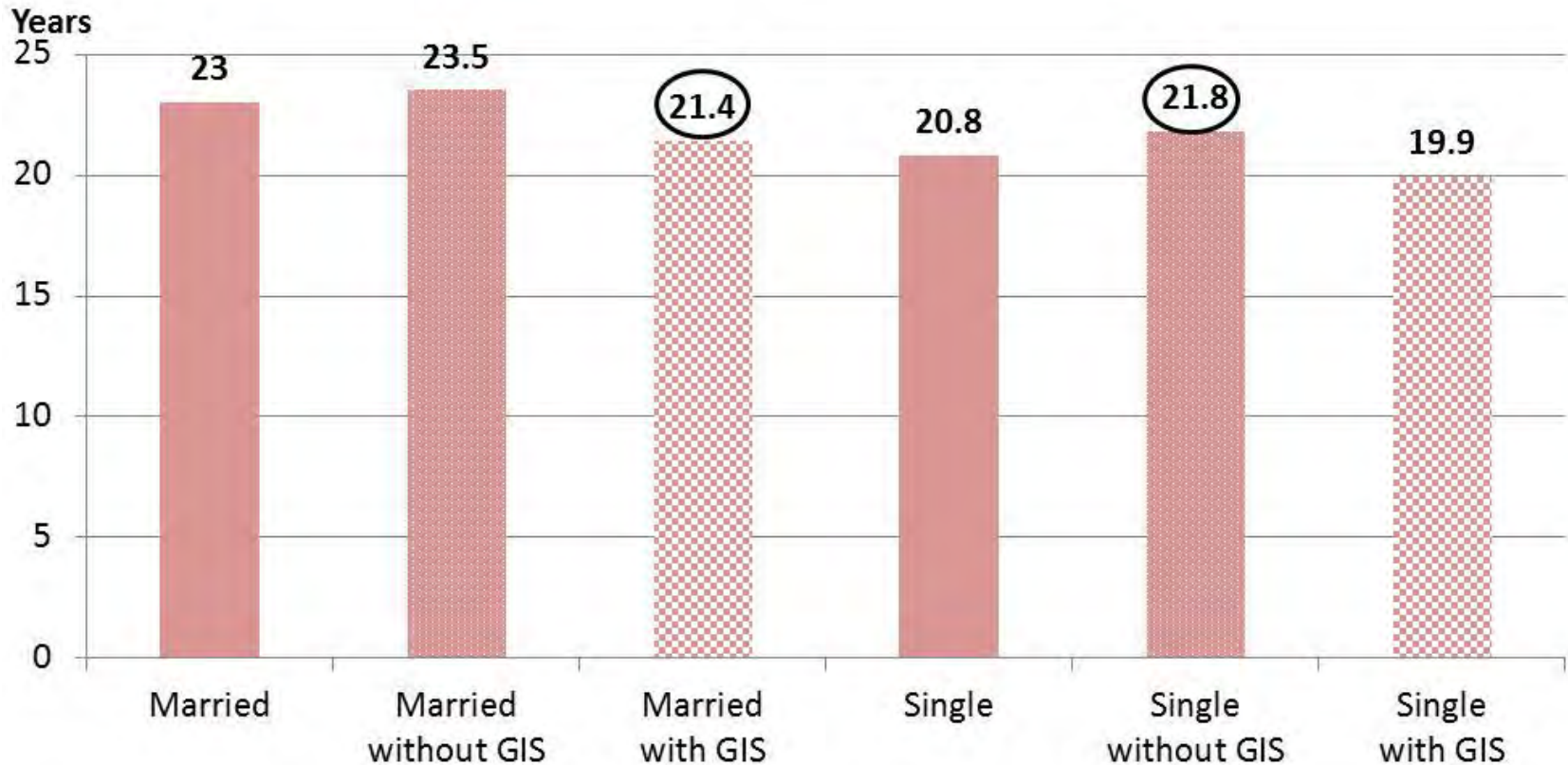
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Source: Office of the Chief Actuary, Actuarial Study No. 11: Old Age Security Program Mortality Experience, July 2012

