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# Living to 100 – Would Canada Pension Plan be Sustainable?

2016 University of Waterloo International Workshop on the Implications of Aging on Asset Values

*by Jean-Claude Ménard, Chief Actuary, OCA, OSFI*

***June 23rd, 2016***

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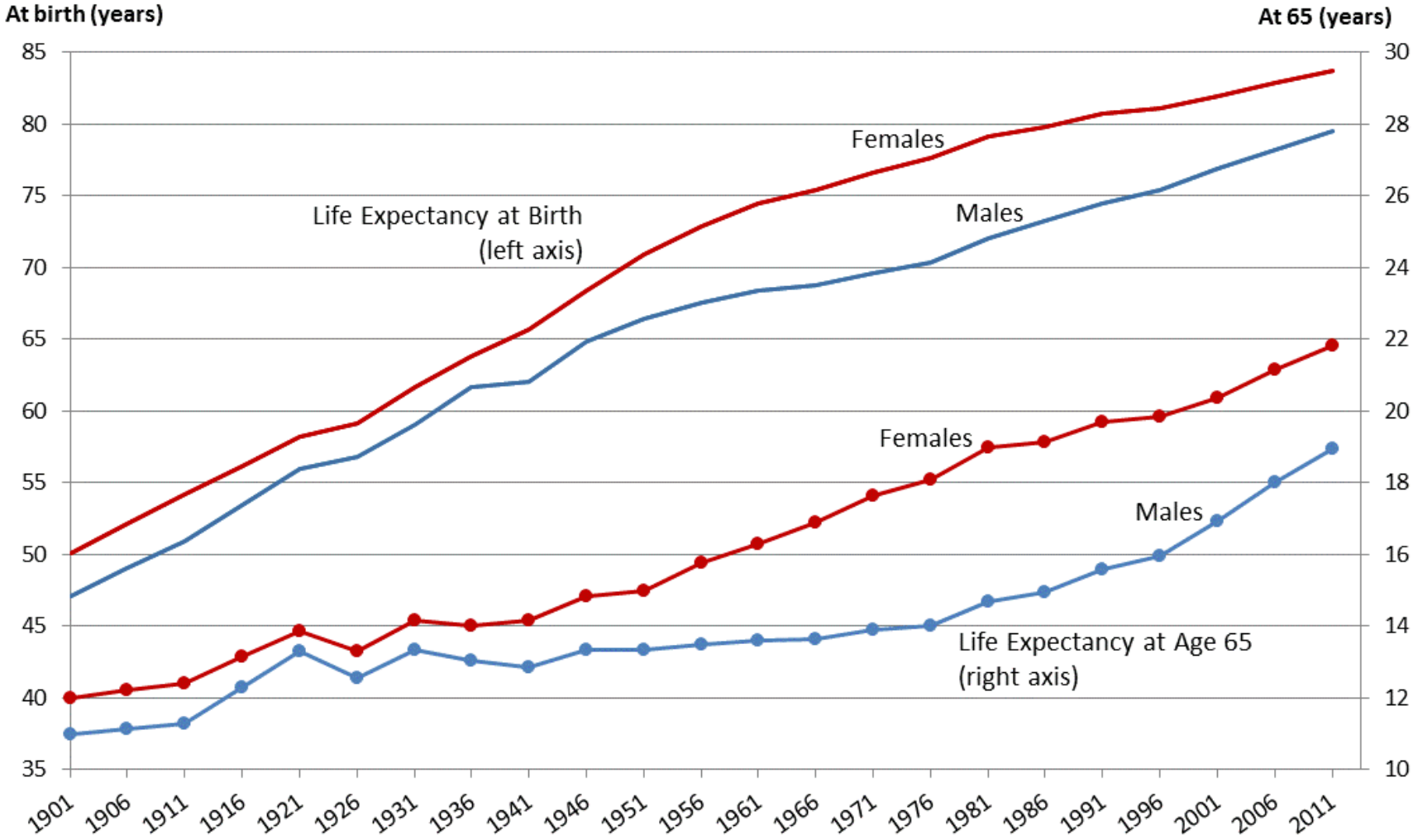
Canada

# *Presentation Outline*

- **Historical Life Expectancies**
- **Mortality Improvement Rates (MIR)**
- **Longevity Drivers**
- **International Comparisons**
- **Probability of Living to a certain Age**
- **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*

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

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

*Source: Canadian Human Mortality Database, University of Montreal and Office of the Chief Actuary calculations*

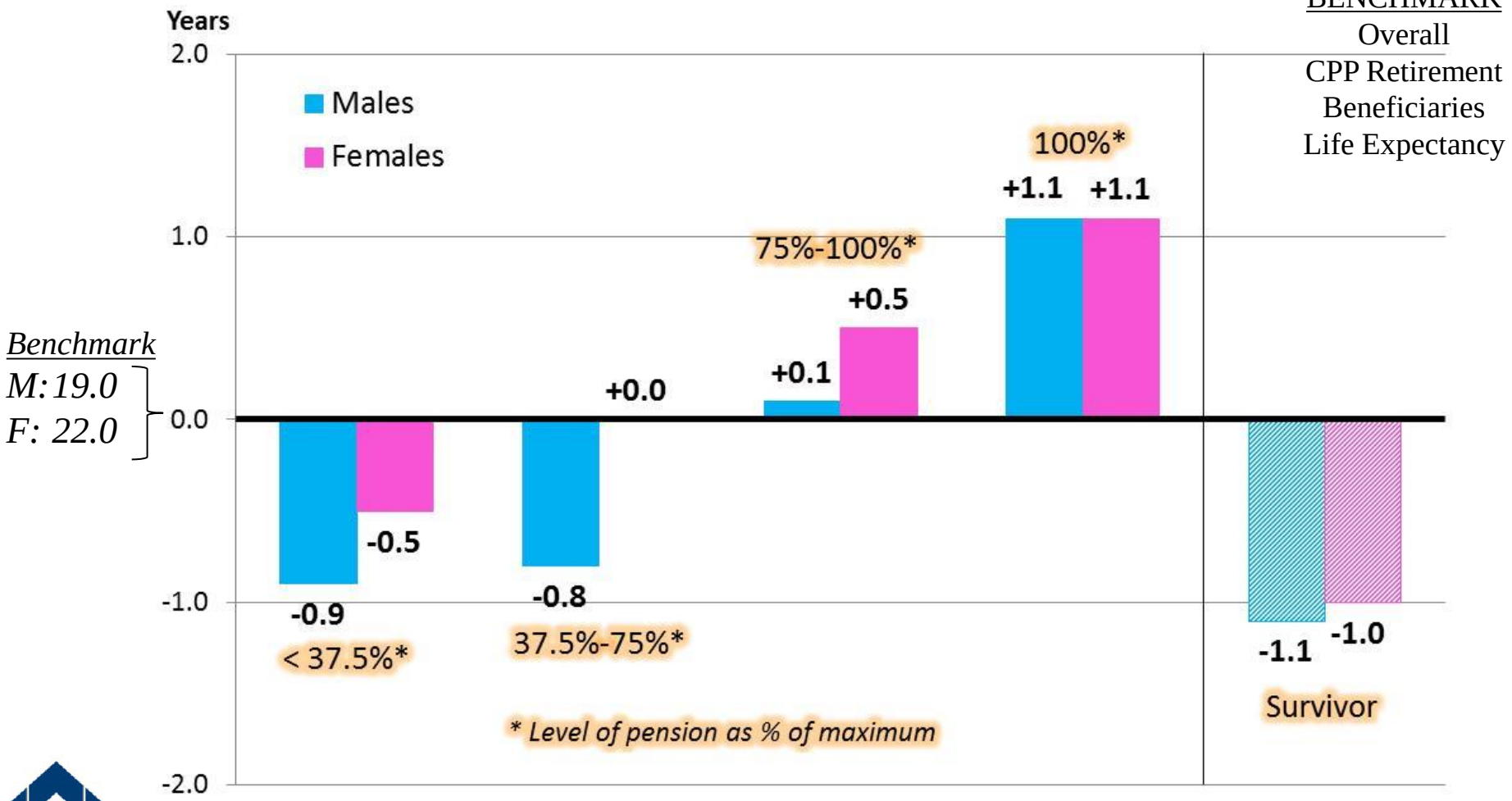
# *Contribution to increase in life expectancy at birth has gradually shifted to people over age 65*

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

*Source: Canadian Human Mortality Database, University of Montreal and Office of the Chief Actuary calculations*

# *Life expectancy is impacted by level of income*

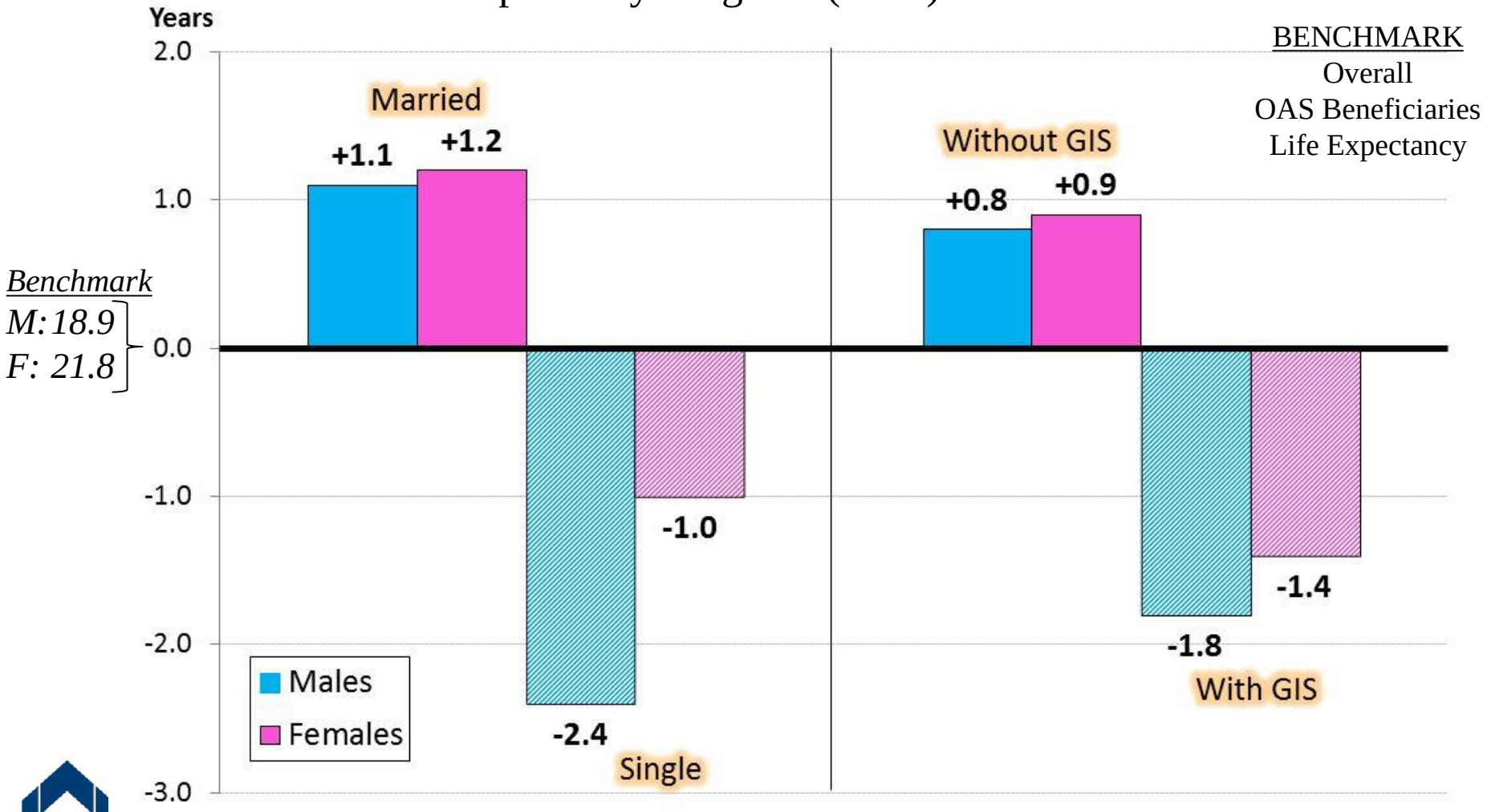
Difference of life expectancy at age 65 (2013)




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

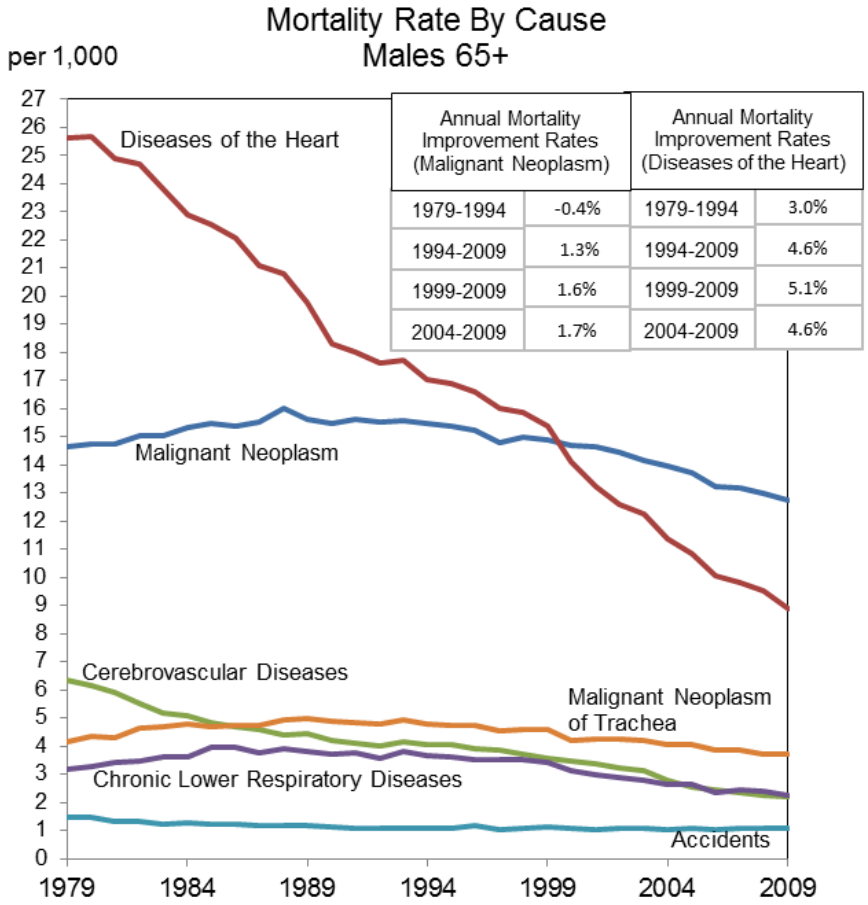
# *Life expectancy is impacted by level of income and marital status*

Difference of life expectancy at age 65 (2013)

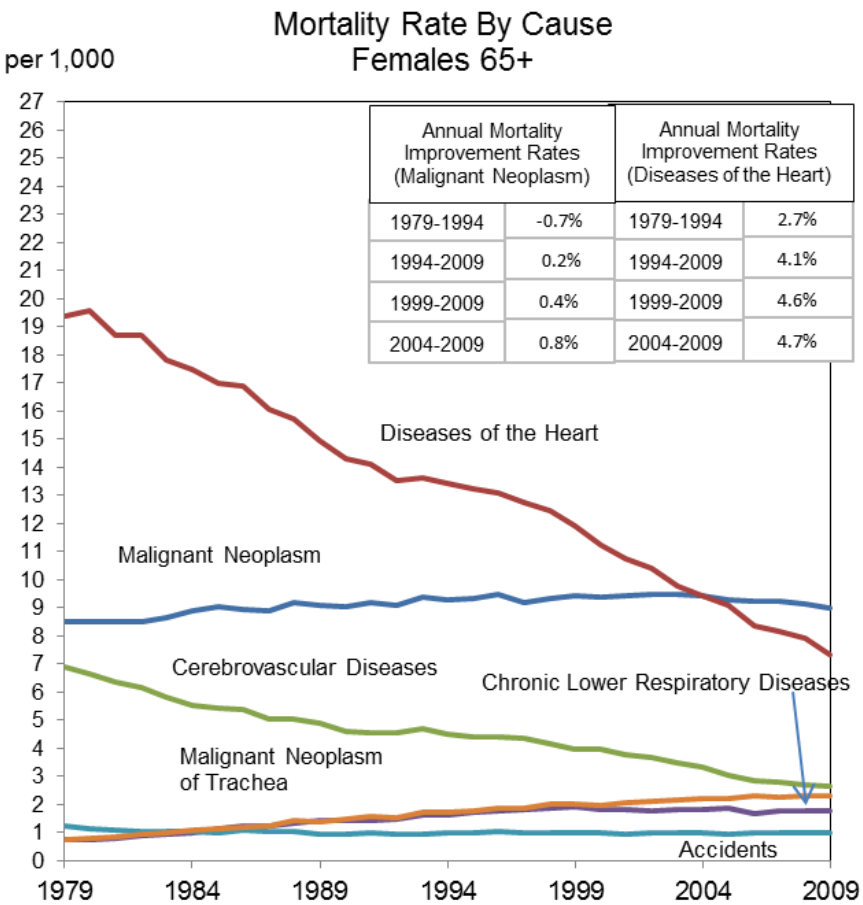



*Source: Office of the Chief Actuary, Actuarial Study No. 17: Old Age Security Program Mortality Experience, June 2016*

