



Life Expectancy in 2040: What do clinical Experts Expect?

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Outline

- Motivation & Aim
- Methods: JHU clinical expert panels
- Age & cause of death contribution:
from 2009 - forecast 2040

Motivation

Mortality projections are based either on:

- Overall mortality: Lee-Carter, Bayesian models (UN), etc.
- Cause-specific mortality: Lee-Carter, least-squares (SSA), etc.

Motivation

- All projections require assumptions about the future.
- Actuaries & demographers are the primary groups consulted on information on future mortality.

AIM

1. To make mortality **projections for the next 30 years** that account for future advancements in medicine and public health.
2. To examine mortality for specific causes of death

Data & Methods

- Cause of death information 2009: CDC data on deaths by age, cause, and sex
- Overall mortality 1933-2009: HMD
- Mortality forecasts from experts

Causes of Death in the US in 2009

Table 1. Distribution of deaths (%) by broad causes of death for the US Population in 2009.

Causes	Females	Males
Cardiovascular D.	32.8	31.6
Neoplasm	22.8	25.0
Respiratory D.	10.2	9.4
Nervous Sys.	6.6	4.4
External	4.7	10.0
Diabetes M.	4.1	4.0
Other	18.9	15.6

Source: CDC, WONDER datafile.

Note: External includes accidents, homicide and suicides.

Clinical Expert Panels

- Identified clinical and content experts in disease and sub-clinical areas in Johns Hopkins School of Medicine and School of Public Health

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- We interviewed 36 experts (42% full professors, 42% associate professors, 16% assistant professors)

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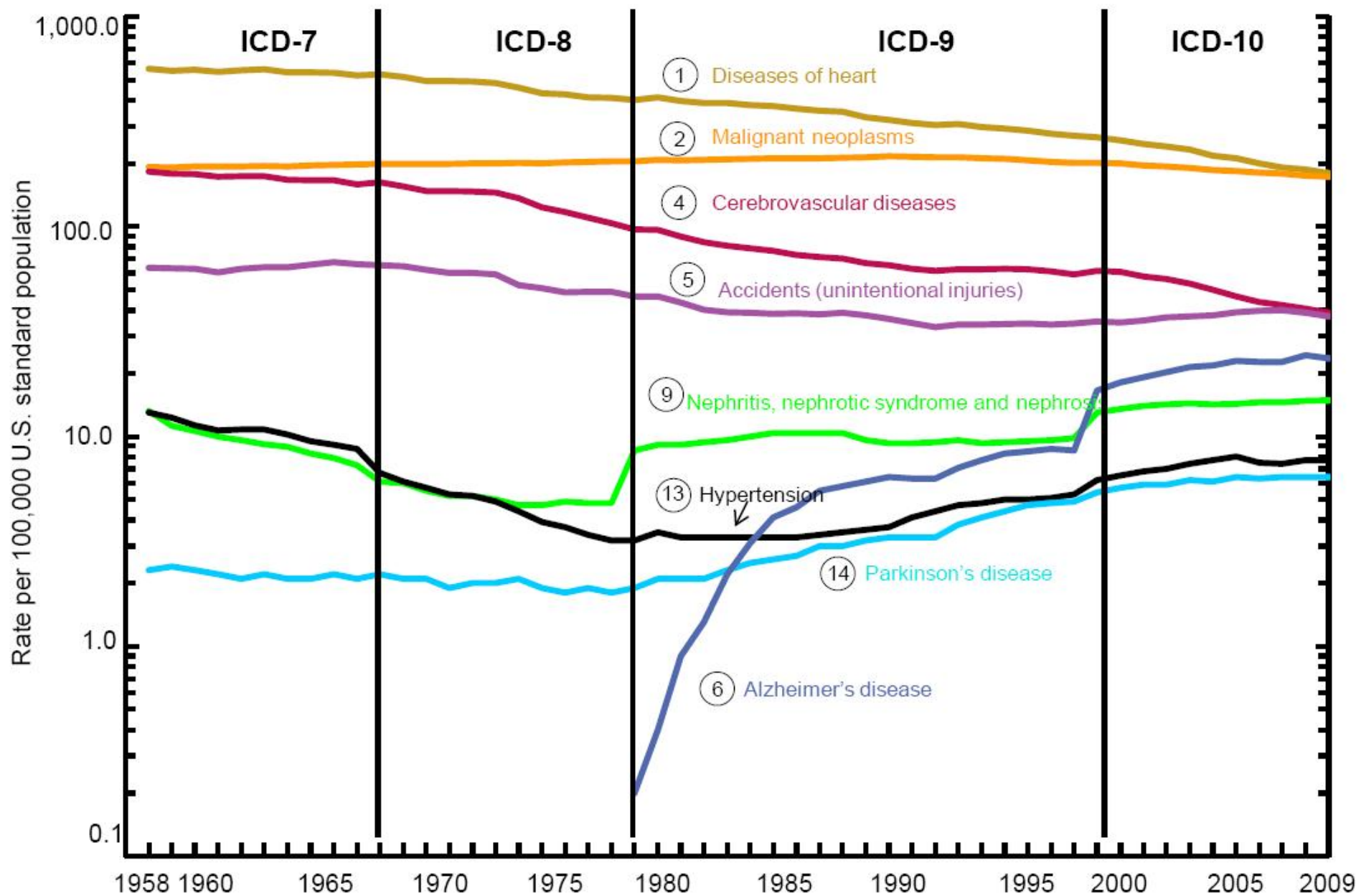
- a) 15 min, presentation of the trends in overall & cause specific mortality in the last 30 yrs
- b) 15 min, given 2009 age- & cause-specific death rates for 6 age groups and asked to estimate the % decline by 2040

