U.S. Population Mortality Observations

Updated with 2020 Experience

Mortality and Longevity

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Section 1: Introduction

The Society of Actuaries has developed this report to provide insights on the historical levels and emerging trends in U.S. population mortality. The most recently released U.S. population mortality experience from calendar year 2020 has been incorporated and added to prior available data to enable analysis of mortality experience over the period 1999-2020. This research is part of its ongoing longevity and mortality research initiatives.

The report begins in section 2 with an Executive Summary, which contains key highlights pulled from sections 3 through 5. Section 3 contains mortality analysis for the overall population and by sex and section 4 looks at mortality results by age group. The impact of COVID is called out in the analyses. Section 5 covers mortality by the 13 individual causes of death (CODs), including COVID, that were selected from the National Center for Health Statistics' (NCHS) list of rankable causes of death. The remainder of section 5 provides more detailed analysis for 8 CODs: heart; cancer; diabetes, liver, hypertension, accidents excluding opioids, opioids and suicide.
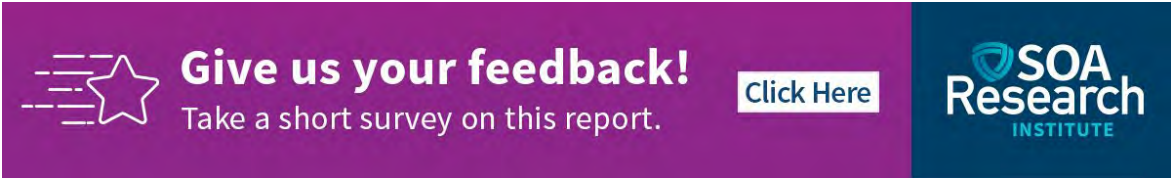
Section 6 includes analysis of experience by socioeconomic status. A Socioeconomic Index Score[1] was computed for each county. The counties were then grouped into quintiles with each quintile holding 20% of the total U.S. population. Mortality rates were then calculated for each county quintile grouping. Quintile group 1 contains the counties with the lowest Socioeconomic Index Score and quintile group 5 contains the counties with the highest Socioeconomic Index Score. The Socioeconomic Index Score used for the groupings in this report takes county-wide variables on education, occupation, employment, income, and housing price and quality into account.

The remaining content of the report is online in five interactive dashboards, which can be found on the same webpage where the pdf of this report is located. In the dashboards, the 13 listed CODs are also shown on a combined basis by physiological and external causes. Given the continued interest in opioid-related deaths, opioids are shown as a COD, as are the accidents without opioids analysis, and they are shown in an exhibit of deaths by opioid type for all ages and sexes. The COD variation of interest can be viewed in the first two dashboards by using a drop-down box at the top right of the data board. The "U.S. Population Mortality by Sex" dashboard includes a graph of age-adjusted death rates from 1999-2020 by sex and both sexes combined and a related table with corresponding average annual mortality improvement rates. The table shows experience by sex for all ages combined and by combined sex for age groups[2]. The 2020 average annual mortality improvement rates are shown over various time periods: since 1999, 5 years, and 1 year. The drop-down box below the COD choice enables the by sex analysis to be filtered by a selected county quintile group. The "U.S. Population Mortality by County Socioeconomic Quintile Group" dashboard is like the "U.S. Population Mortality by Sex" dashboard, except that the graph shows county variation rather than sex variation with a drop-down box choice to filter by a selected sex. The third dashboard, "Opioid Deaths by Opioid Type and County Quintile Group," shows the exhibit of opioid deaths by opioid type with variation by county quintile group for all ages and sexes combined. The fourth dashboard, "Historical Change in Mortality," shows historical mortality rates, the annual change in mortality and the five-year

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[1] Society of Actuaries. Mortality by Socioeconomic Category in the United States. https://www.soa.org/resources/research-reports/2020/us-mort-rate-socioeconomic/. November 2020.
[2] The accidents without opioids COD variation does not contain any experience by age group for the county income groups other than 'All Counties.'

average change for selected county quintile groups, COD and sex. The fifth dashboard, "Annual Change in Mortality by Age Group," shows the annual change in mortality by age group for a selected calendar year, county quintile group, COD and sex. All data supporting this report and the dashboards are included in an appendix in the form of an Excel file that can be found on the same webpage where this report and these dashboards are located.

Section 2: Executive Summary

2.1 KEY HIGHLIGHTS

The following are some of the more notable observations from the analyses detailed in this report:

- The overall age-adjusted mortality rate (both sexes) from all causes of death recorded the historically highest increase of published records dating back to 1900 of 16.8% in 2020, following a 1.2% decrease in 2019. The increase eclipsed the size of recent years' annual volatility and exceeded the 11.7% increase in 1918 that occurred during the Spanish influenza pandemic[3]. When COVID deaths are removed, all other CODs' (Cause of Death) combined mortality increased by 4.9%, which was last exceeded by a 5.6% increase in 1936[4].

- All other CODs featured in this report had increased 2020 mortality. In many instances, the single year mortality increases were the largest for the span of this report. Heart disease and Alzheimer's/Dementia had 4.7% and 7.8% increases, respectively. Other physiological CODs with lower death rates had double-digit increases. Diabetes, liver and hypertension had increases of 14.9%, 16.0% and 13.3%, respectively. The external CODs of assaults and opioid overdoses had extreme increases at ages 15-24 of 35.9% and 61.2%, respectively.

- Cancer, pulmonary and suicide were the only CODs featured in this report with decreased mortality in 2020. Cancer continued its trend of improvement with a 1.4% decrease of mortality. Pulmonary and suicide recorded 4.5% and 3.5% decreases, respectively. However, improvement rates can vary notably by age. For example, suicide for both sexes recorded one-year mortality increases from ages 5-34, with the most severe increase of 15.0% occurring for males aged 5-14.

- The impact of just COVID varied by age and sex. Ages under 5 were largely untouched by COVID. The mortality rate increase from COVID increased almost monotonically from 5-14 to 85+ for both sexes. The COVID increment was larger for males than females. The COVID increment was 0.9% for both sexes at ages 5-14 and peaked at ages 75-84 at 12.4% and 14.9% for females and males, respectively. The increment was slightly lower for ages 85 at 11.7% and 13.5% for females and males, respectively. Overall, COVID contributed -11.9% of the total -16.8% 2020 mortality improvement.

- Female and male mortality patterns were similar but reflected greater impact of adverse mortality on males than females in 2020, both with and without COVID. Female and male mortality with COVID increased by 15.3% and 17.8%, respectively, and increased by 4.2% and 5.1%, respectively, without COVID. This implies that the difference of male minus female mortality rate increases was 2.5% with COVID and 0.9% without COVID.

- Total mortality improvement in 2019-2020 with COVID varied substantially by age group by sex. Ages under 5 saw decreased mortality, while ages 5-14 had a slight 2.3% increase. However, all ages 15 and above had substantially higher mortality rate increases or negative mortality improvement in a range of -21.2% to -15.0% for females and -26.6% to -14.9% for males. Generally, those rates of increase peaked for

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ages 25-54 for both sexes and declined from that age range to the lows of the ranges just stated for ages 85+.

- When COVID is excluded, ages 15-44 had double-digit percentage 2020 mortality increases for both sexes. Male rates were higher than corresponding female rates by approximately 6%. The peak rate of increases for both sexes occurred for ages 25-34, which increased by 16.8% and 21.4%, respectively, for females and males. Very high 2020 mortality rates for opioids, assaults and accidents excluding opioids contributed to these very notable COVID excluded mortality increases.

- The opioid drug overdose death rate increased by 37.6% in 2020, which followed a 6.3%% increase in 2019. The extreme deterioration of mortality in 2020 leaves 2018 as the only year from 2000-2020 with improved mortality and exceeded the next highest of 27.4% that occurred in 2016. Although opioid mortality rates are much lower than other major CODs, their 2020 one-year mortality rates stood out as extreme and historic in terms of their level and change from 2019. The highest 2020 one-year mortality increases for females and males occurred at ages 15-24 for both sexes. Those 2020 one-year increases for females and males were 50.1% and 65.7%, respectively.

- The classification of U.S. counties into quintiles based on a socioeconomic index score (SIS) showed gradient separation of mortality by these quintiles. Generally, the SIS scored counties assigned into five quintiles had death rates in rank-order inverse to their quintiles 1-5. Their mortality improvement, although more fluid in rank-order changes, generally had the highest and lowest improvement for quintiles 5 and 1, respectively. The span of highest to lowest death rates across quintiles widened from 2019 to 2020 in absolute terms and expressed as a percentage index of quintile to all counties mortality. The highest (quintile 1) and lowest (quintile 5) quintile indices for All Causes were 120.3% and 83.2%, respectively, in 2019, and 122.5% and 82.2% in 2020. Unique combinations of the relative impact of COVID and all other CODs for each quintile being above or below their 2019 index baseline produced the combined 2020 result of a widened difference between the highest and lowest quintiles and moderate change for the other quintiles.

- The assignment of the underlying cause of death by certifiers involves judgement within recommended guidelines that were recently updated in 2020 for COVID and published earlier for general application by the CDC in 2003. Readers of this report should be aware that similar circumstances may be viewed differently by individuals and practices may have evolved over time such that consistency of the assignment of the underlying COD could be affected. This is particularly important for this report covering the first year of the COVID pandemic. More information on this with references cited are in Section 7 of this report.

Section 3: Overall Population and by Sex

3.1 TOTAL POPULATION

The overall age-adjusted mortality rate[5] (both sexes) from all causes of death recorded the historically highest increase of published records dating back to 1900 of 16.8% in 2020, following a 1.2% decrease in 2019. The increase eclipsed the size of recent years' annual volatility and exceeded the 11.7% increase in 1918 that occurred during the Spanish influenza pandemic[6]. When the effects of COVID are removed, all other CODs' combined mortality increased by 4.9%, which was last exceeded by a 5.6% increase in 1936[7]. The Five-Year Average graph below shows the impact in 2020 of the COVID pandemic era mortality rates on the longer-term averages. The five-year average mortality improvement rates from 2015-2020, with and without the effects of COVID, were -2.7% and -0.5%, respectively.

Figure 1
U.S. POPULATION ANNUAL AND FIVE-YEAR AVERAGE MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

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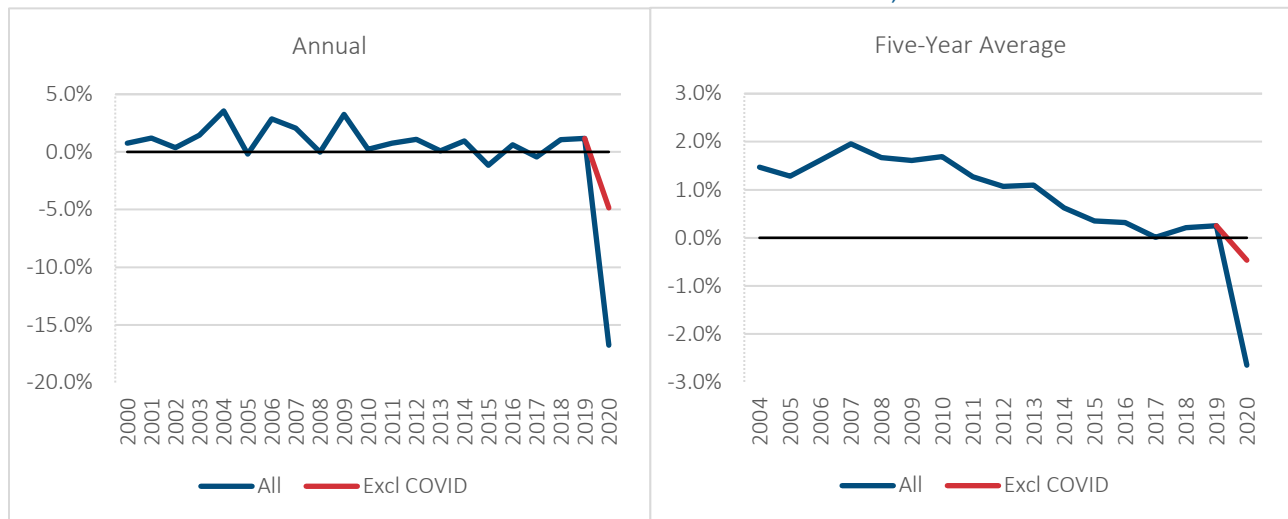
[5] Age-adjusted rates are calculated assuming the mix of ages in the population stays the same each year. Life expectancy is a composite of mortality rates over a single person's future lifetime. This report focuses on age-adjusted rates (2010 baseline year), as opposed to life expectancy, because actuaries generally require mortality rates, not life expectancies, as an input assumption for their work.
[6] AGE-ADJUSTED DEATH RATES FOR SELECTED CAUSES, DEATH REGISTRATION STATES, 1900-32, AND UNITED STATES, 1933-98 https://www.cdc.gov/nchs/nvss/mortality/hist293.htm
[7] Ibid

3.2 BY SEX

Female and male mortality patterns were similar but reflected greater impact of adverse mortality on males than females in 2020, both with and without COVID. Female and male mortality with COVID increased by 15.3% and 17.8%, respectively, and increased by 4.2% and 5.1%, respectively, without COVID. This implies that the difference of male minus female mortality rate increases was 2.5% with COVID and 0.9% without COVID. While male mortality improvement has generally lagged female improvement in recent years, these differences are much larger than those seen during 2015-2019 where the average excess of female to male annual improvement was 0.2%. These differences by sex carry through to the five-year average mortality improvements. The excess of the female to male five-year average mortality improvement rate from 2015-2020 was 0.7% with COVID and 0.4% without COVID.