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




| Annual Mortality Improvement Rates (Malignant Neoplasm) | | Annual Mortality Improvement Rates (Diseases of the Heart) | |
|---|---|---|---|
| 1979-1994 | -0.4% | 1979-1994 | 3.0% |
| 1994-2009 | 1.3% | 1994-2009 | 4.6% |
| 1999-2009 | 1.6% | 1999-2009 | 5.1% |
| 2004-2009 | 1.7% | 2004-2009 | 4.6% |




| Annual Mortality Improvement Rates (Malignant Neoplasm) | | Annual Mortality Improvement Rates (Diseases of the Heart) | |
|---|---|---|---|
| 1979-1994 | -0.7% | 1979-1994 | 2.7% |
| 1994-2009 | 0.2% | 1994-2009 | 4.1% |
| 1999-2009 | 0.4% | 1999-2009 | 4.6% |
| 2004-2009 | 0.8% | 2004-2009 | 4.7% |

*Source: Data from Statistics Canada, Health Division and OCA Calculations*
*Standardized Using 2001 Canadian Population*

# *Recent Study shows a Slowdown in OAS Mortality Improvement Rates for Males 65-79*

| | Males | |
|---|---|---|
| **OAS Average Annual MIR (%)** | **1999-2013** | **2010-2013** |
| **65-69** | 2.7 | 2.0 |
| **70-74** | 2.9 | 1.6 |
| **75-79** | 2.9 | 2.4 |
| **80-84** | 2.5 | 2.6 |
| **85-89** | 1.9 | 1.9 |

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

# *Recent Study shows a slight Slowdown in OAS Mortality Improvement Rates for Females 80-89*

| | Females | |
|---|---|---|
| **OAS Average Annual MIR (%)** | **1999-2013** | **2010-2013** |
| **65-69** | 1.8 | 1.9 |
| **70-74** | 1.9 | 1.8 |
| **75-79** | 2.0 | 2.1 |
| **80-84** | 1.8 | 1.4 |
| **85-89** | 1.7 | 1.5 |

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

# Slowdown in mortality improvements was also observed in UK and USA over the last few years

- ***UK:***

"The average annual improvement from 2011 to 2015 is just 0.3% p.a. for the 18-102 age group and 0.1% p.a. for ages 65-102."

*CMI Working Paper No.83*

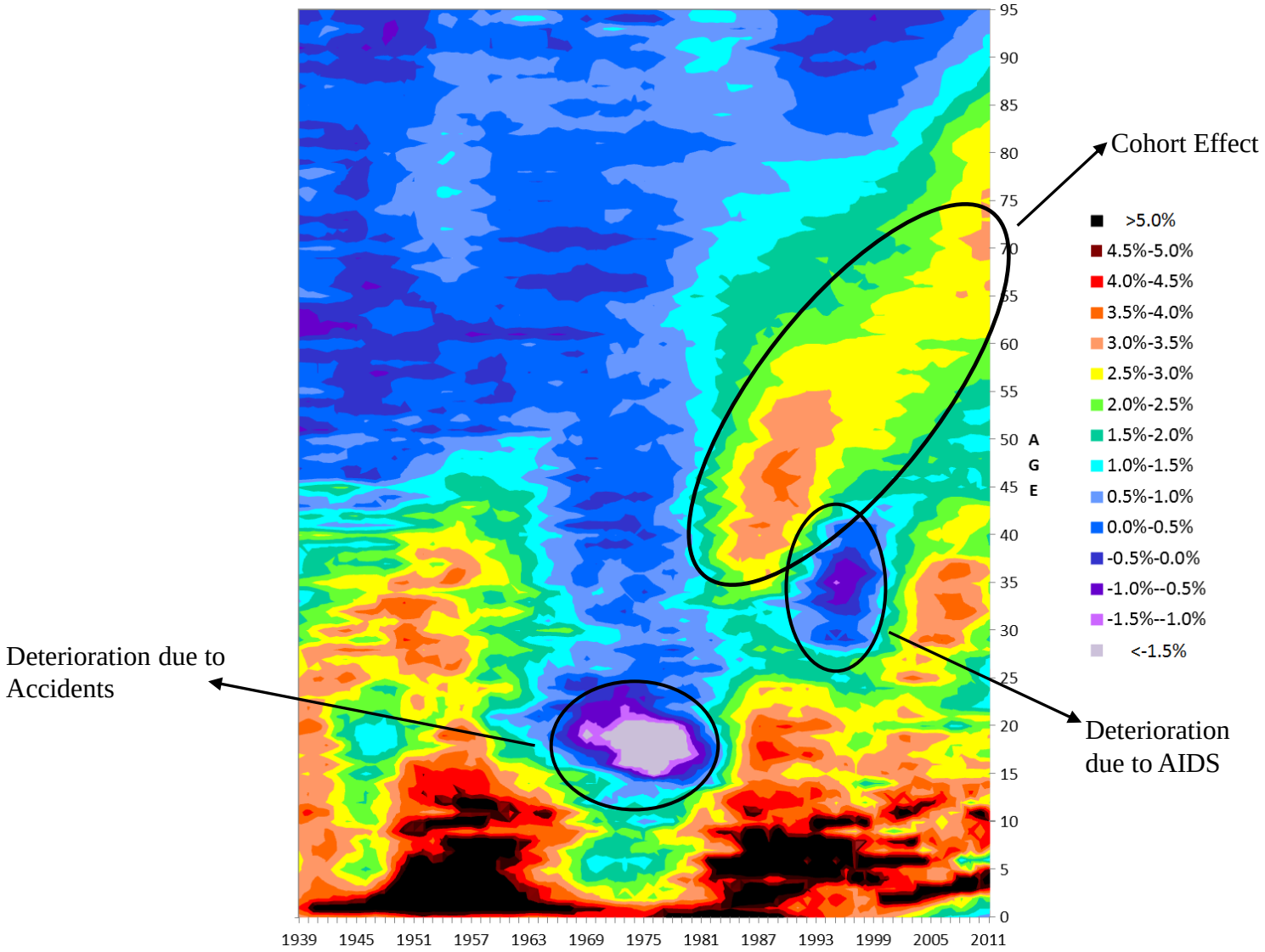
- ***USA:***

In October 2015, the Society of Actuaries released an updated mortality improvement scale for pensions based on two additional years of experience (2010 and 2011).

*Impact of the revised scale on immediate annuity factors at 4% discount rate*

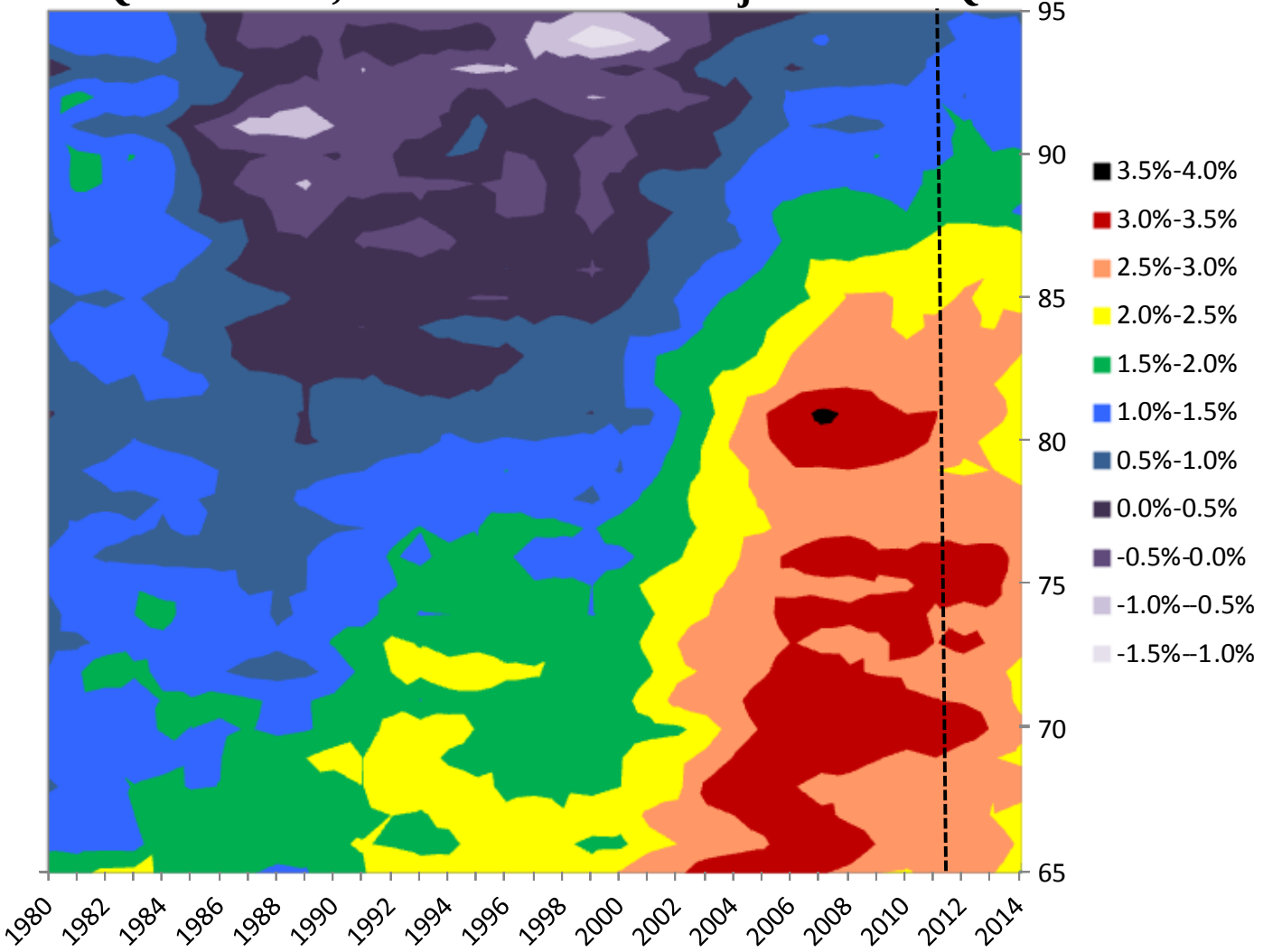
| | Males | Females |
|---|---|---|
| **Age 65** | -1.4% | -1.7% |
| **Age 75** | -2.7% | -3.0% |
| **Age 85** | -3.4% | -4.5% |