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Women

Life Expectancy at age 65 is LOWER for Married with GIS than Single without GIS

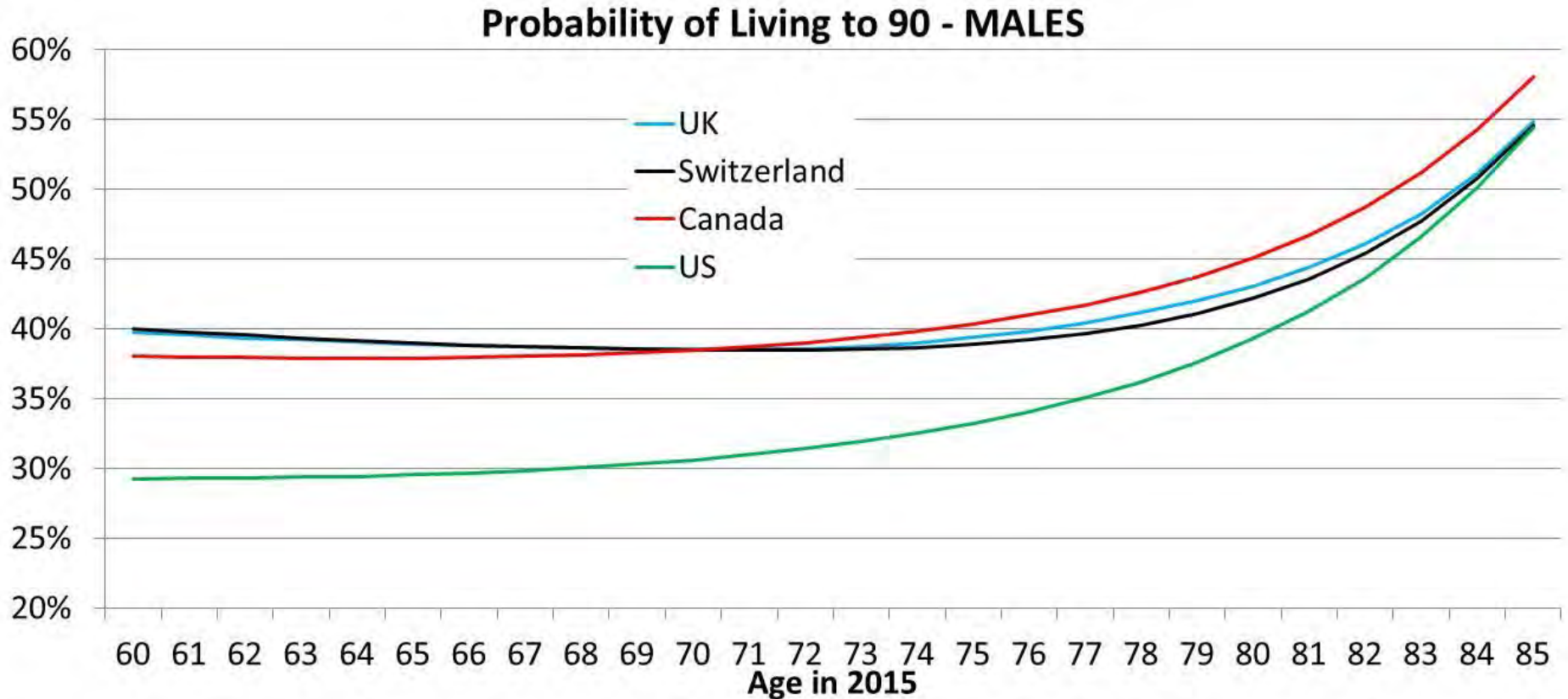


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Source: Office of the Chief Actuary, Actuarial Study No. 11: Old Age Security Program Mortality Experience, July 2012