Figure 2

U.S. POPULATION FEMALE ANNUAL AND FIVE-YEAR AVERAGE MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020
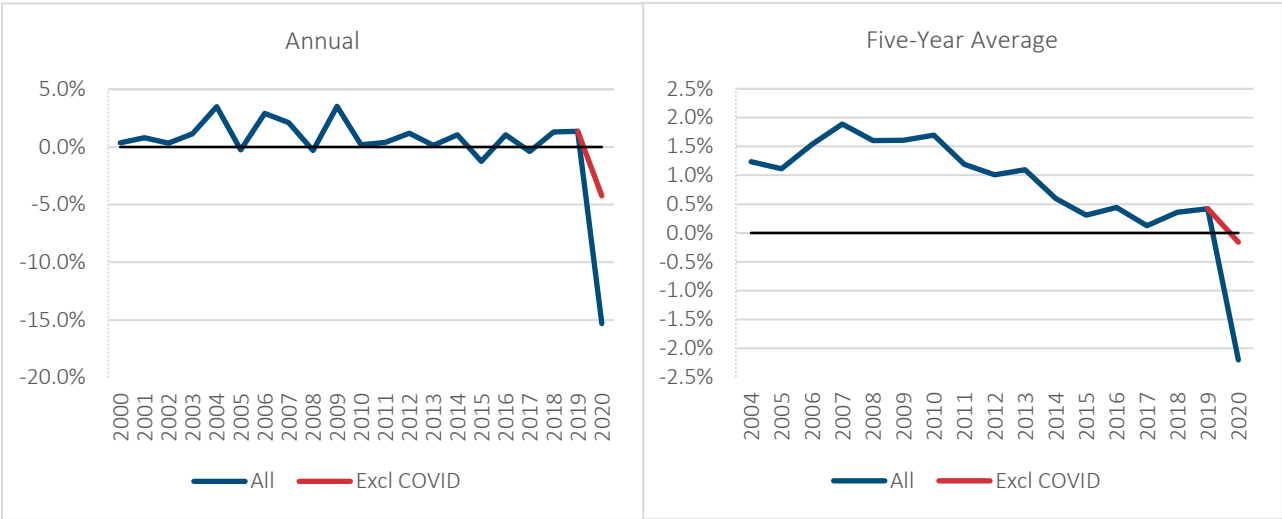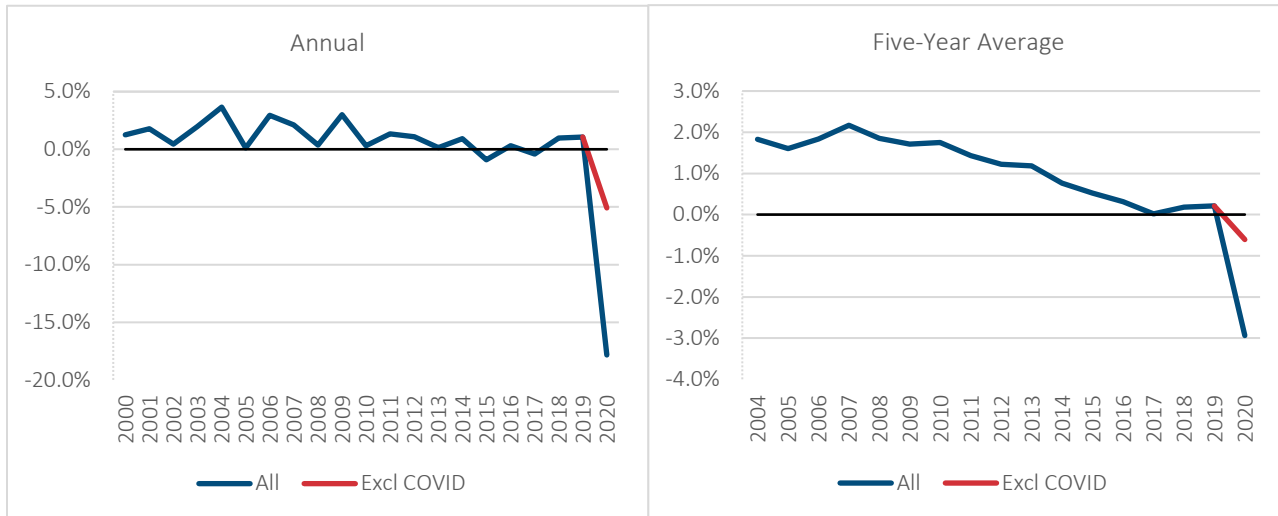
Figure 3

U.S. POPULATION MALE ANNUAL AND FIVE-YEAR AVERAGE MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

Section 4: Age Group

Table 1 below shows mortality improvement in 2019-2020 varied substantially by age group, with and without COVID, and by sex regarding excess COVID mortality. Females under age 15 and males under age 1 saw decreased mortality, while male mortality increased by 0.8% for ages 1-4 and 5.5% for ages 5-14. All ages 15 and above had substantially higher mortality rate increases or negative mortality improvement in a range of -21.2% to -14.8% for females and -26.6% to -14.9% for males. Generally, those rates of increase peaked for ages 25-54 for both sexes. When COVID is excluded, all ages 15 and above for both sexes had increased mortality. The pattern shifts to peak disimprovement at ages 25-34, -16.8% for females and -21.4% for males, with declining mortality rate increases with successively higher age. The difference of with and without COVID, the COVID excess mortality, showed a monotonically increasing impact of COVID, except for ages 85+, across all ages for both sexes. And as discussed in subsection 3.3, the observed overall higher male than female excess COVID mortality is reflected here with the greatest effect from ages 45-85+.

Table 1
U.S. POPULATION 2019-2020 MORTALITY IMPROVEMENT BY AGE AND SEX

Age Group	Female			Male			Male-Female COVID Excess
	With COVID	Excl COVID	COVID Excess	With COVID	Excl COVID	COVID Excess	
< 1	4.6%	4.6%	0.0%	5.7%	5.9%	-0.2%	-0.2%
1-4	6.8%	6.8%	0.0%	-0.8%	-0.8%	0.0%	0.0%
5-14	2.2%	3.1%	-0.9%	-5.5%	-4.6%	-0.9%	0.0%
15-24	-16.6%	-14.2%	-2.4%	-22.2%	-20.8%	-1.4%	1.0%
25-34	-21.2%	-16.8%	-4.4%	-24.9%	-21.4%	-3.5%	0.9%
35-44	-20.5%	-13.8%	-6.7%	-26.6%	-19.1%	-7.5%	-0.8%
45-54	-17.3%	-8.1%	-9.2%	-22.7%	-11.1%	-11.7%	-2.5%
55-64	-15.4%	-5.1%	-10.3%	-19.0%	-7.2%	-11.9%	-1.6%
65-74	-16.0%	-4.0%	-12.0%	-18.5%	-4.3%	-14.2%	-2.2%
75-84	-14.8%	-2.5%	-12.4%	-17.0%	-2.1%	-14.9%	-2.6%
85+	-15.0%	-3.2%	-11.7%	-14.9%	-1.4%	-13.5%	-1.8%
All Ages	**-15.3%**	**-4.2%**	**-11.1%**	**-17.8%**	**-5.1%**	**-12.7%**	**-1.6%**

4.1 MORTALITY ATTRIBUTION BY AGE GROUP

The attribution by age of mortality improvement varied across age and by inclusion or exclusion of COVID. Whether COVID was included or excluded, ages under 15 had no contribution to the attribution of mortality improvement. When COVID is included, the attribution for age groups 15-24 to 85+ decreased monotonically by age group to a maximum impact of a low of -4.6% for ages 85+. Those same ages saw a moderate decreasing trend with the effects of COVID excluded that reached a low of -0.8% at age group 85+. Because the attribution of mortality improvement for an age group is, in part, determined by its proportion of the mortality for all ages, older age groups' attribution of mortality change will naturally be magnified relative to other ages. That factor, combined with the older age groups' more adverse COVID experience, produced -8.4% or half of the -16.8% total 2019-2020 mortality improvement in age groups 75-84 and 85+. When COVID is excluded, those same two age groups' share of the 2019-2020 improvement was -1.3% of the total -4.9% or 26.8% of the total improvement excluding COVID. Relative

improvement of one age group to another also determines age group attributed shares of total change. The very adverse changes with COVID, excluded for ages 15-44, relative to other ages produced -1.2% of the -4.9% total improvement or 24% of it, while the total deaths for those ages were only 6.3% of all deaths.

Table 2
U.S. POPULATION ATTRIBUTION OF 2020 MORTALITY IMPROVEMENT BY AGE

Age Group	Deaths per 100,000		Mortality Improvement		Attribution of Mortality Improvement	
	2020	2020 w/o COVID	2019 to 2020	2019 to 2020 w/o COVID	2019 to 2020	2019 to 2020 w/o COVID
Less than 1	524.3	523.3	5.2%	5.4%	0.0%	0.0%
1-4	22.7	22.7	2.6%	2.6%	0.0%	0.0%
5-14	13.7	13.6	-2.3%	-1.4%	0.0%	0.0%
15-24	84.2	83.0	-20.7%	-19.0%	-0.3%	-0.2%
25-34	159.5	154.6	-23.8%	-20.0%	-0.5%	-0.4%
35-44	248.0	233.6	-24.5%	-17.2%	-0.8%	-0.6%
45-54	473.5	431.5	-20.7%	-10.0%	-1.5%	-0.7%
55-64	1,038.9	939.7	-17.6%	-6.4%	-2.4%	-0.9%
65-74	2,072.3	1,837.9	-17.4%	-4.2%	-2.8%	-0.7%
74-84	4,997.0	4,407.2	-16.0%	-2.3%	-3.8%	-0.5%
85+	15,210.9	13,565.9	-15.0%	-2.5%	-4.6%	-0.8%
All Ages	895.4	804.1	-16.8%	-4.9%	-16.8%	-4.9%

* Rounded Age Group attribution values do not sum to Total. The attribution method is described in section 7.

Section 5: Cause of Death

5.1 CAUSE OF DEATH DISTRIBUTION BY AGE GROUP

Physiological CODs predominated for older ages and external CODs (assault, suicide, and accidents) predominated for younger ages. Age group 15-24 had the highest proportion, 77.2%, of external CODs in 2020. Accidents were the largest portion of those CODs. Age group 25-34 had the highest portion, 42.6%, of accidental deaths.