# Males Mortality Improvement Rates based on HMD 15-year Average

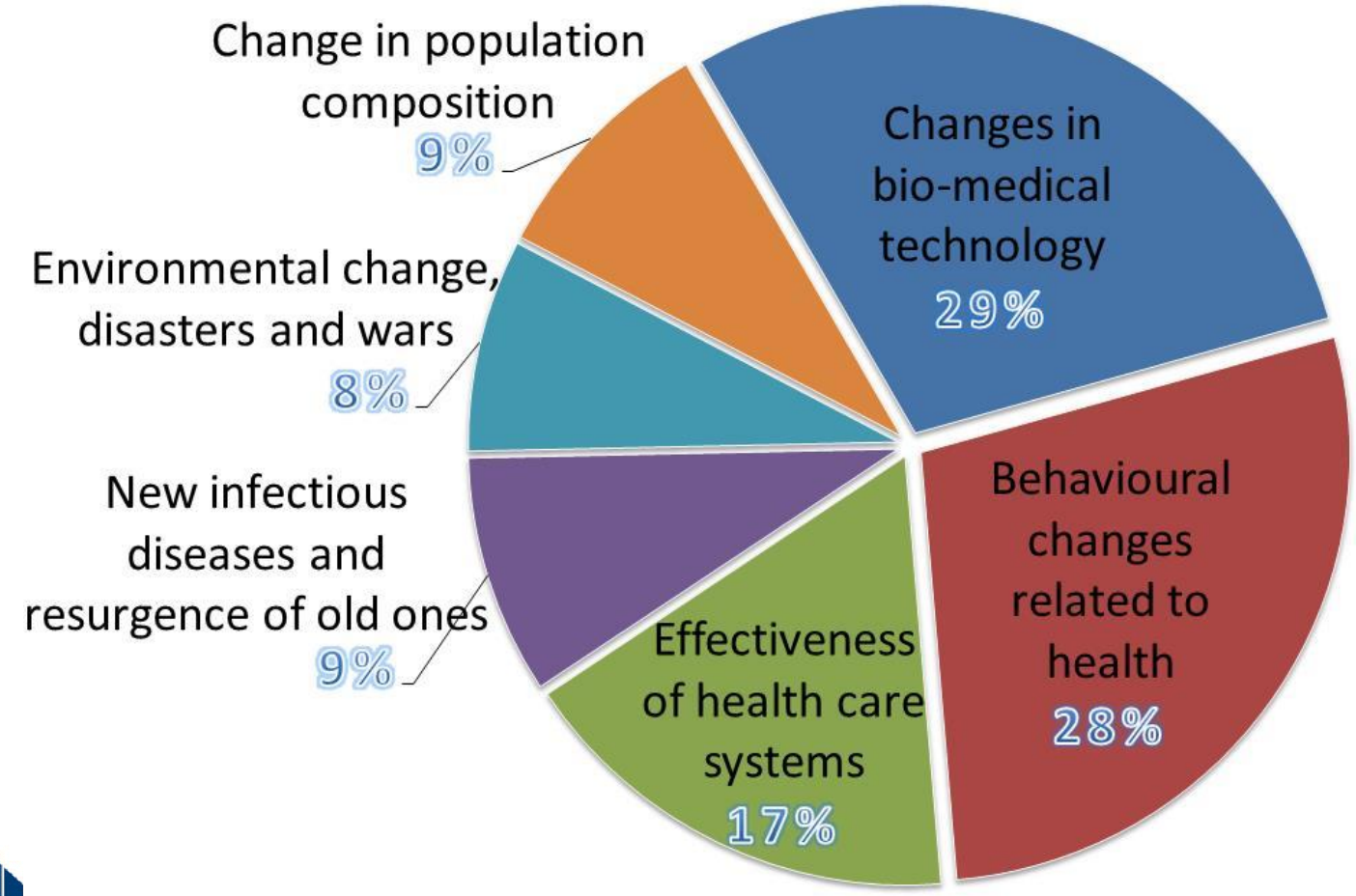


# Males Mortality Improvement Rates
# 10-year Average

**(Based on HMD Qx until 2011, blend of HMD and Adjusted OAS Qx from 2012 to 2014)**



# Bio-medical technology and behavioural changes are identified as the major forces shaping future mortality

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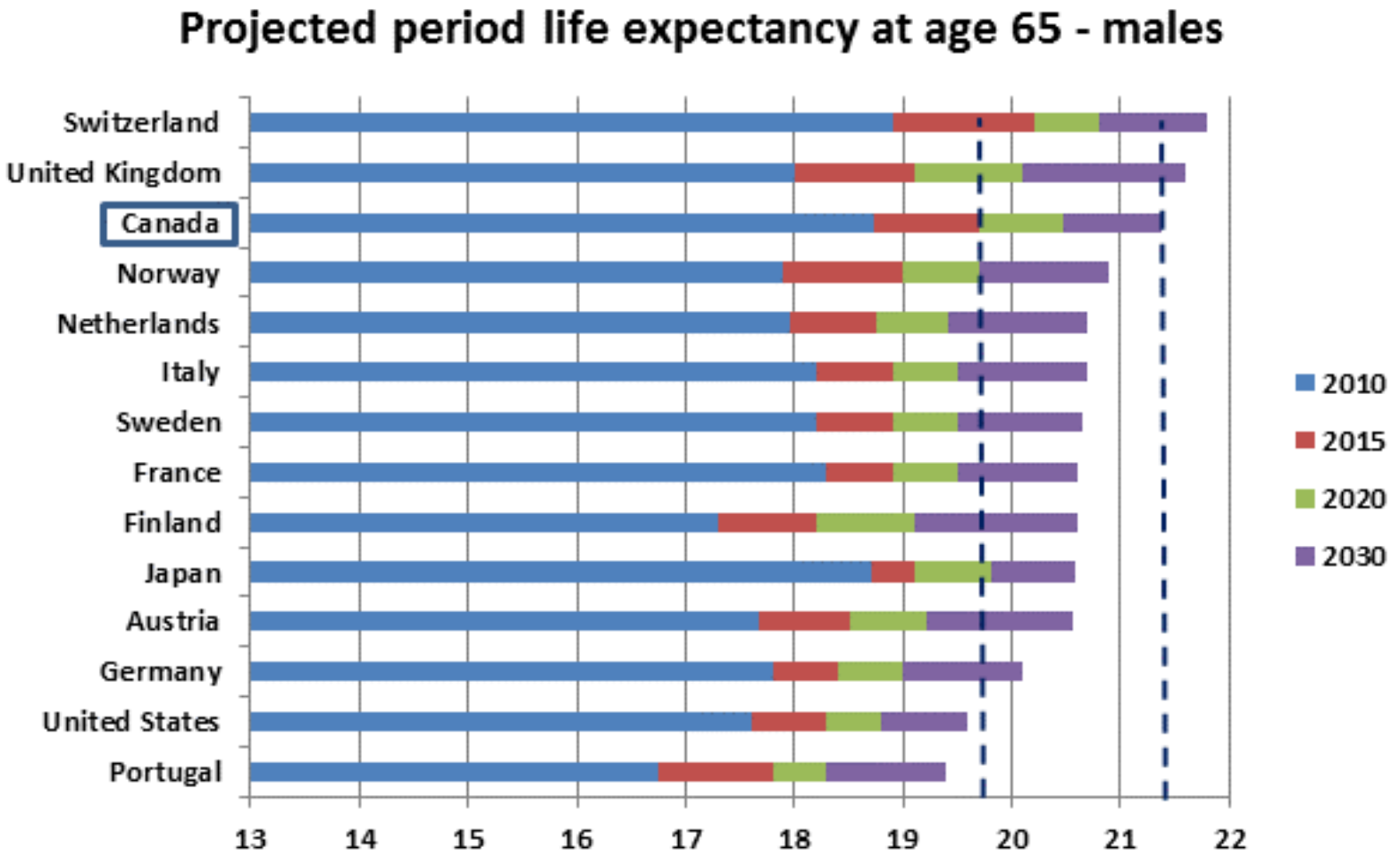
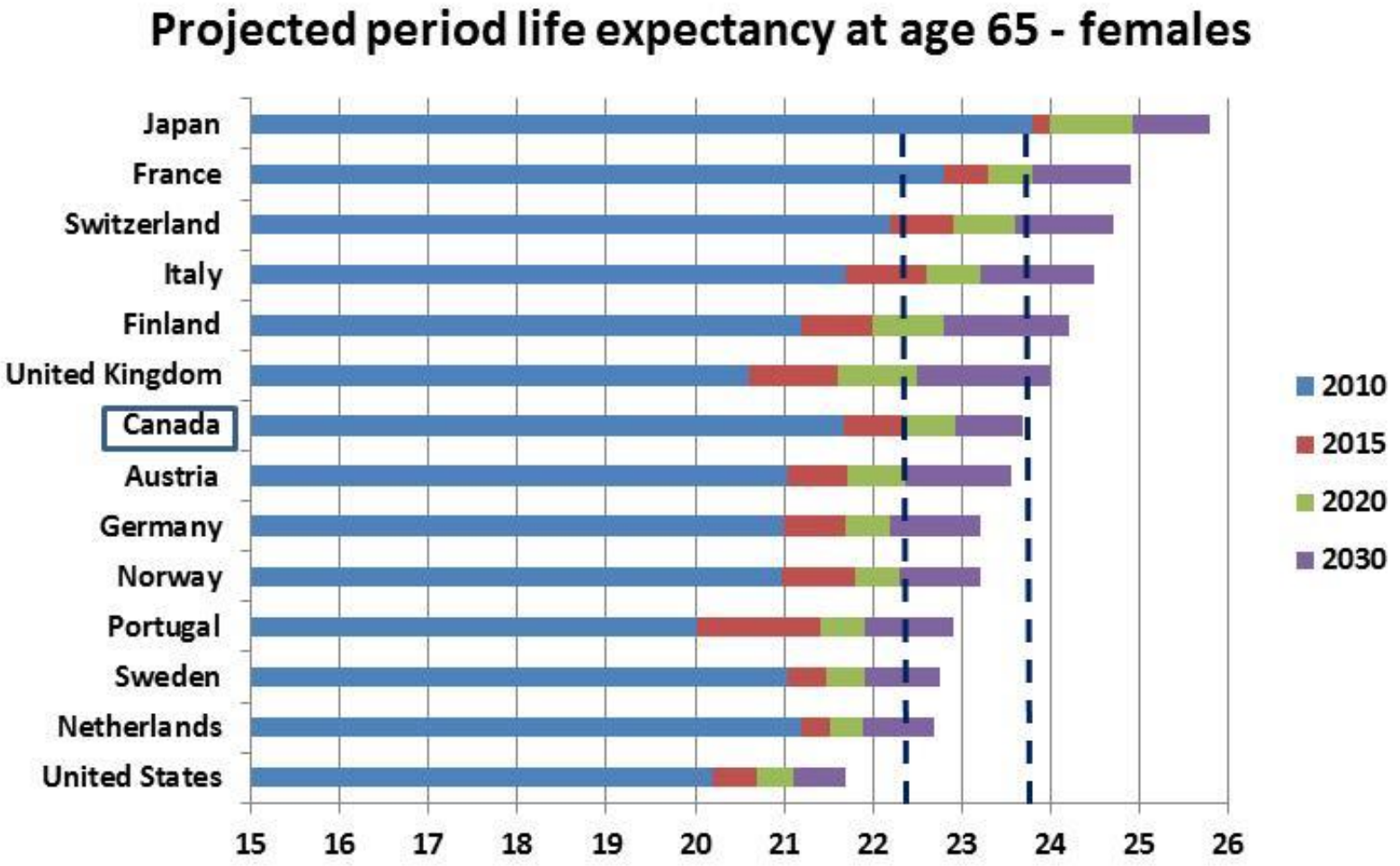
Source: *The National Population Projections Expert Advisory Group: results from a questionnaire about future trends in fertility, mortality and migration*, Office for National Statistics, UK

# International Comparisons - Males



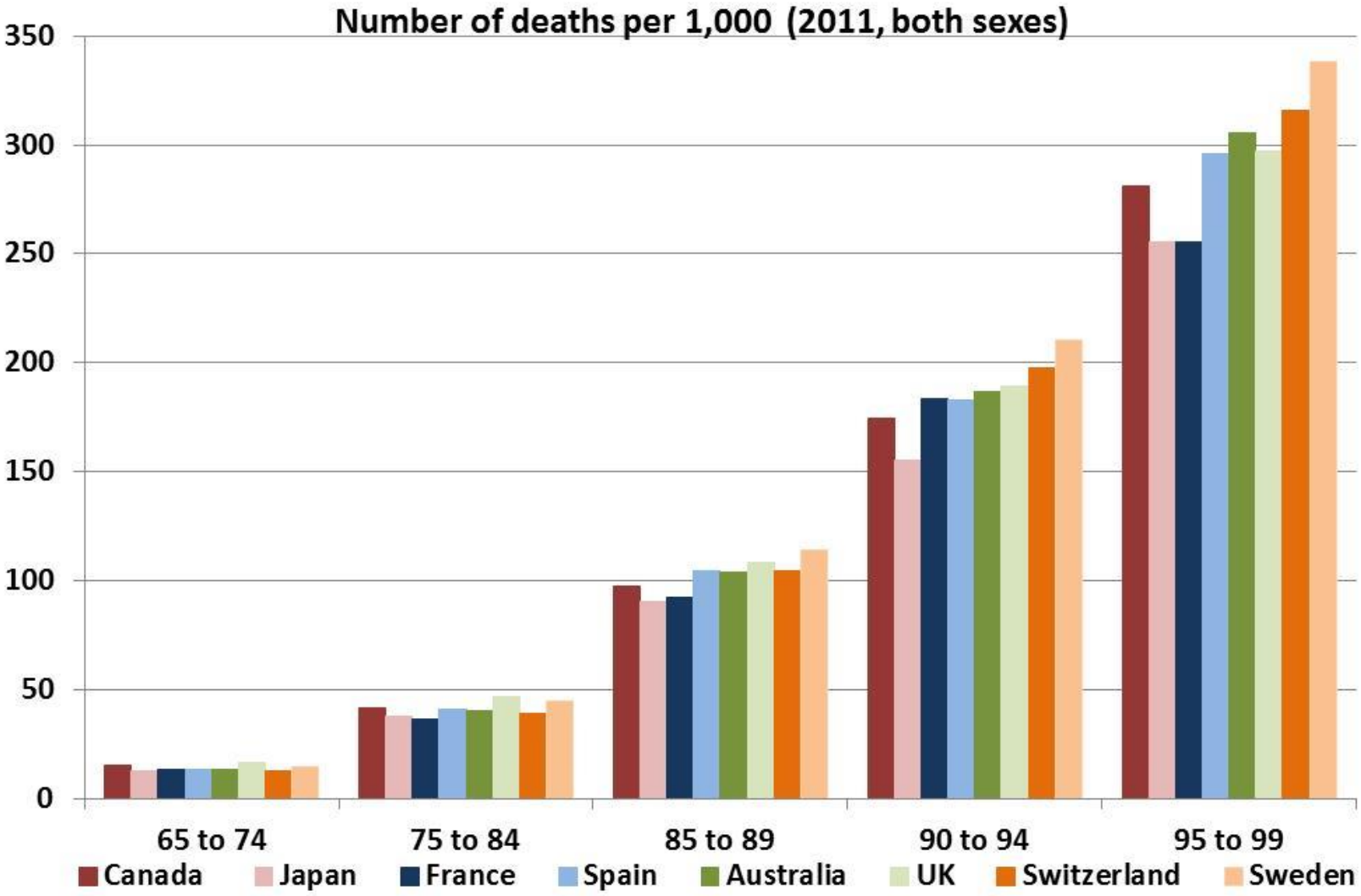

**Source: 18th International Conference of Social Security Actuaries and Statisticians presentations and reports. Data for Canada are produced by the Office of the Chief Actuary, based on CPP27th preliminary assumptions. Data for Japan are from National Institute of Population and Social Security Research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

# International Comparisons - Females




**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).**

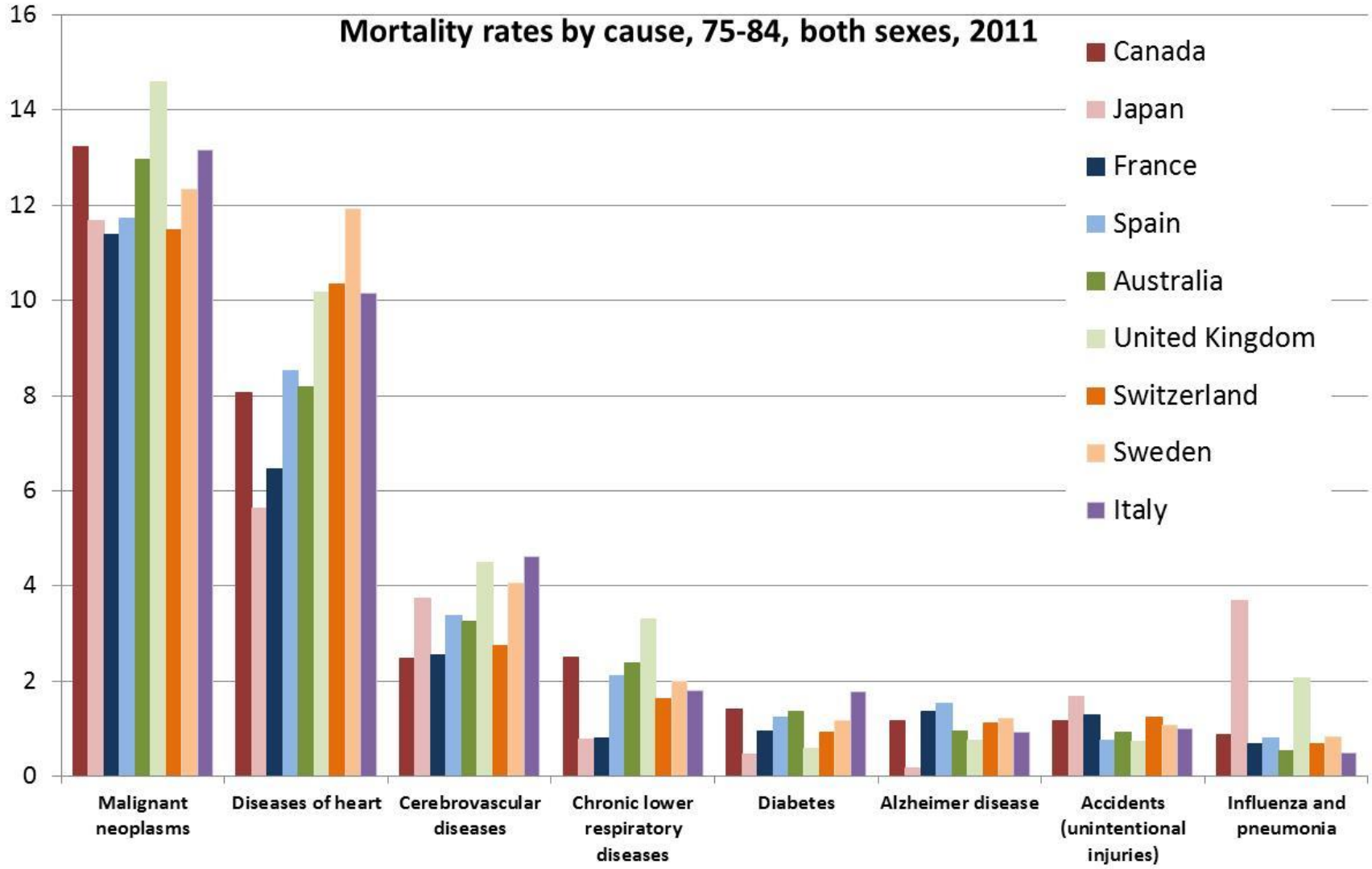
# *After age 85, Canada along with Japan and France has the lowest mortality rates*






