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Recent Population Cause of Death Trends and Implications for Life Insurance

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Recent Trends in Mortality by Cause of Death

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SCOR The Art & Science of Risk | Life

Who Am I? Why Am I Here?

Why Am I Here?

AN ANALYSIS

Recent Trends in Mortality by Cause of Death

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Recent Trends in Mortality by Cause of Death

- Introduction
- Why Do We Care About Population?
- CDC Data
- SCOR Data
- Comparing CDC and SCOR
- Difference Between Population and Insured
- Drivers of Future Trends in Insured Mortality (Dr. Ivanovic)

Introduction: News Flash

- Centers for Disease Control and Prevention
  CDC 24/7: Saving Lives, Protecting People™

  The Centers for Disease Control and Prevention (CDC) regularly issues news releases regarding current trends in US population mortality.

- In June of 2016, articles in *The Washington Post* and *The Wall Street Journal* cited new CDC data from 2015 which showed a rise in the US mortality rate.

Mortality Trends – CDC 2015

Decreases in Mortality	Increases in Mortality
Heart Disease	Unintentional Injuries
Cancer	Suicide
Stroke	Alzheimer's
Pneumonia	Chronic Liver Disease
	Hypertension

- Other recent research published by Case and Deaton (Princeton University), Truesdale and Jenks (Harvard University) and The Lancet all point to changes in US life expectancy, reduction in improvement and increase in socio-economic divide.

Why Do We Care About Population Mortality?

- Industry practice to use population data as the basis for mortality improvement.

- BUT – Insured data is not homogenous from year to year
  - Changes in the underwriting eras, mix of business, and contributing companies cause discontinuities in the data
  - Reinsured data is further challenged in that the client mix changes from year to year

- This creates basis risk, which varies depending on many factors
  - Regional differences
  - Target market & cohort differences
  - Public health policy & access to diagnostic screening and advanced medical care
  - Level of underwriting

- Differences between insured risks and general population
  - Insured population tends to be issued to individuals in a much higher socio-economic class.
  - Deaths due to influenza and pneumonia tend to impact the general population more heavily than the insured population.
  - Insured population tends to have a lower percentage of tobacco/smoker risks than the general population.
  - The underwriting process is somewhat self-selecting (more preferred risks).

Why Do We Care About Population Mortality?

- Changes in the trends by cause of death could impact the mortality level, especially at older ages.
- The trends and frequency of significant causes of death can be leading indicators for insurance claims.
- Environmental and medical advancement can impact causes of death and change future perspective on mortality, resulting in an impact on future trend and possibly level of mortality.
- Important to examine how an individual COD trend change would affect overall mortality, including trend change by subgroups.
- New US national population data shows a slowdown in mortality improvement.

Reviewing CDC Data – Ages 20-89 (Male+Female Combined)

- Heart diseases and cancers were at the top of the list, though year to year trend, proportion and ranking vary both by gender and by age.

COD33	2011	2012	2013	2014	2015	2016
Alcohol-related conditions	2.1%	2.1%	2.2%	2.3%	2.3%	2.4%
Alzheimer's & dementia	6.1%	6.3%	6.4%	6.3%	6.1%	6.0%
Breast cancer	1.8%	1.8%	1.8%	1.8%	1.7%	1.7%
Chronic lower respiratory diseases	6.1%	6.0%	6.1%	6.0%	6.1%	6.0%
Colon & rectum cancer	2.3%	2.2%	2.2%	2.2%	2.1%	2.1%
Diabetes	3.2%	3.2%	3.2%	3.2%	3.3%	3.2%
Digestive system diseases	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
Drug-related conditions	1.8%	1.8%	1.9%	2.0%	2.2%	2.7%
Heart diseases 1: Ischemic heart disease	14.5%	14.2%	13.9%	13.5%	13.2%	13.0%
Heart diseases 2: Heart failure	6.0%	6.1%	6.3%	6.4%	6.6%	6.6%
Heart diseases 3: Pulmonary embolism & right ventricle dysfunction	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%
HIV	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%
Homicide	0.7%	0.7%	0.7%	0.6%	0.7%	0.7%
Influenza & pneumonia	1.9%	1.8%	1.9%	1.9%	1.9%	1.7%
Leukemia	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%
Lung cancer	7.3%	7.3%	7.1%	7.0%	6.7%	6.4%
Motor vehicle accidents	1.5%	1.5%	1.5%	1.5%	1.5%	1.6%
Obesity	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Oral cancer	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Other	6.0%	6.0%	5.9%	5.8%	5.8%	5.8%
Other endocrine, nutritional, & metabolic diseases	1.0%	1.0%	1.0%	1.1%	1.1%	1.1%
Other external causes	2.0%	2.0%	2.0%	2.0%	2.1%	2.1%
Other infectious diseases	2.5%	2.5%	2.6%	2.6%	2.6%	2.5%
Other neoplasms	8.8%	8.9%	8.8%	8.9%	8.8%	8.8%
Other nervous system diseases	1.6%	1.7%	1.8%	1.9%	2.0%	2.1%
Other respiratory system diseases	2.0%	2.0%	2.1%	2.1%	2.2%	2.2%
Ovarian cancer	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Pancreatic cancer	1.7%	1.8%	1.7%	1.8%	1.8%	1.8%
Parkinson's disease	0.9%	1.0%	1.0%	1.0%	1.0%	1.1%
Prostate cancer	1.2%	1.1%	1.1%	1.1%	1.1%	1.2%
Skin cancer	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Stroke	8.3%	8.3%	8.3%	8.4%	8.5%	8.6%
Suicide	1.8%	1.8%	1.8%	1.9%	1.9%	1.9%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Cause of death categories have been mapped from CDC/ICD notation to SCOR's practice.

Reviewing CDC Data – Ages 20-54 (Male+Female Combined)

- Cardiovascular and cancer average around 35% of all deaths and accidental causes (poisoning, external causes, and motor vehicle accidents) are around 20%. Suicides average about 8% and strokes at 6%.

