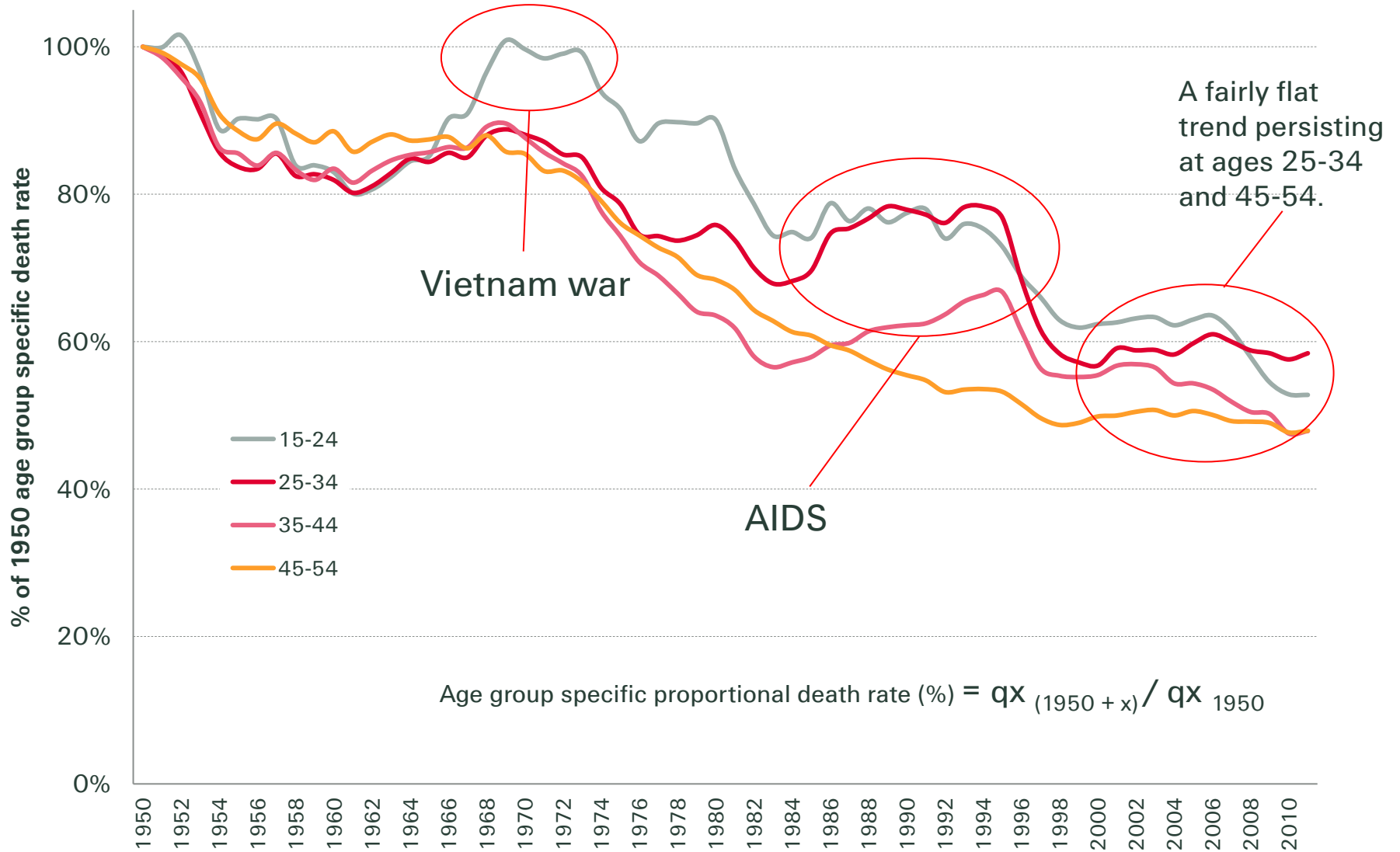# Questions to consider

- What are the existing and new causal drivers of recent trend?

- Do causal drivers of trend vary in population subgroups?

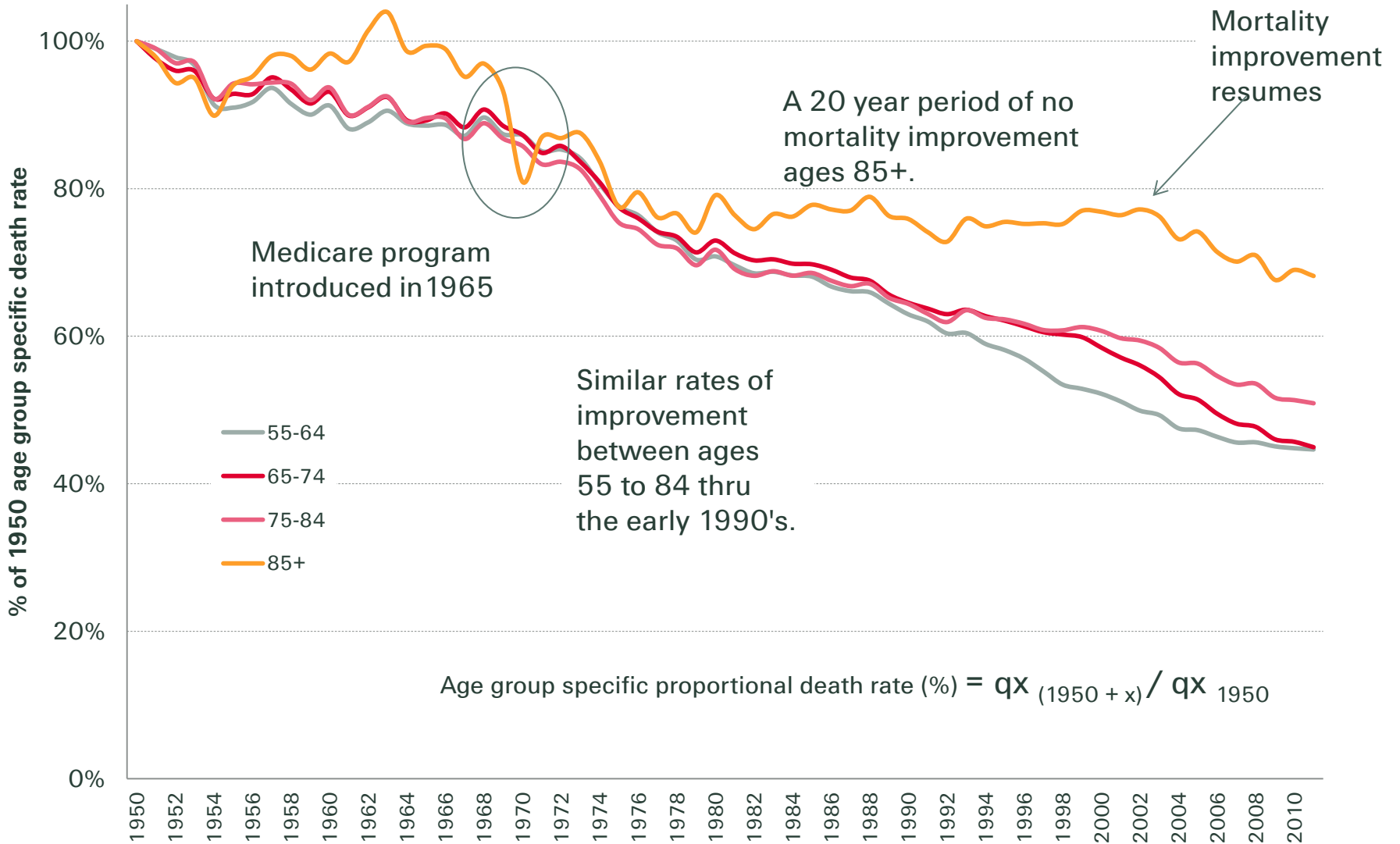- What are the potential implications of these findings on future trend in insured groups?