*Source : Canadian human Mortality Database, University of Montreal*

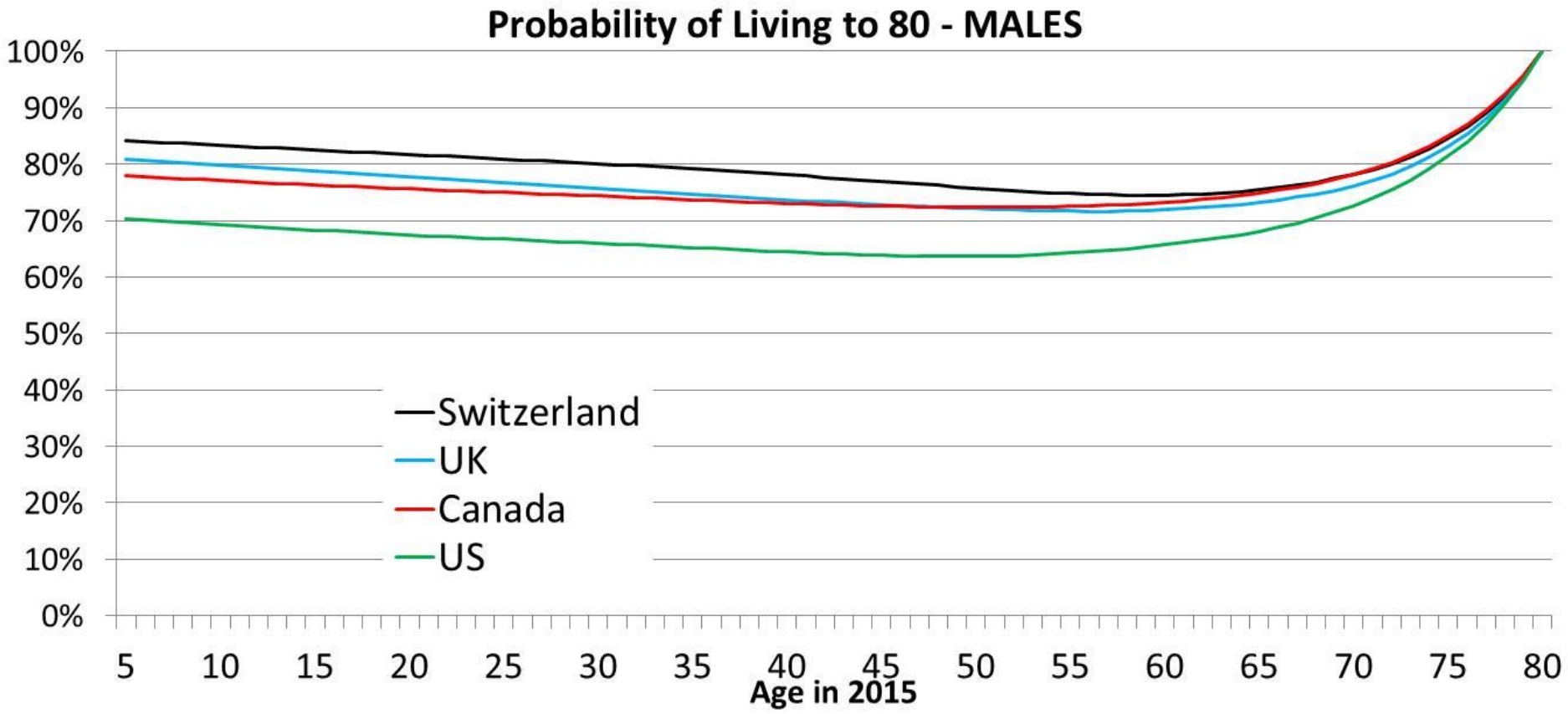
# Mortality Rates by Cause





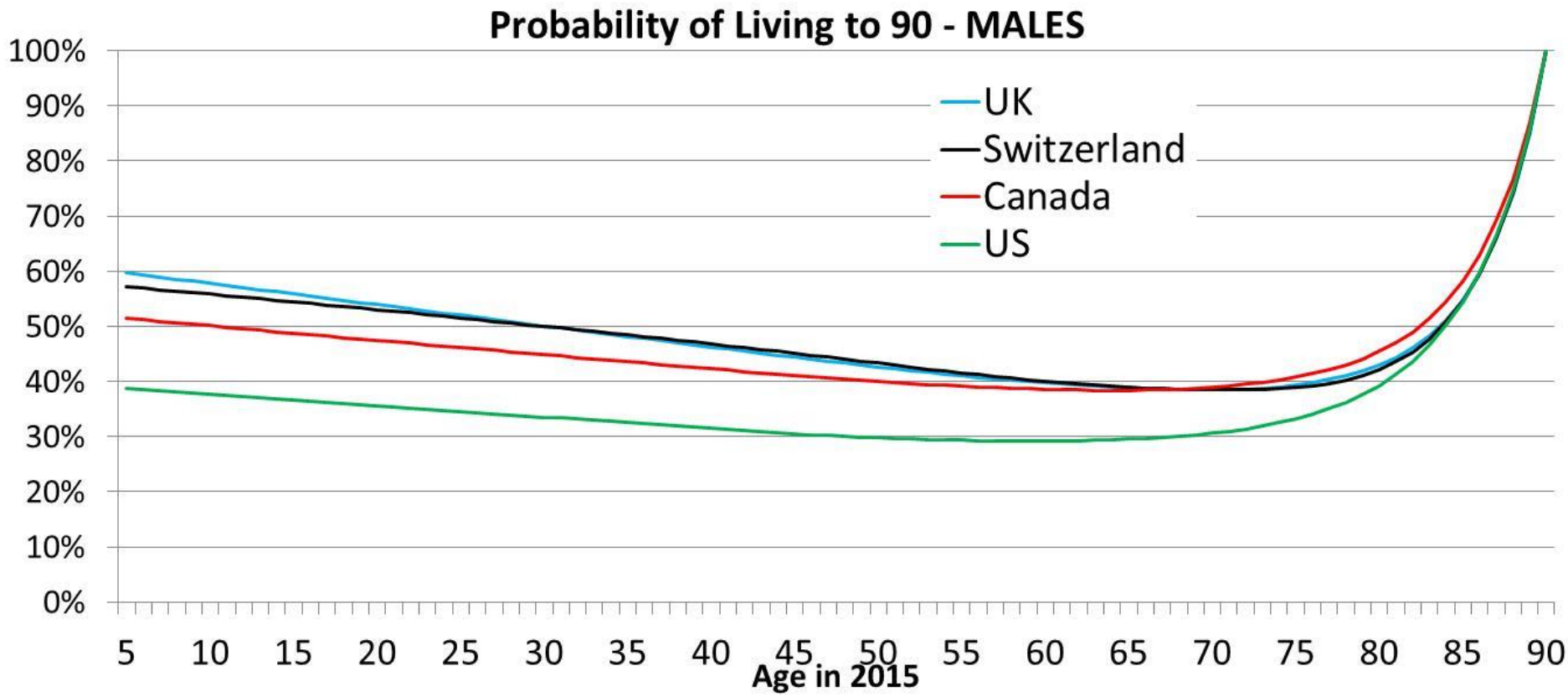

*Source : World Health Organization*

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



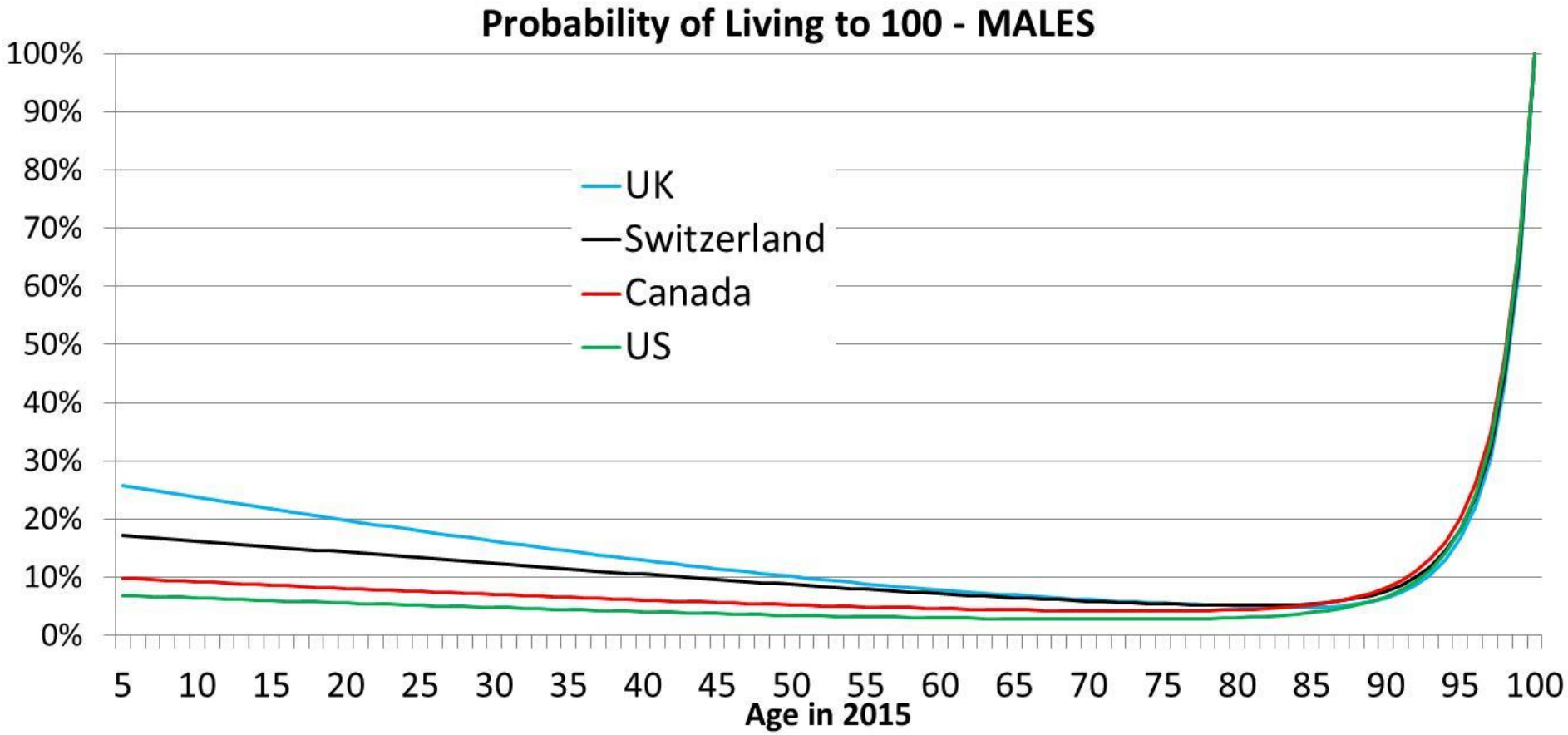

*Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report (preliminary assumptions), 2015 OASDI Trustees Report*

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



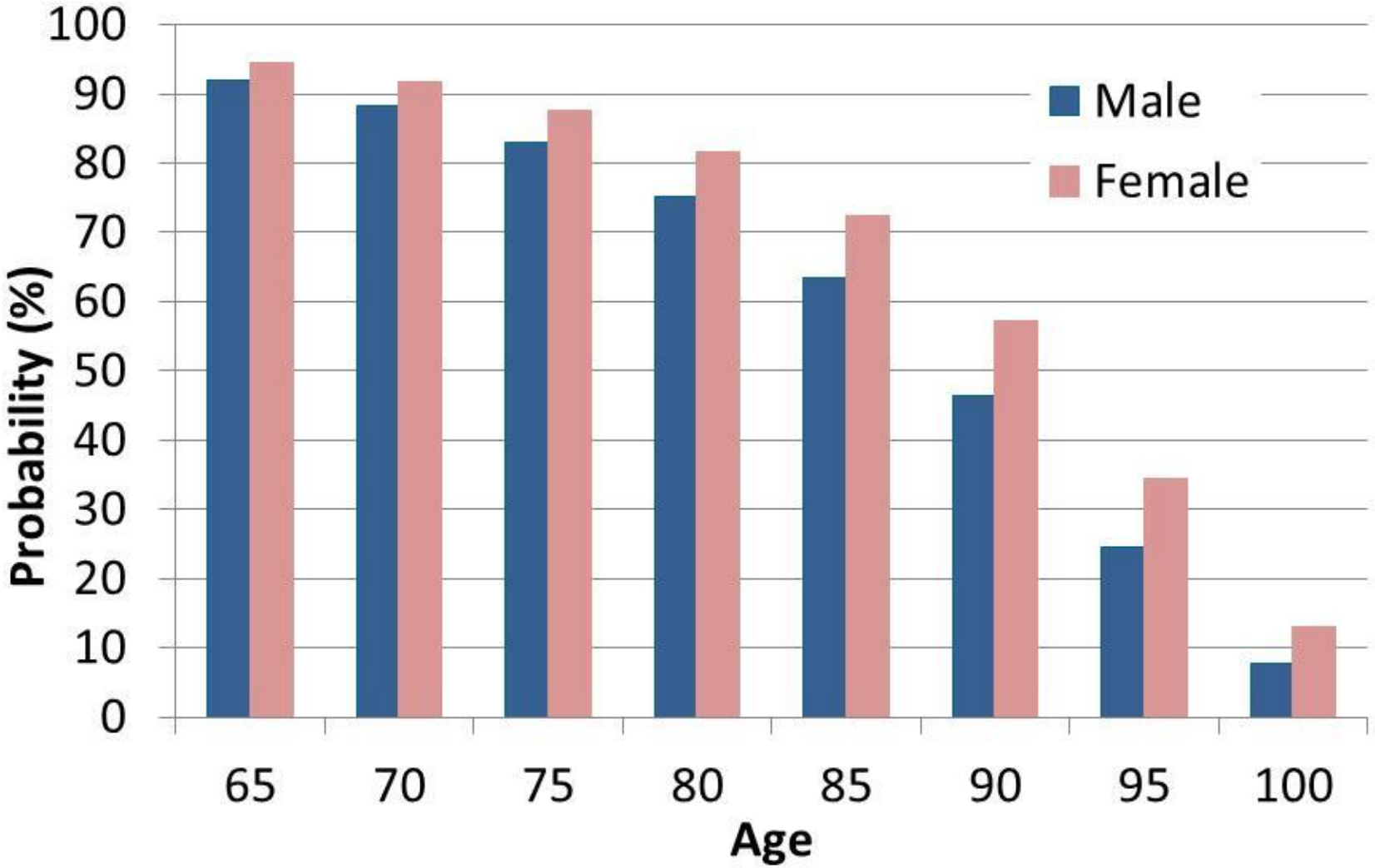

*Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report (preliminary assumptions), 2015 OASDI Trustees Report*

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



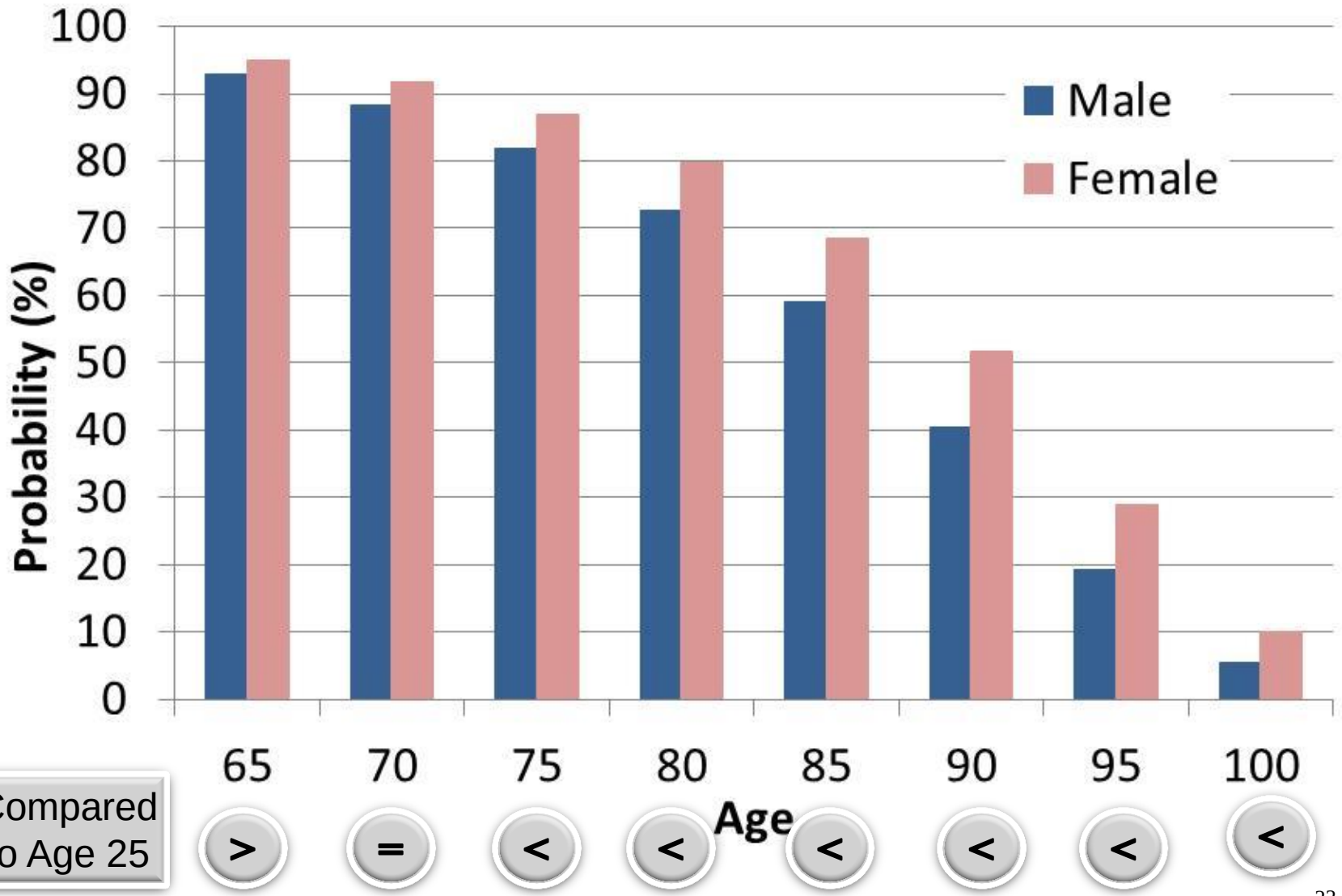

*Source: UK Office for National Statistics, Confédération Suisse – Office fédéral de la statistique, 27th CPP Actuarial Report (preliminary assumptions), 2015 OASDI Trustees Report*