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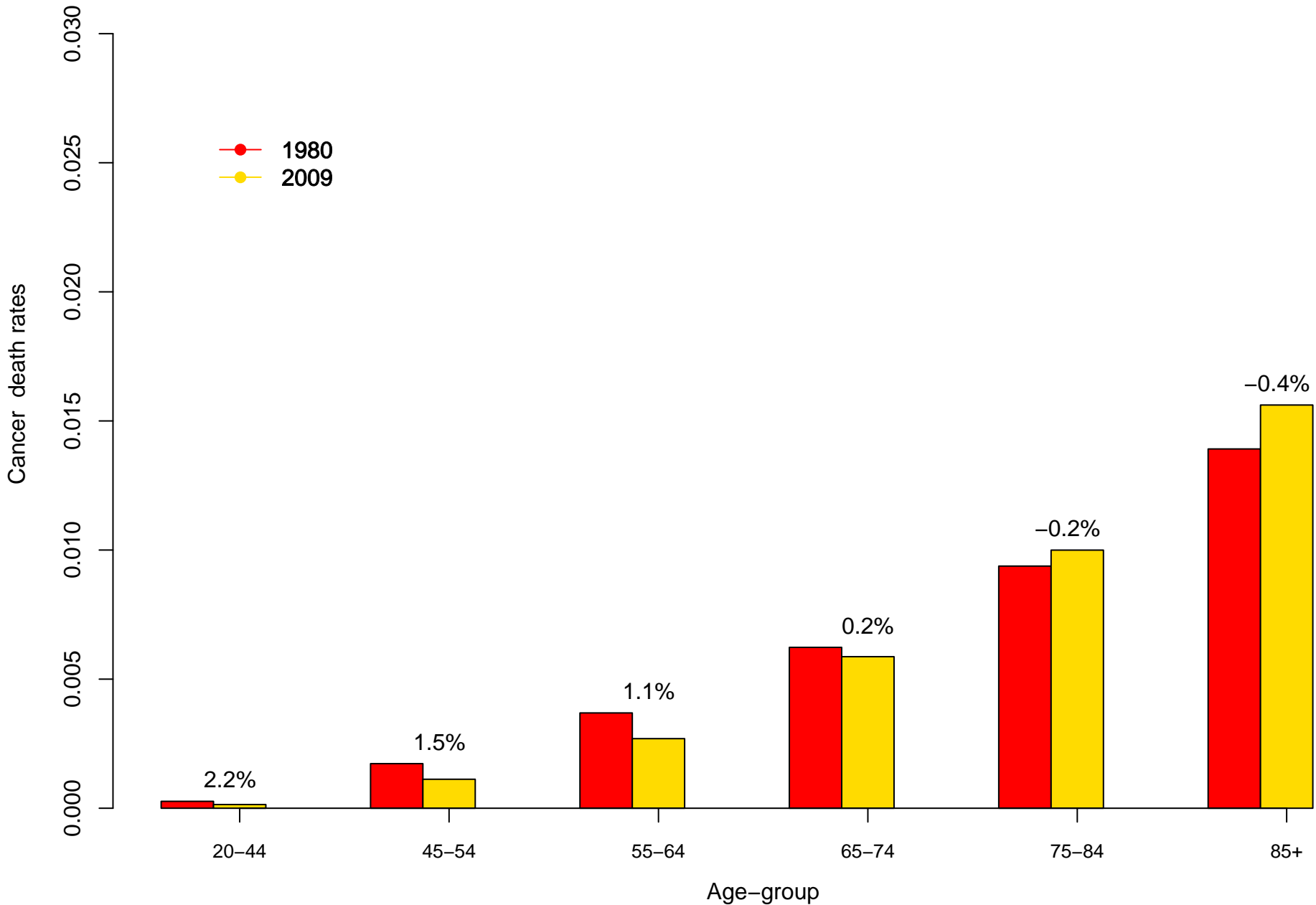
- a) 15 min, presentation of the trends in overall & cause specific mortality in the last 30 yrs
- b) 15 min, given 2009 age- & cause-specific death rates for 6 age groups and asked to estimate the % decline by 2040
- c) 1:30 hour the experts debated on the reasons for the expected declines.

