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COVID-19 Mortality Data Sources in the U.S.

May 22, 2020

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Caveat and Disclaimer

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Section 1: Introduction

As the COVID-19 pandemic continues, more and more information on recent deaths emerges each day. Over the past several weeks, the U.S. Centers for Disease Control and Prevention (CDC) has increased the quantity and cuts of data available to the public on a weekly basis. Descriptive information, such as gender, age, geographical information and cause of death (COD), is now available. This information can provide helpful insights to actuaries who are trying to understand how COVID-19 will impact the mortality risk in their insurance liabilities.

The following is a list of the current summary data[1] now being produced by the CDC that may be of interest to actuaries:

- Weekly data by gender and age group since February 2020 for COVID-19 deaths and all CODs
- Weekly data since January 2019 by state and select CODs
- Weekly data for COVID-19, Influenza/Pneumonia and all CODs since February 2020 by state
- Cumulative data for COVID-19, Influenza/Pneumonia and all CODs since February 2020 by age, gender and state
- Cumulative data for COVID-19 and all CODs since February 2020 by county and state
- Cumulative COVID-19 deaths with comorbidities since February 2020
- Excess deaths since January 2017 by state

This report provides various summaries of the above listed data and observations from these summaries, with a goal to help actuaries understand the emerging trends in mortality due to COVID-19.

It is important to note that all the summaries in this report are based on death certificate data that continues to work its way through the National Vital Statistics System (NVSS). This data is not yet final and is updated on a daily or weekly basis. This needs to be considered before making any decisions using data from the most recent 1-2 weeks. An excellent summary of the technical aspects behind all this data is provided on the CDC website at *https://www.cdc.gov/nchs/nvss/vsrr/covid19/tech_notes.htm*.

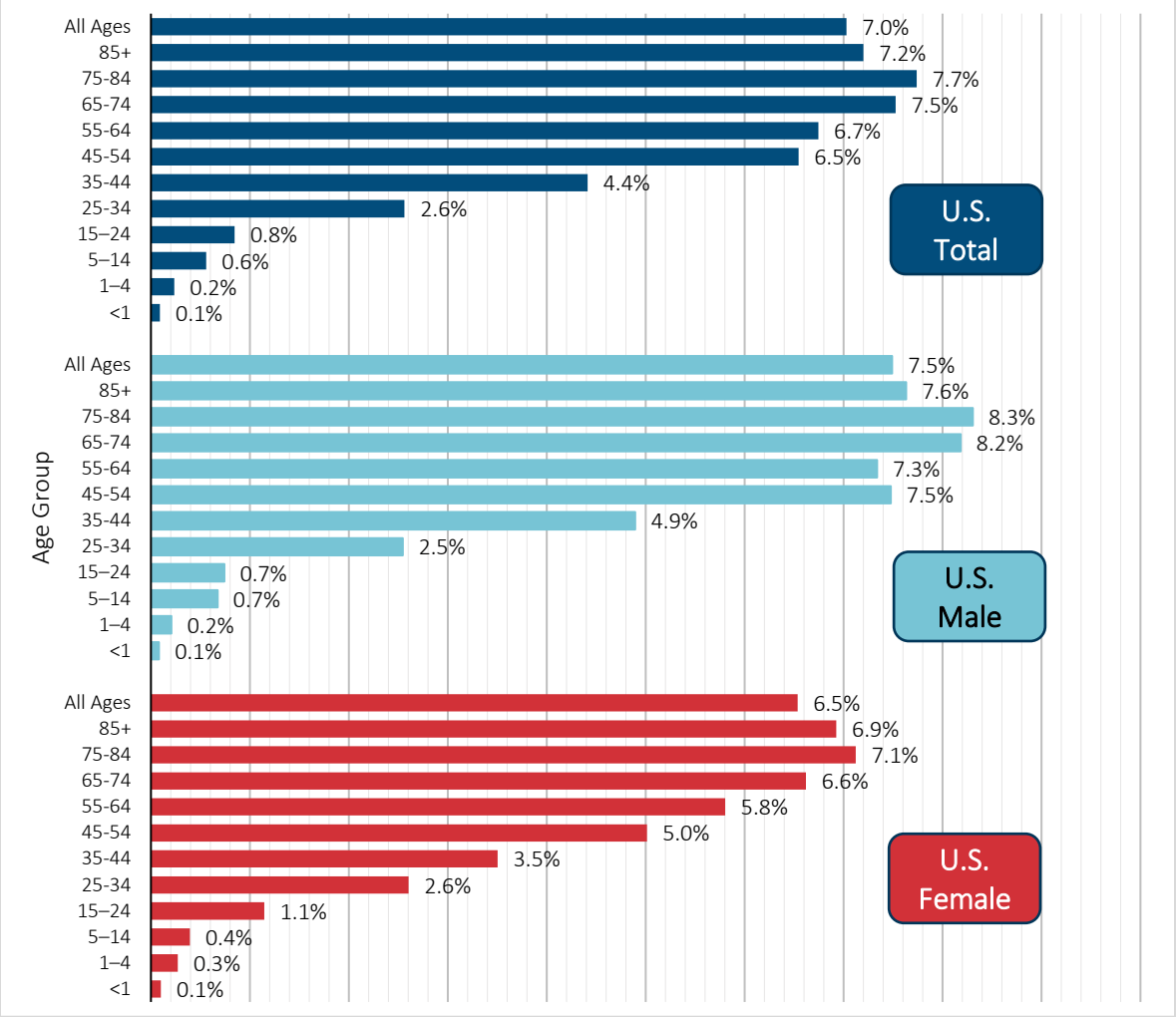
[1] See *https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm#AgeAndSex* and *https://www.cdc.gov/nchs/nvss/vsrr/COVID19/index.htm*,