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




*Source: 27th CPP Actuarial Report (preliminary assumptions)*

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

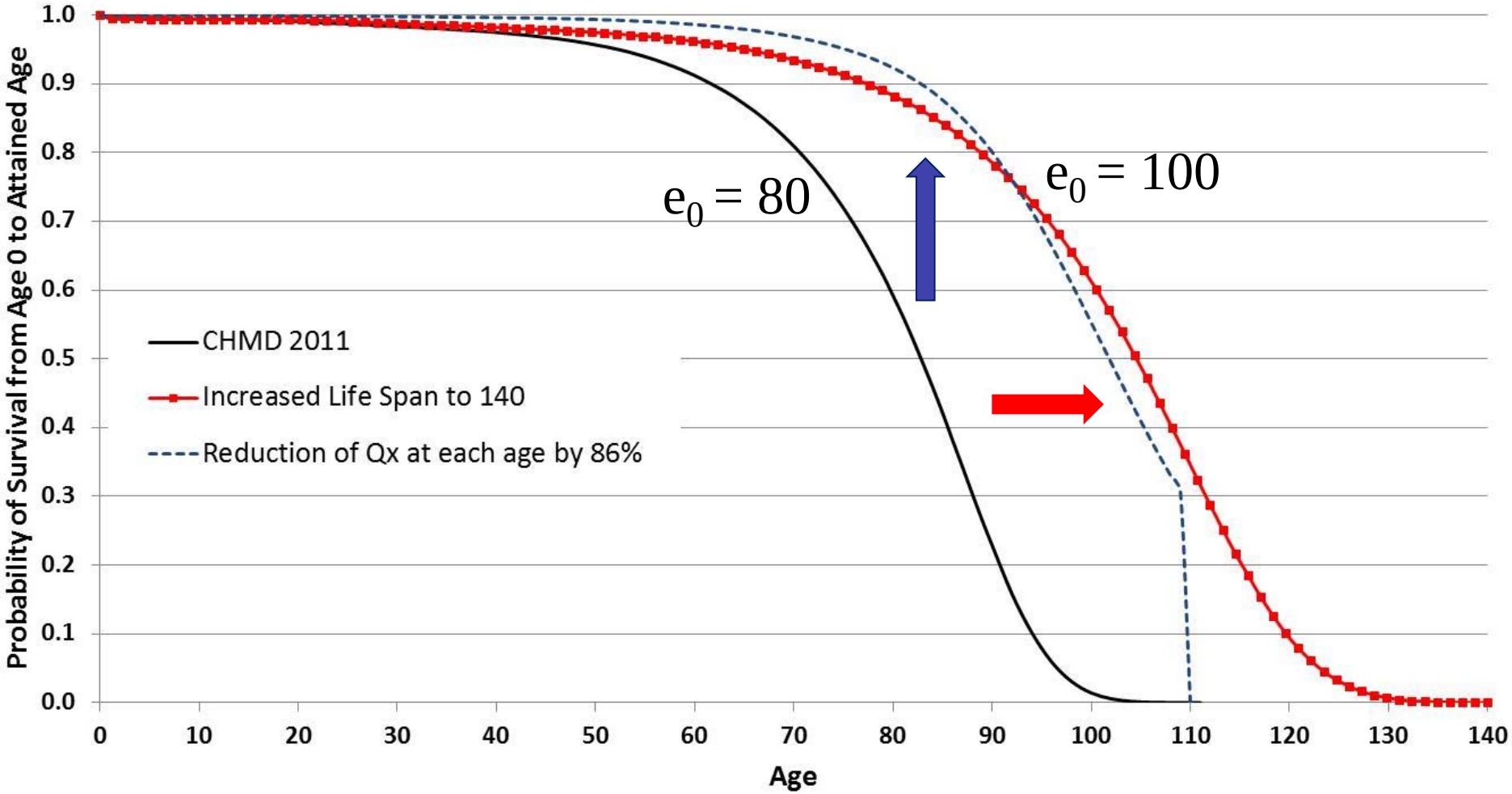



| Compared to Age 25 | > | = | < | < | < | < | < | < |
|---|---|---|---|---|---|---|---|---|



*Source: 27th CPP Actuarial Report (preliminary assumptions)*

# *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 86% for males (82% 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?*

## Preliminary Mortality Assumptions of the 27th CPP Report

Life expectancy at age 65 in **2016** (***with*** future improvements)

**M: 21.3 years**
**F: 23.7 years**

(without)
(19.9)
(22.5)

Life expectancy at age 65 in **2050** (***with*** future improvements)

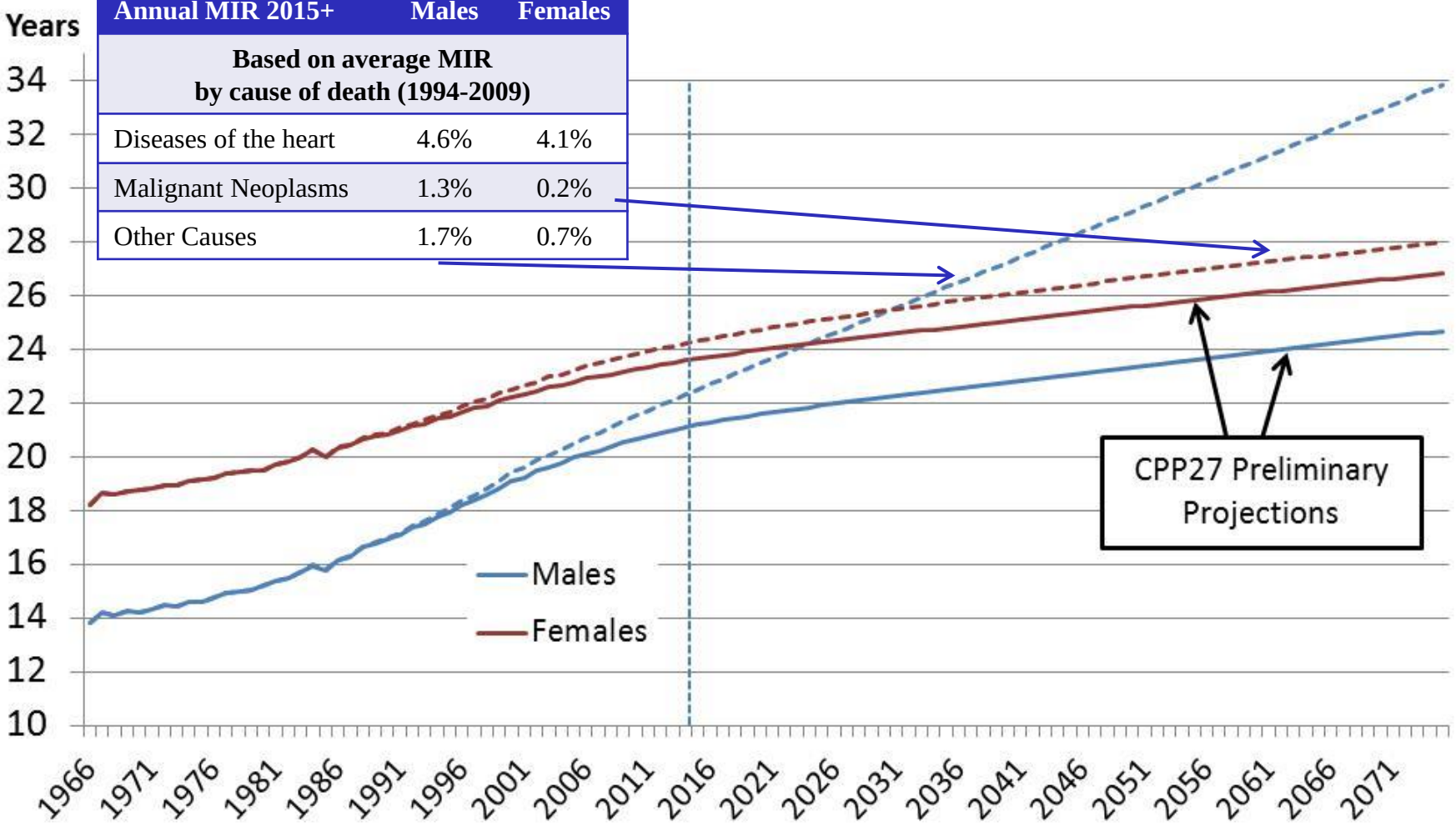
**M: 23.3 years**
**F: 25.6 years**

Sensitivity Tests on Life Expectancy:

| | *+2.5 years* | *-2.5 years* |
|---|---|---|
| | M: **25.8 years**<br>F: **28.1 years** | M: **20.8 years**<br>F: **23.1 years** |
| **Impact on Contribution Rate** | ↑ +0.4% | ↓ -0.4% |

# *Uncertainty of Results*
# *Life Expectancies at age 65 if MIRs by cause are sustained*

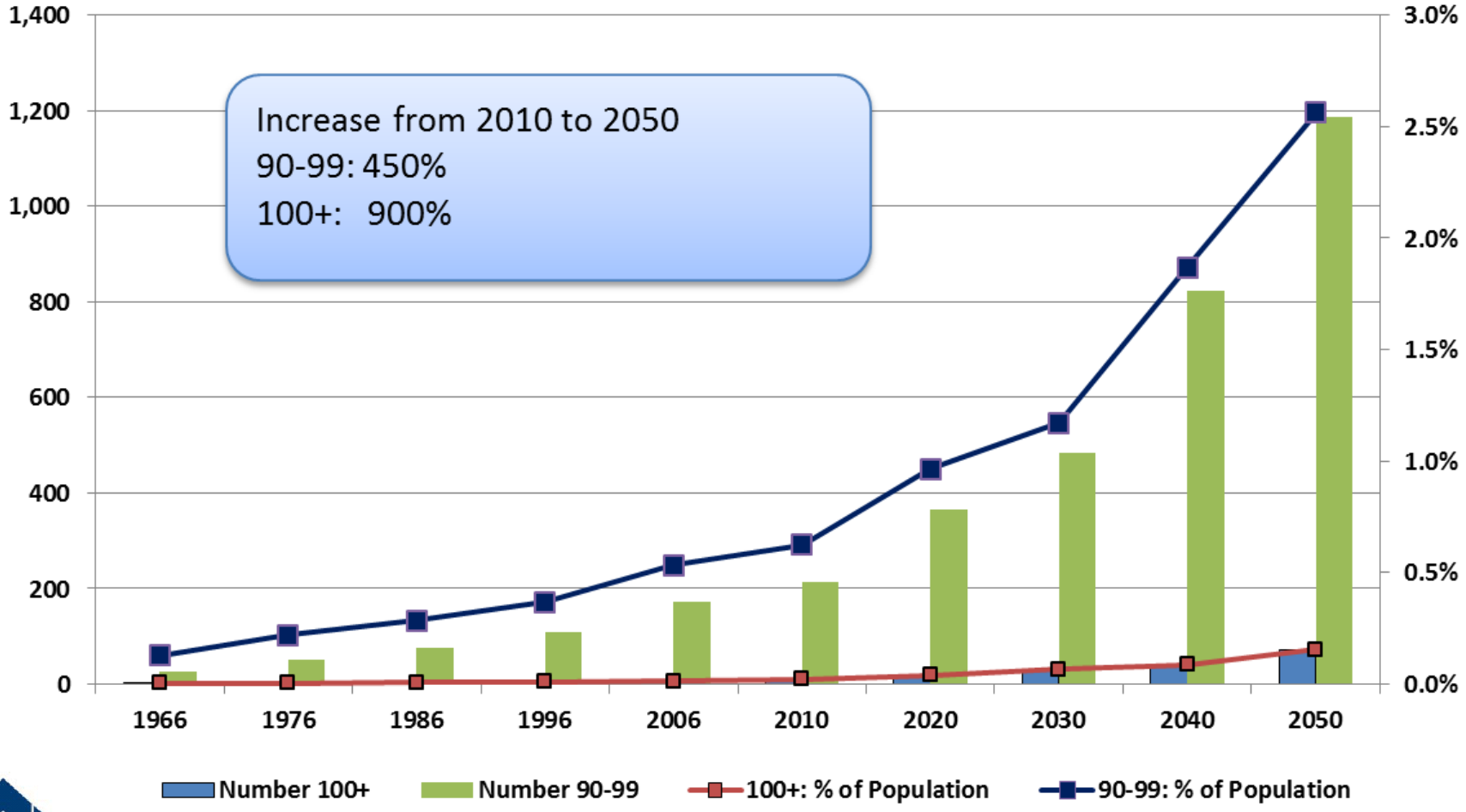
| Annual MIR 2015+ | Males | Females |
|---|---|---|
| **Based on average MIR by cause of death (1994-2009)** | | |
| Diseases of the heart | 4.6% | 4.1% |
| Malignant Neoplasms | 1.3% | 0.2% |
| Other Causes | 1.7% | 0.7% |




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

# *The number of people aged 90 and over increases dramatically*

(in thousands) % of Population



# *Conclusion*

- Retirement is expensive and will become even more expensive in the future with improved longevity
- Projected mortality rates are highly uncertain, especially for people older than age 90
- It is a professional duty of the actuary to examine all available information in order to develop best-estimate mortality assumptions.

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# Living to 100 – Would Canada Pension Plan be Sustainable?

*Thank you*

Questions?

***June 23rd, 2016***

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# Living to 100 – Would Canada Pension Plan be Sustainable?

*Appendix*

***June 23rd, 2016***

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# *Average Mortality Improvement Rates*

| | Males | | | |
|---|---|---|---|---|
| **Average Annual MIR (%)** | **1931-1951** | **1951-1971** | **1971-1991** | **1991-2011** |
| **65-74** | 0.1 | 0.0 | 1.5 | 2.8 |
| **75-84** | 0.3 | 0.4 | 0.9 | 2.3 |
| **85-94** | 0.0 | 0.5 | 0.6 | 1.2 |
| **95-109** | -0.3 | 0.4 | 0.4 | 0.2 |
| **65+** | 0.1 | 0.3 | 1.0 | 2.1 |

*Source: Canadian Human Mortality Database, University of Montreal and Office of the Chief Actuary calculations*

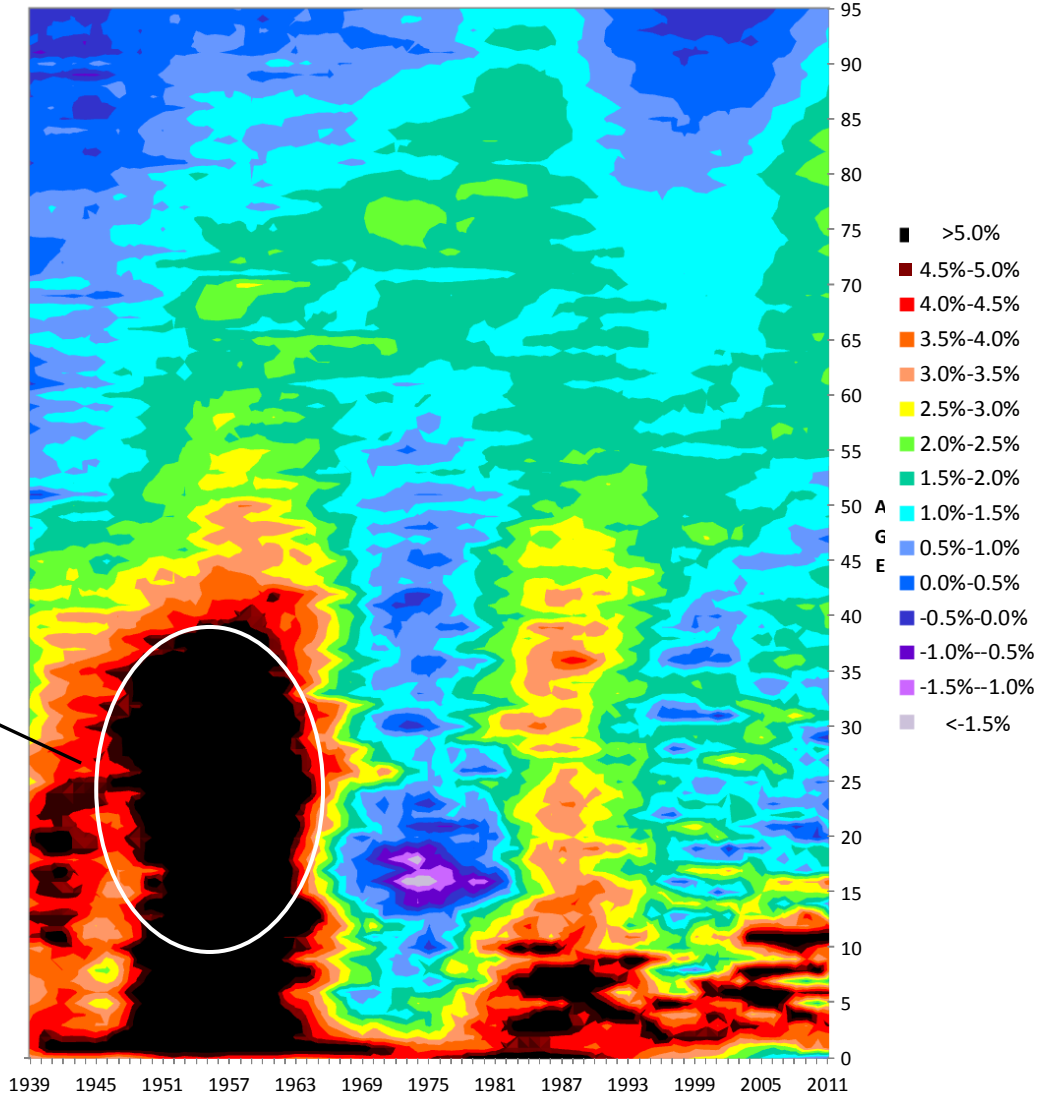
# *Average Mortality Improvement Rates*

| | Females | | | |
|---|---|---|---|---|
| **Average Annual MIR (%)** | **1931-1951** | **1951-1971** | **1971-1991** | **1991-2011** |
| **65-74** | 1.0 | 1.7 | 1.5 | 1.7 |
| **75-84** | 0.6 | 1.5 | 1.4 | 1.7 |
| **85-94** | 0.2 | 0.9 | 1.2 | 0.9 |
| **95-109** | -0.1 | 0.4 | 0.8 | 0.2 |
| **65+** | 0.5 | 1.3 | 1.3 | 1.3 |