COD33	2011	2012	2013	2014	2015	2016
Alcohol-related conditions	5.3%	5.3%	5.4%	5.4%	5.6%	5.3%
Alzheimer's & dementia	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Breast cancer	2.6%	2.6%	2.5%	2.4%	2.3%	2.2%
Chronic lower respiratory diseases	1.8%	1.8%	1.8%	1.8%	1.7%	1.6%
Colon & rectum cancer	2.0%	2.1%	2.1%	2.1%	2.0%	2.0%
Diabetes	2.7%	2.7%	2.8%	2.8%	2.8%	2.8%
Digestive system diseases	2.3%	2.3%	2.3%	2.2%	2.2%	2.1%
Drug-related conditions	9.5%	9.6%	10.0%	10.8%	12.0%	14.5%
Heart diseases 1: Ischemic heart disease	9.1%	9.0%	8.7%	8.4%	8.1%	7.6%
Heart diseases 2: Heart failure	4.1%	4.0%	4.1%	4.1%	4.1%	4.1%
Heart diseases 3: Pulmonary embolism & right ventricle dysfunction	1.0%	1.0%	1.1%	1.1%	1.1%	1.1%
HIV	1.6%	1.5%	1.4%	1.3%	1.2%	1.0%
Homicide	3.7%	3.8%	3.7%	3.6%	4.0%	4.3%
Influenza & pneumonia	1.2%	0.9%	1.2%	1.4%	1.0%	1.1%
Leukemia	0.8%	0.8%	0.8%	0.8%	0.7%	0.7%
Lung cancer	4.0%	4.0%	3.7%	3.5%	3.1%	2.7%
Motor vehicle accidents	6.3%	6.6%	6.4%	6.3%	6.6%	6.8%
Obesity	0.8%	0.8%	0.8%	0.9%	0.9%	0.9%
Oral cancer	0.4%	0.5%	0.4%	0.4%	0.4%	0.4%
Other	6.9%	7.1%	7.1%	7.0%	7.0%	6.9%
Other endocrine, nutritional, & metabolic diseases	0.8%	0.7%	0.8%	0.8%	0.8%	0.8%
Other external causes	3.5%	3.3%	3.2%	3.2%	3.3%	3.3%
Other infectious diseases	2.4%	2.3%	2.3%	2.3%	2.2%	2.0%
Other neoplasms	7.2%	7.1%	6.9%	6.8%	6.5%	6.1%
Other nervous system diseases	2.3%	2.4%	2.5%	2.5%	2.5%	2.4%
Other respiratory system diseases	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Ovarian cancer	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%
Pancreatic cancer	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Parkinson's disease	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Prostate cancer	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%
Skin cancer	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
Stroke	5.7%	5.7%	5.8%	5.9%	5.8%	5.7%
Suicide	7.7%	7.9%	7.8%	8.0%	8.1%	7.9%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Reviewing CDC Data – Ages 55-89 (Male+Female Combined)

- Cancer is first with over 27% and cardiovascular is second at a little less than 22%. Strokes are around 9% and accidental causes (poisoning, external causes, and motor vehicle accidents) are around 3%.

COD33	2011	2012	2013	2014	2015	2016
Alcohol-related conditions	1.5%	1.6%	1.6%	1.7%	1.8%	1.8%
Alzheimer's & dementia	7.2%	7.4%	7.5%	7.4%	7.1%	7.0%
Breast cancer	1.7%	1.7%	1.7%	1.7%	1.6%	1.6%
Chronic lower respiratory diseases	6.9%	6.8%	6.9%	6.7%	6.8%	6.8%
Colon & rectum cancer	2.3%	2.3%	2.2%	2.2%	2.2%	2.1%
Diabetes	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
Digestive system diseases	2.5%	2.4%	2.5%	2.5%	2.5%	2.5%
Drug-related conditions	0.4%	0.4%	0.5%	0.5%	0.6%	0.7%
Heart diseases 1: Ischemic heart disease	15.5%	15.1%	14.8%	14.4%	14.1%	13.9%
Heart diseases 2: Heart failure	6.4%	6.5%	6.7%	6.8%	7.0%	7.0%
Heart diseases 3: Pulmonary embolism & right ventricle dysfunction	0.7%	0.7%	0.7%	0.7%	0.8%	0.7%
HIV	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Homicide	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Influenza & pneumonia	2.0%	1.9%	2.1%	2.0%	2.0%	1.8%
Leukemia	1.0%	1.0%	1.0%	1.0%	0.9%	1.0%
Lung cancer	7.9%	7.9%	7.7%	7.6%	7.3%	7.0%
Motor vehicle accidents	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%
Obesity	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Oral cancer	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Other	5.8%	5.8%	5.7%	5.6%	5.6%	5.7%
Other endocrine, nutritional, & metabolic diseases	1.0%	1.0%	1.0%	1.1%	1.2%	1.2%
Other external causes	1.7%	1.7%	1.8%	1.8%	1.9%	1.9%
Other infectious diseases	2.6%	2.6%	2.6%	2.6%	2.6%	2.5%
Other neoplasms	9.1%	9.2%	9.1%	9.3%	9.2%	9.3%
Other nervous system diseases	1.5%	1.5%	1.6%	1.8%	1.9%	2.1%
Other respiratory system diseases	2.2%	2.2%	2.3%	2.3%	2.4%	2.4%
Ovarian cancer	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%
Pancreatic cancer	1.8%	1.9%	1.8%	1.9%	1.9%	1.9%
Parkinson's disease	1.1%	1.1%	1.2%	1.2%	1.2%	1.3%
Prostate cancer	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
Skin cancer	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%
Stroke	8.8%	8.7%	8.7%	8.8%	9.0%	9.1%
Suicide	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Reviewing SCOR Data – Ages 20-54 (Male+Female Combined)

- Similar to the general US population, cardiovascular and cancers were the leading causes for these ages. Cancer 33%; Cardiovascular 15%; Accidents 13%; Strokes 6%.