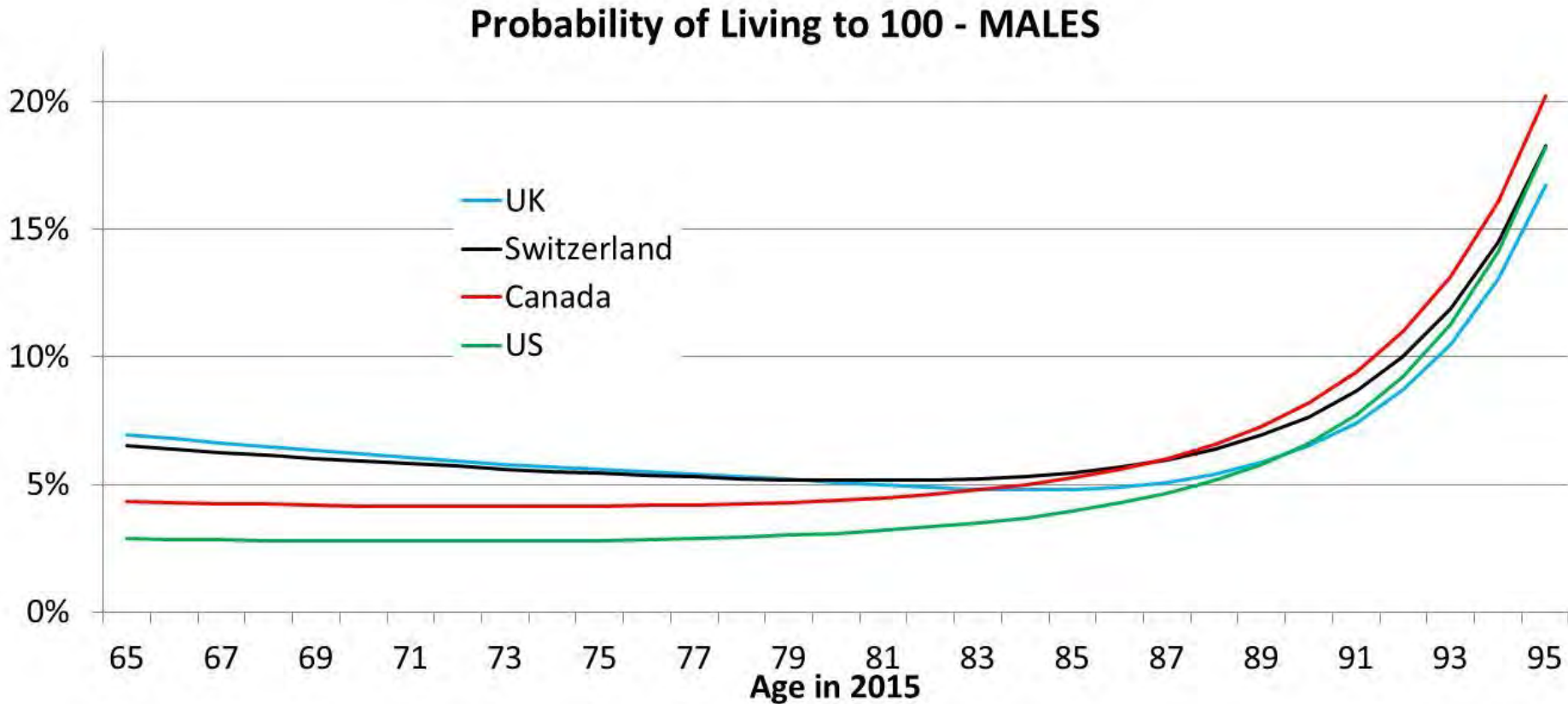
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Probability of living to 90 for Canada, the U.S., the U.K. and Switzerland