Section 2: COVID-19 Mortality by Gender and Age Group

Using the weekly COVID-19 deaths and all COD death data since the end of January 2020, one can see how the COVID-19 deaths as a percent of all deaths varies by age group. As shown in Figure 1, 7.0% of all deaths have been due to COVID-19. The percentage varies between 6.5% and 8.3% for ages above 65. The percentages drop to about 2.5% at ages 25-34. Male rates tend to be higher than female rates with the largest difference of 2.5% at ages 45-54.

Figure 1

COVID-19 DEATHS AS A PERCENT OF ALL DEATHS BY AGE GROUP FROM JANUARY 26 TO MAY 9, 2020



Data source: CDC, Accessed 5/20/2020

The COVID-19 death counts underlying Figure 1 are shown in Table 1. The number of deaths for males significantly exceeds the number of deaths for females for ages below 75. However, for ages 85+, the female deaths exceed male deaths. Note that only 60,304 deaths are included here. This number is lower than the number of deaths reported through various media outlets because it is based on death certificate data, which takes time to work the reporting process.

Table 1

COVID-19 DEATHS BY AGE GROUP AND GENDER FROM JANUARY 26 TO MAY 9, 2020

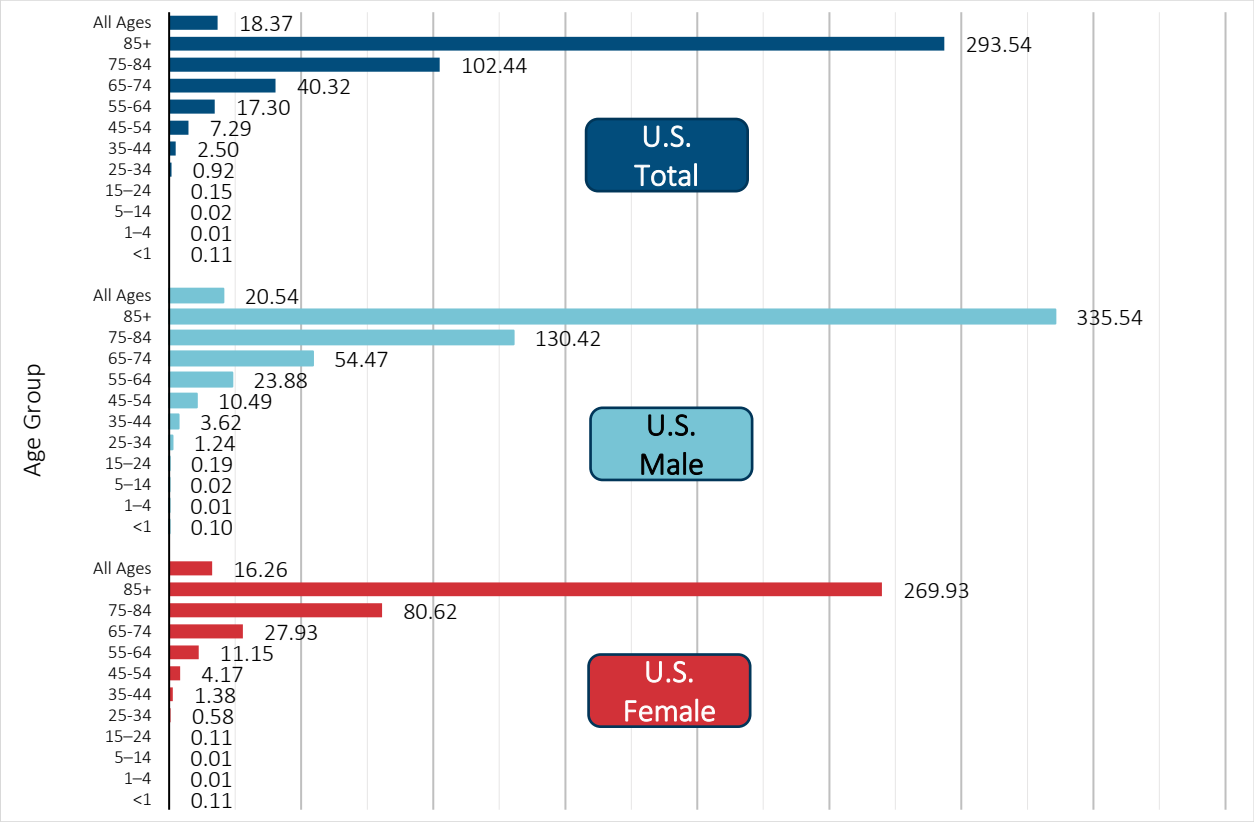
Age Group	Total	Male	Male % of Total	Female	Female % of Total
Under 1 year	4	2	50%	2	50%
1-4 years	2	1	50%	1	50%
5-14 years	7	5	71%	2	29%
15-24 years	65	42	65%	23	35%
25-34 years	421	290	69%	131	31%
35-44 years	1,040	753	72%	287	28%
45-54 years	2,979	2,116	71%	863	29%
55-64 years	7,343	4,895	67%	2,448	33%
65-74 years	12,695	8,007	63%	4,688	37%
75-84 years	16,360	9,127	56%	7,233	44%
85 years and over	19,388	7,974	41%	11,414	59%
All Ages	**60,304**	**33,212**	**55%**	**27,092**	**45%**

Data source: CDC, Accessed 5/20/2020

COVID-19 mortality rates per 100,000 of population by gender in the U.S. are shown in Figure 2. The population numbers used to develop these rates were from the United States Census Bureau as of July 1, 2019. Even though the number of female COVID-19 deaths for ages 85+ is greater than the number of deaths for males (see Table 1), female mortality rates are running about 80% of male rates for ages 85+. For ages 65–75, the female rate is about half the male rate, and for ages 35–54, the female rate is about 40% of the male rate.