Heart, cancer, COVID and Alzheimer's/dementia combined predominated within physiological causes for older ages. The combined deaths of those four CODs were at least 50% of the total deaths for age groups 55-64 and higher. The percentage of deaths from those four CODs ranged from 55.3% for age group 55-64 to 62.8% for age group 85+. Within the mix of those four CODs and those age groups, each COD had an increasing share of deaths by age except for cancer and COVID. Cancer peaked at age group 65-74 with 26.0% of deaths, and declined to 10.1% for age group 85+. COVID peaked at age group 75-84 with 11.8% of deaths, and declined to 10.8% for age group 85+.

The combination of the other physiological CODs shown, stroke, pulmonary, diabetes, flu & pneumonia, liver and hypertension, produced at least 10% of the deaths for age groups 35-44 and higher. The combined percentage of deaths of those six CODs for those age groups ranged from a low of 11.8% for age group 35-44 to 18.1% for age group 65-74. Within that mix of those six CODs for those age groups, stroke, pulmonary and hypertension generally increased with advancing age, and diabetes and liver decreased with that same age progression, while flu was relatively constant across the age groups.

Figure 4
2020 COD PROPORTION OF DEATHS BY AGE GROUP
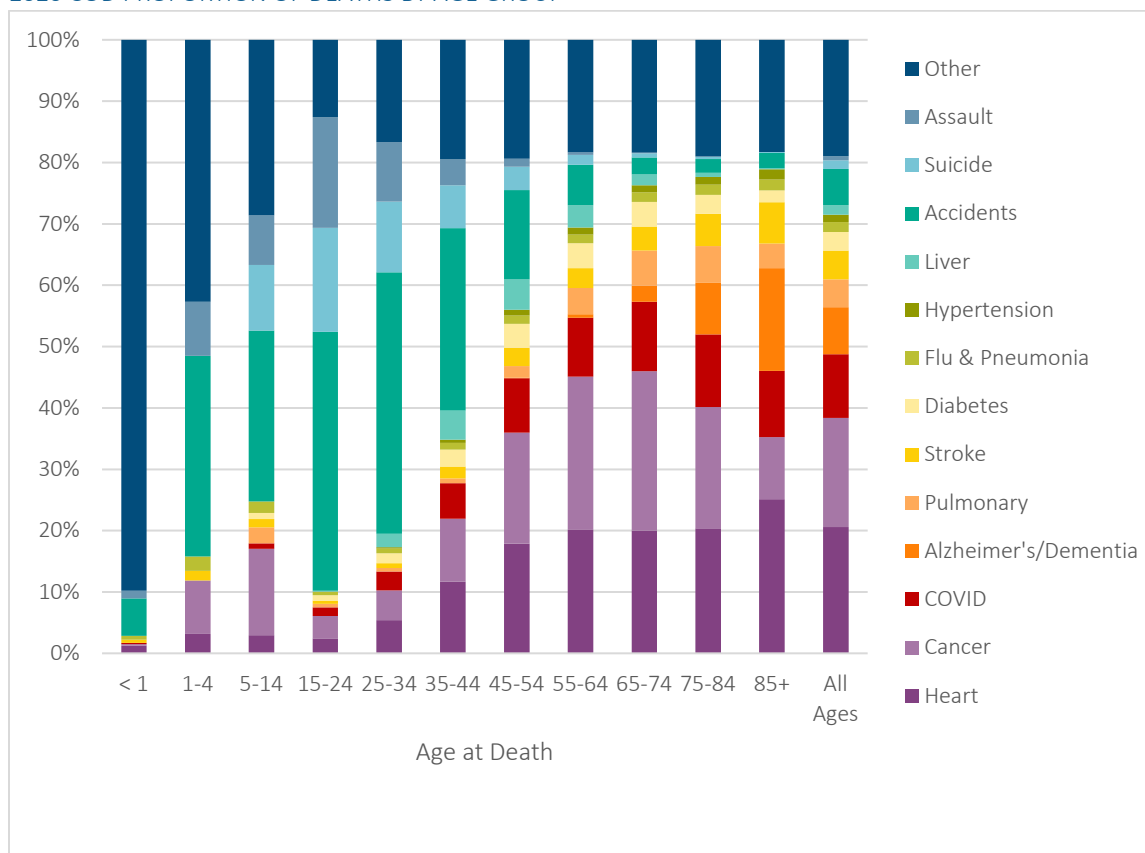
5.2 MORTALITY ATTRIBUTION BY CAUSE OF DEATH

U.S. population deaths of 3,383,729 in 2020 were the highest in history[8]. Heart disease remained the number one killer and accidents continued to be the highest external[9] COD in 2020. The number of deaths in 2020 for the population by the CODs studied in this report are shown below in descending rank order. The attribution of COVID to the total eclipsed all other CODs and contributed -11.9% to the -16.9% 2020 improvement rate. Cancer, pulmonary and suicide were the only CODs that had improved mortality in 2020. Cancer reflected a continued long-term trend, while suicide and pulmonary continued very recent trends. Taken together, those three CODs produced a 0.6% offset to all other CODs' negative improvement. Heart disease was the next largest impact to improvement after COVID. Its -4.2% improvement rate translated into a -1.0% contribution to total improvement, which was also 20% of the -4.9% improvement excluding COVID. Accidents were the largest external COD contributor to attributed mortality improvement. Their very low -16.3% improvement translated into a -1.1% contribution to total improvement. Although assault is a small proportion of all deaths, it recorded a very large 28.6% increase in 2020

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[8] Based on individual years 1933 and later, National Center for Health Statistics. *Vital Statistics of the United States*, Volume II: Mortality, Part A. Washington, D.C.: Government Printing Office, various years. (Data obtained through the Human Mortality Database, www.mortality.org, on 2/3/2020).
[9] See Section 7 for definition of external COD.

that produced -0.2% of contribution to total improvement. Assault deaths were most prevalent by age at 15.4% for ages 15-24 and were in the top five rankable causes of death for both sexes for ages less than 35.

Table 3
2020 U.S. POPULATION MORTALITY BY COD

Cause of Death	Deaths	%	Age-Adjusted 2019-2020 Mortality Improvement	Attribution to All CODs*
Heart Disease	696,962	20.6%	-4.2%	-1.0%
Cancer	602,350	17.8%	1.4%	0.3%
COVID	350,831	10.4%	n/a	-11.9%
Alzheimer's/Dementia	259,200	7.7%	-7.8%	-0.6%
Accidents	200,955	5.9%	-16.3%	-1.1%
Stroke	160,264	4.7%	-5.2%	-0.3%
Pulmonary	152,657	4.5%	4.5%	0.2%
Diabetes	102,188	3.0%	-14.9%	-0.5%
Flu & Pneumonia	53,544	1.6%	-5.7%	-0.1%
Liver	51,642	1.5%	-16.0%	-0.3%
Suicide	45,979	1.4%	3.5%	0.1%
Hypertension	41,907	1.2%	-13.3%	-0.2%
Assault	24,576	0.7%	-28.6%	-0.2%
Other	640,674	18.9%	-6.2%	-1.3%
All COD	3,383,729	100.0%	-16.8%	-16.8%

* The attribution method is described in section 7.

5.3 HEART DISEASE

The death rate from heart disease was up 4.2% in 2020, which followed a 1.2% decrease in 2019. The 2020 increase was the highest and only the second increase in the entire study period. Its impact reduced the 2020 five-year annual average improvement to 0.0%. Within ages 45-85+, age group 85+ was the only one to have a higher five-year average in 2020 than 2019. The five-year average female and male mortality for ages 85+ improved by 0.3% and 0.1%, respectively, in 2020. The change in the five-year average annual improvement for the other ages decreased with age between 2019 and 2020. Ages 45-54 saw the greatest decrease, 2.3%, in the five-year average improvement for both females and males. The slowdown of heart disease improvement and the near-term reversal of stroke improvement prior to 2020 (stroke not shown) was very significant because these two CODs have been the overwhelming contributors to overall mortality improvement over the past 20 years. The adverse 2020 experience for both heart disease and stroke amplifies the concerns about potential future mortality improvement.

Figure 5

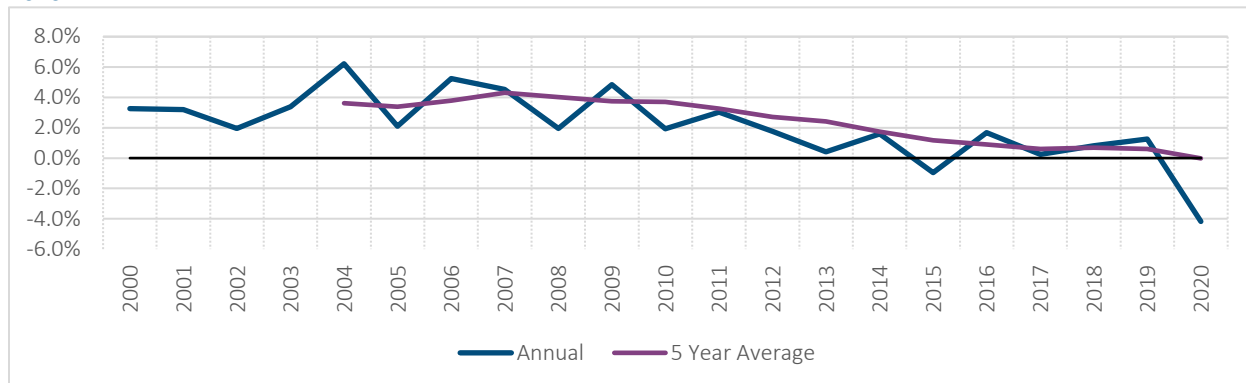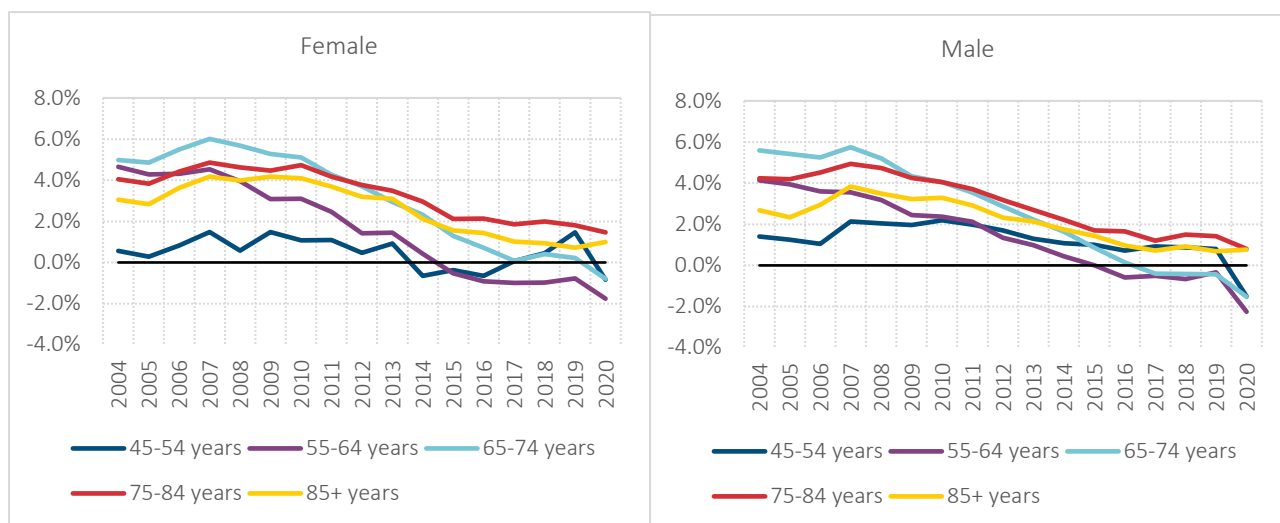HEART DISEASE ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

Figure 6

HEART DISEASE FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020

5.4 CANCER

The positive trend in the cancer death rate for all ages, which decreased on an age adjusted basis every year from 1999-2019, continued in 2020. Cancer mortality improved by 1.4% in 2020, following a 2.0% improvement in 2019. Five-year average annual improvement remained the same in 2020 as 2019 at 1.9%.