Figure 6. Age-adjusted death rates for selected leading causes of death: United States, 1958-2009

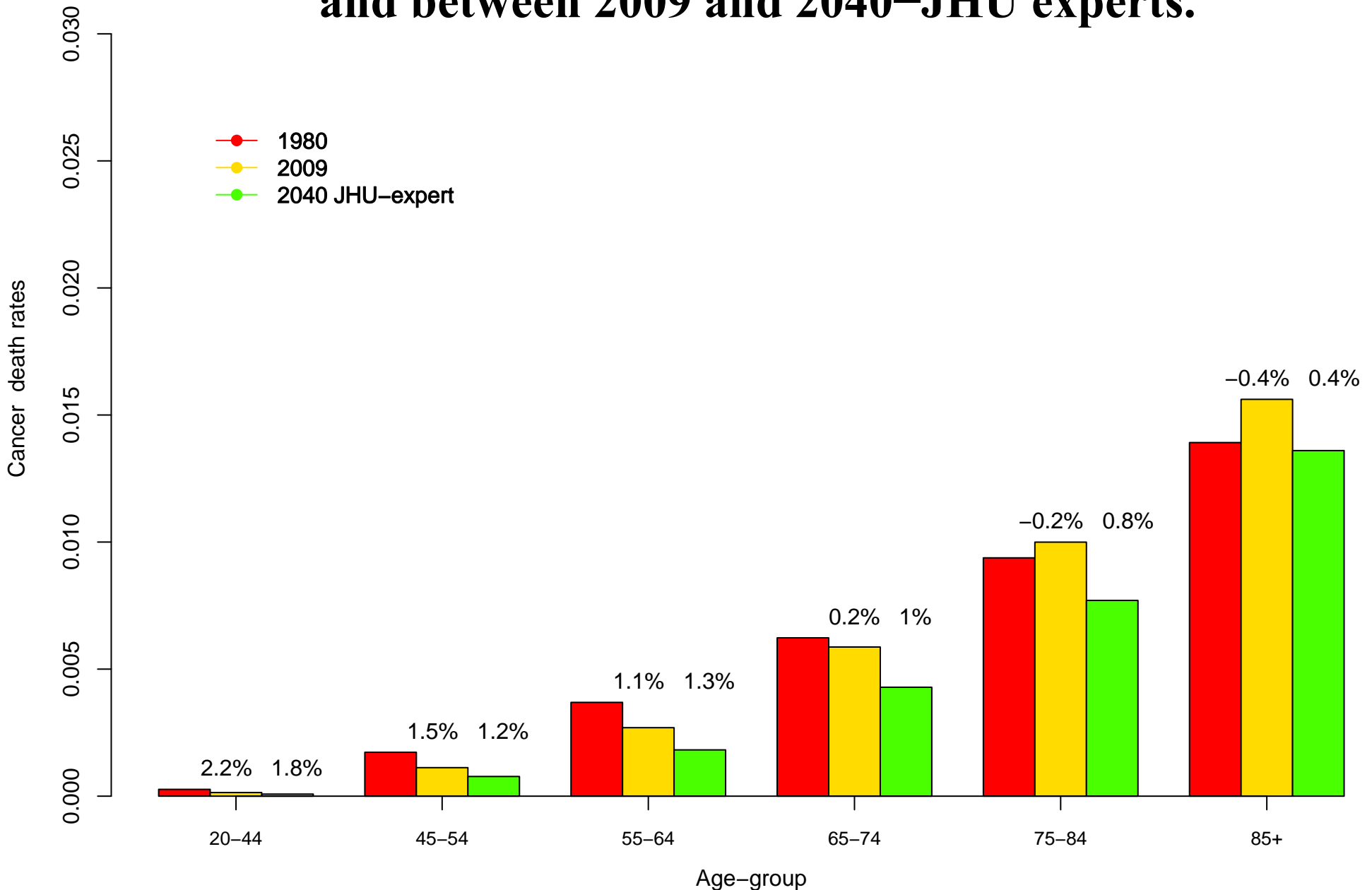


NOTE: ICD is the *International Classification of Diseases*. Circled numbers indicate ranking of conditions as leading causes of death in 2009. Age-adjusted death rates per 100,000 U.S. standard population; see "Technical Notes."
SOURCE: CDC/NCHS, National Vital Statistics System, Mortality.