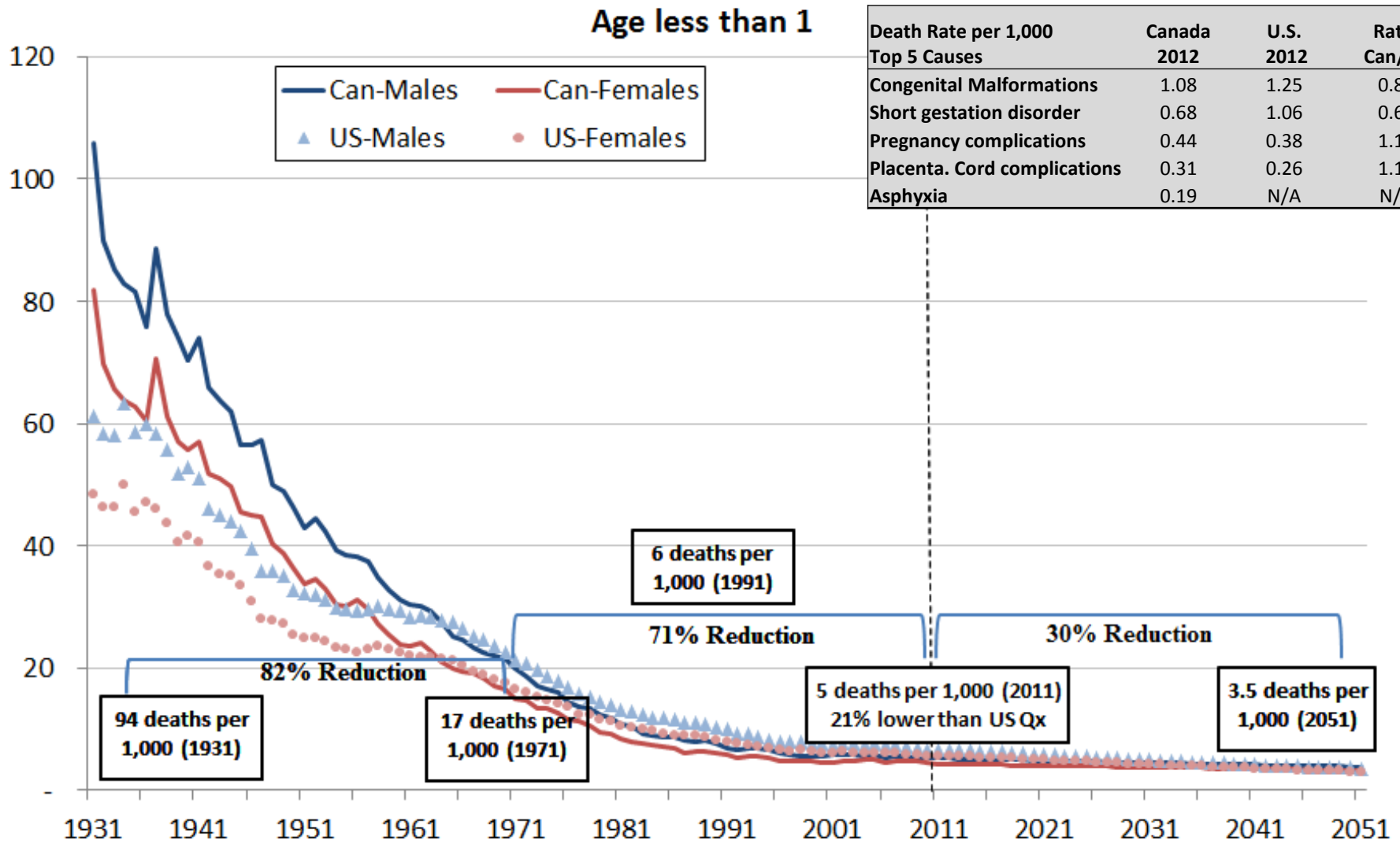
Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report (preliminary assumptions), 2015 OASDI Trustees Report

Probability of living to 100 for Canada, the U.S., the U.K. and Switzerland



Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report (preliminary assumptions), 2015 OASDI Trustees Report