*Source: Canadian Human Mortality Database, University of Montreal and Office of the Chief Actuary calculations*

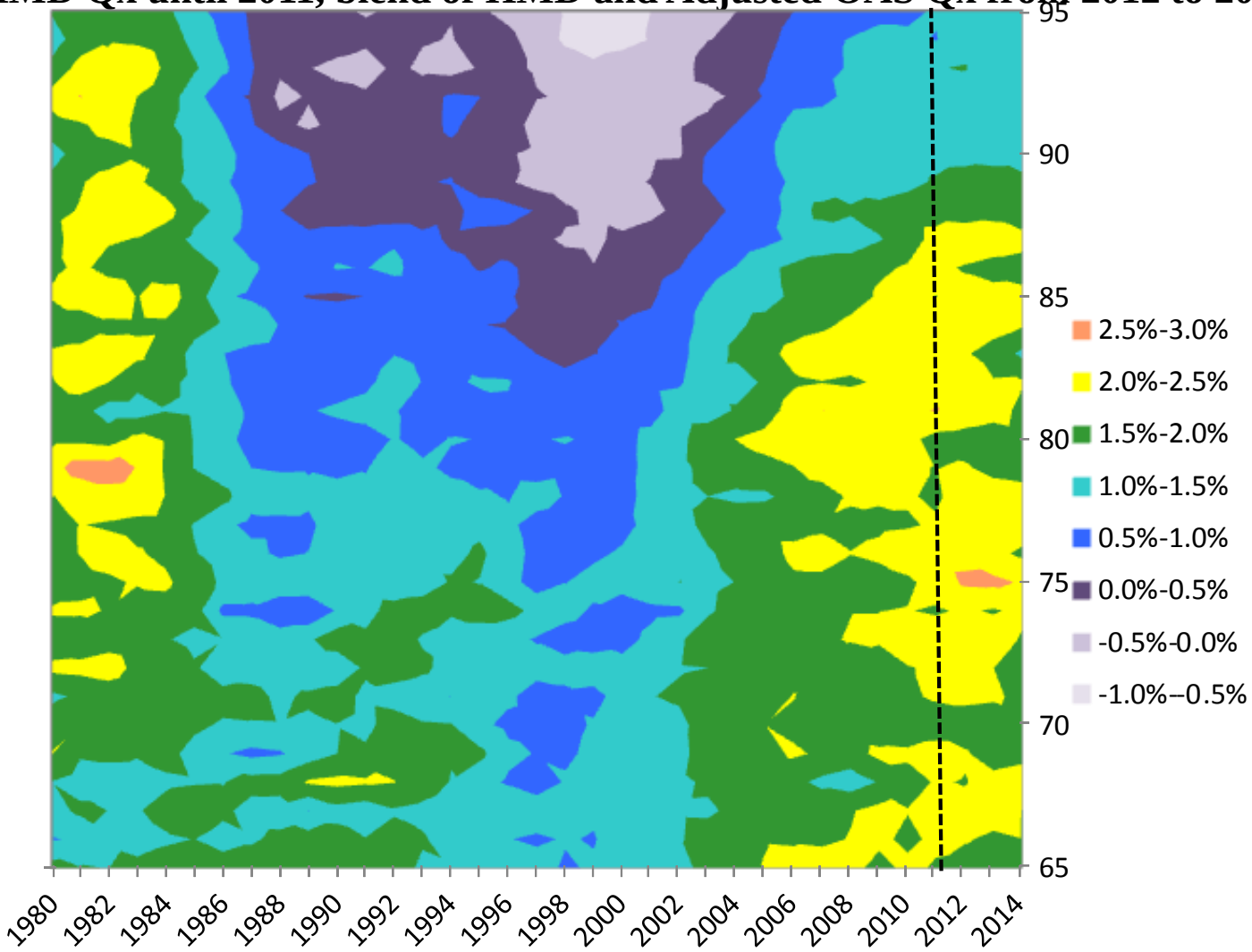
# Females Mortality Improvement Rates based on HMD 15-year Average

Significant Improvements in mothers' health



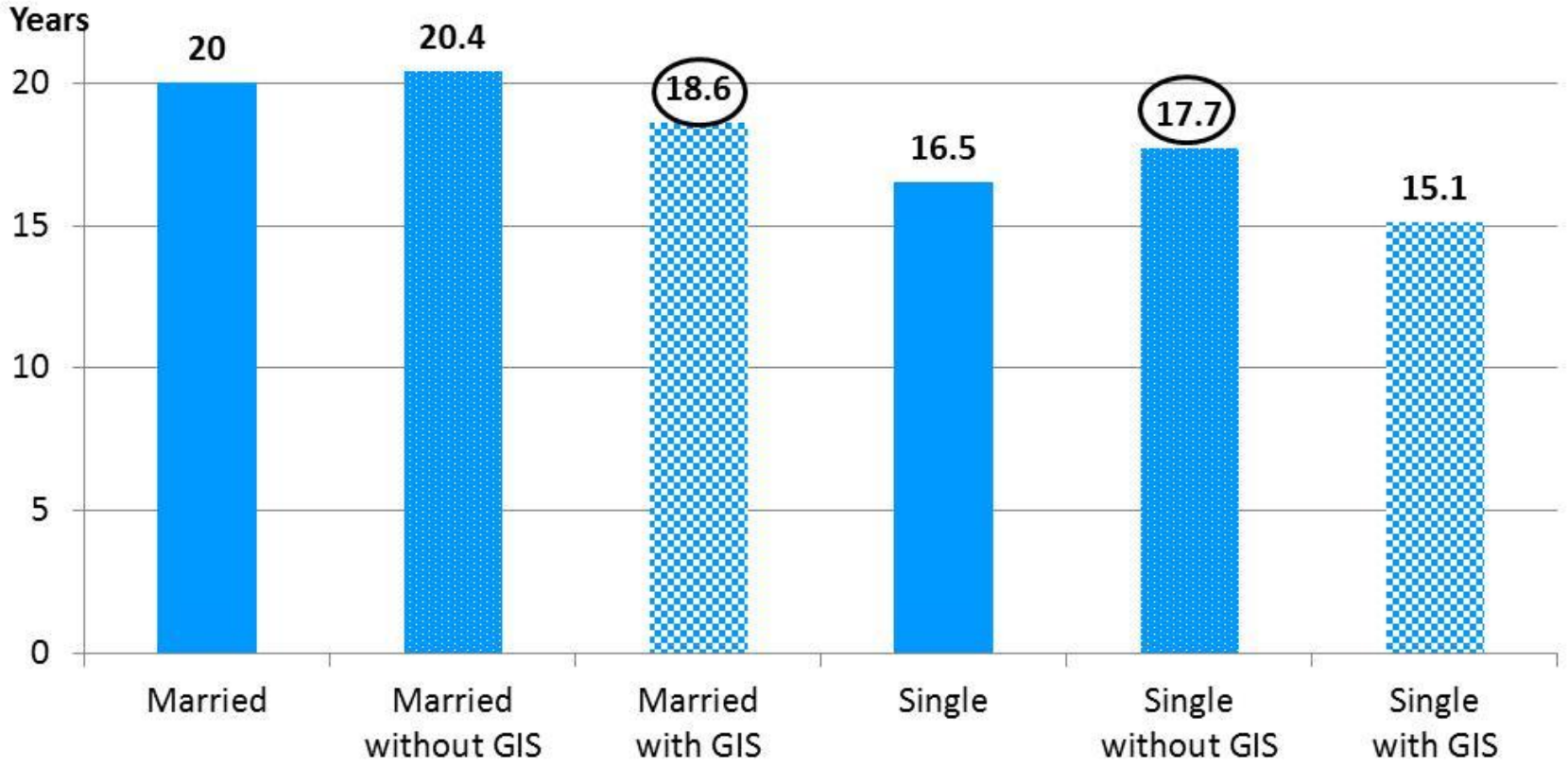
# Females Mortality Improvement Rates
# 10-year Average

**(Based on HMD Qx until 2011, blend of HMD and Adjusted OAS Qx from 2012 to 2014)**



# *Marital Status has more Impact than Level of Income for Men*

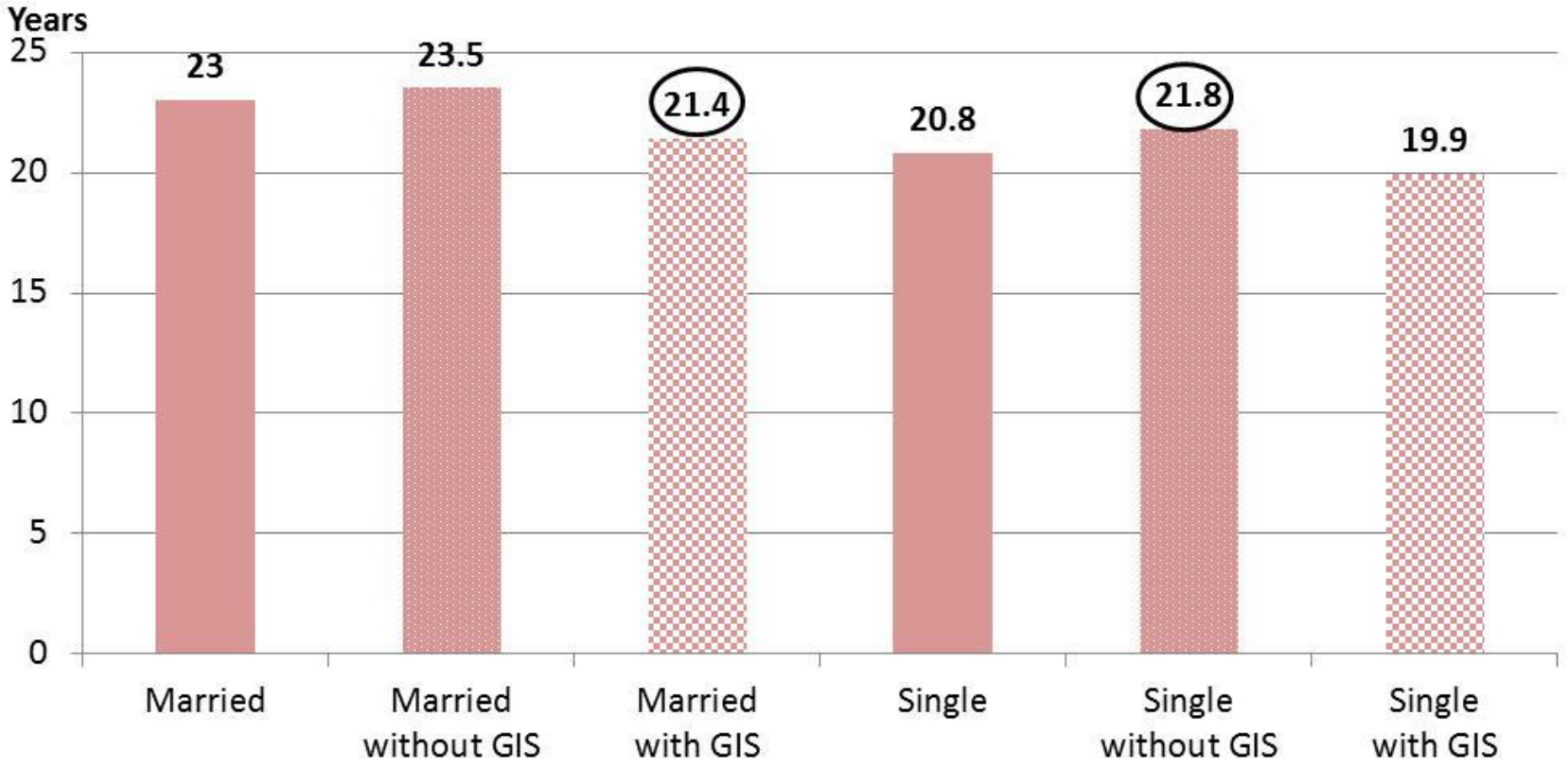
**Life Expectancy at age 65 is HIGHER for Married with GIS than Single without GIS**




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

# *Women*

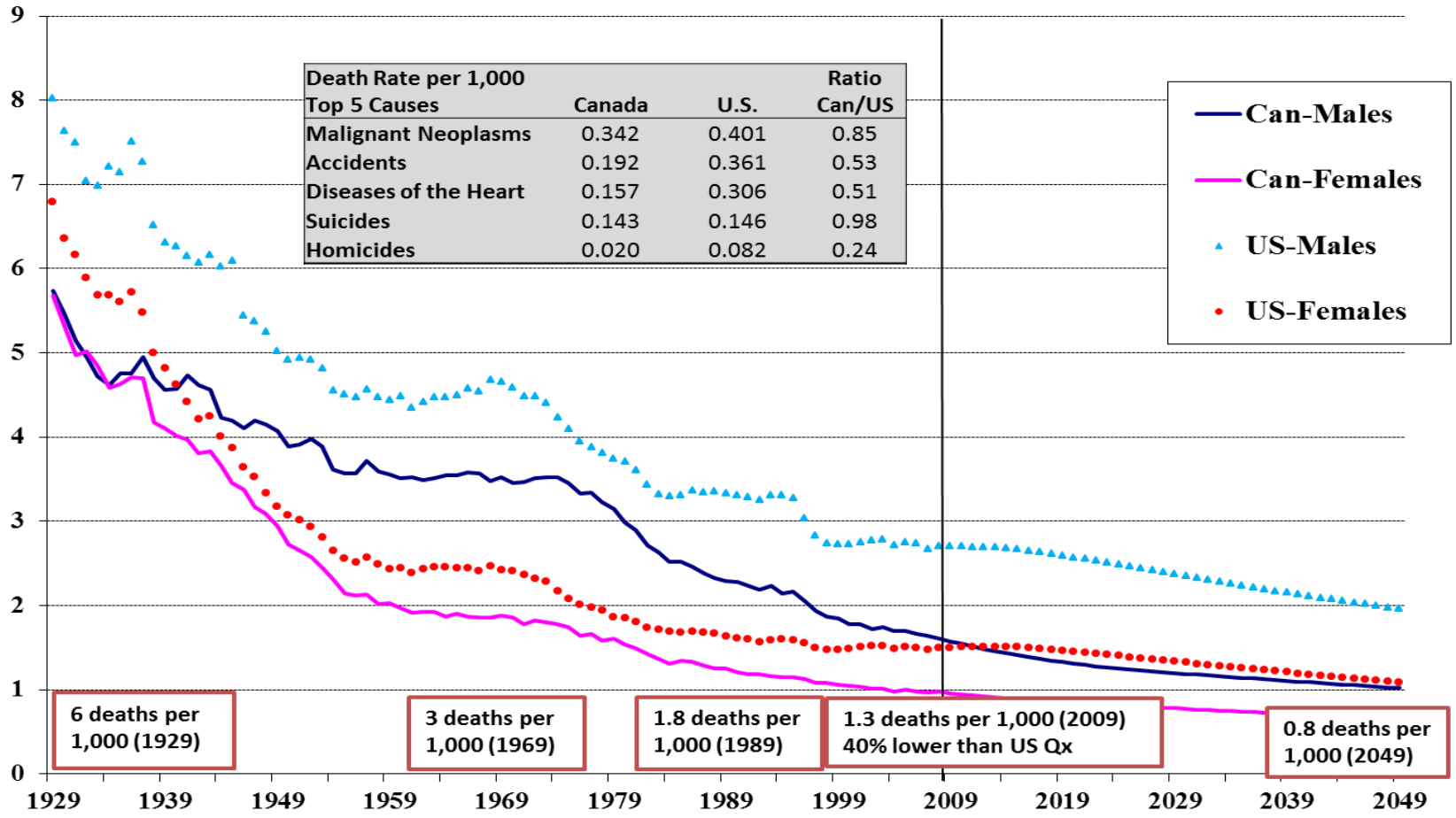
**Life Expectancy at age 65 is LOWER for Married with GIS than Single without GIS**