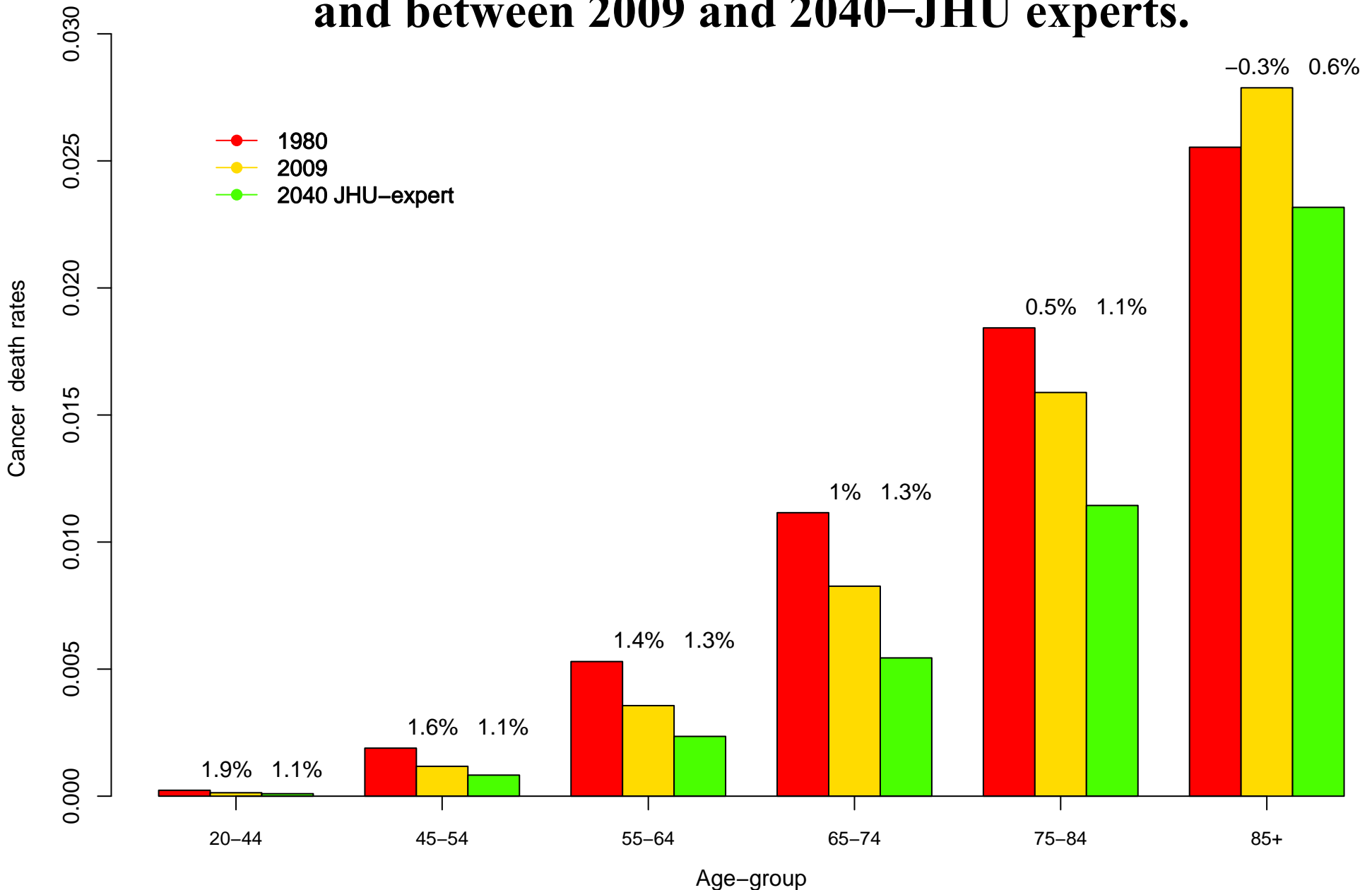
Female annual rates (%) of decline (positive) or increase (negative) in cancer death rates 1980-2009



Female annual rates (%) of decline (positive) or increase (negative) in cancer death rates 1980-2009 and between 2009 and 2040—JHU experts.



Male annual rates (%) of decline (positive) or increase (negative) in cancer death rates 1980-2009 and between 2009 and 2040–JHU experts.



Overall mortality: JHU expert opinion

- **Overall mortality, $m(x)$,** combines:
cardiovascular disease, cancer, external causes, diabetes, respiratory diseases, nervous system and *other causes* of death.

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cardiovascular disease, cancer, external causes, diabetes, respiratory diseases, nervous system and *other causes* of death.
- We assumed death rates from *other causes* changed at half the rate of the 6-panels .

US life expectancy at age 20 by sex in 2009 & JHU experts in 2040

<u>Year</u>	<u>Gender</u>	
	Female	Male
2040	64.6	60.5
2009	61.8	57.1
Change	2.8	3.4

The Age- & Cause-Contribution in the 2009-Forecast 2040

Age- & cause-contribution to the change in life expectancy

Most of the increase in life expectancy by period - attributable to causes of death