Infant Mortality Rates have decreased significantly over the last 80 years

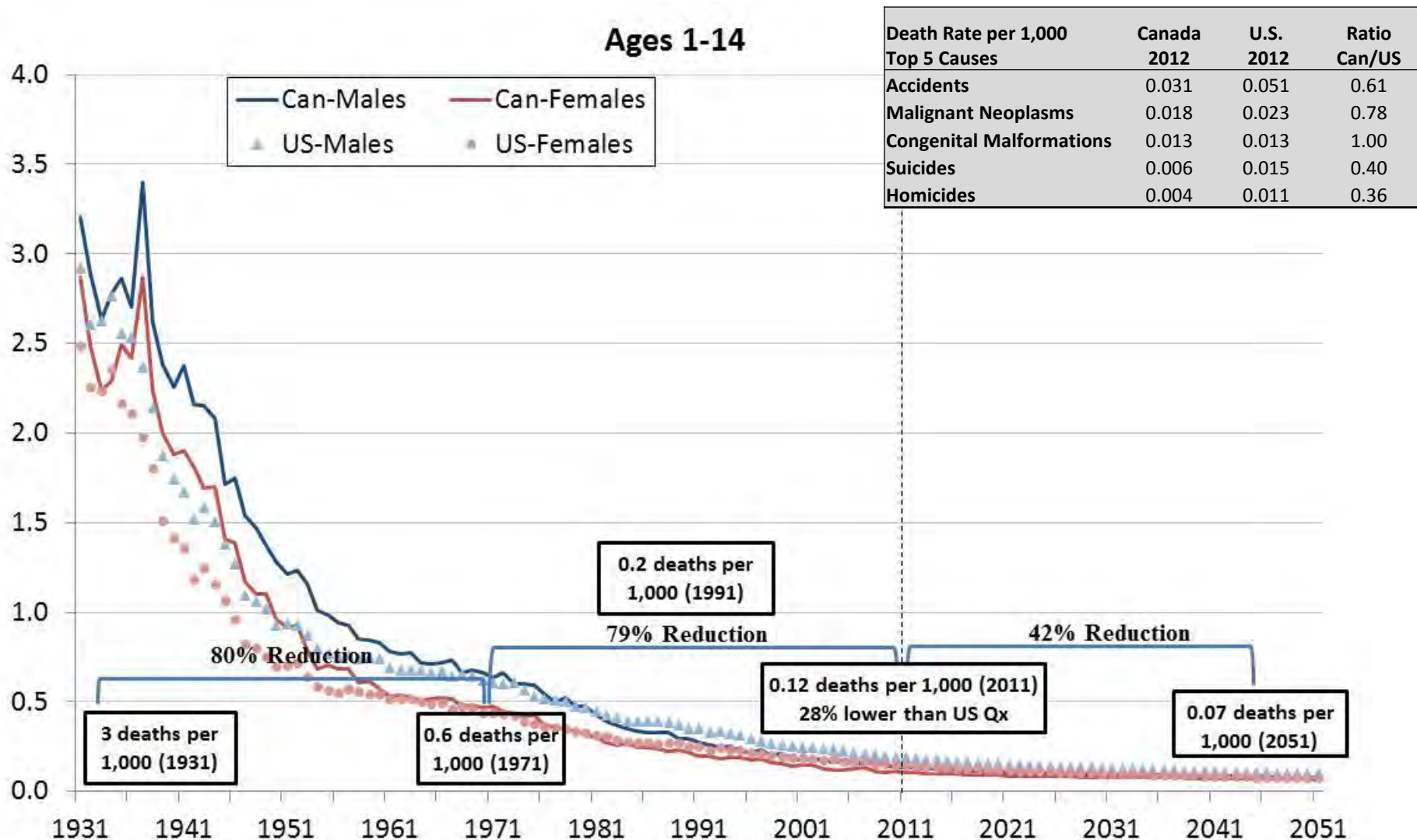


Canada: Office of the Chief Actuary, 27th CPP Actuarial Report and Statistics Canada catalogue 84-215-x

U.S.: 2015 OASDI Trustees Report and National Vital Statistics Report, Volume 63 No.9

All rates are standardized using 2015 Canadian population.