COD33	2011	2012	2013	2014	2015	2016
Alcohol-related conditions	0.7%	1.3%	0.9%	1.4%	1.4%	0.8%
Alzheimer's & dementia	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%
Breast cancer	6.0%	5.8%	5.8%	5.2%	4.7%	5.7%
Chronic lower respiratory diseases	0.5%	0.2%	0.5%	0.6%	0.3%	0.4%
Colon & rectum cancer	3.6%	4.9%	3.9%	5.5%	4.3%	5.2%
Diabetes	0.9%	0.8%	1.1%	0.8%	0.8%	1.4%
Digestive system diseases	2.1%	2.5%	2.0%	1.6%	2.4%	2.5%
Drug-related conditions	3.1%	2.9%	2.5%	2.0%	2.2%	3.1%
Heart diseases 1: Ischemic heart disease	7.0%	7.3%	7.6%	7.4%	6.9%	6.1%
Heart diseases 2: Heart failure	8.2%	5.8%	6.2%	5.8%	7.8%	6.1%
Heart diseases 3: Pulmonary embolism & right ventricle dysfunction	1.3%	1.6%	1.5%	1.3%	1.8%	1.7%
HIV	0.5%	0.3%	0.3%	0.4%	0.1%	0.5%
Homicide	2.6%	2.9%	2.4%	2.1%	2.7%	3.5%
Influenza & pneumonia	0.7%	1.0%	1.0%	1.4%	0.8%	0.9%
Leukemia	0.9%	1.4%	1.6%	1.4%	1.4%	1.6%
Lung cancer	5.3%	4.0%	3.8%	4.0%	3.3%	3.1%
Motor vehicle accidents	5.7%	5.5%	5.5%	4.2%	5.6%	5.0%
Obesity	0.2%	0.3%	0.3%	0.3%	0.4%	0.3%
Oral cancer	0.3%	0.3%	0.7%	0.6%	0.6%	0.5%
Other	6.4%	6.3%	5.8%	7.4%	6.9%	9.2%
Other endocrine, nutritional, & metabolic diseases	0.3%	0.5%	1.0%	0.5%	0.6%	0.6%
Other external causes	5.3%	5.5%	5.5%	5.9%	5.0%	4.2%
Other infectious diseases	1.4%	1.5%	1.8%	2.4%	1.7%	2.1%
Other neoplasms	17.8%	14.0%	13.8%	13.3%	14.2%	12.2%
Other nervous system diseases	1.9%	2.0%	2.1%	2.4%	2.1%	2.1%
Other respiratory system diseases	0.7%	1.4%	1.4%	1.6%	1.7%	1.3%
Ovarian cancer	1.5%	1.7%	2.4%	2.4%	2.3%	2.1%
Pancreatic cancer	1.4%	1.6%	1.4%	1.9%	2.4%	2.0%
Parkinson's disease	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Prostate cancer	0.3%	0.5%	0.4%	0.2%	0.3%	0.4%
Skin cancer	1.2%	1.2%	0.9%	1.3%	0.8%	0.9%
Stroke	4.5%	5.6%	6.7%	5.7%	6.3%	6.9%
Suicide	7.8%	9.0%	8.9%	8.9%	8.2%	7.4%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Distribution of death counts (not amounts of reinsurance) by cause category.

Reviewing SCOR Data – Ages 55-89 (Male+Female Combined)

- Similar to the general US population, cardiovascular and cancers were the leading causes for these ages. Cancer 37%; Cardiovascular 18%; Strokes 7%; Accidents 4%.

COD33	2011	2012	2013	2014	2015	2016
Alcohol-related conditions	0.2%	0.8%	0.6%	0.6%	0.6%	0.7%
Alzheimer's & dementia	1.2%	2.6%	2.9%	3.2%	2.7%	2.7%
Breast cancer	3.0%	2.6%	2.9%	2.7%	2.7%	2.6%
Chronic lower respiratory diseases	1.6%	1.6%	1.5%	1.7%	1.7%	1.6%
Colon & rectum cancer	3.6%	3.9%	3.9%	3.5%	3.4%	3.2%
Diabetes	1.3%	1.3%	1.6%	1.6%	1.6%	1.6%
Digestive system diseases	2.3%	2.6%	2.9%	2.5%	3.1%	2.8%
Drug-related conditions	0.3%	0.6%	0.7%	0.4%	0.4%	0.3%
Heart diseases 1: Ischemic heart disease	10.3%	8.7%	9.2%	8.5%	8.2%	8.1%
Heart diseases 2: Heart failure	7.9%	7.4%	8.1%	8.1%	8.3%	8.7%
Heart diseases 3: Pulmonary embolism & right ventricle dysfunction	0.8%	1.2%	1.1%	1.1%	1.1%	1.0%
HIV	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%
Homicide	0.3%	0.3%	0.4%	0.4%	0.2%	0.2%
Influenza & pneumonia	1.7%	1.9%	1.8%	2.2%	1.9%	1.8%
Leukemia	0.9%	1.5%	1.6%	1.4%	1.7%	1.3%
Lung cancer	10.2%	9.4%	8.5%	7.8%	7.6%	6.9%
Motor vehicle accidents	1.4%	1.6%	1.1%	1.4%	1.5%	1.2%
Obesity	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%
Oral cancer	0.2%	0.5%	0.5%	0.5%	0.4%	0.4%
Other	9.5%	7.1%	6.5%	8.3%	7.0%	9.0%
Other endocrine, nutritional, & metabolic diseases	0.3%	0.7%	0.8%	0.7%	0.9%	0.9%
Other external causes	2.0%	2.0%	2.0%	2.0%	1.5%	1.7%
Other infectious diseases	1.3%	1.7%	1.9%	2.0%	2.2%	2.1%
Other neoplasms	20.8%	15.3%	15.0%	15.1%	15.1%	14.7%
Other nervous system diseases	2.0%	2.4%	2.3%	2.4%	2.9%	3.6%
Other respiratory system diseases	3.0%	3.7%	3.7%	3.7%	3.8%	3.8%
Ovarian cancer	1.1%	1.9%	2.6%	2.0%	2.2%	2.0%
Pancreatic cancer	2.5%	4.0%	3.6%	3.7%	4.2%	3.6%
Parkinson's disease	0.6%	0.7%	0.9%	0.7%	0.9%	0.9%
Prostate cancer	1.6%	1.5%	1.6%	1.5%	2.0%	2.2%
Skin cancer	0.5%	1.0%	0.7%	0.9%	0.7%	0.6%
Stroke	5.9%	7.9%	7.7%	7.0%	7.3%	8.1%
Suicide	1.7%	1.7%	1.3%	1.8%	2.0%	1.4%
Grand Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Distribution of death counts (not amounts of reinsurance) by cause category.