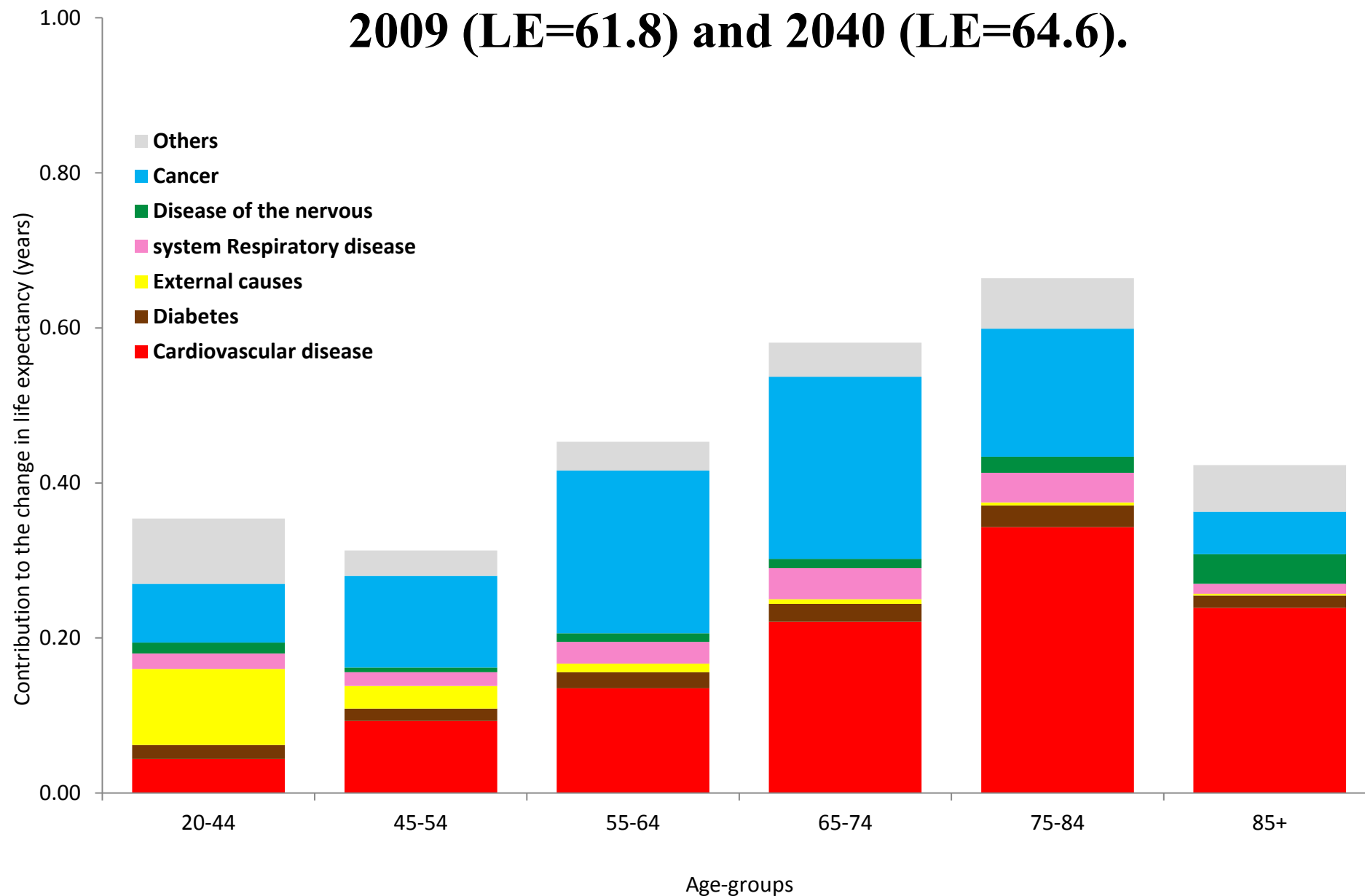
Period	Main cause of death
1970-2009	Cardiovascular disease