Figure 2

U.S. MORTALITY RATES PER 100,000 OF POPULATION BY AGE GROUP AND GENDER AS OF MAY 9, 2020



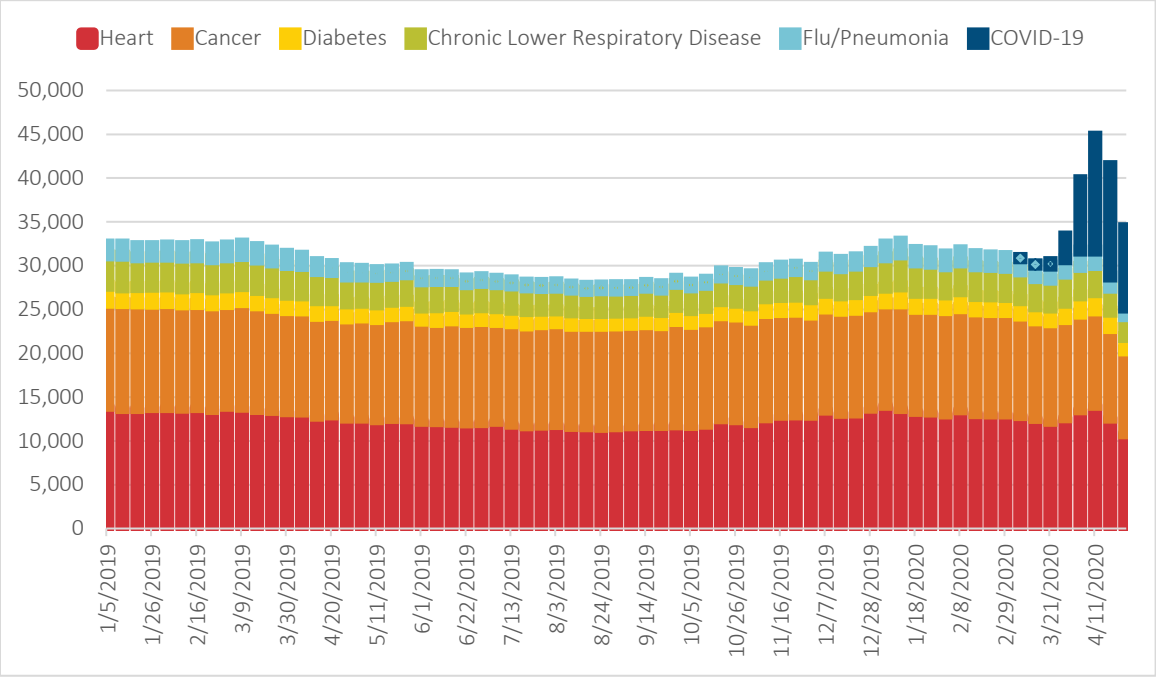
Data source: CDC, Accessed 5/20/2020

Section 3: COVID-19 Mortality Versus Other Causes of Death

There have been questions about whether the increase in COVID-19 deaths has had an impact on deaths from other causes such as heart disease. Figure 3 shows weekly deaths since the beginning of 2019 for COVID-19 and selected other causes of death. The CODs shown here are based on the underlying, or primary, cause of death indicated on a death certificate. Because of the 1- to 2-week lag in death certificate data, only data through April 25 is shown. At this point, not all the death certificate data is available and past data may be revised, so it is pre-mature to make any conclusions on the impact of the pandemic on non-COVID-19 CODs. However, one could monitor this source for patterns and observations as additional data continues to become available.