The only sex/age group with higher five-year average annual improvement in 2020 in the 45-85+ age range was females 85+, which increased from 0.6% in 2019 to 1.3% in 2020. All other sex/age groups in the 45-85+ age range had either no change or small decreases in mortality improvement in the five-year average improvement rate. (The largest decrease was 0.5% in the female, age 45-54 group.) Although the male age 45-54 rate declined, it held its position as the highest five-year improvement rate and maintained the largest margin in 2020, 1.3%, relative to the next highest five-year improvement rate for any of the age groups 45-85+ for both sexes.

Figure 7

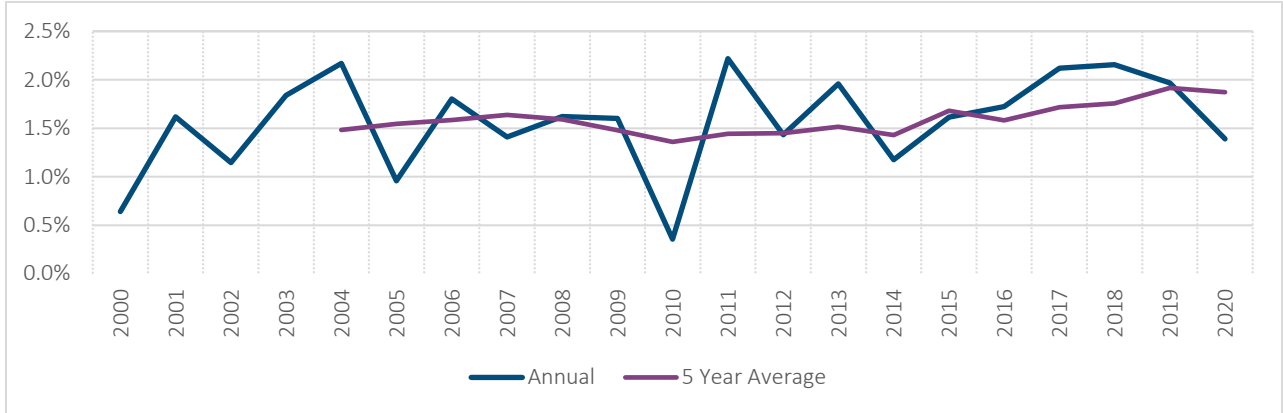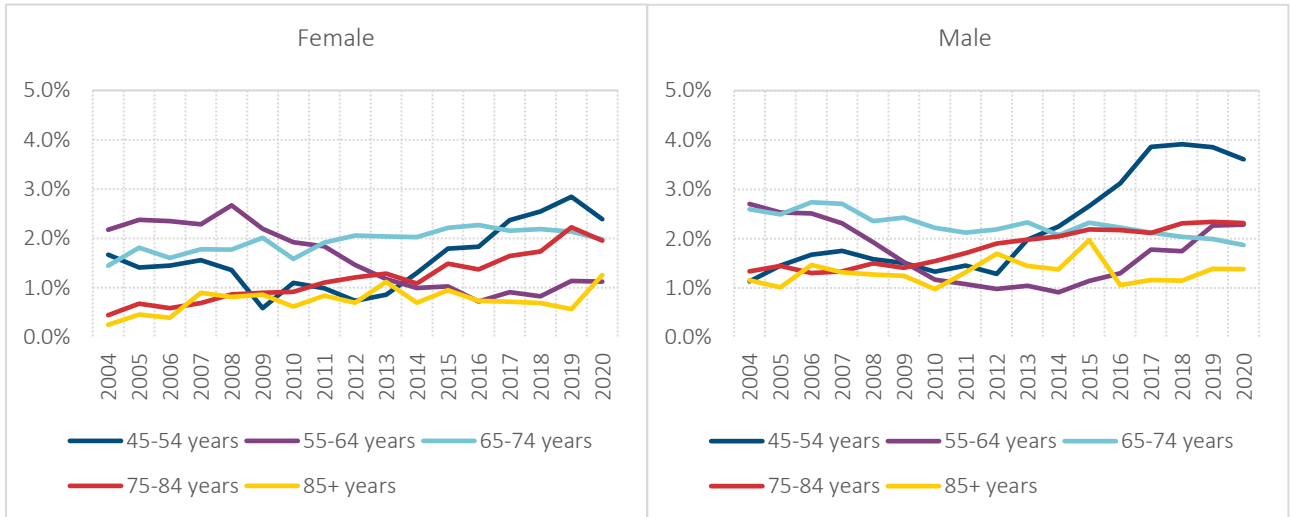CANCER ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

Figure 8

CANCER FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020

5.5 DIABETES

The death rate from diabetes was up 14.9% in 2020, which followed a 1.2% increase in 2019. The 2020 increase was the largest annual increase from 2000-2020. Its impact lowered the five-year average annual mortality improvement from 0.0% in 2019 to -3.1% in 2020. The recent downtrend of five-year average annual mortality improvement extended for all ages 45-85+ and both sexes into 2020. Generally, those improvement rates were highest (but still negative) for the higher ages, 75-85+, and decreased with successively lower age groups. The lowest, age group 45-54, had 2020 five-year average improvement rates of -4.3% and -6.0% for females and males, respectively. The highest 2020 five-year improvement rates were female, ages 75-84, at -0.8%, and male, ages 85+, at -2.0%. Because there are a very small proportion of diabetes deaths, 4.3%, for both sexes combined in ages 15-44, their experience is not shown below. But they have had five-year improvement rates more adverse than ages 45 and higher. Ages 15-24 had the lowest rates for both sexes, which were -8.8% for females and -11.4% for males.

Figure 9

DIABETES ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020
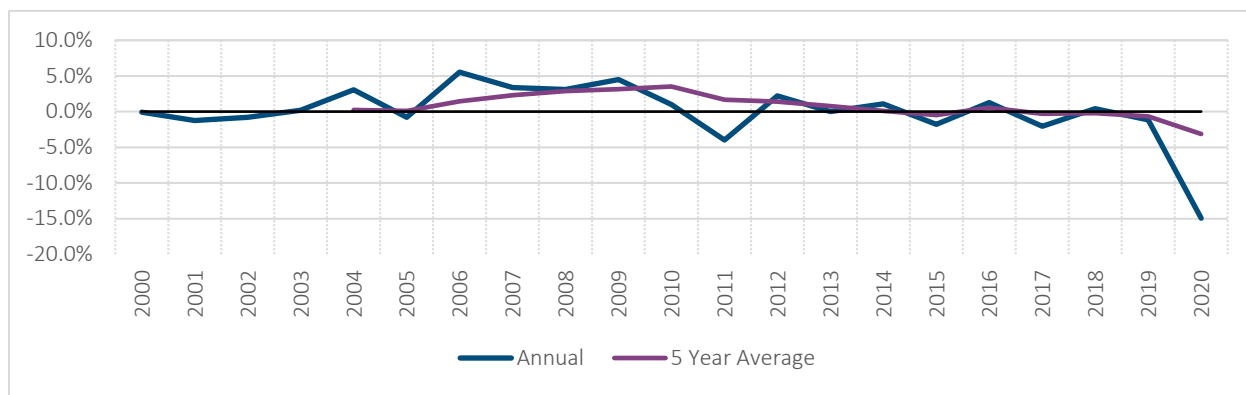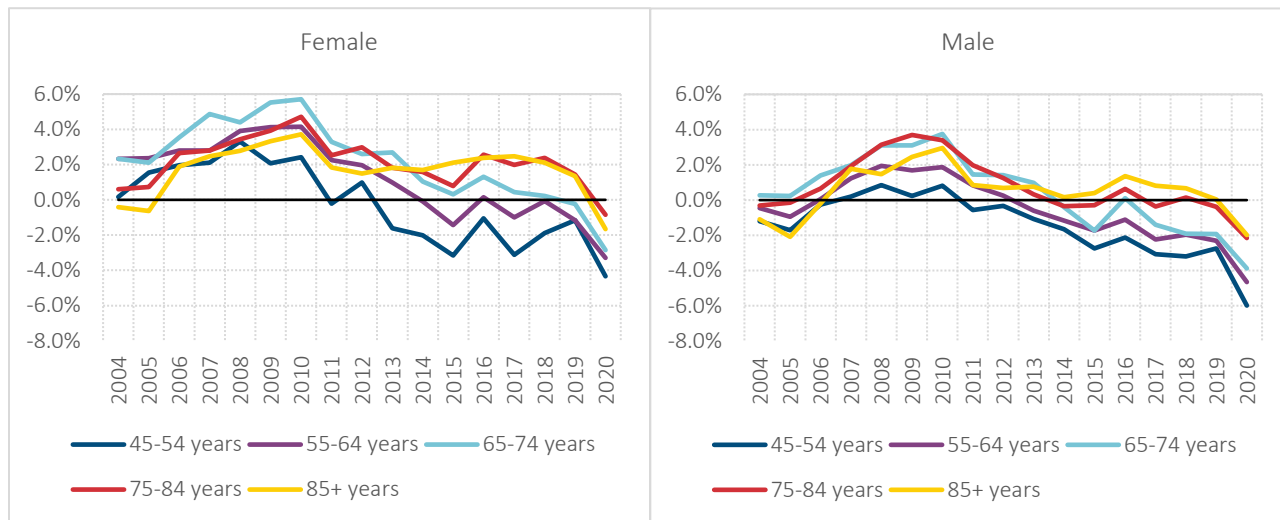

Figure 10

DIABETES FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020

5.6 LIVER

The death rate from liver was up 16.0% in 2020, which followed a 2.5% increase in 2019. The 2020 increase was the largest annual increase from 2000-2020 and four times as large as the 4.0% increase in 2007. Slight easing of adverse mortality in recent years was overridden by 2020 experience to reduce the five-year average annual mortality improvement from -1.6% in 2019 to -3.9% in 2020. Ages 25-84 comprised 96.4% of liver deaths in 2020. Each age group for both sexes had a negative five-year annual average mortality improvement rate in 2020 and only male ages 45-54 had positive five-year improvement, 0.6%, in 2019. Generally, in recent years, the five-year annual improvement rate has been inversely related to age. The difference between the age 75-84 and 25-34 five-year rates increased from 2019 to 2020 by 5.7% and 4.4% for females and males, respectively. The lowest five-year rates in 2020 were at ages 25-34, -12.4% and -13.5%, for females and males, respectively. The highest five-year rates in 2020 were at ages 75-84, -0.5% and -2.4%, for females and males, respectively.