# 60-year US population view

**Death rate trends: US population 1950-2011**
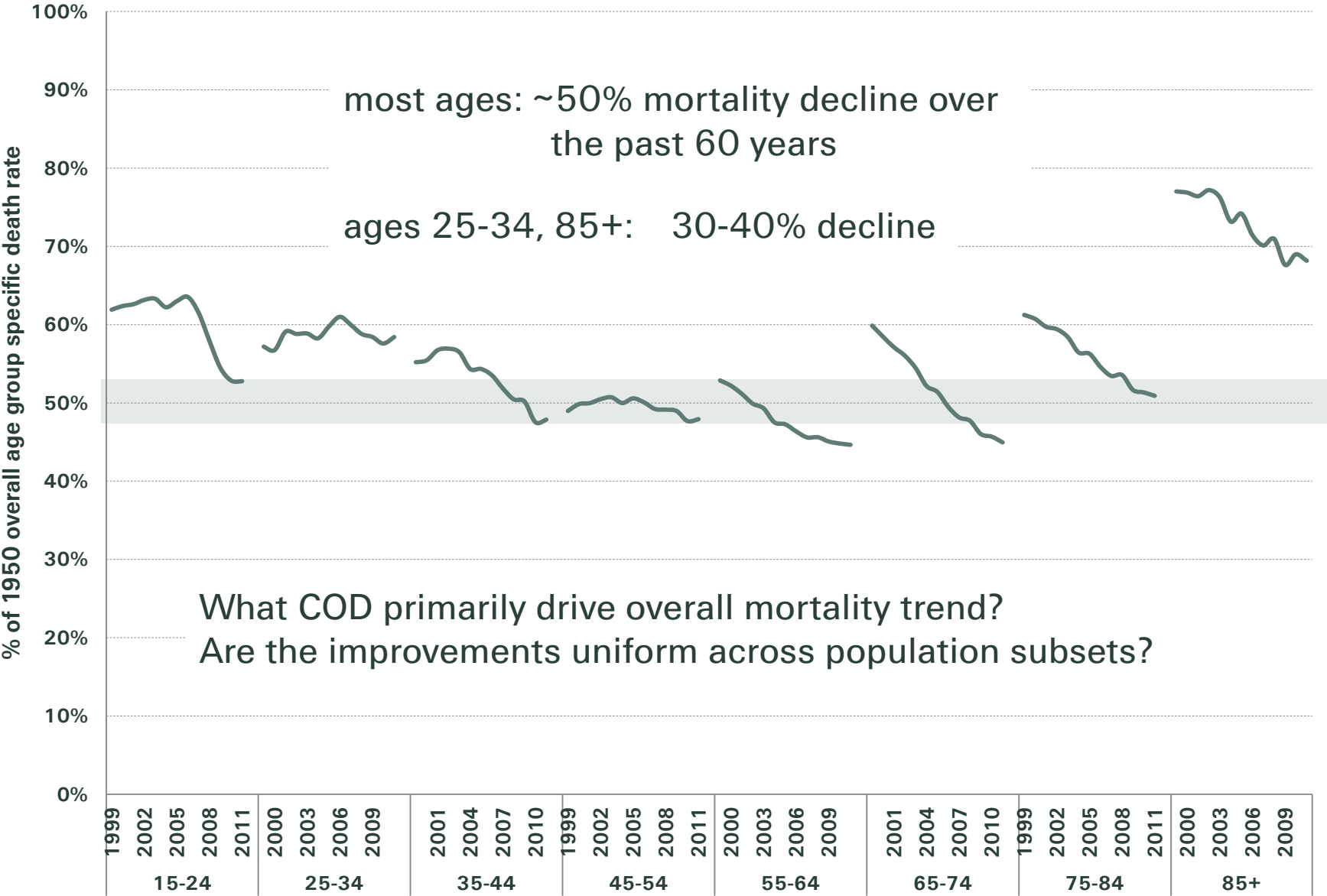


Vietnam war

AIDS

A fairly flat trend persisting at ages 25-34 and 45-54.

% of 1950 age group specific death rate

15-24
25-34
35-44
45-54

Age group specific proportional death rate (%) $= qx_{(1950 + x)} / qx_{1950}$

NCHS 2013

# 60-year US population view

**Death rate trends: US population 1950-2011**



Chart legend:
- 55-64 (grey)
- 65-74 (dark red)
- 75-84 (pink)
- 85+ (orange)

Y-axis: **% of 1950 age group specific death rate** (0% to 100%)

X-axis: years 1950 to 2010

Annotations on chart:
- Mortality improvement resumes
- A 20 year period of no mortality improvement ages 85+.
- Medicare program introduced in 1965
- Similar rates of improvement between ages 55 to 84 thru the early 1990's.

Age group specific proportional death rate (%) $= qx_{(1950 + x)} / qx_{1950}$

Swiss Re

4

# Recent US population mortality trend

**Death rate trends 1999-2010:  Overall and PCI subsets**



most ages: ~50% mortality decline over
the past 60 years

ages 25-34, 85+:   30-40% decline

What COD primarily drive overall mortality trend?
Are the improvements uniform across population subsets?

*% of 1950 overall age group specific death rate*

Age groups: 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, 85+

NCHS 2013

# Key causal drivers of trend

| Overall | CVD | CA | Resp | Neuro | GU | GI | Acc | Other | Total % evaluated |
|---|---|---|---|---|---|---|---|---|---|
| 15-24 | 5% | 6% | 2% | 3% | 0% | 1% | **75%** | 8% | **75%** |
| 25-34 | **10%** | **9%** | 2% | 2% | 1% | 3% | **60%** | 13% | **79%** |
| 35-44 | **19%** | **17%** | 3% | 3% | 1% | 6% | **36%** | 15% | **72%** |
| 45-54 | **25%** | **28%** | 5% | 2% | 1% | 7% | **18%** | 14% | **70%** |
| 55-64 | **27%** | **36%** | **7%** | 3% | 2% | 6% | **7%** | 12% | **77%** |
| 65-74 | **28%** | **36%** | **11%** | 3% | 3% | 4% | 3% | 11% | **79%** |
| 75-84 | **33%** | **26%** | **12%** | **7%** | 3% | 3% | 3% | 13% | **80%** |
| 85+ | **41%** | **13%** | **10%** | **9%** | 3% | 3% | 3% | 18% | **76%** |

NCHS 2013

Allowing for effects of self selection and risk selection, general population and insured COD proportions demonstrate a number of similarities.

Studying causal trend drivers in the overall population and in pop subsets should yield information relevant to drivers of future trend in insured groups.