Age- & cause-contribution to the change in life expectancy

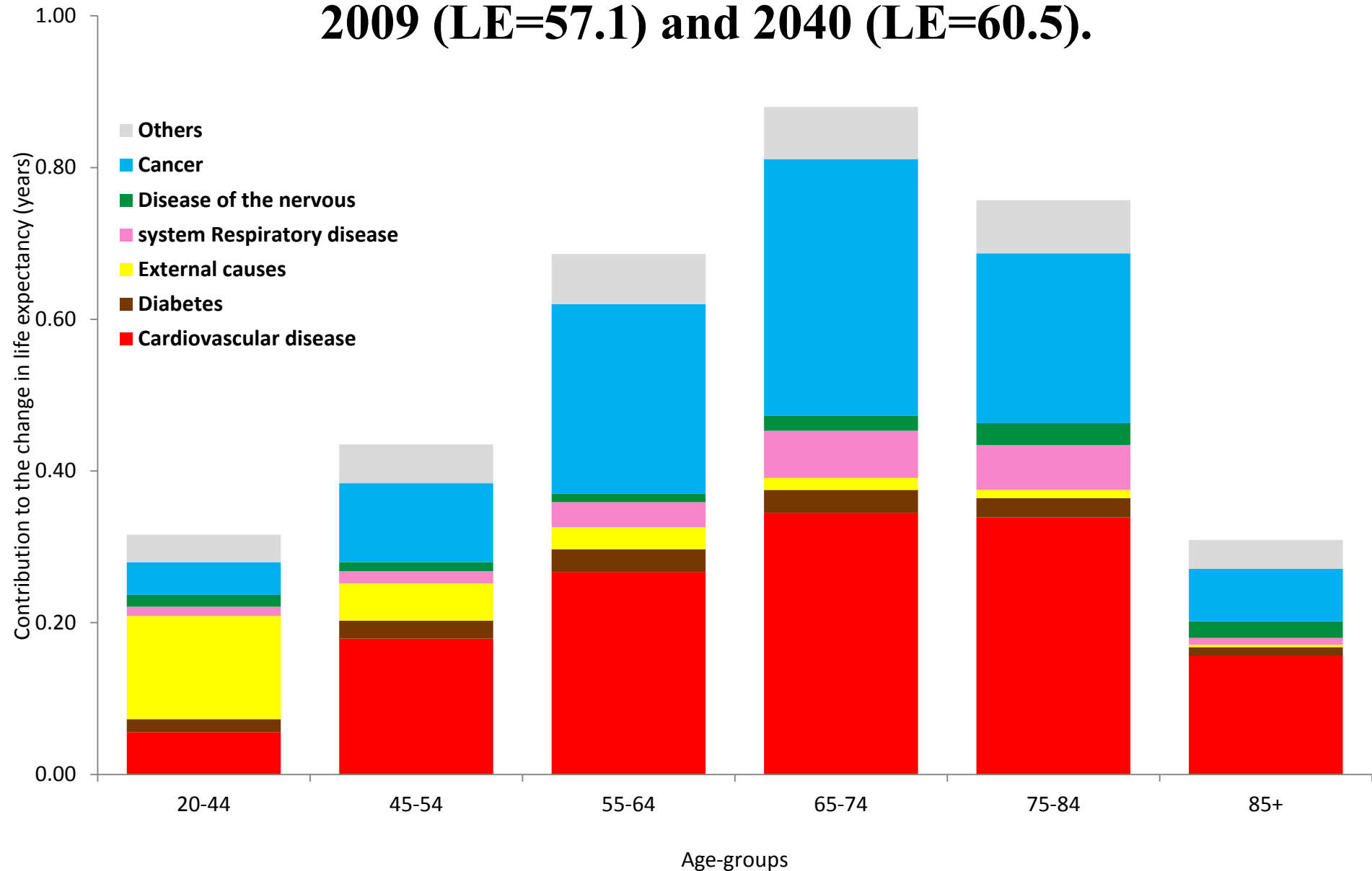
Most of the increase in life expectancy by period - attributable to causes of death

Period	Main cause of death
1970-2009	Cardiovascular disease
2009-2040	Cardiovascular and cancers

Age- and cause-contribution to the 2.8 years in the US female life expectancy at age 20 (LE) between 2009 (LE=61.8) and 2040 (LE=64.6).



Age- and cause-contribution to the 3.4 years in the US male life expectancy at age 20 (LE) between 2009 (LE=57.1) and 2040 (LE=60.5).



Contributions

- JHU experts: US life expectancy will keep increasing, it will be 3 years higher by 2040
- CVD and cancers will be the driving causes of the changes in mortality
- The experts discussed some of the reasons of these changes in mortality

What Will Improve Mortality ?