Figure 11

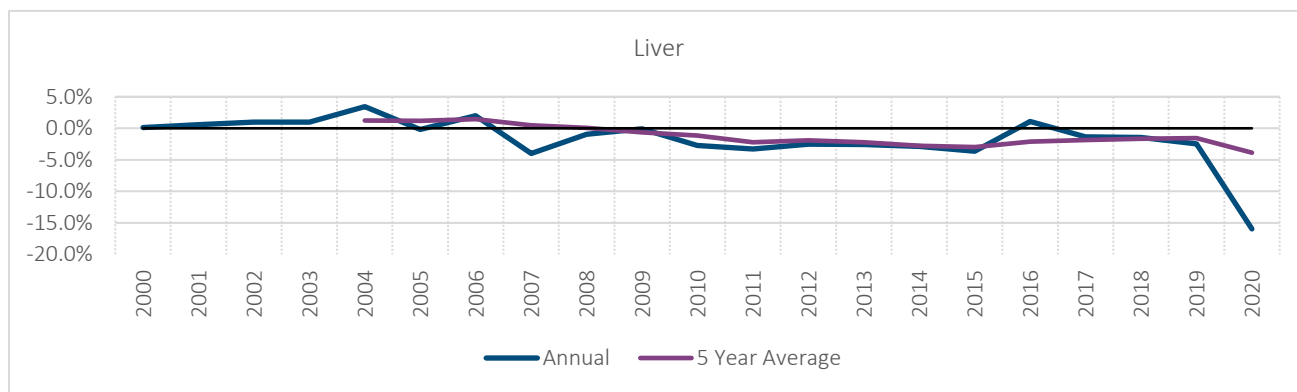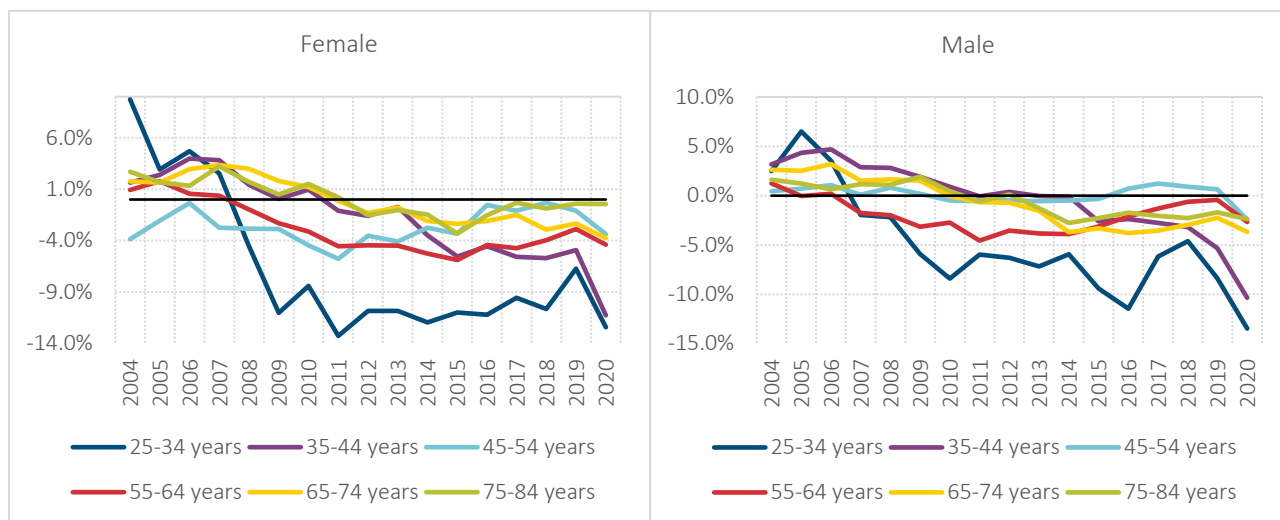**LIVER ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020**

Figure 12

LIVER FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020

5.7 HYPERTENSION

The death rate from hypertension was up 13.3% in 2020, which followed no change in 2019. The 2020 increase was the largest annual increase from 2000-2020 and over double the next highest 6.3% increase in 2003. Slight recent easing of mostly adverse mortality over a longer period overridden by extreme 2020 experience reduced the five-year average annual mortality improvement from -1.8% in 2019 to -3.5% in 2020. The most adverse 2020 one-year increases for the age range shown in Figure 14 occurred at ages 45-54 where females and males increased by 22.4% and 26.0%, respectively. All ages shown for both sexes saw very adverse 2020 experience reduce their five-year average annual rates in 2020. Ages75-85+ comprised 63.4% of hypertension deaths, but had the highest five-year annual improvement rates in recent years. In the sex/age groups shown, the highest 2020 five-year improvement rates were seen by female ages 75-84, -1.4%, and male ages 85+, -2.1%. The lowest 2020 five-year improvement rates by sex were seen by female ages 55-64, -5.7%, and male ages 45-54, -6.6%.

Figure 13

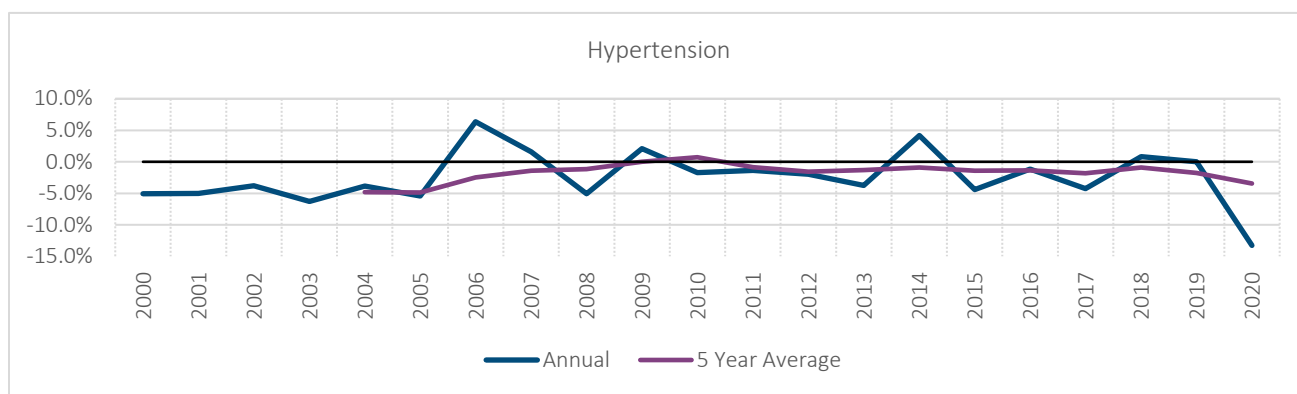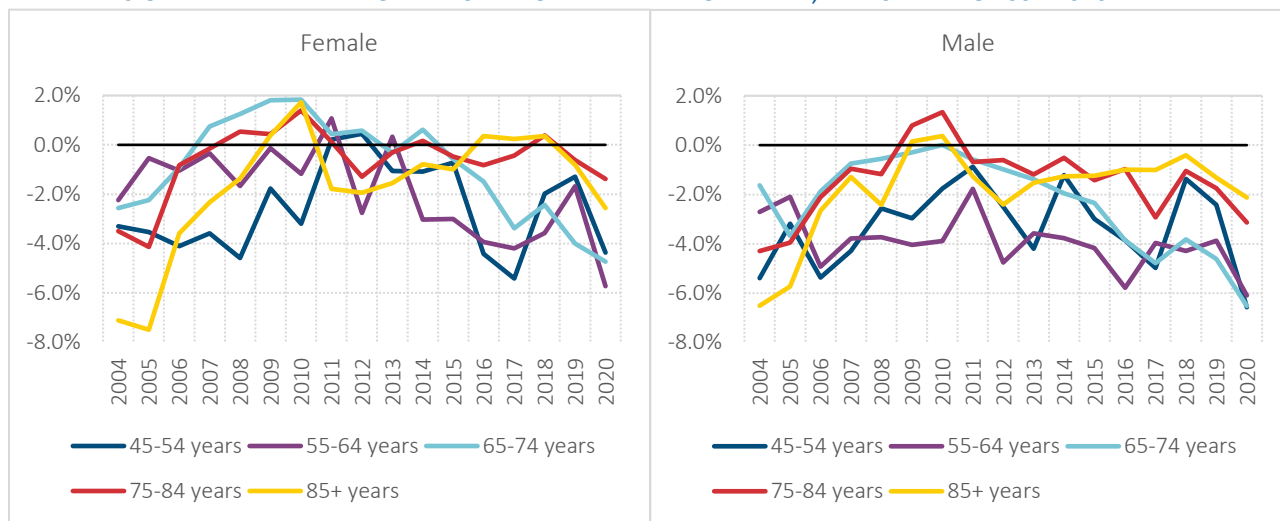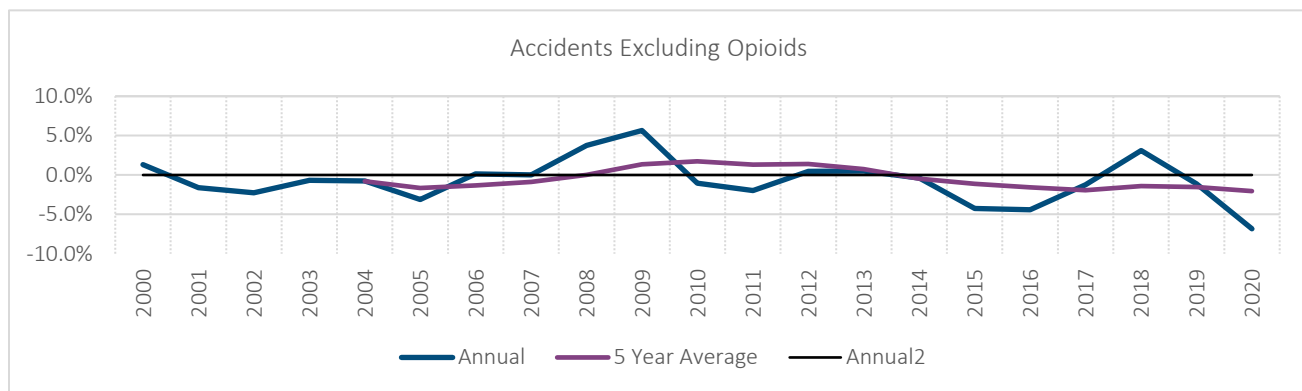HYPERTENSION ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

Figure 14

HYPERTENSION FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020

5.8 ACCIDENTS EXCLUDING OPIOIDS

The death rate from accidents excluding opioids was up 6.8% in 2020, which followed a 1.1% increase in 2019. The 2020 increase was the largest annual increase from 2000-2020 and over 50% higher than the next highest 4.4% increase in 2016. Motor vehicle accidents (MVA) comprised a large portion of accidents excluding opioids. The death rate from MVAs increased 8.4% in 2020. That was the highest increase during the span of this report and exceeded the next highest 6.4% MVA death rate increase in 2016 by 32%[10]. The impact of high mortality in 2020 reduced the five-year average annual improvement rate in 2020 to -2.0% from -1.5% in 2019. For the ages shown in Figure 16, ages 65-74, for both sexes, was the only age group that did not have a lower 2020 five-year rate than in 2019. Generally, male five-year improvement rates were inversely related to age, whereas the corresponding female rates did not correlate well with age. Generally, 2020 male five-year annual improvement rates were lower than corresponding female rates by age and, in aggregate, the female and male rates were, -1.4% and -2.3%, respectively.

Figure 15

ACCIDENTS EXCLUDING OPIOIDS ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

Figure 16

ACCIDENTS EXCLUDING OPIOIDS FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020
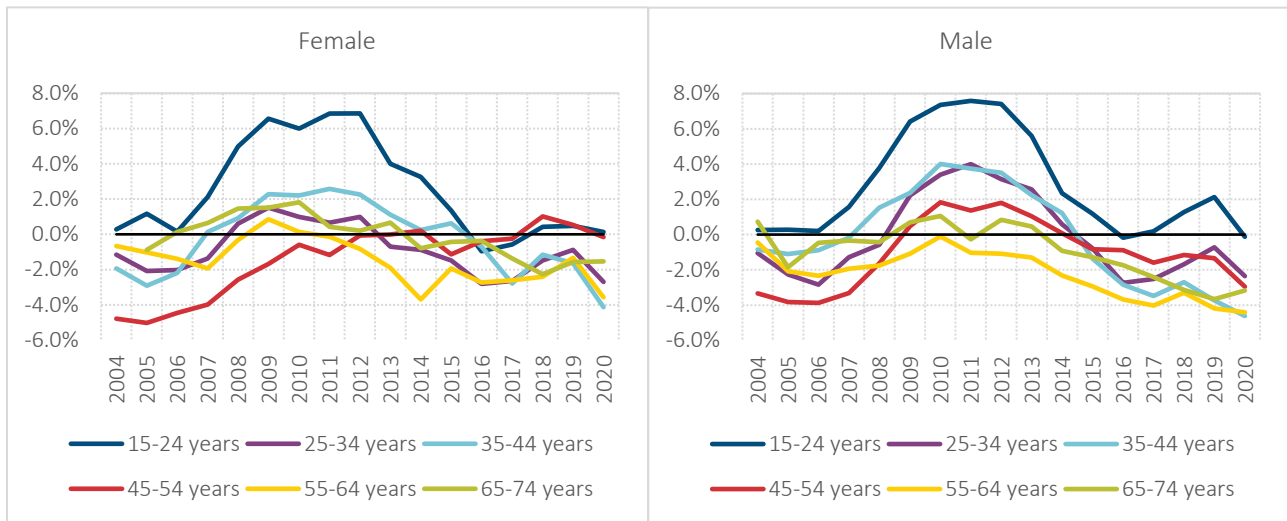
5.9 OPIOIDS

The Opioid drug overdose death rate, which intersects a key component of accidental deaths, increased 37.6% in 2020, which followed a 6.3%% increase in 2019. The extreme deterioration of mortality in 2020 leaves 2018 as the only year from 2000-2020 with improved mortality and exceeded the next highest of 27.4% that occurred in 2016. The online Tableau "Opioid Deaths by Opioid Type and County Quintile Group" dashboard (included as companion information to this study) provides perspective on the source of overdose types across the span of this report. In recent years, Tramadol and Fentanyl death rates increased very rapidly and, in 2020, saw a 55.4% increase. Methadone and natural and semi-synthetic opioids also saw double digit 2020 increases, 31.7% and 13.0%, respectively, but because their death rates are much lower than Tramadol and Fentanyl overdoses, they have less impact on the total opioid death statistics. Heroin deaths saw a 6.2% decreased rate in 2020, but also had much lower death rates than Tramadol and Fentanyl.