Swiss Re

# Trend differentials in population subgroups:
## County level analysis of mortality trend by cause and per capita income
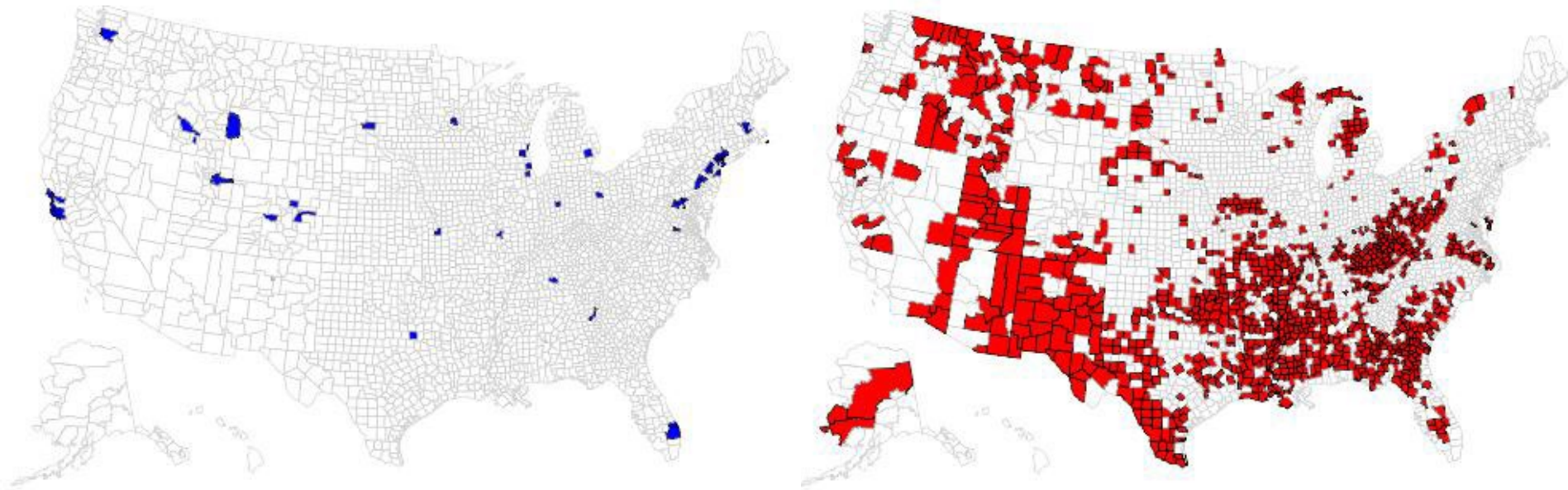


County Group ■ High PCI County
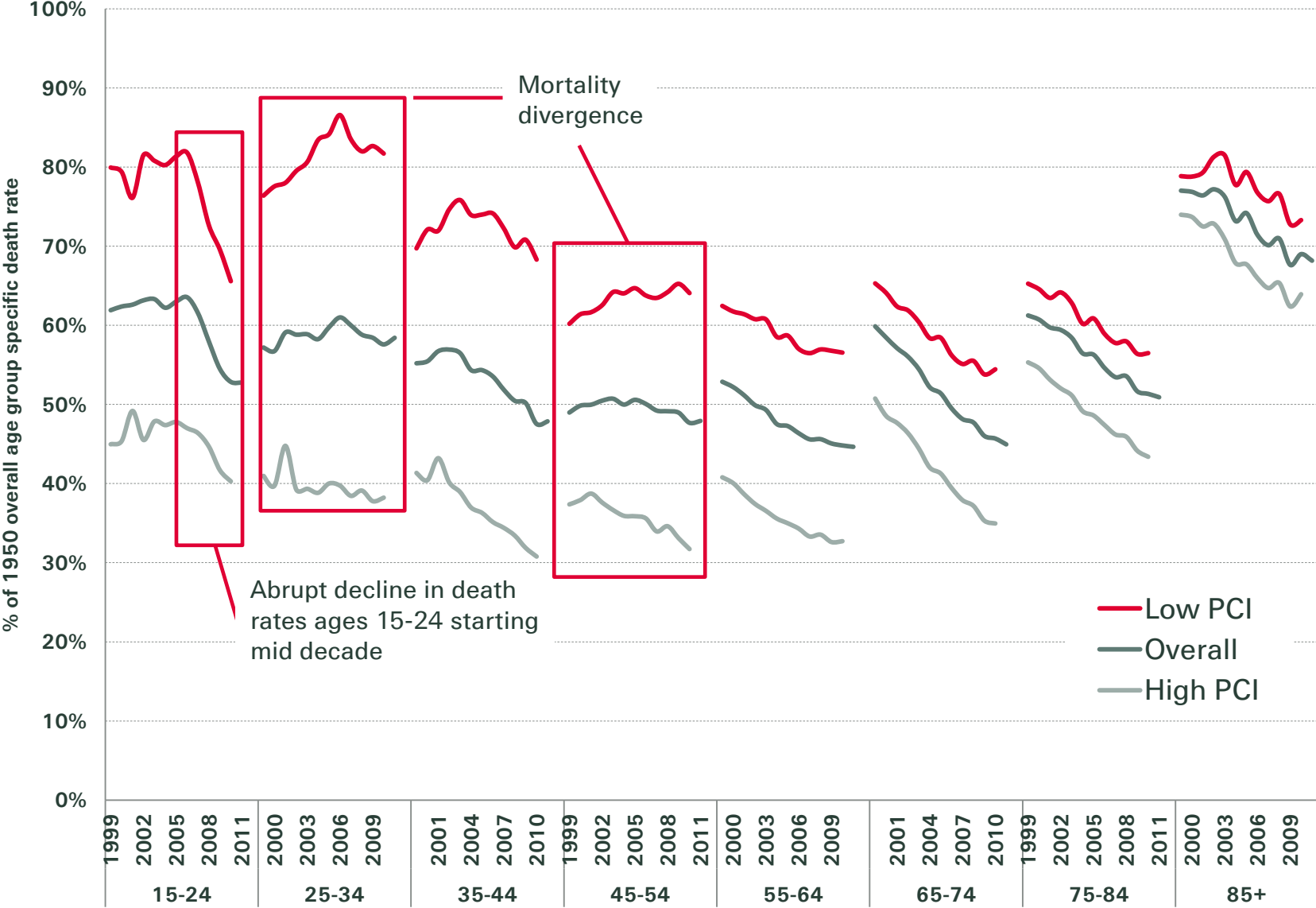
County Group ■ Low PCI County

High PCI county group
≥ $40,730
n=52 counties

Low PCI county group
≤ $21,026
n~1000 counties

Define groupings of ~25 million people living in the highest and lowest PCI counties as of the year 2000.