	Primary Prevention	Secondary Prevention	Tertiary Prevention
Cardiovascular Disease			
Cancer			

* Identified by experts as having a significant impact

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	Primary Prevention	Secondary Prevention	Tertiary Prevention
Cardiovascular Disease	<ul style="list-style-type: none">• Smoking reductions *• Improved diet• Greater use of statins and aspirin• Improvements in genomics leading to better risk prediction	<ul style="list-style-type: none">• Technologies simplifying medication adherence	<ul style="list-style-type: none">• Stem cell therapies• Artificial hearts• Greater use of percutaneous therapies• Greater use of ICDs
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Cancer	<ul style="list-style-type: none">• Smoking reductions *• New vaccines that prevent cancers	<ul style="list-style-type: none">• Earlier diagnosis and treatment• Epi-genetic testing	<ul style="list-style-type: none">• New Immuno-therapies

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What Will Improve Mortality ?

	Primary Prevention	Secondary Prevention	Tertiary Prevention
Respiratory Disease	<ul style="list-style-type: none">• Smoking reductions*• Declines in air pollution	<ul style="list-style-type: none">• Increased use of spirometry• Better classifications of IPF and COPD subtypes	<ul style="list-style-type: none">• Longer acting treatments
Alzheimer's Disease	<ul style="list-style-type: none">• Smoking reductions*• Physical activity• Improving sleeping habits	<ul style="list-style-type: none">• Cerebrospinal Fluid Profile	

What Will Improve Mortality ?

	Primary Prevention	Secondary Prevention	Tertiary Prevention
External Causes	<ul style="list-style-type: none">• Smoking & alcohol reductions• Improvements in automobile safety*		<ul style="list-style-type: none">• Improvements in trauma care
Diabetes Mellitus	<ul style="list-style-type: none">• Smoking reductions• Improved diet• Immunotherapy curing Type-1 diabetes	<ul style="list-style-type: none">• Increasing use of insulin• Development of faster acting insulins	<ul style="list-style-type: none">• Health care reform – intensive life style interventions

Compare Forecasts:

- JHU Experts
- Social Security Administration
- Demographic Model

Comparing forecasts

We compare JHU experts' forecasts to:

- Social Security Administration (SSA)
- Standard demographic models (Lee-Carter) based on historical mortality information from Human Mortality Database from 1933 to 2009.

US life expectancy at age 20 by sex in 2009 and 2040 JHU-experts, SSA and Lee-Carter.

		<u>Gender</u>	
		Female	Male
<u>2040</u>	2009	61.8	57.1
	JHU	64.6	60.5
	SSA	64.4	60.4
	Lee-Carter	65.6	60.7

US life expectancy at age 65 by sex in 2009 and 2040 JHU-experts, SSA and Lee-Carter.

		<u>Gender</u>	
		Female	Male
<u>2040</u>	2009	20.5	17.8
	JHU	22.3	20.2
	SSA	22.2	20.1
	Lee-Carter	22.7	19.4

Conclusions

- Multidisciplinary mortality forecast
- Experts shared reasons of future change

Funding

- The insurance company AIG
- European Research Council

Life Expectancy in 2040: What Do Clinical Experts Expect?

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and Gerard Anderson**

We use expert clinical and public health opinion to estimate likely changes in the prevention and treatment of important disease conditions and how they will affect future life expectancy. Focus groups were held including clinical and public health faculty with expertise in the six leading causes of death in the United States. Mortality rates and life tables for 2040 were derived by sex and age. Life expectancy at age 20 and 65 was compared to figures published by the Social Security Administration and to estimates from the Lee-Carter method. There was agreement among all three approaches that life expectancy at age 20 will increase by approximately one year per decade for females and males between now and 2040. According to the clinical experts, 70% of the improvement in life expectancy will occur in cardiovascular disease and cancer, while in the last 30 years most of the improvement has occurred in cardiovascular disease. Expert opinion suggests that most of the increase in life expectancy will be attributable to the already achieved reduction in smoking rates, especially for women.



Tak!