The 2020 experience from all opioid sources reduced the five-year average annual improvement rate in 2020 to -15.3% from -11.1% in 2019. Male experience has been more adverse in recent years resulting in 2020 five-year average improvement rates of -11.5% and -17.1% for females and males, respectively. Females and males had different five-year average improvement rate patterns in 2020 by age. Generally, female five-year improvement rates broadly declined by age, with the greatest severity in ages 15-44. The most adverse female five-year improvement rate in 2020 was -16.1% for ages 25-34. Male five-year improvement rates also generally declined by age group down to a low at ages 65-74 of -22.1%. Although opioid mortality rates are much lower than other major CODs, their 2020 one-year mortality rates stood out as extreme and historic in terms of their level and change from 2019. The highest 2020 one-year mortality increases for females and males occurred at ages 15-24 for both sexes. Those 2020 one-year increases for females and males were 50.1% and 65.7%, respectively, which contrasted sharply with their corresponding values in 2019 of a 2.5% decrease for females and a 6.3% increase for males.

Figure 17

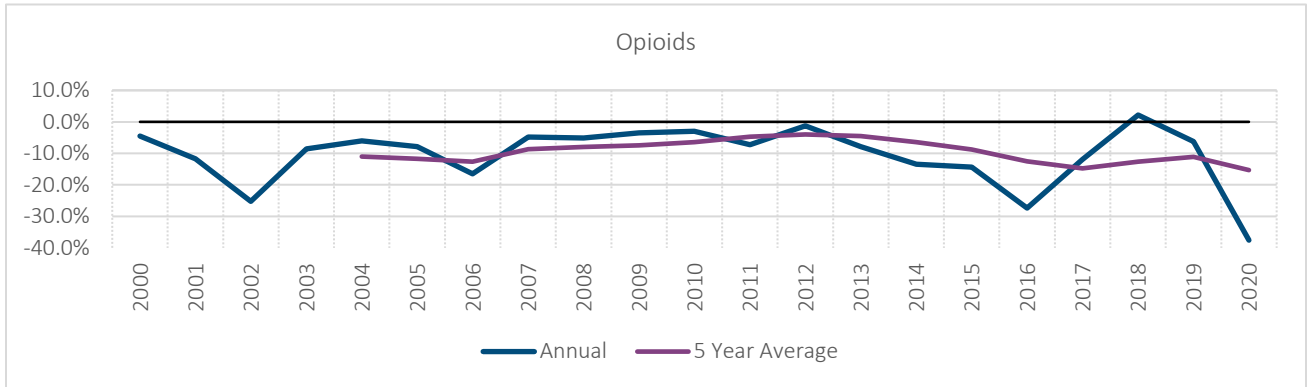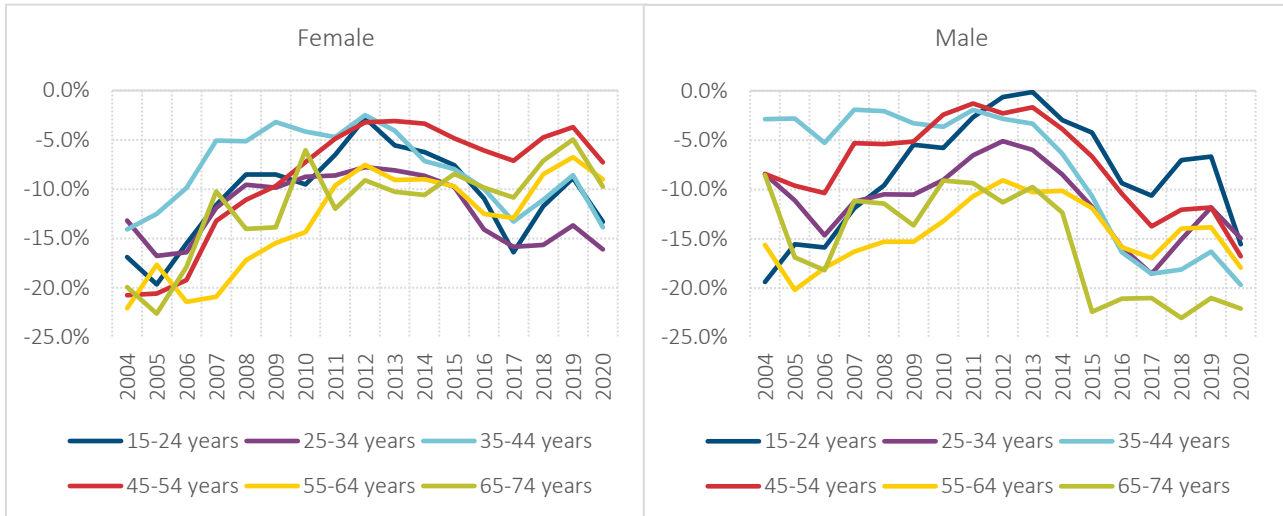OPIOIDS ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

Figure 18

OPIOIDS FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020

5.10 SUICIDE

The suicide death rate decreased 3.5% in 2020, following a 2.3% decrease in 2019. The 2020 decrease extended the 2019 break in prior increases from 2018 and earlier. Those adverse earlier years caused the five-year average annual improvement rate to be negative but to a lesser degree with 2020 experience. The five-year average improvement rate was -0.2% in 2020 and -1.3% in 2019. In the most recent five years, male experience has consistently been less favorable than female results, which produced 2020 five-year average improvement for females and males of 2.0% and -0.7% respectively. The one-year improvement gap between females and males was wider than at any point between 2000-2020. During 2020, female and male mortality rates decreased by 8.5% and 2.3%, respectively. Generally, the five-year improvement rates increased with increasing age. Except for male ages 5-14 and 25-34, all other age groups for both sexes had higher five-year improvement rates in 2020 than 2019. While that 2019 to 2020 decrease of the five-year improvement rate of 0.2% was small for male ages 25-34, it was much greater, 4.7%, for male ages 5-14. Although the age 5-14 death rates are comparatively small relative to the major physiological CODs, their occurrence is material to this age group where they comprised 10.7% of all deaths for both sexes combined. That age group had the lowest 2020 five-year average improvement rates for both sexes, -6.0% and -8.9%, for females and males, respectively, and for males deteriorated further with a 2020 one-year mortality rate increase of 15.0%.

Figure 19

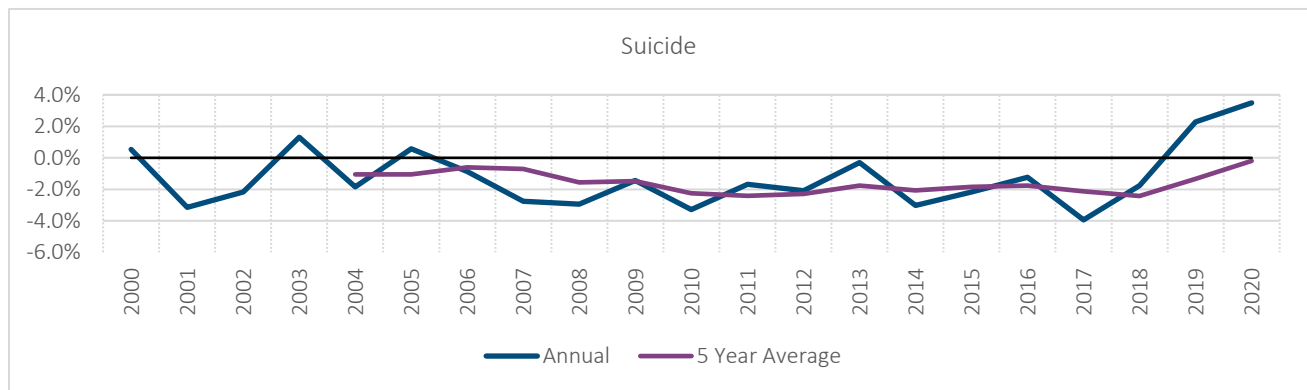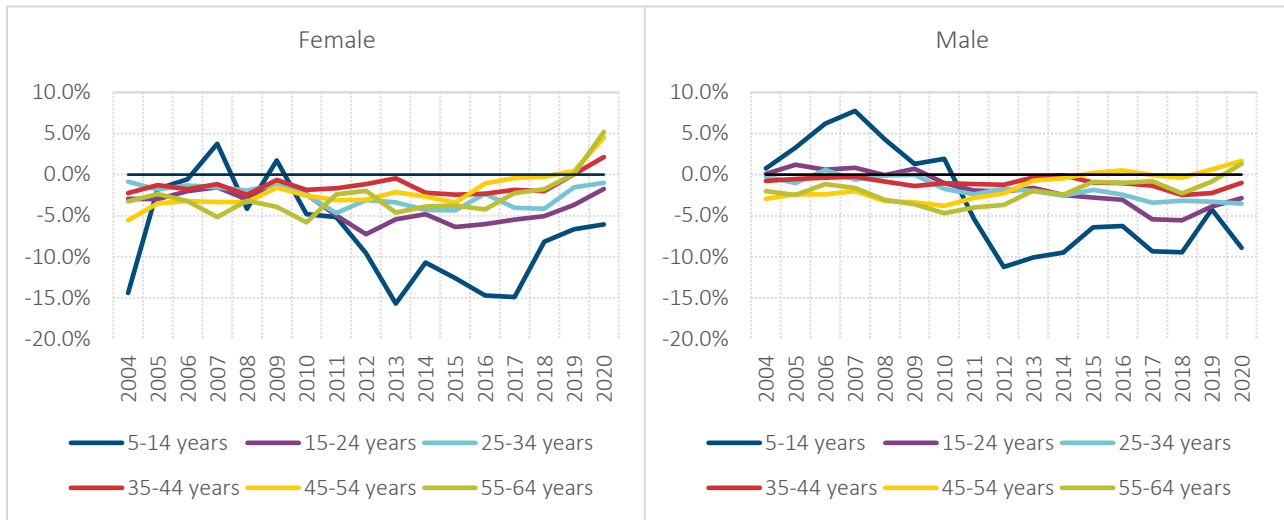SUICIDE ANNUAL AND FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2000-2020

Figure 20
SUICIDE FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT, YEARS ENDING 2004-2020

Section 6: Socioeconomic Quintile County Groups

Mortality was analyzed over the entire U.S. population (All Counties) and compared to mortality in the socioeconomic quintile county groups. These quintile county groups were developed based on socioeconomic factors, as described in section 7. The map below shows the counties. Generally, quintile groups 1 and 2 are geographically large, but widely dispersed, rural areas. Quintile groups 4 and 5 are mostly, but not exclusively, geographically small metropolitan areas. For example, in addition to major metropolitan areas, quintile 4 regions can be seen in less populated New England areas, the oil patch of North Dakota, and the eastern front of the Sierras in California. Quintile group 3 does not show a distinct urban or rural pattern, but is more geographically prevalent west of the Mississippi River than east of it.