For ages 1 to 14, main causes of death are accidents, followed by cancer



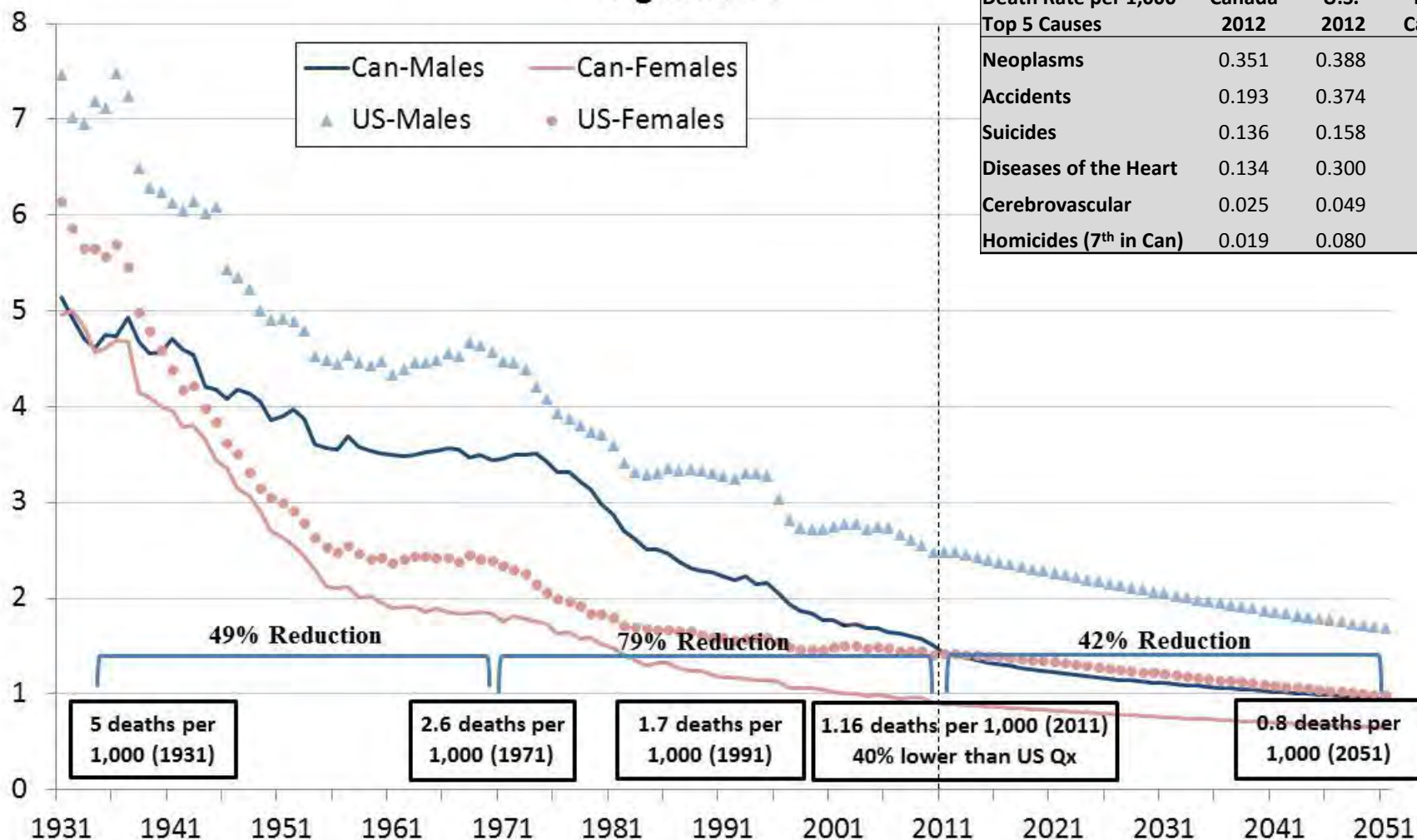
Canada: Office of the Chief Actuary, 27th CPP Actuarial Report and Statistics Canada catalogue 84-215-x

U.S.: 2015 OASDI Trustees Report and National Vital Statistics Report, Volume 63 No.9

All rates are standardized using 2015 Canadian population.