Swiss Re

# Mortality trends by PCI grouping



**Death rate trends 1999-2010: Overall and PCI subsets**

Mortality divergence

Abrupt decline in death rates ages 15-24 starting mid decade

Low PCI
Overall
High PCI

% of 1950 overall age group specific death rate
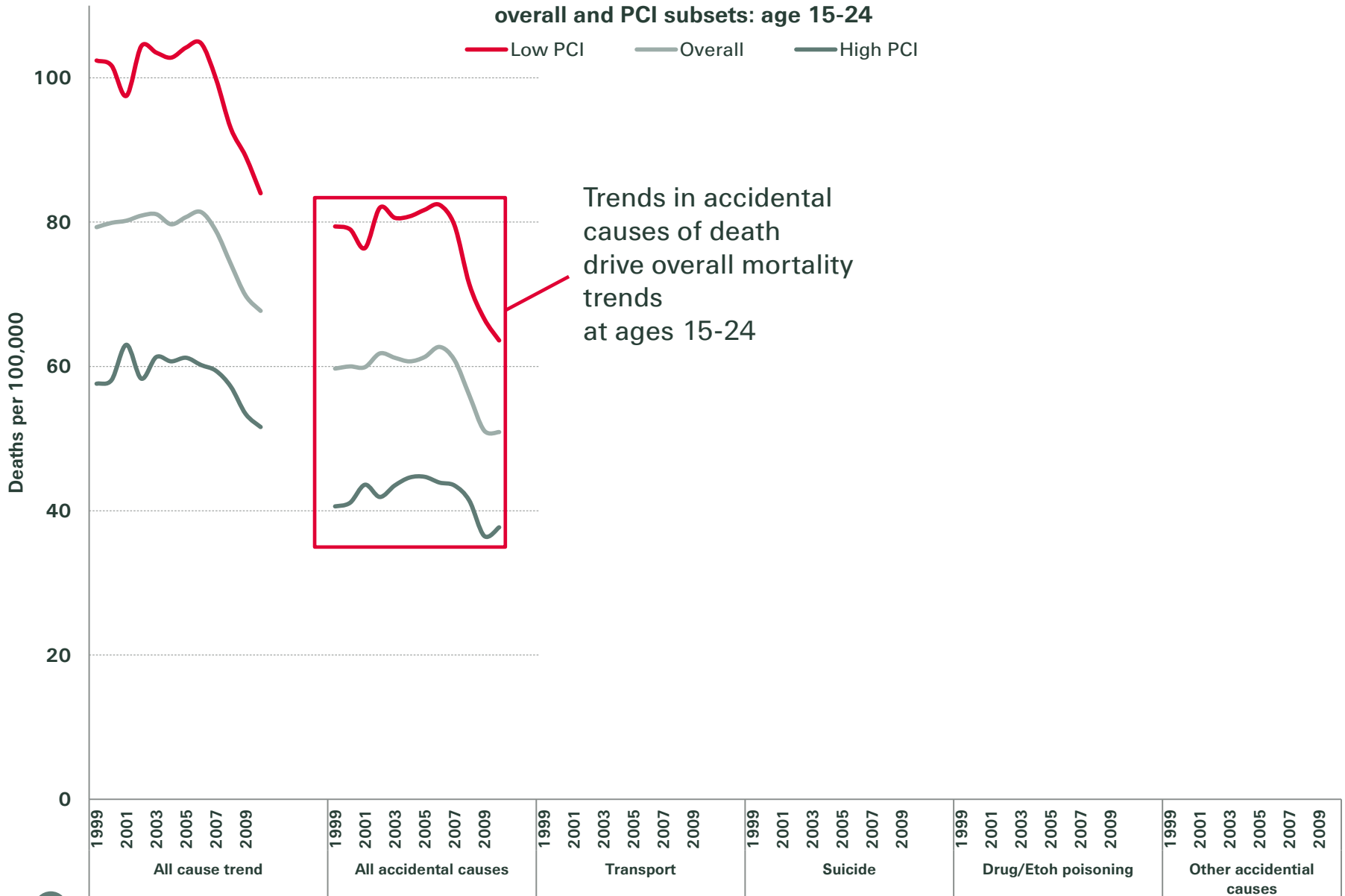
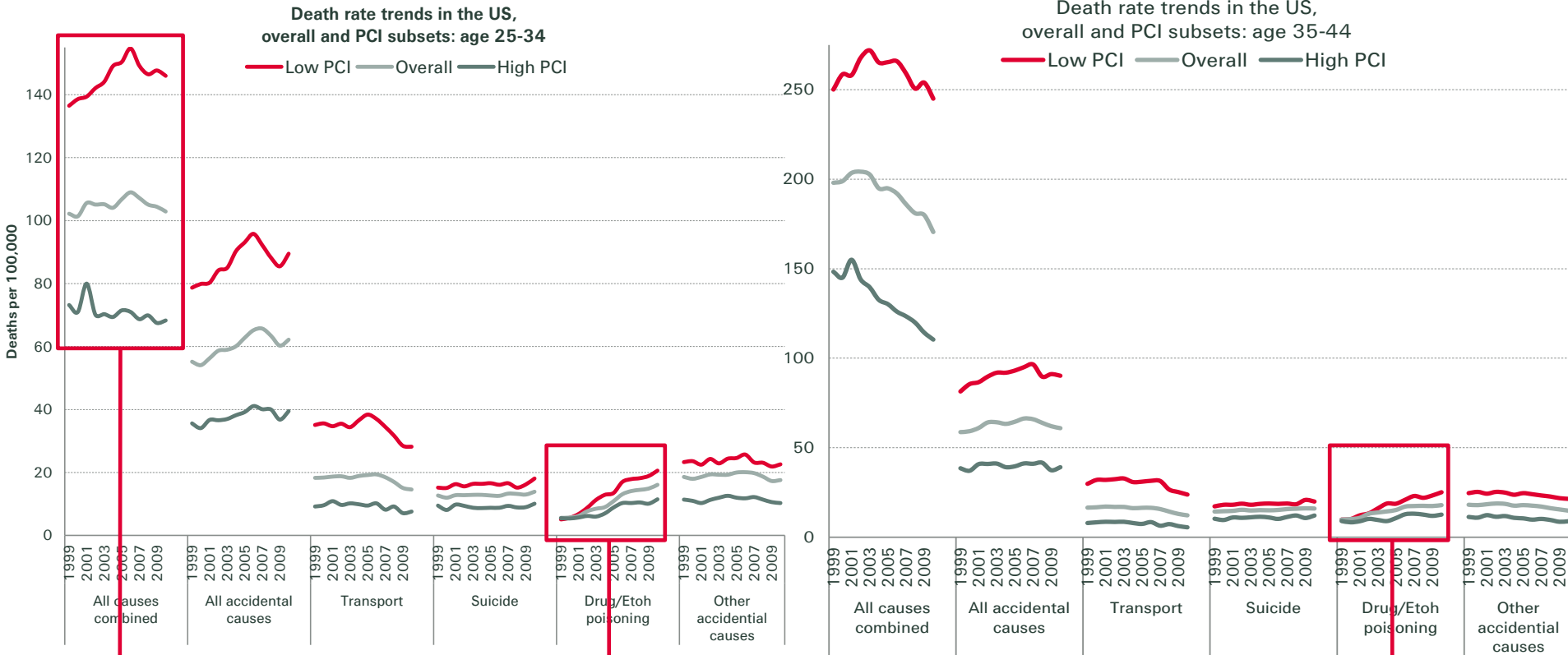15-24　25-34　35-44　45-54　55-64　65-74　75-84　85+