Comparing CDC to SCOR – Male/Female Age 20-54

	CDC		SCOR	
COD33	M	F	M	F
Alcohol-related conditions	5.8%	4.6%	1.2%	0.8%
Alzheimer's & dementia	0.1%	0.1%	0.1%	0.1%
Breast cancer	0.0%	6.5%	0.0%	14.8%
Chronic lower respiratory diseases	1.3%	2.5%	0.3%	0.6%
Colon & rectum cancer	1.8%	2.4%	4.7%	4.6%
Diabetes	2.7%	2.9%	1.1%	1.0%
Digestive system diseases	2.1%	2.5%	2.2%	2.3%
Drug-related conditions	11.5%	10.4%	2.8%	2.5%
Heart diseases 1: Ischemic heart disease	10.0%	5.9%	8.9%	3.6%
Heart diseases 2: Heart failure	4.2%	3.9%	7.1%	5.7%
Heart diseases 3: Pulmonary embolism & right ventricle dysfunction	0.8%	1.5%	1.2%	2.1%
HIV	1.5%	1.1%	0.4%	0.3%
Homicide	5.0%	1.9%	3.3%	2.0%
Influenza & pneumonia	1.0%	1.4%	0.9%	1.0%
Leukemia	0.7%	0.9%	1.2%	1.8%
Lung cancer	2.9%	4.4%	3.1%	5.0%
Motor vehicle accidents	7.7%	4.6%	6.2%	3.6%
Obesity	0.8%	1.0%	0.3%	0.3%
Oral cancer	0.5%	0.3%	0.6%	0.4%
Other	6.1%	8.6%	7.4%	7.1%
Other endocrine, nutritional, & metabolic diseases	0.7%	0.9%	0.6%	0.7%
Other external causes	4.0%	2.1%	6.7%	2.4%
Other infectious diseases	2.1%	2.6%	1.6%	2.2%
Other neoplasms	6.8%	6.7%	14.2%	13.6%
Other nervous system diseases	2.2%	2.9%	2.1%	2.1%
Other respiratory system diseases	0.9%	1.2%	1.0%	1.9%
Ovarian cancer	0.0%	3.8%	0.0%	5.4%
Pancreatic cancer	1.0%	1.1%	1.8%	1.8%
Parkinson's disease	0.0%	0.0%	0.0%	0.1%
Prostate cancer	0.2%	0.0%	0.6%	0.0%
Skin cancer	0.5%	0.5%	1.1%	1.0%
Stroke	5.7%	5.9%	6.4%	5.6%
Suicide	9.6%	4.9%	10.9%	3.8%
Grand Total	100.0%	100.0%	100.0%	100.0%

Comparing CDC to SCOR – Male/Female Age 55-89

	CDC		SCOR	
COD33	M	F	M	F
Alcohol-related conditions	2.1%	1.2%	0.7%	0.4%
Alzheimer's & dementia	5.1%	9.6%	2.2%	3.3%
Breast cancer	0.0%	3.5%	0.1%	7.5%
Chronic lower respiratory diseases	6.3%	7.4%	1.5%	1.8%
Colon & rectum cancer	2.3%	2.1%	3.4%	3.7%
Diabetes	3.4%	3.2%	1.5%	1.6%
Digestive system diseases	2.2%	2.7%	2.6%	2.9%
Drug-related conditions	0.6%	0.4%	0.5%	0.3%
Heart diseases 1: Ischemic heart disease	16.9%	12.2%	10.1%	5.9%
Heart diseases 2: Heart failure	6.5%	6.9%	8.6%	7.7%
Heart diseases 3: Pulmonary embolism & right ventricle dysfunction	0.6%	0.9%	0.9%	1.3%
HIV	0.2%	0.1%	0.0%	0.0%
Homicide	0.1%	0.1%	0.3%	0.2%
Influenza & pneumonia	1.9%	2.0%	1.8%	2.1%
Leukemia	1.1%	0.9%	1.6%	1.1%
Lung cancer	8.0%	7.1%	7.9%	8.2%
Motor vehicle accidents	0.8%	0.4%	1.6%	0.9%
Obesity	0.2%	0.2%	0.1%	0.1%
Oral cancer	0.6%	0.2%	0.5%	0.3%
Other	5.3%	6.1%	8.0%	8.2%
Other endocrine, nutritional, & metabolic diseases	1.0%	1.1%	0.8%	0.7%
Other external causes	1.9%	1.7%	2.2%	1.1%
Other infectious diseases	2.5%	2.7%	1.8%	2.2%
Other neoplasms	10.7%	7.6%	17.1%	12.8%
Other nervous system diseases	1.7%	1.8%	2.8%	3.0%
Other respiratory system diseases	2.4%	2.2%	3.6%	3.9%
Ovarian cancer	0.0%	2.5%	0.0%	5.6%
Pancreatic cancer	1.9%	1.9%	3.5%	3.9%
Parkinson's disease	1.4%	0.9%	1.0%	0.5%
Prostate cancer	2.5%	0.0%	2.9%	0.0%
Skin cancer	0.5%	0.3%	0.9%	0.4%
Stroke	8.1%	9.7%	7.4%	7.7%
Suicide	1.2%	0.3%	2.2%	0.6%
Grand Total	100.0%	100.0%	100.0%	100.0%

2011-2016 trend highlights Male+Female Age 20-54

	CDC						SCOR					
	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
Cancer	20.2%	20.1%	19.5%	19.0%	18.0%	16.8%	38.2%	35.6%	34.9%	35.8%	34.3%	33.6%
Cardiovascular	14.2%	14.0%	13.9%	13.6%	13.3%	12.7%	16.4%	14.7%	15.2%	14.5%	16.5%	13.9%
Drug-related conditions	9.5%	9.6%	10.0%	10.8%	12.0%	14.5%	3.1%	2.9%	2.5%	2.0%	2.2%	3.1%
Suicide	7.7%	7.9%	7.8%	8.0%	8.1%	7.9%	7.8%	9.0%	8.9%	8.9%	8.2%	7.4%
Motor vehicle accidents	6.3%	6.6%	6.4%	6.3%	6.6%	6.8%	5.7%	5.5%	5.5%	4.2%	5.6%	5.0%
Stroke	5.7%	5.7%	5.8%	5.9%	5.8%	5.7%	4.5%	5.6%	6.7%	5.7%	6.3%	6.9%
Homicide	3.7%	3.8%	3.7%	3.6%	4.0%	4.3%	2.6%	2.9%	2.4%	2.1%	2.7%	3.5%
Respiratory diseases	2.8%	2.7%	2.8%	2.8%	2.7%	2.6%	1.3%	1.6%	1.9%	2.1%	2.0%	1.8%
Influenza & pneumonia	1.2%	0.9%	1.2%	1.4%	1.0%	1.1%	0.7%	1.0%	1.0%	1.4%	0.8%	0.9%