Figure 21
U.S. COUNTIES BY SOCIOECONOMIC QUINTILE GROUP
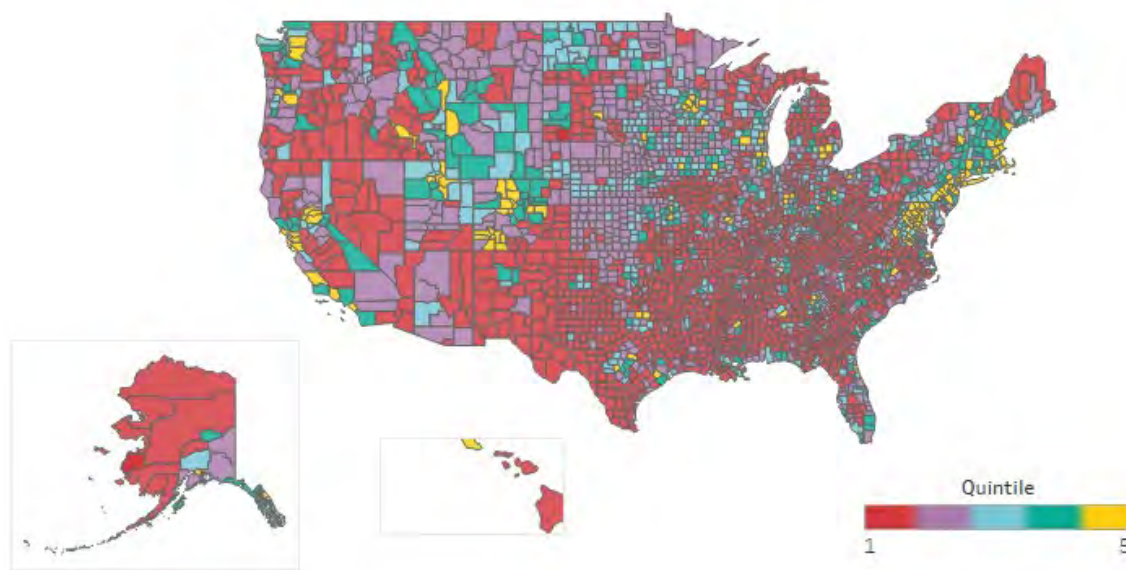
Generally, with few exceptions, mortality rates by county grouping follow a rank-order of the lowest mortality for quintile group 5 and highest mortality for quintile group 1. There is a corresponding rank-order pattern for mortality improvement, which is generally highest for quintile group 5 and lowest for quintile group 1. However, the rank-order of the quintile groups' mortality improvement is more fluid than their corresponding level of mortality and is the focus of discussion in this section. Whereas quintile groups 1 and 5 most often had the lowest and highest improvement rates, respectively, quintiles 2-4 were more prone to switch rank order with one another across years. Examining five-year average annual mortality improvement of the county income groups over time gives insight on the counties' evolving mortality experience relative to one another.

The graphs below show five-year average annual mortality improvement by county groups for All Causes of Death, which is representative of the general county relationships and five CODs that are exceptions to that. Unless otherwise noted as one-year improvement, all the following references to mortality improvement in this section imply a five-year annual average ending in the year noted. Note that, because the range of mortality improvement is wide across CODs, the scales are different in each of the six graphs.

The All Causes show a similar pattern across time for each county group with rank-order generally preserved for the five quintile groups but, as mortality improvement slowed, the differences in the improvement rates between the quintile groups compressed. Recent years' compression between quintile groups 1 and 5 indicated that the speed of a continued widening mortality rate gap slowed down was interrupted in 2020. The improvement rate gap between quintiles 1 and 5 widened from 0.4% in 2019 improvement to 1.0% in 2020. That degree of separation was last seen in 2007.

The difference between the highest and lowest death rates across quintiles widened from 2019 to 2020. Table 4 below shows recent death rate experience for All Causes and COVID that helps to explain the sources of how the quintile gap widened. When expressed as a percentage index of quintile to all counties mortality, the quintile 1 2020 COVID and All Causes Excl COVID indices, 128.7% and 121.8%, respectively, both exceeded their 2019 All Causes 120.3% index. This implies that both COVID and all other CODs combined were more adverse on a relative basis for quintile 1 than its 2019 experience. Quintile 5 was also affected more adversely by COVID than its 2019 All Causes index, but all other CODs were better than the 2019 index with a combined effect of a lower index 82.2% in 2020 for All Causes than 83.2% in 2019. The COVID index for the other quintiles was lower than their 2019 index baseline, while their 2020 index for all other CODs was close to their 2019 index. The blend of COVID and all causes excluding COVID experience resulted in reductions for the 2020 All Causes indices for quintiles 2 and 4 of .06% and .04%, respectively, and a slight increase, 0.1%, for quintile 3.

Table 4
U.S. POPULATION SIS QUINTILES ALL CAUSES AND COVID DEATH RATES RELATIVE TO ALL COUNTIES IN 2019-2020

	Death Rate per 100,000				Percentage of Quintile Death Rate to All Counties			
	All Causes		COVID	All Causes Excl COVID	All Causes		COVID	All Causes Excl COVID
SIS Quintile	2019	2020	2020	2020	2019	2020	2020	2020
1	922.7	1097.2	117.5	979.7	120.3%	122.5%	128.7%	121.8%
2	808.5	937.9	88.2	849.7	105.4%	104.8%	96.6%	105.7%
3	771.9	902.8	89.6	813.2	100.7%	100.8%	98.1%	101.1%
4	703.7	818.3	83.1	735.2	91.8%	91.4%	91.0%	91.4%
5	638.4	736.1	79.1	656.9	83.2%	82.2%	86.7%	81.7%
All Counties	766.9	895.4	91.3	804.1	100.0%	100.0%	100.0%	100.0%

There are five CODs that showed notable exceptions to the All Causes patterns.

1. Suicide showed substantial switching of rank-order over the full range of years studied and a widening of improvement rates between the quintile groups. Relative to All CODs, the rank-order is notable in that quintile group 1 was, in most years, not the lowest and, in some years, had the highest improvement rates. Conversely, quintile 5 sank to the lowest improvement rate in 2010-2011 and then ascended to the highest rank from 2015-2020. In 2020, only quintile 1 had one-year disimprovement, which caused a widening of the five-year improvement rates across the county quintiles.

2. Accidents excluding Opioids, like suicide, showed notable rank-order switching with a widening of improvement rates across ranks from the earliest to most recent years studied. Through the full period, quintiles 1 and 5 each held the highest and lowest improvement rates. Progress that had been made in reversing declining improvement for quintile1 ended in 2020 as its improvement rate in that year declined along with quintiles 2-4, while quintile 5 held mostly steady. That extended the abnormal pattern of quintile 1 being ranked third from 2019 to 2020.

3. Opioids' improvement rates showed a wide gap between the highest and lowest quintile groups in 2004 that reached its narrowest gap in the year ending 2013 and then widened again, but by less than the starting point, by the year ending 2020. Quintile groups' rank-order across time was notable. Like accidents excluding opioids, quintiles 1 and 5 each held the highest and lowest improvement rates at different points during the period. All quintiles saw 2020 improvement rates decrease to varying degrees. That resulted in moderate rank order switching where quintiles 1 and 2 decreased one rank and quintiles 4 and 5 increased one, while quintile 3 remained the lowest improvement rate. Quintile 3 has had the highest death rate for opioids since 2012.

4. Heart shows a distinctive result in recent years for quintile 1. It had the lowest improvement rate for all years through 2017. In 2018 and 2019, its improvement rate increased relative to other quintiles, moving it up to rank 3 in 2019 where there was a tight cluster of quintiles 1, 3 and 4. But that reversed in 2020 when quintile 1 moved back to rank five. During 2020, one-year heart mortality improvement nearly fit the ranking norm by quintile with quintiles 1-5 ranking 5, 3, 4, 2 and 1, respectively (rank 5 lowest and rank 1 highest improvement rate). During 2020, quintiles 1 and 5 had one-year improvement rates of -6.4% and -2.3%, respectively.

5. Stroke had an unusual quintile pattern where a relatively narrow range in 2004 between the improvement rates widened to a maximum in 2009, then narrowed to a minimum in 2013 and widened again in ensuing years. The gap of 1.5% in 2019 narrowed to 1.0% in 2020. While the death rates in both of those years followed the usual ranking of highest to lowest for quintiles 1 and 5, respectively, the improvement rates did not follow their expected rank-order. Although quintile 1 had a greater improvement rate decrease than the other quintiles, it maintained its number one rank, while quintile 5 near the bottom ranked number four in a cluster with quintiles 2, 3 and 4.

Figure 22

FIVE-YEAR AVERAGE ANNUAL MORTALITY IMPROVEMENT BY COUNTY QUINTILE GROUPS YEARS ENDING 2004-2020
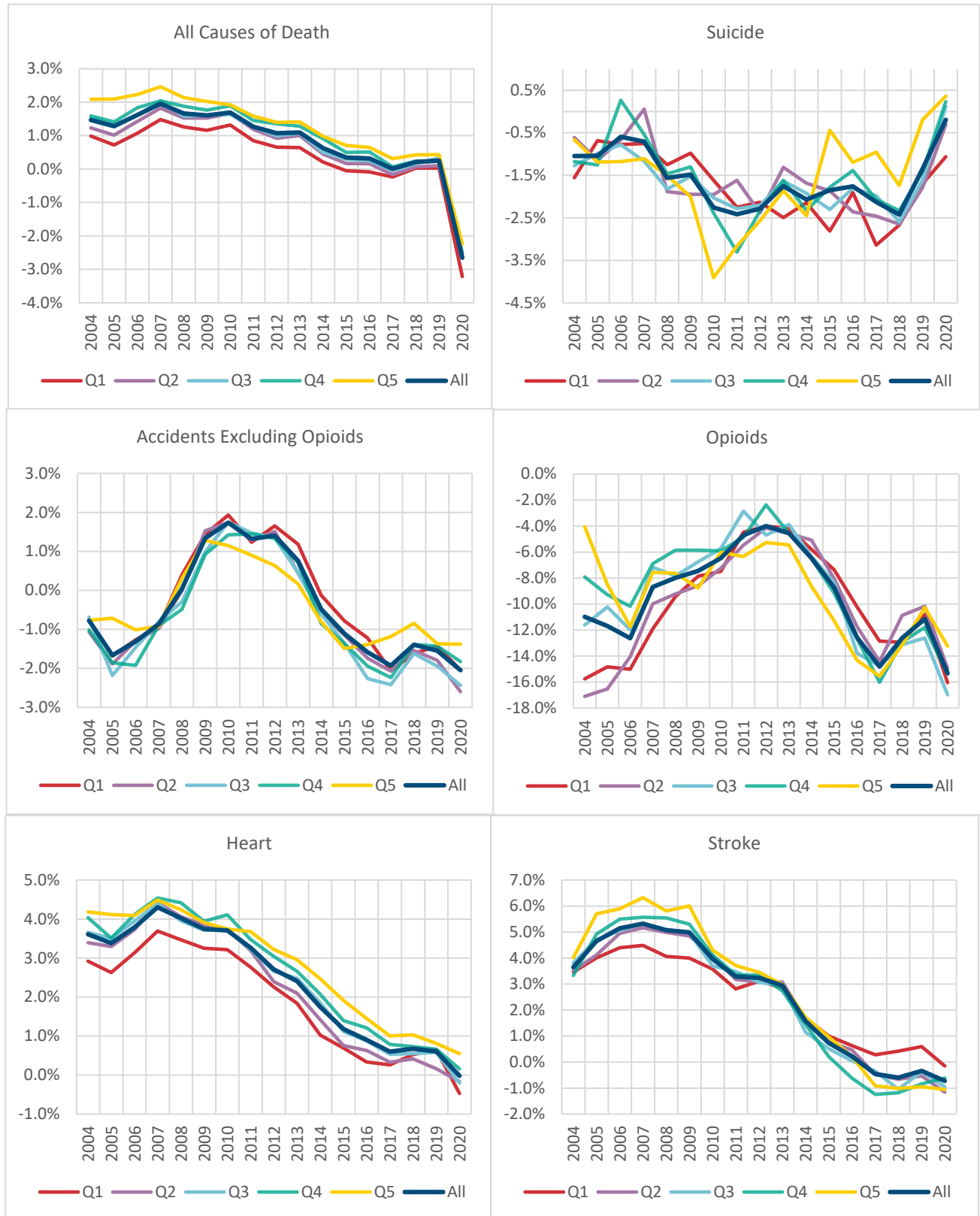
Section 7: Methodology

The source of the mortality rates found in this report was the Centers for Disease Control and Prevention's (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER) database, released in December 2021[11].