# Age specific trends

- Evaluate PCI subsets to assess for differential rates of near term trend

- Identify age specific causal drivers of trend and their recent trajectories

# 15-24



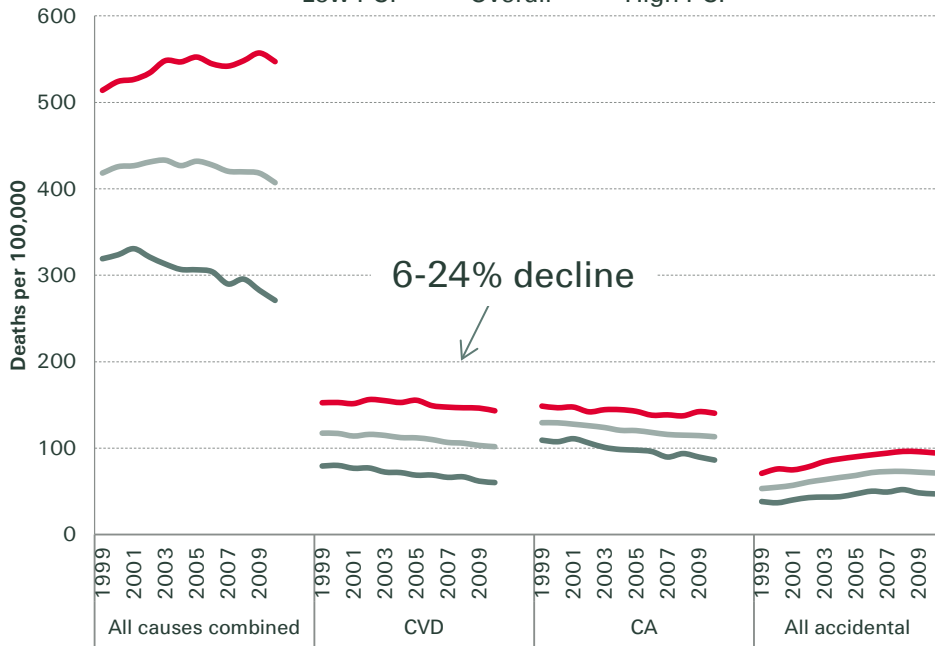**Death rate trends in the US, overall and PCI subsets: age 15-24**

Legend: — Low PCI  — Overall  — High PCI

Trends in accidental causes of death drive overall mortality trends at ages 15-24

Y-axis: Deaths per 100,000

Panels: All cause trend | All accidental causes | Transport | Suicide | Drug/Etoh poisoning | Other accidental causes

X-axis years: 1999, 2001, 2003, 2005, 2007, 2009

Swiss Re

NCHS 2013

# 25-34 /35-44



Death rate trends in the US,
overall and PCI subsets: age 25-34

Low PCI — Overall — High PCI

Death rate trends in the US,
overall and PCI subsets: age 35-44

Low PCI — Overall — High PCI

The divergent pattern appears to be mostly driven by accidental COD's

Contributing to the divergent pattern are differential increases in drug poisoning deaths.

Swiss Re
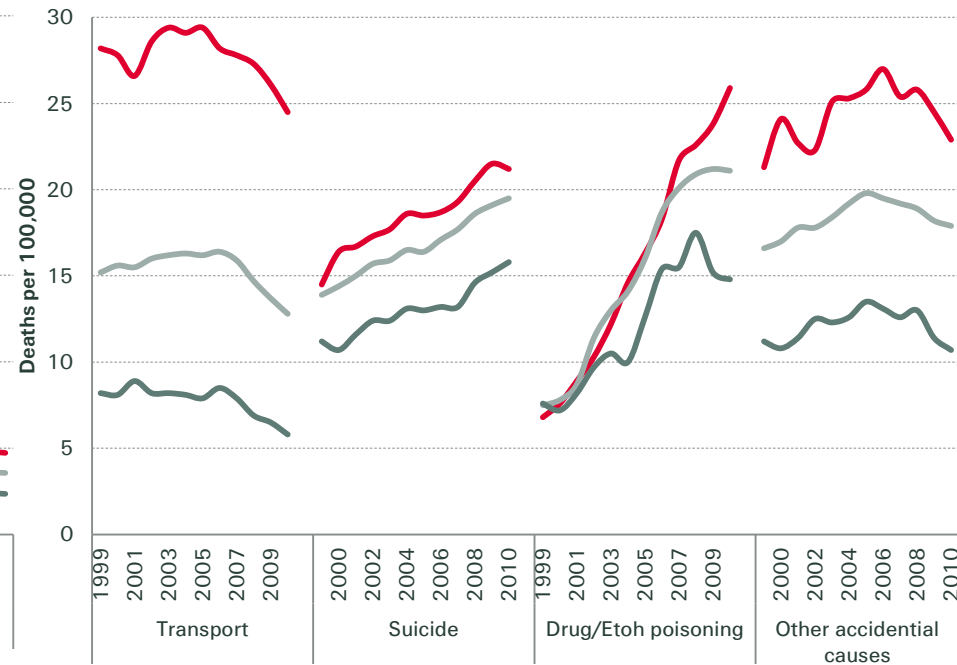
# 45-54

**Death rate trends in the US, overall and PCI subsets: age 45-54**

Low PCI — Overall — High PCI



6-24% decline

**Accidental death rate trend details in the US, overall and PCI subsets: age 45-54**

Low PCI — Overall — High PCI



- CVD and cancer become more important COD's than accidents.
- Death rate differentials by PCI can be seen across major COD groups.
- Velocity of declines in CVD and cancer death rates highest in high PCI group
- Drug poisoning continues to materially contribute to accidental deaths.

Swiss Re

# Transport accident deaths and economic recessions

## Figure 1:
### Percentage Change in Fatalities in Every Quarter as Compared to the Fatalities in the Same Quarter During the Previous Year
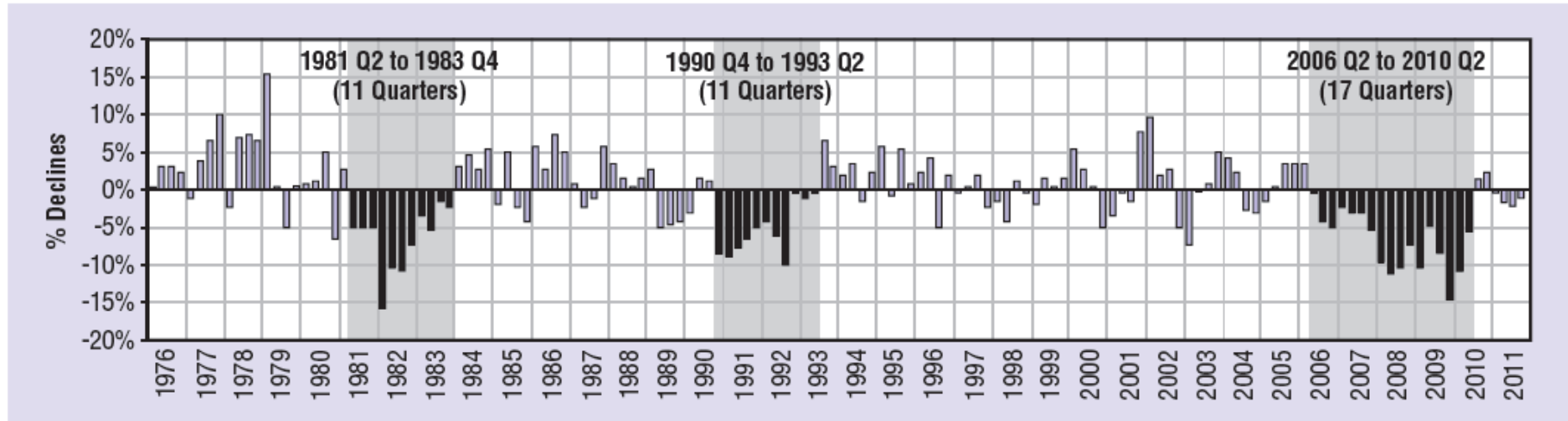


- The notable decline in accidental death rates at ages 15-24 may be associated with the 2007 recession.