- Decline in Cancer both CDC and SCOR (note magnitude)
- Decline in Cardiovascular both CDC and SCOR
- Increase in Drug-related conditions in CDC but not in SCOR
- Suicides roughly stable and similar magnitude
- MVR stable for CDC but slightly declining for SCOR
- Stroke stable for CDC but increasing for SCOR
- Homicide increasing for both CDC and SCOR
- Respiratory diseases stable for CDC but increasing for SCOR
- Influenza & pneumonia stable and similar for both CDC and SCOR

2011-2016 trend highlights Male+Female Age 55-89

	CDC						SCOR					
	2011	2012	2013	2014	2015	2016	2011	2012	2013	2014	2015	2016
Cancer	27.2%	27.3%	26.8%	26.9%	26.4%	26.3%	44.3%	41.5%	41.0%	39.3%	40.1%	37.6%
Cardiovascular	22.6%	22.3%	22.1%	21.9%	21.9%	21.7%	19.0%	17.2%	18.5%	17.8%	17.6%	17.8%
Respiratory diseases	9.1%	9.0%	9.2%	9.0%	9.2%	9.1%	4.6%	5.3%	5.2%	5.4%	5.5%	5.4%
Stroke	8.8%	8.7%	8.7%	8.8%	9.0%	9.1%	5.9%	7.9%	7.7%	7.0%	7.3%	8.1%
Alzheimer's & dementia	7.2%	7.4%	7.5%	7.4%	7.1%	7.0%	1.2%	2.6%	2.9%	3.2%	2.7%	2.7%
Influenza & pneumonia	2.0%	1.9%	2.1%	2.0%	2.0%	1.8%	1.7%	1.9%	1.8%	2.2%	1.9%	1.8%
Suicide	0.7%	0.7%	0.8%	0.8%	0.8%	0.8%	1.7%	1.7%	1.3%	1.8%	2.0%	1.4%
Motor vehicle accidents	0.6%	0.6%	0.6%	0.6%	0.6%	0.7%	1.4%	1.6%	1.1%	1.4%	1.5%	1.2%
Drug-related conditions	0.4%	0.4%	0.5%	0.5%	0.6%	0.7%	0.3%	0.6%	0.7%	0.4%	0.4%	0.3%

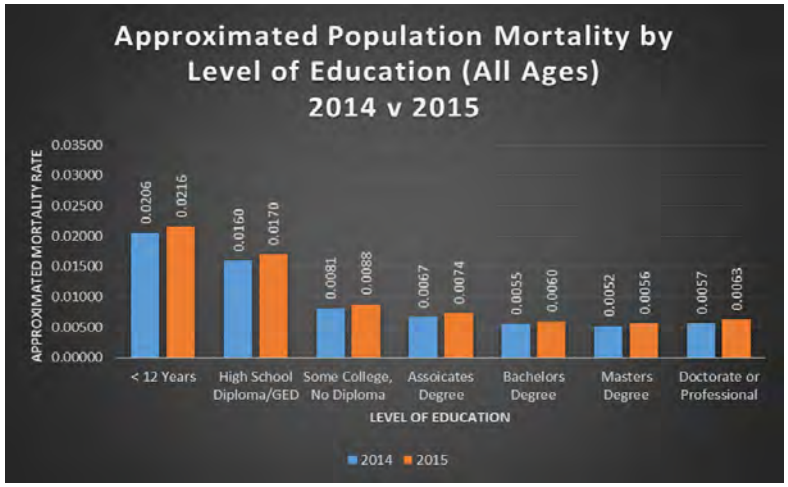
- Cancer stable for CDC but decreasing slightly for SCOR (especially 2016)
- Cardiovascular decreasing slightly for both CDC and SCOR
- Stroke stable for CDC and SCOR (except 2011) but lower magnitude
- Respiratory diseases stable, but lower magnitude for SCOR
- Alzheimer's & dementia stable for CDC but increasing for SCOR (but much lower magnitude)
- Influenza & pneumonia stable for both CDC and SCOR
- MVR stable but slightly higher magnitude for SCOR
- Drug-related conditions increasing slightly for CDC but recently stable for SCOR

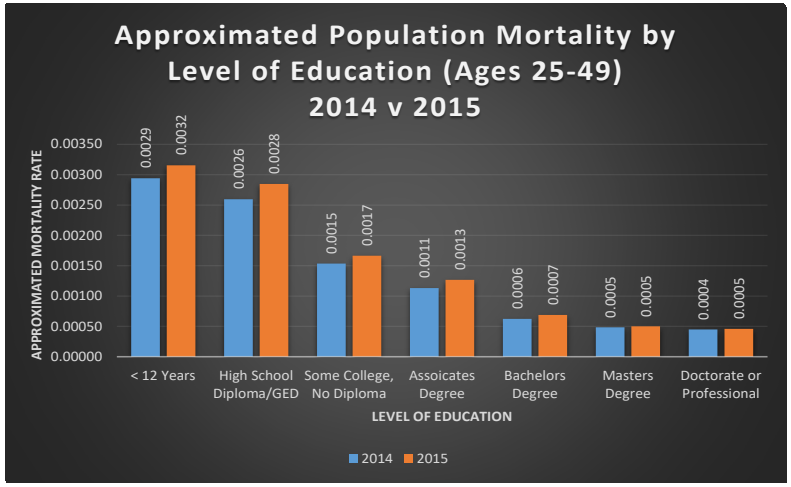
Why The Difference Between CDC and SCOR?

- The make-up of the SCOR policyholder is considerably different than that of the US population (i.e., basis risk) whereas the SCOR population tends to be of a higher socio-economic group than the general population.

- There are clear differences in mortality by socio-economic class. This can be seen across all age groups in the general population whereby level of attained education is used as a proxy for socio-economic status.