To analyze mortality by socioeconomic status, a Socioeconomic Index Score[12] was computed for each county. The counties were then grouped into quintiles with each quintile holding 20% of the total U.S. population. Counties in each of the quintile county groups were entered into WONDER and mortality rates for the group were retrieved. Quintile group 1 contains the counties with the lowest Socioeconomic Index Score, or the lowest socioeconomic status, and quintile group 5 contains the counties with the highest Socioeconomic Index Score, or the highest socioeconomic status. The county groups were held constant over the 1999-2020 period and based on total U.S. data from 2008-2012. Any reference to "All Counties" refers to the entire U.S. population or all U.S. counties.

The mortality rates from WONDER are based on annual death data and, generally, mid-year populations. For any mortality rate calculation, deaths for age x are equal to calendar year deaths between ages x and x+1 and the populations are estimates from the U.S. Census Bureau. See the CDC WONDER 'Dataset Documentation' for more information[13].

Age group mortality rates in this report are derived using calendar-year deaths and population from WONDER with rates per 100,000 rounded to six decimal places. All subsequent calculations for mortality improvement and age-adjusted mortality rates use these rounded rates.

Mortality improvement rates in this report are geometric average annual rates of improvement. They are derived as follows for age x over an n year period ending in calendar year CY.

$$1 - \left(\frac{q_x^{CY}}{q_x^{CY-n}} \right)^{\left(\frac{1}{n}\right)}$$

All mortality rates shown in this report, other than those shown for ten-year age groups, are age-adjusted rates based on the CDC's non-standard population option of 2010. The non-standard population in 2010 was chosen here as opposed to the 2000 standard population, used in age-adjusted rates published by the CDC, because 2010 was more central to the mid-point of the years of data, 1999-2020, covered in this report. To achieve consistent comparisons across sex, all age-adjusted rates were determined using the 2010 combined female and male age group distribution. Age-adjusted mortality rates and improvement in this report are based on age only with no demographic adjustments for mixes of sex or race.

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[11]Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2019 on CDC WONDER Online Database, released in 2020. Data are from the Multiple Cause of Death Files, 1999-2019, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program. Accessed at http://wonder.cdc.gov/ucd-icd10.html on various dates December 2020.
[12]Society of Actuaries. Mortality by Socioeconomic Category in the United States. https://www.soa.org/resources/research-reports/2020/us-mort-rate-socioeconomic/. November 2020.
[13] Source: https://wonder.cdc.gov/wonder/help/ucd.html#

Age-adjusted rates in this report are calculated as follows using 2010 as the base year and rounded to six decimal places.

$$\sum_{n=1}^{11} Pct_{Age_n} * q_{Age_n}$$

Where:

Age_n = Age group *n* (11 age groups)

Pct_{Age_n} = % of age group *n* 2010 Population

q_{Age_n} = Calendar year crude q_x for age group *n*

Attributions of mortality improvement by ages and CODs shown in section 2 are determined as follows:

Age Group Attribution

Age group n attribution to all ages improvement is:

$$\frac{Pct_{Age_1} * q_{Age_1}}{\sum_{n=1}^{11} Pct_{Age_n} * q_{Age_n}} * Improvement_{Age_1}$$

Where:

Age_n = Age group *n* (11 age groups)

Pct_{Age_n} = % of age group *n* 2010 Population

q_{Age_n} = 2019 Crude q_x for age group *n*

$Improvement_{Age_n}$ = Age group *n* 2020 mortality improvement rate

q_{Age_n} and $Improvement_{Age_n}$ are based on crude rates per 100,000 lives rounded to one decimal place, which is consistent with age-adjustment calculation methodology[14].

COD Attribution

COD is simpler because COD mortality improvement is already expressed on an age-adjusted basis. Unrounded values are used.

COD_n , attribution to all causes mortality improvement is:

$$\frac{q^{COD_n}}{q^{COD_{All}}} * Improvement_{COD_n}$$

---

[14] Source: https://wonder.cdc.gov/wonder/help/ucd.html#

Where:

q^{COD_n} = 2019 COD$_n$ age-adjusted mortality rate

$q^{COD_{All}}$ = 2019 age-adjusted mortality rate for all causes of mortality

$Improvement_{COD_n}$ = COD$_n$ 2020 mortality improvement rate

To meet the CDC's privacy data use requirements, calculated annual improvement values are not shown for age groups where the number of deaths for that age group was less than ten in any one year.

The NCHS's rankable causes of death are a subset of its "113 Selected Causes of Death." The selected 13 causes of death covered in the report are, with four exceptions, the top five rankable causes of death in 2020 for each of the ten-year age and sex groups available in WONDER. Because of limited interest, two of the top five rankable CODs for ages less than 1 were excluded[15], while flu & pneumonia and hypertension, which were not in the top rankable causes, were included due to interest in those CODs. Below is a table of the 13 selected causes of death covered in this report and their International Classification of Diseases, Tenth Revision[16] (ICD-10) 113 Code and Cause List as they appear in WONDER.

Report Cause of Death	ICD-10 113 Code	ICD-10 113 Cause List (with ICD-10 codes)
Physiological:		
Alzheimer's/Dementia[17]	GR113-052	#Alzheimer's disease (G30)
Cancer	GR113-019	#Malignant neoplasms (C00-C97)
COVID	GR113-137	COVID-19 (U07.1)
Diabetes	GR113-046	#Diabetes mellitus (E10-E14)
Flu/Pneumonia	GR113-076	#Influenza and pneumonia (J09-J18)
Heart	GR113-054	#Diseases of heart (I00-I09,I11,I13,I20-I51)
Hypertension	GR113-069	#Essential hypertension and hypertensive renal disease (I10,I12,I15)
Liver	GR113-093	#Chronic liver disease and cirrhosis (K70,K73-K74)
Pulmonary	GR113-082	#Chronic lower respiratory diseases (J40-J47)
Stroke	GR113-070	#Cerebrovascular diseases (I60-I69)
External:		
Accidents	GR113-112	#Accidents (unintentional injuries) (V01-X59,Y85-Y86)
Assault	GR113-127	#Assault (homicide) (*U01-*U02,X85-Y09,Y87.1)
Suicide	GR113-124	#Intentional self-harm (suicide) (*U03,X60-X84,Y87.0)

For opioid deaths by opioid type, the method to identify drug overdose deaths involving opioids was taken from the Increases in Drug Overdose Deaths in the United States, 1999–2018[18]. These deaths were identified by the ICD-10 underlying cause-of-death codes X40–44 (unintentional), X60–64 (suicide), X85 (homicide), or Y10–Y14 (undetermined intent) in combination with any one of the following multiple cause-of-death codes: T40.0 (opium);

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[15] GR113-108 - Certain conditions originating in the perinatal period (P00-P96) and GR113-109 - Congenital malformations, deformations and chromosomal abnormalities (Q00-Q99)

[16] World Health Organization https://icd.who.int/browse10/2016/en

[17] Dementia is not one of the NCHS's rankable causes of death but has been included with the review of Alzheimer's. The ICD-10 codes for Dementia are (F01, F03)

[18] Hedegaard H, Miniño AM, Warner M. Drug overdose deaths in the United States, 1999–2018. NCHS Data Brief, no 356. Hyattsville, MD: National Center for Health Statistics. 2020.

heroin (T40.1); natural/semisynthetic opioids (T40.2); methadone (T40.3); synthetic opioids other than methadone (T40.4); or other and unspecified narcotics (T40.6).

Appendices with the following data and information can be found in an accompanying Excel file.

A. Age-Adjusted Death Rates used to produce graphs, tables, and observations in this report.
B. Age Group Rates used to produce tables and observations in this report.
C. Age-Adjusted Rates by Opioid Type used to produce tables and observations in this report.
D. Links to sample CDC WONDER queries[19] used to pull values for the 'All' and 'Opioid' CODs analyses.
E. Listings of the counties in each of the five socioeconomic county groups.

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[19] The SOA is not responsible if these links do not continue to work and will not update them if they break.

Section 8: Reliances and Limitations

Data to calculate mortality rates in this report were drawn from the Centers for Disease Control and Prevention (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER) database. There are limited instances where the mortality rates, associated mortality improvement, or comparative results between the quintile county groups and All Counties are not shown. This is because death counts of less than ten for sub-national data are suppressed by WONDER.

Data provided through WONDER is subject to restricted use for health statistical reporting and analysis. This research confines itself to those parameters. While the data may be useful for application in specific purposes, no assessment has been made concerning the applicability of this experience to other such purposes.

Opioid deaths overlap with the accident, assault, and suicide deaths analyzed in this report. The opioid deaths have a meaningful impact on the accident results and, therefore, have been removed from accident deaths in a separate COD analysis shown as Accident no Opioids. The impact of opioid deaths in the assault and suicide analyses was deemed to be immaterial and, therefore, not included in this report.

This report does not attempt to comment on changes or improvements in the process to record cause of death codes over the report horizon and their potential impact on observations noted in this report. For example, possible limitations regarding the accuracy or completeness of the assignment of COD could affect the determination of the accidents no opioids COD in this report. Some of the deaths associated with the increases in 2016-2020 that were not identified as opioid-related to determine the accidents no opioid deaths could, in fact, be opioid-related. Insights regarding the mortality reporting process with a focus on COVID were provided by Robert Anderson, Chief of Mortality Statistics at NCHS in a recent podcast[20]. The CDC provided guidance to certifiers on COVID mortality reporting in 2020[21] as an update to the general concepts published in 2003[22]. Potential changes in recording processes should be considered if utilizing the information provided in this report.

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[20] Death Certificate Data & COVID-19: Interview with Robert Anderson, Part One (cdc.gov)

[21] https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg03-508.pdf

[22] https://www.cdc.gov/nchs/data/misc/hb_cod.pdf

Section 9: Acknowledgments

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Erika Schulty, Research Administrator

About The Society of Actuaries Research Institute

Serving as the research arm of the Society of Actuaries (SOA), the SOA Research Institute provides objective, data-driven research bringing together tried and true practices and future-focused approaches to address societal challenges and your business needs. The Institute provides trusted knowledge, extensive experience and new technologies to help effectively identify, predict and manage risks.

Representing the thousands of actuaries who help conduct critical research, the SOA Research Institute provides clarity and solutions on risks and societal challenges. The Institute connects actuaries, academics, employers, the insurance industry, regulators, research partners, foundations and research institutions, sponsors and non-governmental organizations, building an effective network which provides support, knowledge and expertise regarding the management of risk to benefit the industry and the public.

Managed by experienced actuaries and research experts from a broad range of industries, the SOA Research Institute creates, funds, develops and distributes research to elevate actuaries as leaders in measuring and managing risk. These efforts include studies, essay collections, webcasts, research papers, survey reports, and original research on topics impacting society.

Harnessing its peer-reviewed research, leading-edge technologies, new data tools and innovative practices, the Institute seeks to understand the underlying causes of risk and the possible outcomes. The Institute develops objective research spanning a variety of topics with its strategic research programs: aging and retirement; actuarial innovation and technology; mortality and longevity; diversity, equity and inclusion; health care cost trends; and catastrophe and climate risk. The Institute has a large volume of topical research available, including an expanding collection of international and market-specific research, experience studies, models and timely research.

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