- Individuals have less resources to travel during recessions, reducing their exposure to travel related risks. Travel activity in the higher PCI groups may be less affected by recessionary pressures, resulting in a more modest decline in transported related death rates for the high PCI group.

- Since transport fatalities have increased historically post-recession, the same may be seen as we exit the current recession.

Swiss Re

# Drug poisoning

90% of poisoning deaths are caused by drugs. Opioid analgesic pain relievers were involved in more poisoning deaths that other drugs, including heroin and cocaine.

78% of drug poisoning deaths were unintentional, 14% were suicides and 8% were of undetermined intent

This issue is present in both high and low PCI groups, suggesting we have exposure to this risk in insurance applicants.



Motor vehicle traffic, poisoning, drug poisoning, and unintentional drug poisoning death rates: United States, 1999 – 2010

Nearly 9 out of 10 poisoning deaths are caused by drugs. Opioid analgesic pain relievers were involved in more drug poisoning deaths than other specified drugs, including heroin and cocaine.
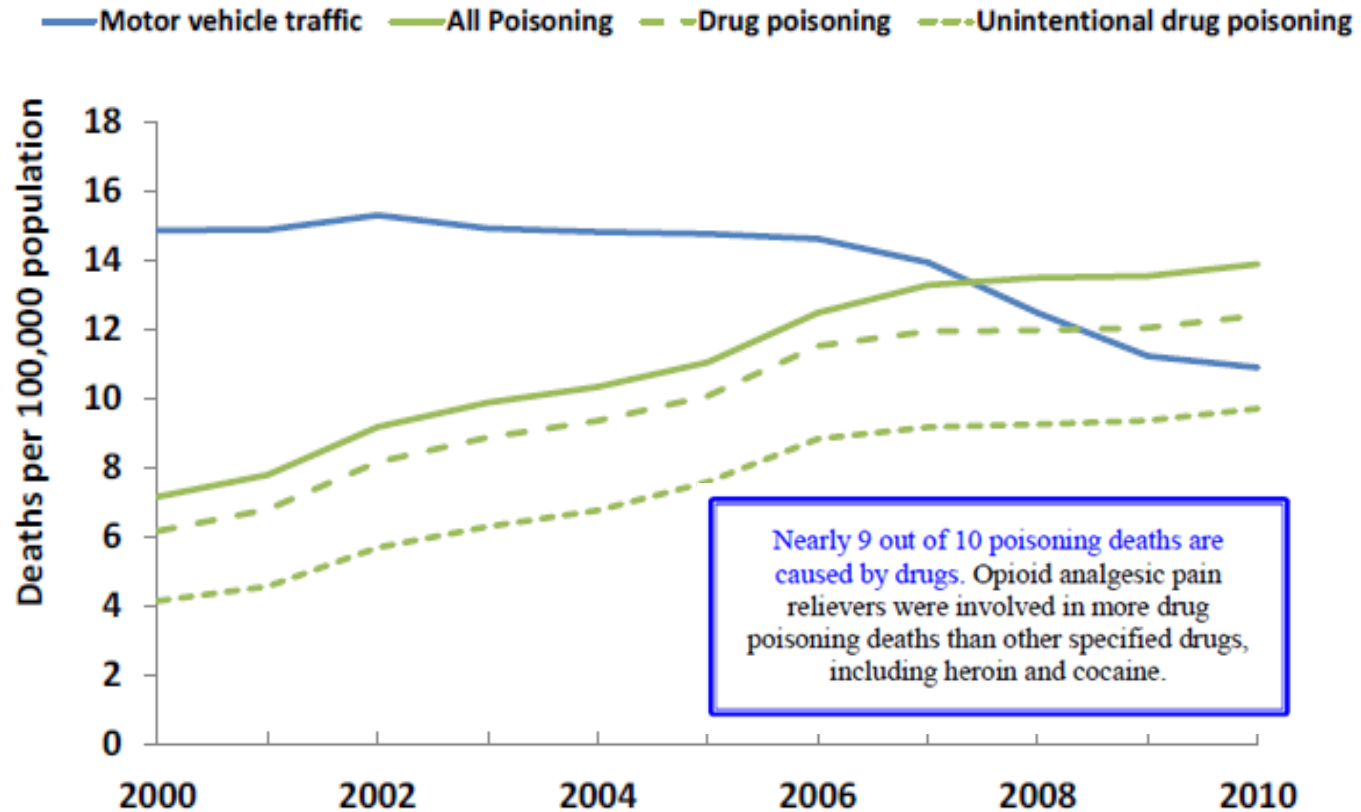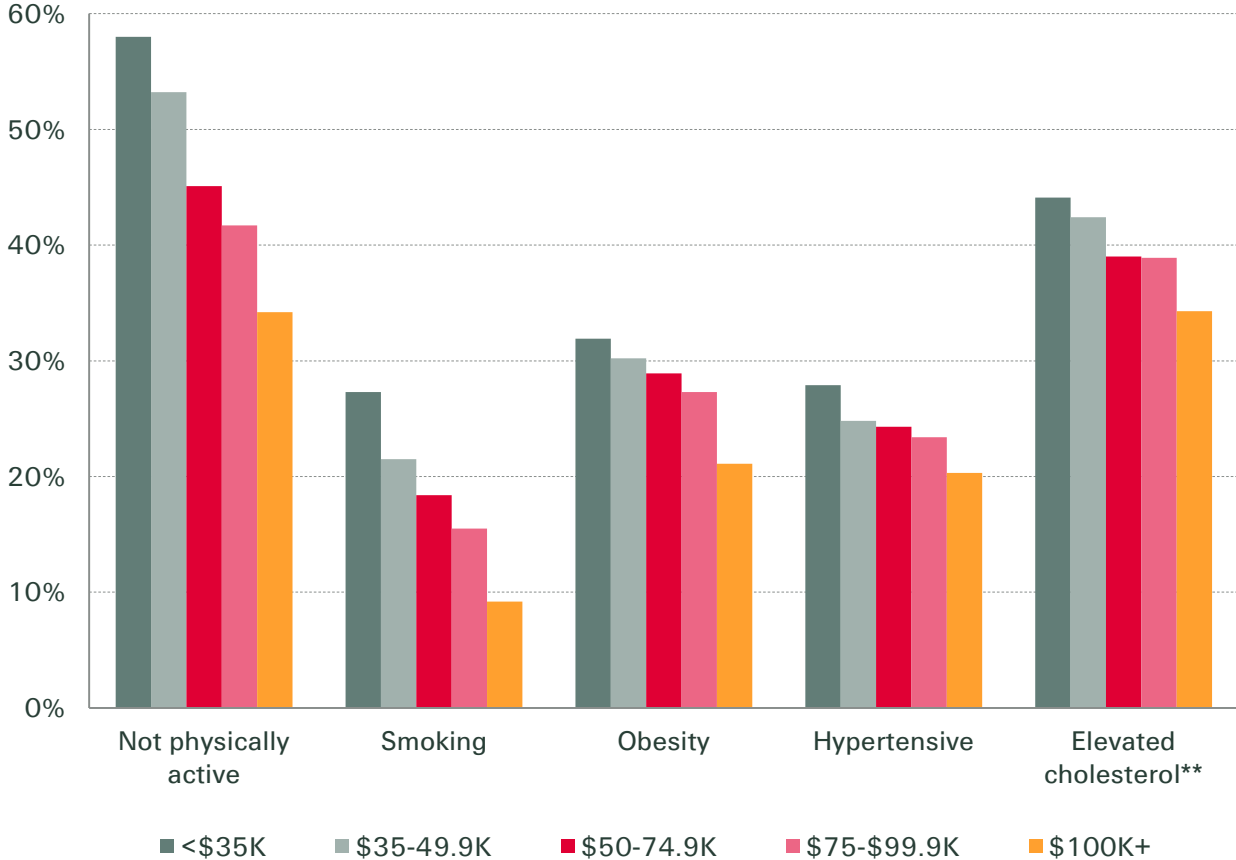
# Future drivers of trend: Risk factors

Income is a determinant in the level of risk factor burden observed in the population.