- Although mortality rates increased for the general population for all education levels, mortality continues to be significantly higher for lower educated (i.e., lower socio-economic) groups. This is true across all ages, but even more so at younger age groups.





Difference Between US and Insured Populations

- There has been much press and scrutiny regarding a decline in expected longevity for the US population relative to other developed nations.
- While these studies have received noted publicity in the press, it is important to recognize that trends in the general population do not necessarily translate to trends in the insured population, which underlies SCOR's reinsurance experience.
- These individuals tend to be in a higher socio-economic class with access to better health care and living conditions and generally make healthier lifestyle choices.
- For example, the insured population has a lower percentage of tobacco/smoker risks than the general population (less than 5% in the SCOR experience) with a significantly increased cost of insurance for tobacco users.

Jama (2016)

Special Communication

The Association Between Income and Life Expectancy in the United States, 2001-2014

Raj Chetty, PhD; Michael Stepner, BA; Sarah Abraham, BA; Shelby Lin, MPhil; Benjamin Scuderi, BA; Nicholas Turner, PhD; Augustin Bergeron, MA; David Cutler, PhD

Frontiers in Public Health Services and Systems Research (2016)

Income Inequality and Health: Strong Theories, Weaker Evidence

Beth C. Truesdale
Harvard University, truesdal@fas.harvard.edu

Christopher Jencks
Harvard University, cjencks@hks.harvard.edu

Slate (2017)

SCIENCE THE STATE OF THE UNIVERSE. | MARCH 28 2017 9:00 AM

Stop Saying White Mortality Is Rising

It's an argument that relies on misinterpreting the data.

By Jonathan Auerbach and Andrew Gelman

Recent Trends in Mortality by Cause of Death

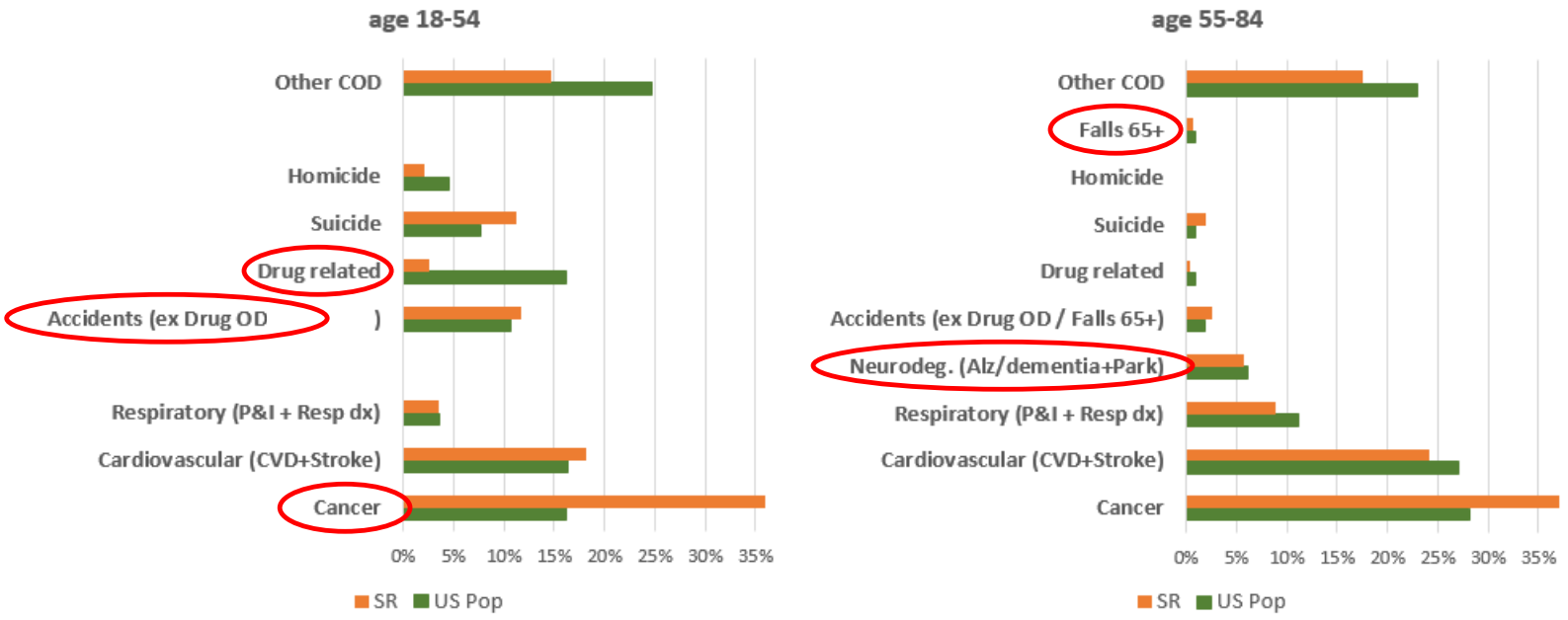
- Introduction
- Why Do We Care About Population?
- CDC Data
- SCOR Data
- Comparing CDC and SCOR
- Difference Between Population and Insured
- Drivers of Future Trends in Insured Mortality (Dr. Ivanovic)

Swiss Re

Causal drivers of future mortality trend in insured groups

Dr. Brian Ivanovic

Have the relationships identified by David continued?: Pop vs. Insured COD proportional comparison, 2017



- I see similar insured vs pop COD patterns in Swiss Re's reinsured business.
  - More CA vs CVD claims,
  - Lower drug OD claims
  - More suicides
- And certain COD's are trending up

Swiss Re

What do we learn from these comparisons?