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

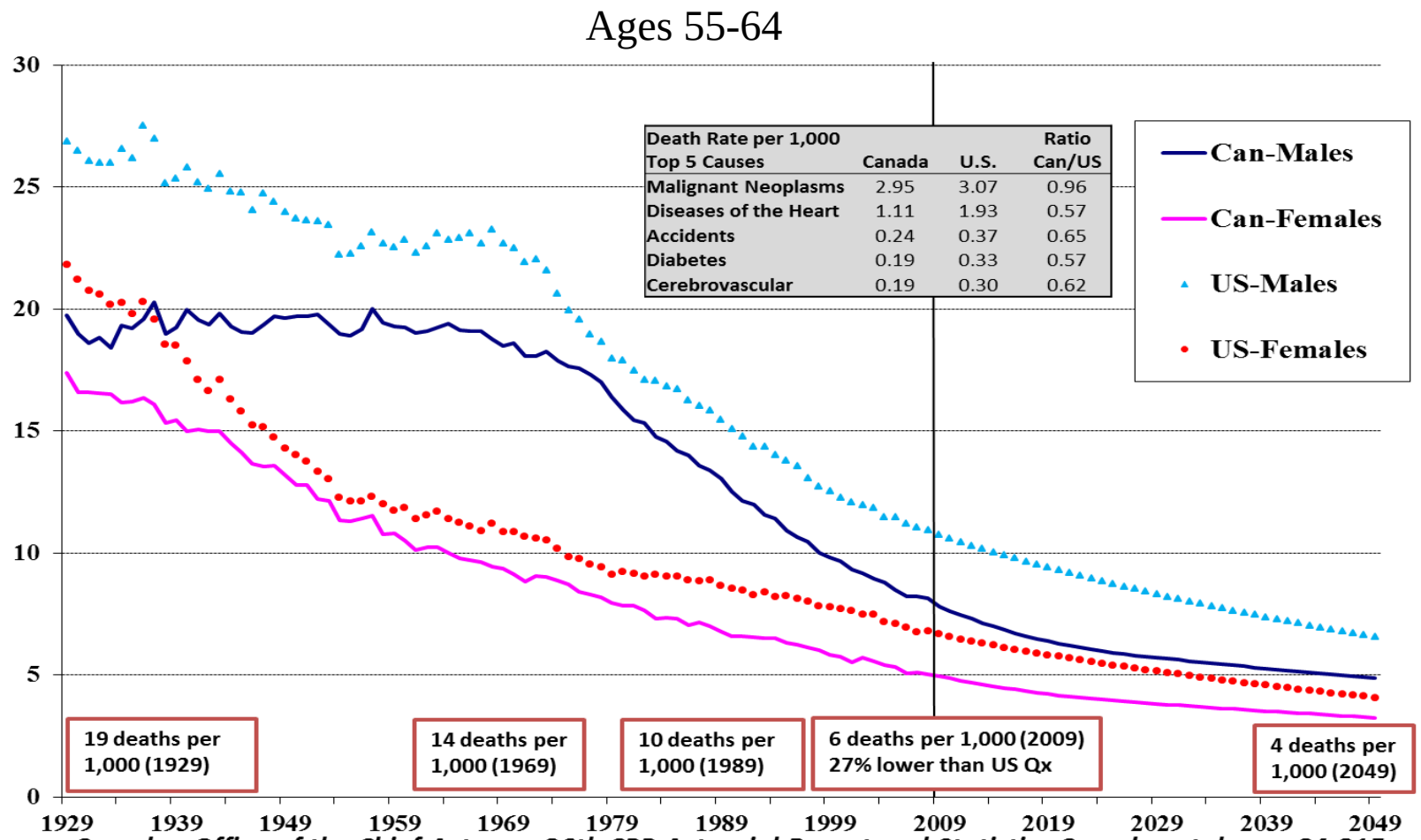
# *Canadian mortality rates at ages 15 to 54 are significantly lower than US rates*

Ages 15-54



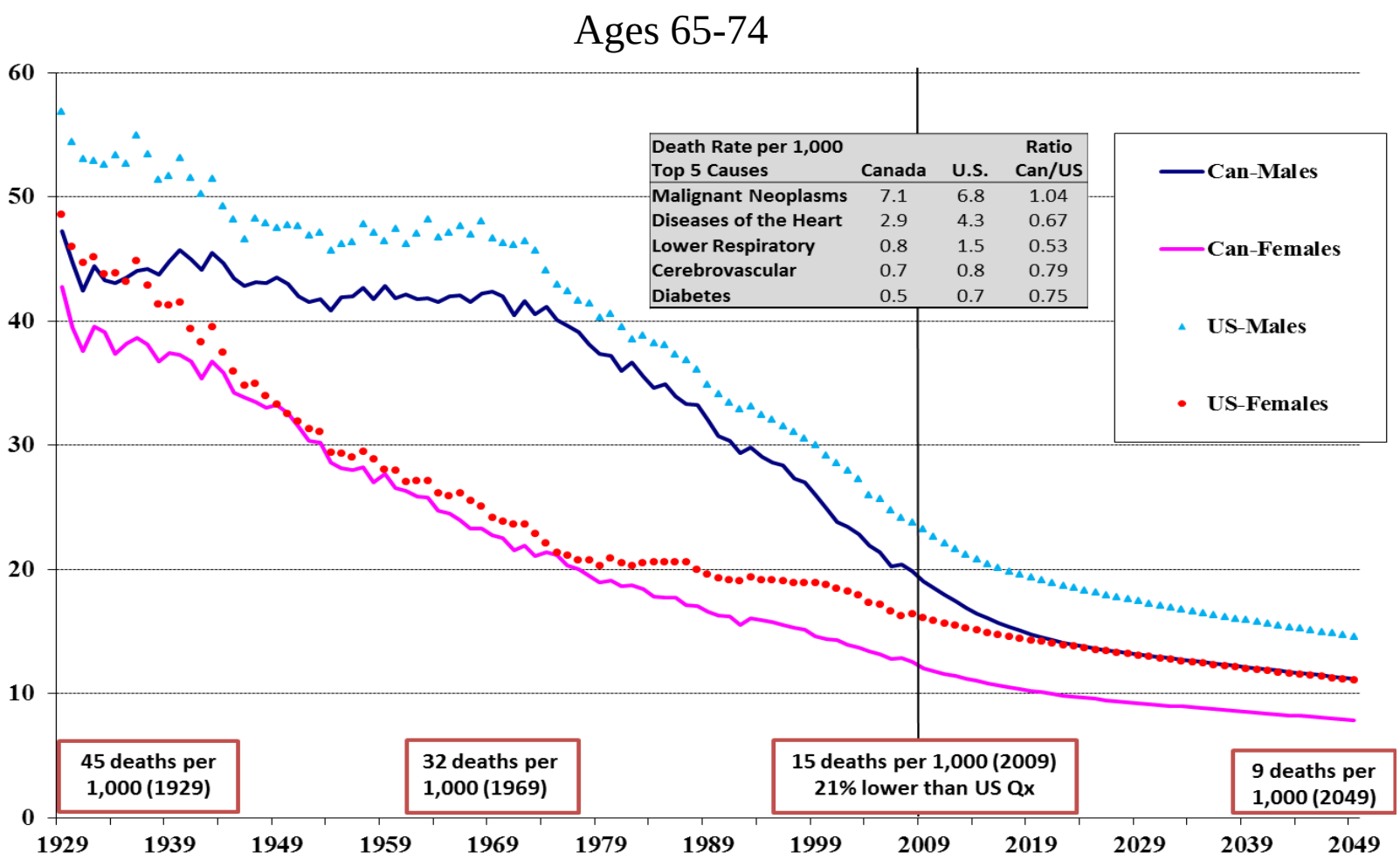

*Source : Canada : Office of the Chief Actuary, 26th CPP Actuarial Report and Statistics Canada catalogue 84-215*
*U.S. : 2012 OASDI Trustees Report and U.S. National Vital Statistics Report, Volume 60 No.3*
*All rates are standardized using the 2012 Canadian population*

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




*Source : Canada : Office of the Chief Actuary, 26th CPP Actuarial Report and Statistics Canada catalogue 84-215-x*
*U.S. : 2012 OASDI Trustees Report and U.S. National Vital Statistics Report, Volume 60 No.3*
*All rates are standardized using the 2012 Canadian population*

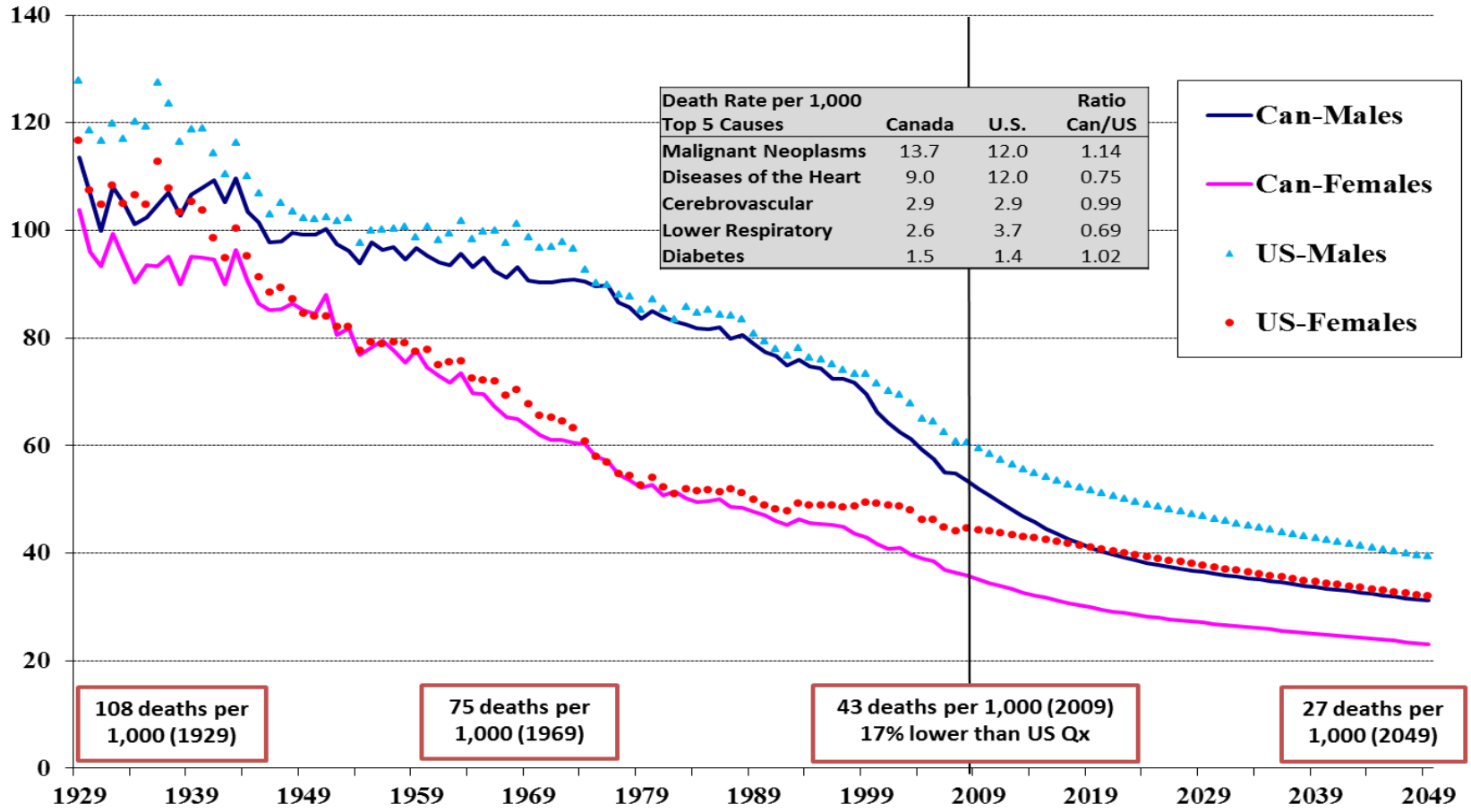
# *For ages 65 to 74, 7 deaths per 1,000 are from cancer, while only 3 deaths per 1,000 are from heart diseases*




*Source : Canada : Office of the Chief Actuary, 26th CPP Actuarial Report and Statistics Canada catalogue 84-215-x*
*U.S. : 2012 OASDI Trustees Report and U.S. National Vital Statistics Report, Volume 60 No.3*
*All rates are standardized using the 2012 Canadian population*

# *Male mortality rates for ages 75 to 84 for Canada are projected to become lower than US female mortality rates*

Ages 75-84

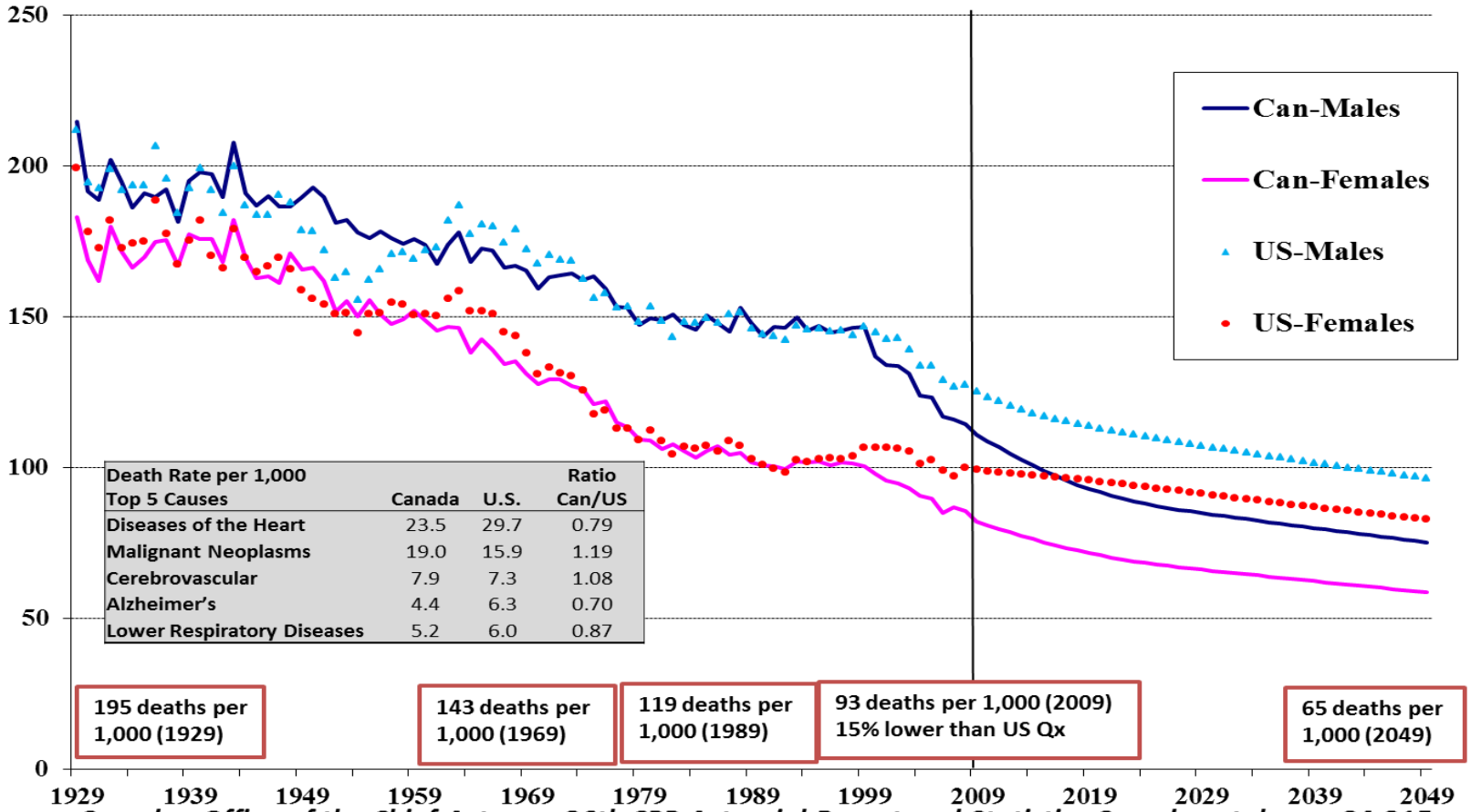



| Death Rate per 1,000 Top 5 Causes | Canada | U.S. | Ratio Can/US |
|---|---|---|---|
| Malignant Neoplasms | 13.7 | 12.0 | 1.14 |
| Diseases of the Heart | 9.0 | 12.0 | 0.75 |
| Cerebrovascular | 2.9 | 2.9 | 0.99 |
| Lower Respiratory | 2.6 | 3.7 | 0.69 |
| Diabetes | 1.5 | 1.4 | 1.02 |

*Source : Canada : Office of the Chief Actuary, 26th CPP Actuarial Report and Statistics Canada catalogue 84-215-x*
*U.S. : 2012 OASDI Trustees Report and U.S. National Vital Statistics Report, Volume 60 No.3*
*All rates are standardized using the 2012 Canadian population*