Canadian mortality rates at ages 15 to 54 are significantly lower than US rates

Ages 15-54

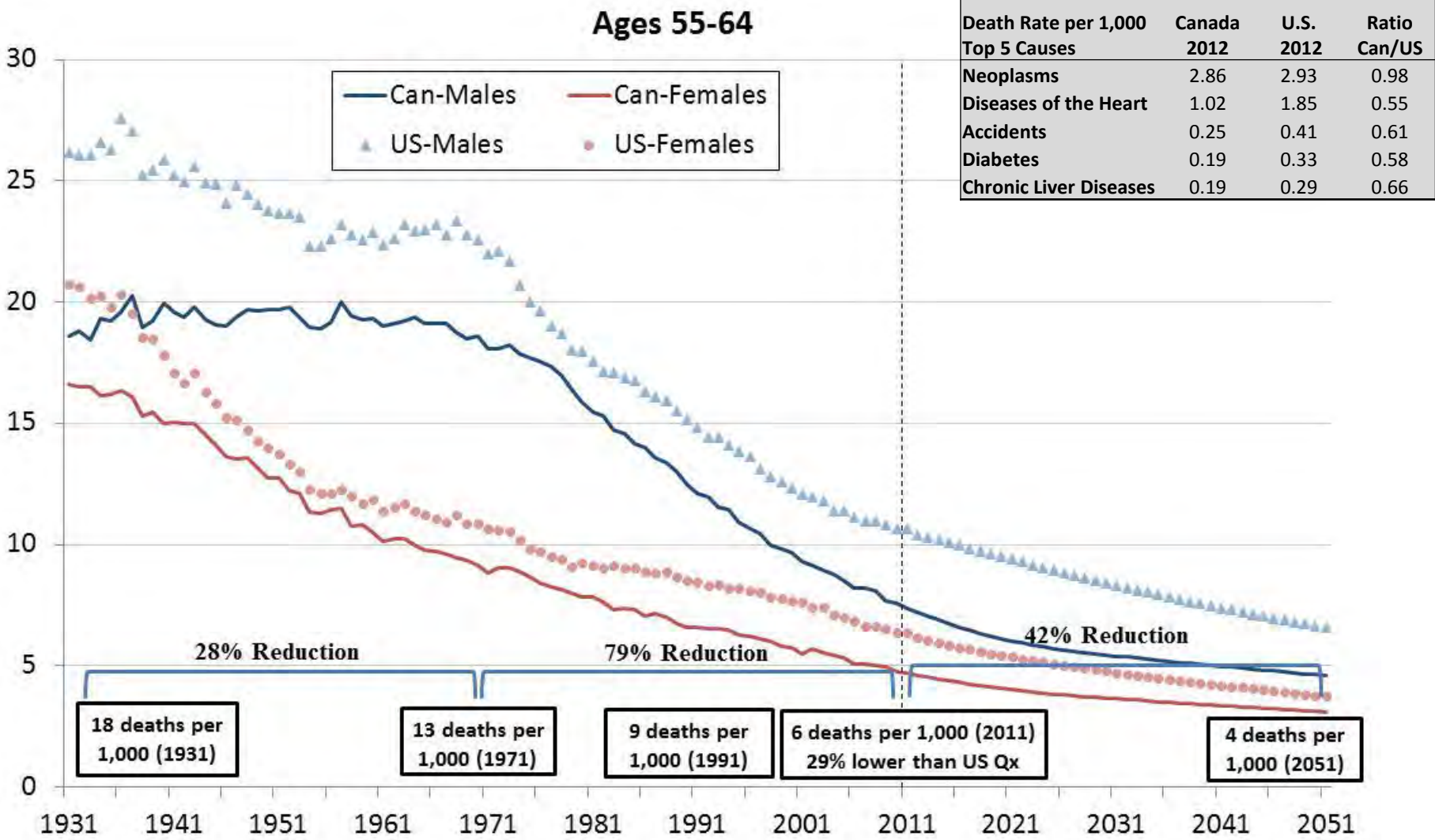


Canada: Office of the Chief Actuary, 27th CPP Actuarial Report and Statistics Canada catalogue 84-215-x

U.S.: 2015 OASDI Trustees Report and National Vital Statistics Report, Volume 63 No.9

All rates are standardized using 2015 Canadian population.

Mortality rates for older age groups have decreased over the last 80 years, more so over the last 40 years for males



Canada: Office of the Chief Actuary, 27th CPP Actuarial Report and Statistics Canada catalogue 84-215-x

U.S.: 2015 OASDI Trustees Report and National Vital Statistics Report, Volume 63 No.9

All rates are standardized using 2015 Canadian population.

Slowdown in mortality improvements in recent years: a blip or a new trend?

- **UK:**

“improvements have slowed considerably since then [2011] and mortality in 2015 was at a similar level to that in 2011, 10% above the projected trend.”

CMI Working Paper No.90

- **USA:**

In 2015 and 2016, the Society of Actuaries released an updated mortality improvement scale for pensions MP-2015 and MP-2016

Cohort Life Expectancies at age 65

	Males	Females
MP-2014	21.6	23.8
MP-2016	20.8	22.8
Changes	(0.8)	(1.0)