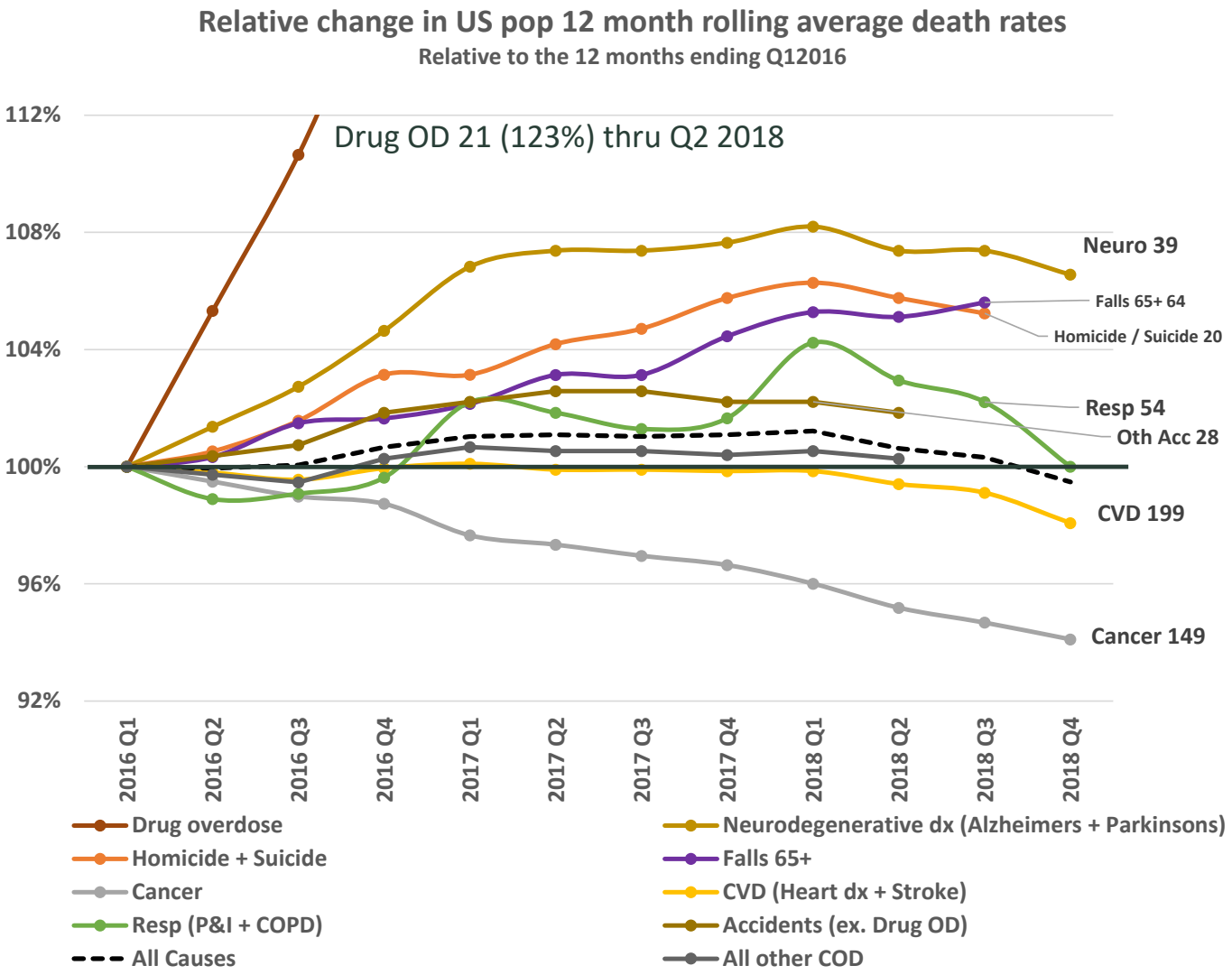
- Thru the effects of self selection and risk selection we can influence certain COD proportions in insured groups, but what is a significant COD in the population often remains a material COD in insured groups. Studying cause specific mortality trend in the population can often provide important insights into insured trends.
- We haven't (yet) been able to totally eliminate major categories of death as a cause of claim.
  - At best an underwriting process can only identify prevalent disease and the presence of risk factors for specific causes of death. The intensity of risk selection influences how much disease and risk factors are identified.
  - Not all disease (or accidental COD) that will emerge can be attributed to risk factors we presently measure or inquire on. The continued evolution in our understanding of underlying drivers of disease will likely influence how we underwrite in the future.

Swiss Re

Recent gen pop trends:
NVSS Rapid release (General pop / all ages)

Most notable findings:

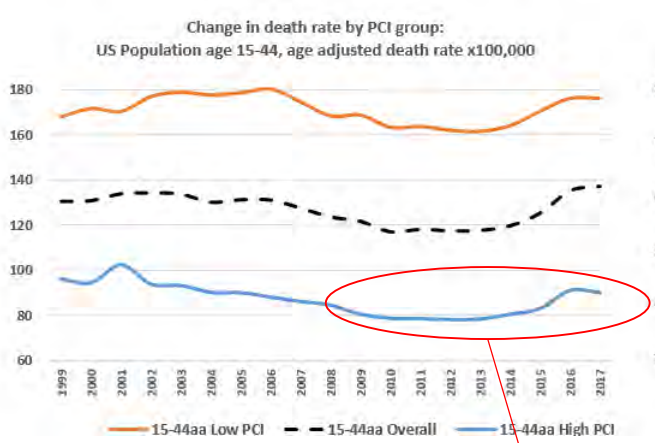
- **Continued increase**
  - Fall deaths age 65+
- **Flattening**
  - Drug OD deaths
  - NeuroDegen.
  - Homicide
- **Declining**
  - Cancer
  - ? CVD
- **Bad Q1 2018 flu season**

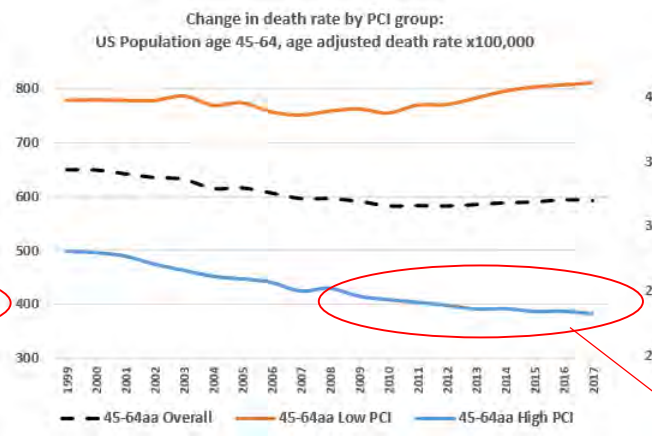


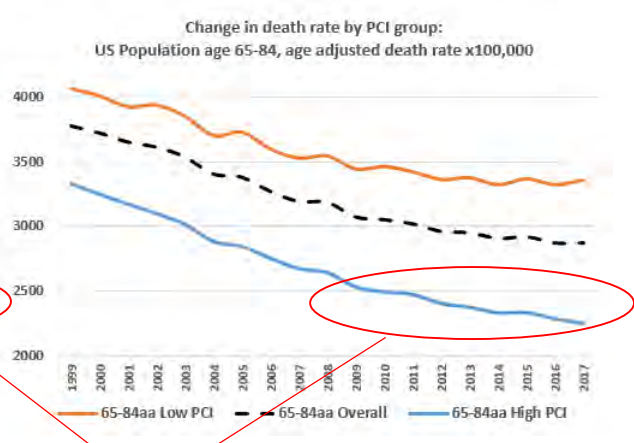
Swiss Re

Relevance of most recent gen pop trends to applicant pool?