# *Elderly Mortality Rates have decreased over the last 80 years, more so over the last 10 years*

Ages 85-89

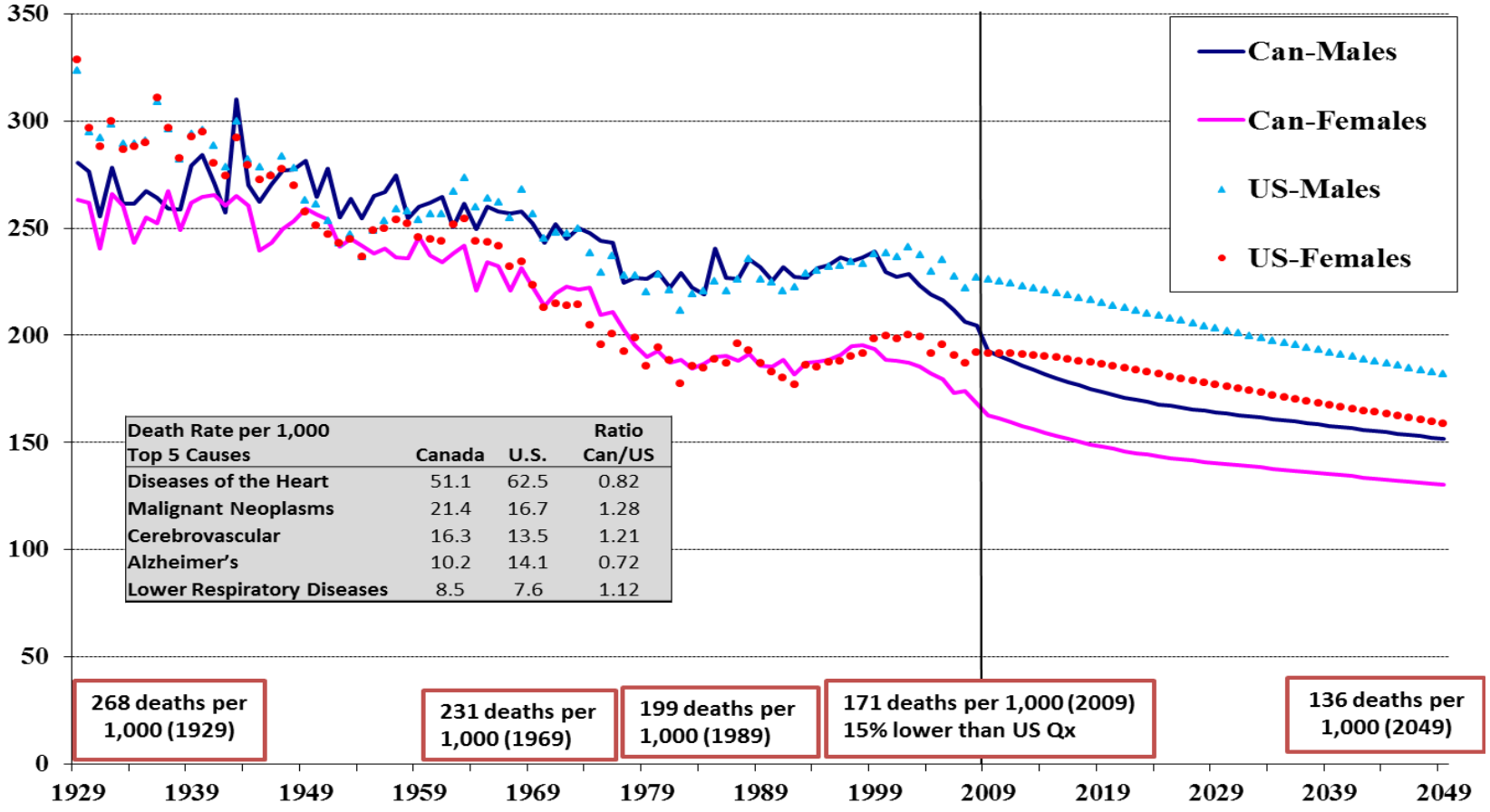



| Death Rate per 1,000 Top 5 Causes | Canada | U.S. | Ratio Can/US |
|---|---|---|---|
| Diseases of the Heart | 23.5 | 29.7 | 0.79 |
| Malignant Neoplasms | 19.0 | 15.9 | 1.19 |
| Cerebrovascular | 7.9 | 7.3 | 1.08 |
| Alzheimer's | 4.4 | 6.3 | 0.70 |
| Lower Respiratory Diseases | 5.2 | 6.0 | 0.87 |

*Source : Canada : Office of the Chief Actuary, 26th CPP Actuarial Report and Statistics Canada catalogue 84-215-x*
*U.S. : 2012 OASDI Trustees Report and U.S. National Vital Statistics Report, Volume 60 No.3*
*All rates are standardized using the 2012 Canadian population*

# *For ages over 90, heart diseases remain the main cause of deaths*

Ages 90+

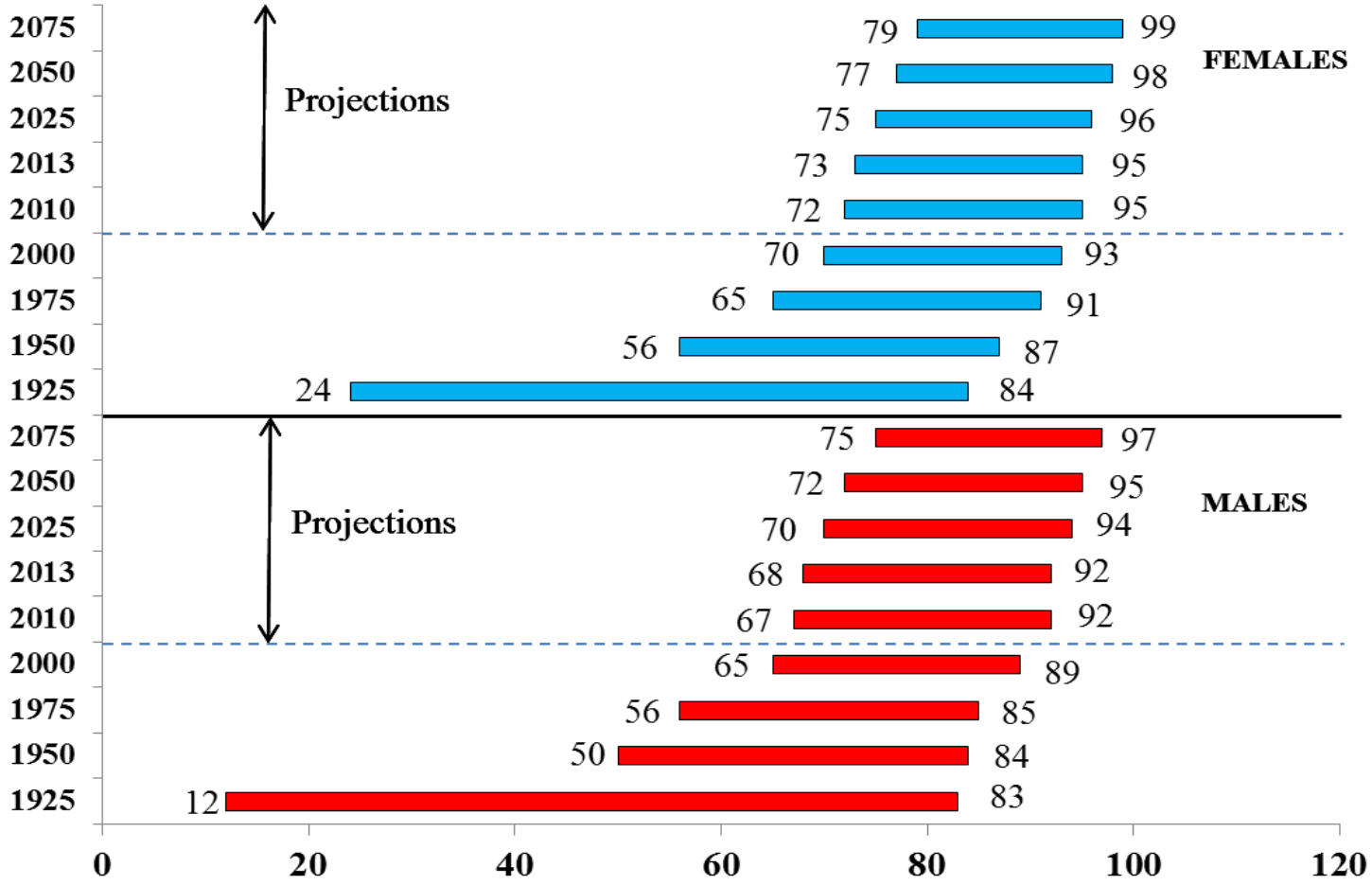



| Death Rate per 1,000 Top 5 Causes | Canada | U.S. | Ratio Can/US |
|---|---|---|---|
| Diseases of the Heart | 51.1 | 62.5 | 0.82 |
| Malignant Neoplasms | 21.4 | 16.7 | 1.28 |
| Cerebrovascular | 16.3 | 13.5 | 1.21 |
| Alzheimer's | 10.2 | 14.1 | 0.72 |
| Lower Respiratory Diseases | 8.5 | 7.6 | 1.12 |

*Source : Canada : Office of the Chief Actuary, 26th CPP Actuarial Report and Statistics Canada catalogue 84-215-x*
*U.S. : 2012 OASDI Trustees Report and U.S. National Vital Statistics Report, Volume 60 No.3*
*All rates are standardized using the 2012 Canadian population*

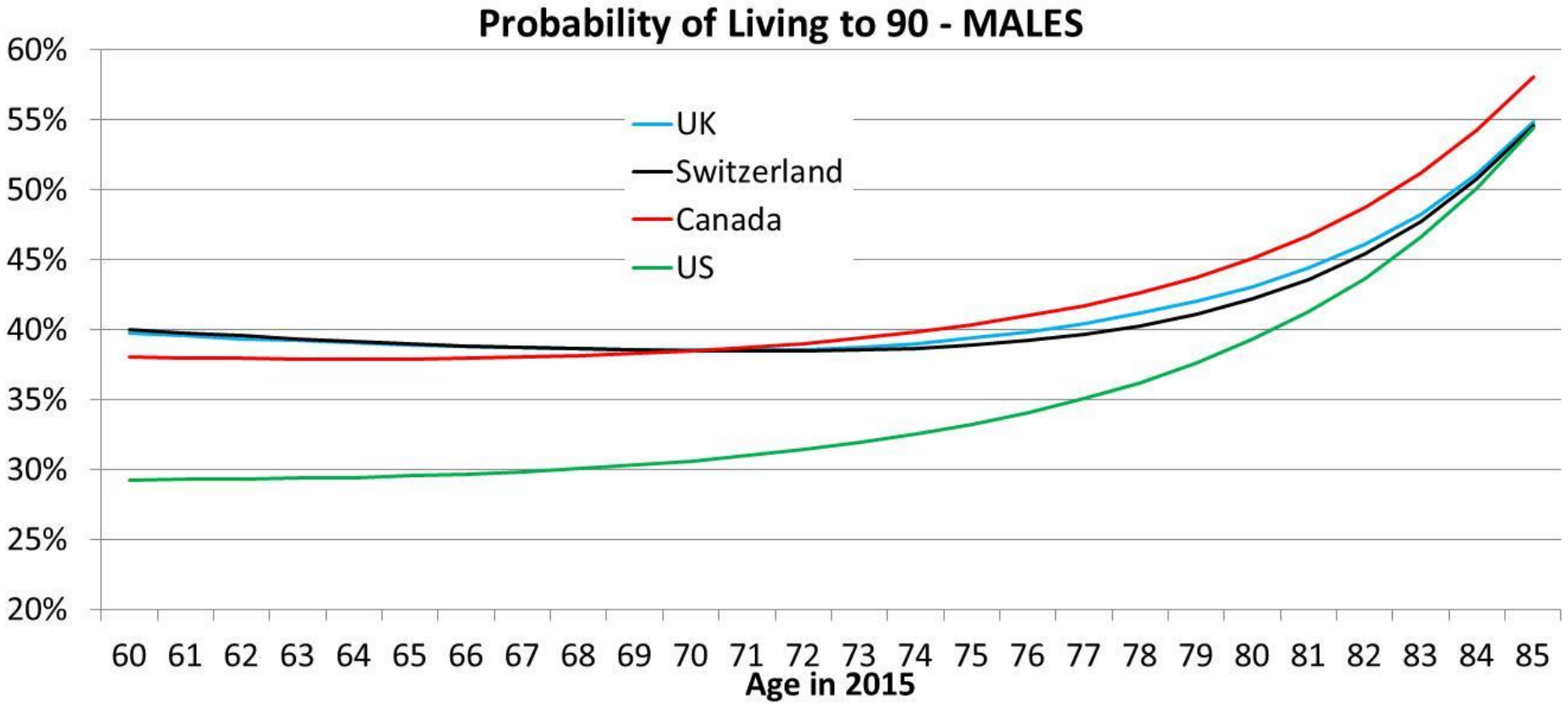
# *The likelihood of premature mortality decreased significantly*

**Evolution of Distribution of Age at Death (15th to 85th Percentile)**



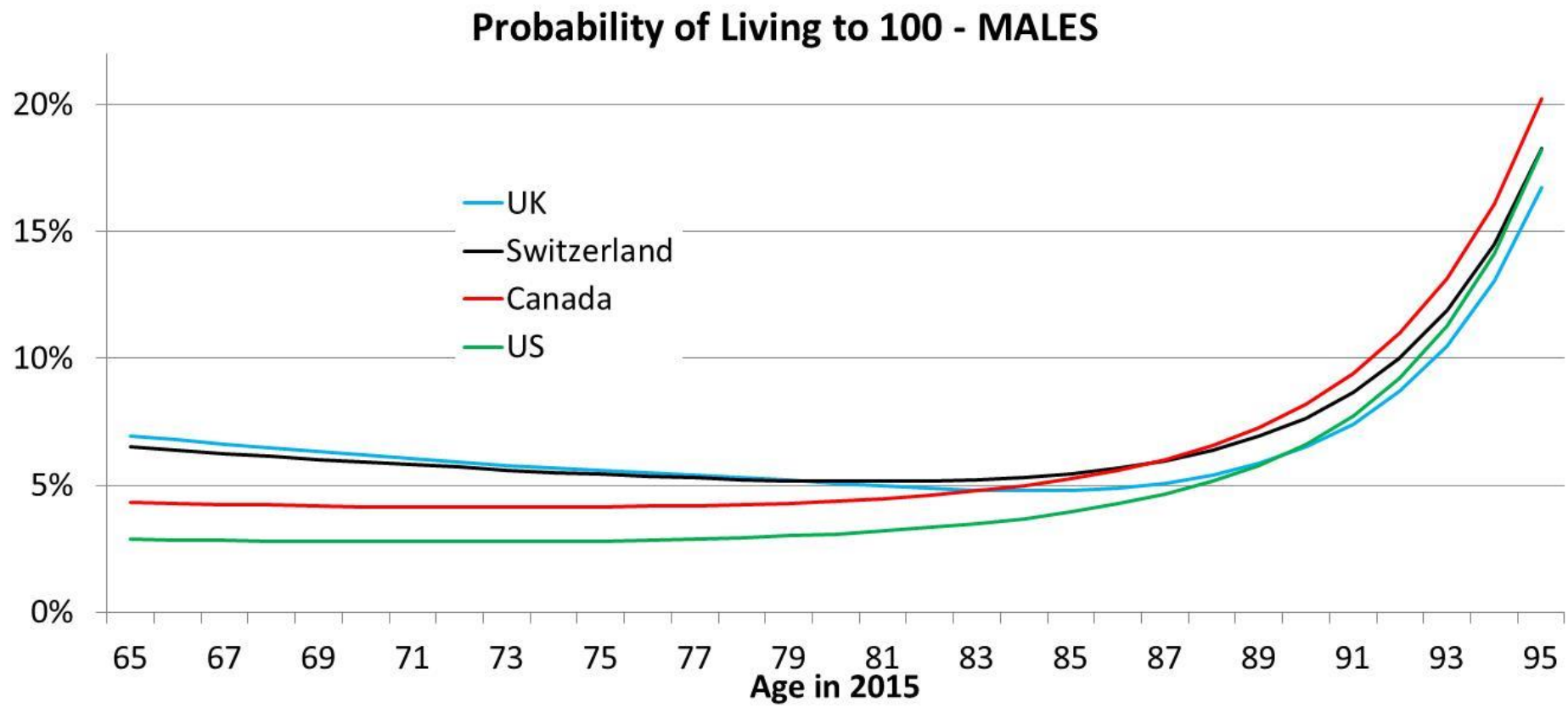

Probabilities are based on the mortality rates of the calendar year of birth.

# *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*