Monitoring for any divergence in risk factor trends could help explain widening gaps in mortality trend certain population subgroups.

Short term trends across most risk factor categories are fairly stable.

## Health risk factor burden by income level: 2011



Legend: ■ <$35K  ■ $35-49.9K  ■ $50-74.9K  ■ $75-$99.9K  ■ $100K+

X-axis categories: Not physically active, Smoking, Obesity, Hypertensive, Elevated cholesterol**

** Income groups for cholesterol
<$15K, $15-24K, $25-34K, $35-49K, $50K

National Health Interview Survey
Behavioural Risk Factor Surveillance System

# Future drivers of trend: Morbidity

Differences in the burden of disease between groups defined by income measures may contribute to differences in death rates by cause for certain conditions.
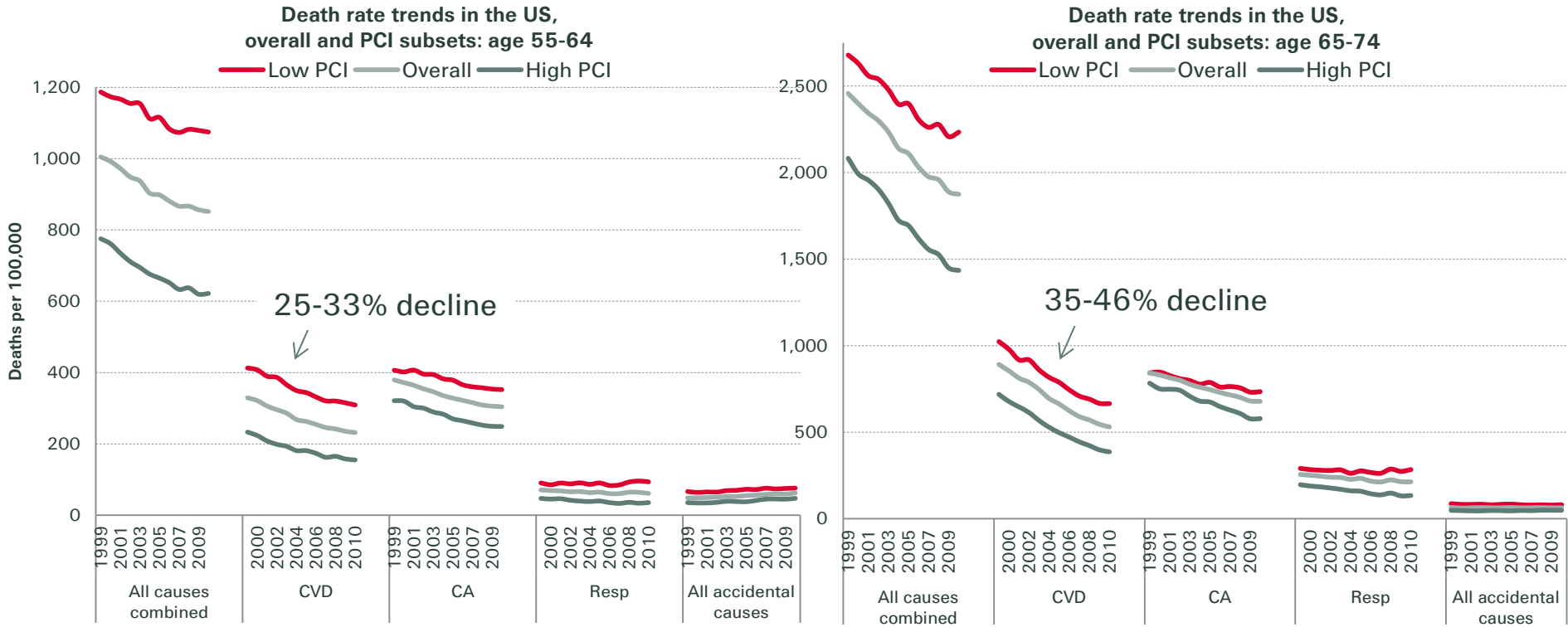
Differentials in the prevalence of diabetes by income category is a potential risk for increasing disparities in future cardiovascular disease rates between income groups.