NCHS all cause mortality trends by age group and per capita income







Reversal

Deceleration

Most notable findings:

- Varying trend differentials by population sub-group (parallel, divergent, widening)
- Frank reversal or deceleration in death rate declines of varying magnitude across PCI groups
- Could higher PCI subset better reflect insured trends?

Swiss Re

Deceleration in the rate of mortality decline exists in more select subsets of the general population

At ages 15-44 88% of the underlying High PCI COD proportion is experiencing either deceleration in the rate of death rate declines in the more recent period or acceleration in the rate of death rate increases.

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Overall and cause specific change in average annual death rates: High PCI group

	1999-2017	2009-2017	Worsening trend[1]	COD proportion[2]
All causes of death	**0.37%**	**-1.42%**	**X**	
Cancer	2.4%	2.5%		11%
CVD (Heart dx + stroke)	1.5%	0.3%	**X**	9%
Respiratory	3.1%	5.4%		2%
Accidents (ex. Drug related)	1.9%	0.5%	**X**	11%
Drug related	-6.2%	**-10.3%**	**X**	27%
Suicide	-1.0%	**-2.1%**	**X**	12%
Homicide	0.3%	**-0.2%**	**X**	6%
All other causes	1.7%	0.8%	**X**	23%

1. Either slowing of the rate of death rate declines (smaller percentiles) or acceleration in the rate of death rate increases (negative percentiles)

2. Based on 2017 death rates

Swiss Re

Deceleration in the rate of mortality decline exists in more select subsets of the general population

At ages 45-64 58% of the underlying High PCI COD proportion is experiencing either deceleration in the rate of death rate declines in the more recent period or acceleration in the rate of death rate increases.

Overall and cause specific change in average annual death rates: High PCI group

	1999-2017	2009-2017	Worsening trend[1]	COD proportion[2]
All causes of death	**1.46%**	**1.01%**	**X**	
Cancer	2.5%	2.8%		31%
CVD (Heart dx + stroke)	2.5%	1.2%	**X**	22%
Respiratory	1.6%	0.7%	**X**	5%
Accidents (ex. Drug related)	-0.2%	**-0.7%**	**X**	4%
Drug related	-6.3%	**-5.3%**		6%
Suicide	-2.1%	**-1.3%**		4%
Homicide	-0.2%	**-4.5%**	**X**	1%
All other causes	0.7%	0.5%	**X**	27%

1. Either slowing of the rate of death rate declines (smaller percentiles) or acceleration in the rate of death rate increases (negative percentiles)

2. Based on 2017 death rates

Swiss Re

Deceleration in the rate of mortality decline exists in more select subsets of the general population

At ages 65-84 60% of the underlying High PCI COD proportion is experiencing either deceleration in the rate of death rate declines in the more recent period or acceleration in the rate of death rate increases.

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Overall and cause specific change in average annual death rates: High PCI group

	1999-2017	2009-2017	Worsening trend[1]	COD proportion[2]
All causes of death	**2.16%**	**1.46%**	**X**	
Cancer	2.2%	2.5%		29%
CVD (Heart dx + stroke)	3.8%	2.2%	**X**	27%
Respiratory	2.3%	1.8%	**X**	10%
Neurodegenerative	-2.9%	**-0.9%**		8%
Accidents (ex. Falls)	0.5%	**-1.6%**	**X**	1%
Homicide & Suicide	0.0%	0.2%		1%
Falls	-2.9%	**-0.6%**		1%
All other causes	1.0%	0.0%	**X**	21%

1. Either slowing of the rate of death rate declines (smaller percentiles) or acceleration in the rate of death rate increases (negative percentiles)

2. Based on 2017 death rates

Swiss Re

Drivers of future mortality improvement trends

- Pop (applicant pool)
  - Trends in cardiovascular risk factors
  - Earlier cancer diagnosis/ treatment progress
  - Opioid abuse
  - Rise of neurodegenerative and other conditions in the elderly as a COD (due to increased longevity)
  - Period effects (ex. Flu)

- Policyholders
  - Self selection
  - Target market characteristics
  - The permeability of risk selection over time
    - How do changes to the underwriting process alter our ability to identify prevalent disease and underlying risk factors for future cause of losses?
    - Does future underwriting increase our access to existing and new health risk factor information?

It's the combo of the 2 that drive future insured COD trends

Swiss Re

Additional determinants of insured trend

- The rate at which emerging tools become widely available on applicants. Are we maintaining an equilibrium in the permeability of underwriting as the industry adopts new underwriting methods?
- How the sentinel effect associated with responses to app questions will change as underlying underwriting requirements evolve away from objective biometric measures
- Effect of predictive mortality scores on modifying the burden of applicant risk factors and prevalent disease on future COD patterns.
- For underwriting that is based off of continuous/periodic applicant monitoring: persistency of use of monitoring tools
- The potential for increased regulatory constraints on the use of alternative underwriting methods.

Summary

- Higher PCI groups that have characteristics more similar to certain insured populations have experienced increases in cause specific and/or all cause mortality rates.
- In researching population mortality improvement researchers typically report on certain common drivers of trend:
  - Risk factor and disease burden
  - Socioeconomic status
  - Period effects (ex: pandemics, war, recessions)
- We need to consider additional factors that will influence future insured trend
  - Target market
  - Changes in self-selection
  - The coverage, utilization and protective value of new underwriting tools and their effects on future insured COD
  - Regulatory developments
  - The effects of selective lapsation on portfolios

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