**Trends in the prevalence of chronic disease by various income measures**
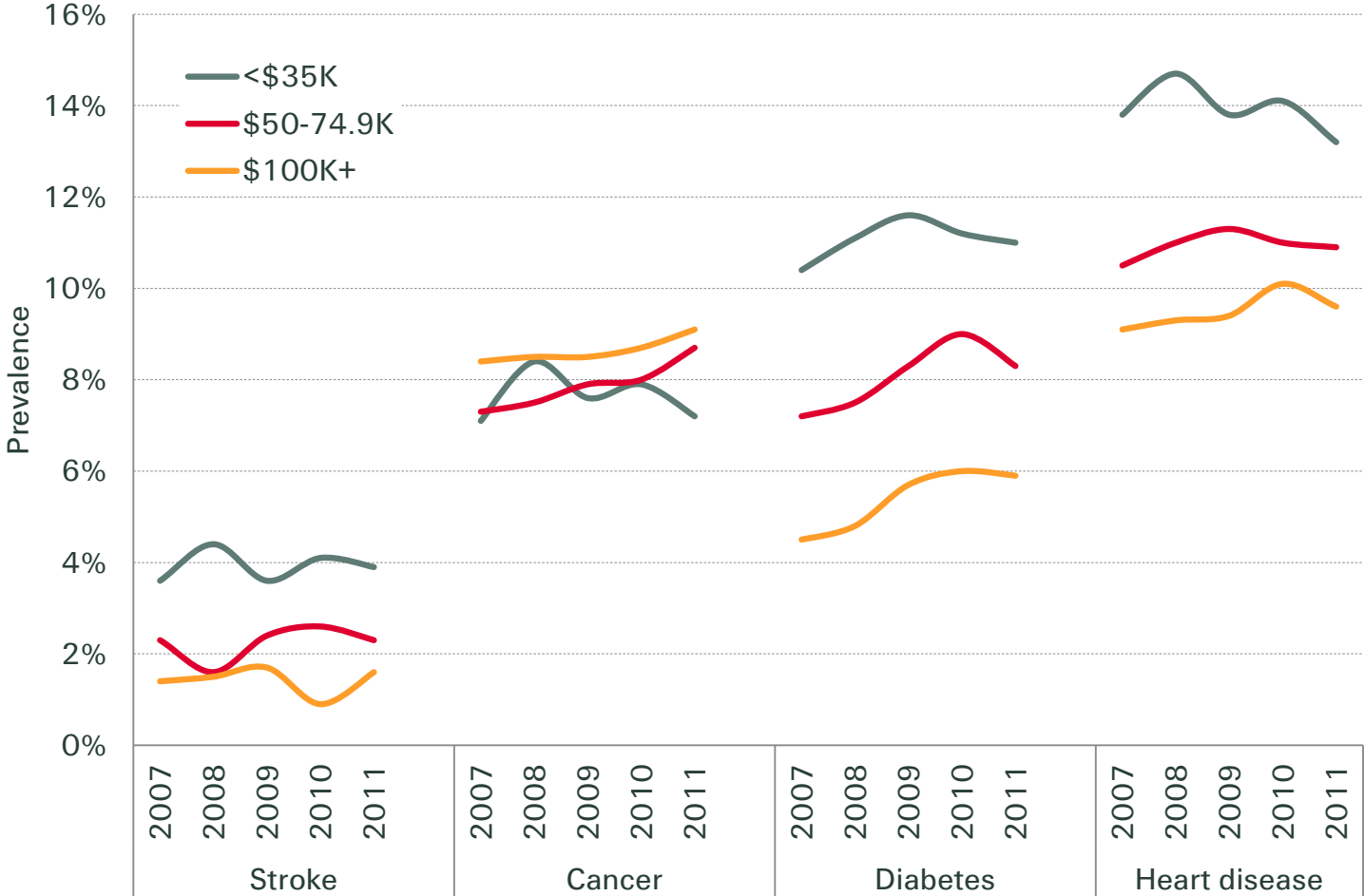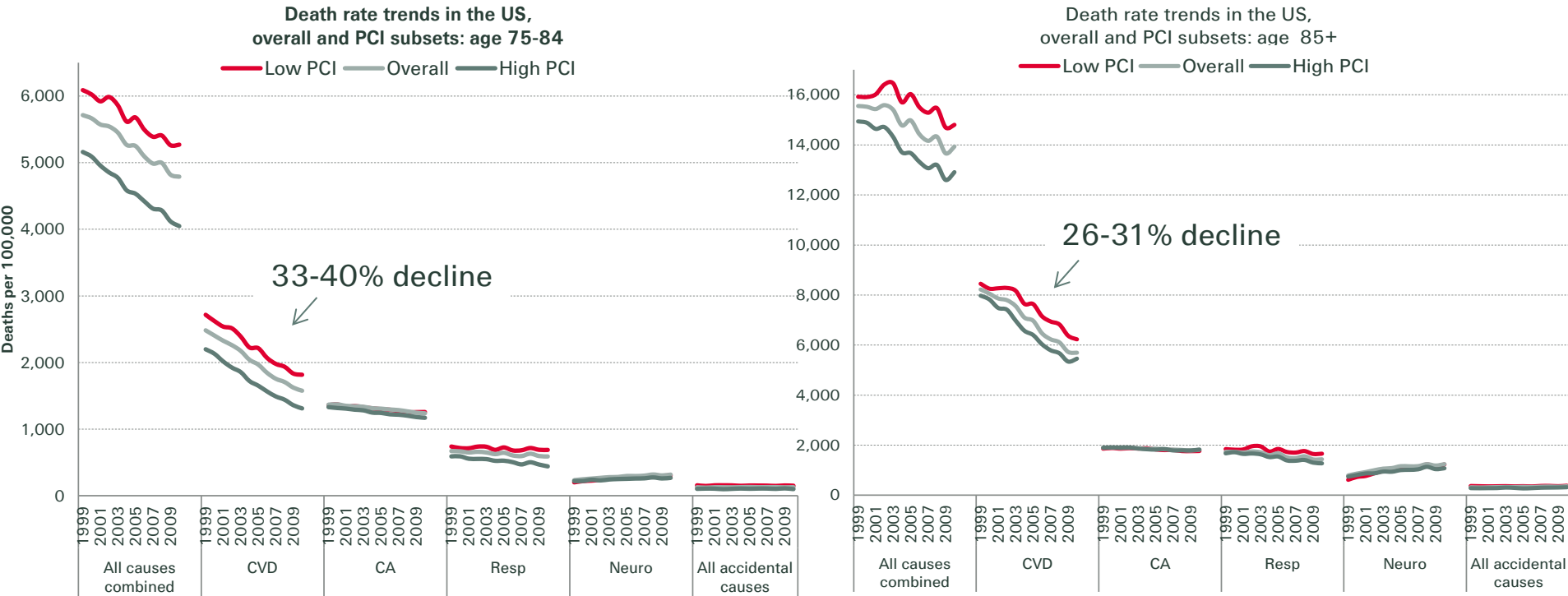
Legend:
- <$35K
- $50-74.9K
- $100K+

Swiss Re

# Drivers of trend at mid to older ages:
## Sustained progress in reducing cardiovascular disease death rates.



**Death rate trends in the US, overall and PCI subsets: age 55-64** — Low PCI, Overall, High PCI. 25-33% decline.

**Death rate trends in the US, overall and PCI subsets: age 65-74** — Low PCI, Overall, High PCI. 35-46% decline.

- >50% of deaths after age 50 attributed to cardiovascular diseases and cancer in both population and insured groups.

- At these ages strong declines in cardiovascular death rates continue to be observed with more modest declines in cancer death rates.

Swiss Re

# Drivers of trend at mid to older ages:
## Sustained progress in reducing cardiovascular disease death rates.



**Death rate trends in the US, overall and PCI subsets: age 75-84**

Low PCI — Overall — High PCI

33-40% decline

**Death rate trends in the US, overall and PCI subsets: age 85+**

Low PCI — Overall — High PCI

26-31% decline

- Separation of death rates by PCI grouping strongest for cardiovascular diseases possibly due SES correlates to smoking and other CV risk factors.  (Over a 10 year follow-up) little to no evidence of differentials in slope of decline by PCI.

- Above age 75 rising trends in deaths due to neurodegenerative conditions is noted (Alzheimer's and Parkinson's dx). But with neurodegenerative conditions contributing less than 10% of deaths cardiovascular disease remains a dominant COD that will drive near and mid term future trends.

Swiss Re

# Accidental causes of death trends ages 65+

- Small contribution to overall death rates
  - 65-74:  Trends in transport, suicide and other accidental causes flat. Trends in drug poisoning on the rise but more moderate than observed at earlier ages.
  - 75-84:  Accidental trends generally flat
  - 85+:  Trends in other external causes of accidents (falls) rising, but this trend is not observed due to the small relative contribution of this specific cause to overall death rate.

# PCI summary of findings

- All cause death rates are inversely influenced by PCI level. This affect appears to moderate at older age.

- The PCI effect on death rates is not uniform by COD and is age dependent.

- Short term rates of mortality improvement are often (but not always) higher in the higher PCI groups.

# Underwriting implications

- Causal drivers of trend are similar across economic groups suggesting population wide trends in these causes should have relevance in predicting future trends in more selected groups such as insured policyholders.

  - Further economic recovery may be associated with a rebound in accidental death rates at younger ages.

  - Trends in drug poisoning deaths need to be monitored and underwriting tools that could uncover high narcotic utilization may have increasing protective value in this environment.

  - As death rates for cardiovascular disease and cancer decline neurodegenerative causes of death and accidental falls are increasing in frequency in the elderly. Neurocognitive underwriting and functional status assessments take on greater importance in this environment.

  - In middle and older age cardiovascular deaths continue to dominate as a major cause of death. Underwriting should continue to employ screens to identify prevalent CVD and assess future risk for incident CVD.

Swiss Re

# Legal notice

Swiss Re