Figure 3

U.S. WEEKLY DEATHS BY CAUSE OF DEATH FROM JANUARY 2019 TO APRIL 25, 2020



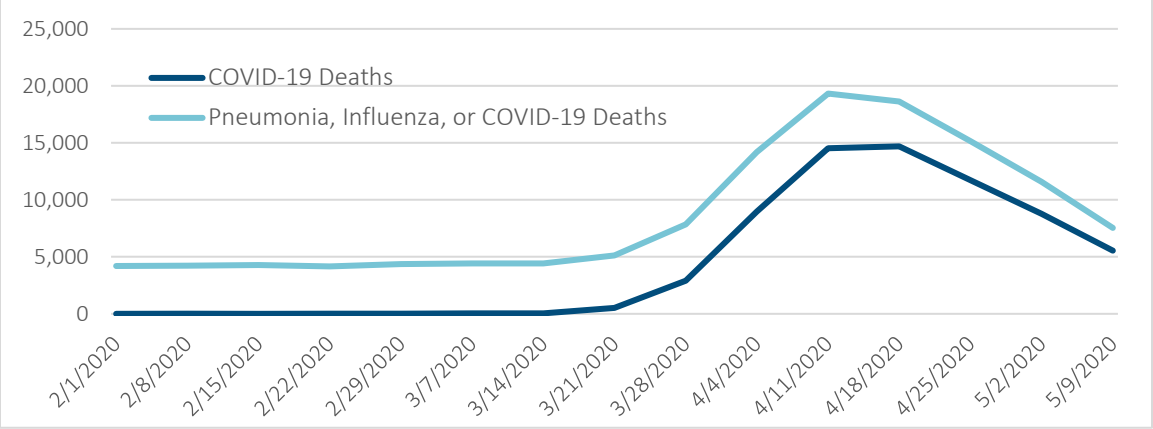
Data source: CDC, Accessed 5/20/2020

Section 4: COVID-19, Influenza, and Pneumonia Deaths

Deaths due to COVID-19 may be misclassified as flu or pneumonia deaths and the resulting increase in flu/pneumonia deaths could be an indicator of excess COVID-19 related mortality. By including flu/pneumonia deaths with COVID-19 deaths, it is possible to provide context for understanding the completeness of COVID-19 mortality data and related trends. Figure 4 shows COVID-19 deaths and COVID-19 plus flu and pneumonia deaths by week since February 1, 2020. The difference between the two lines has generally ranged between 4,000 and 5,000 deaths.

Figure 4

U.S. COVID-19 AND PNEUMONIA/INFLUENZA/COVID-19 DEATHS FROM JANUARY 25 TO MAY 9, 2020

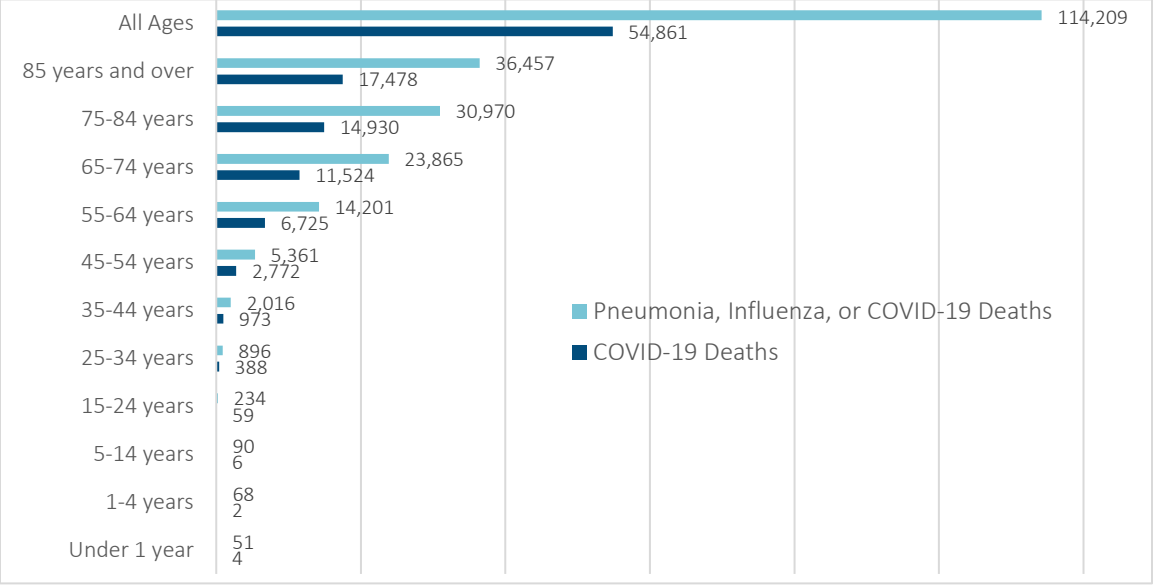


Data source: CDC, Accessed 5/20/2020

Figure 5 shows the cumulative COVID-19 deaths and COVID-19 plus flu and pneumonia deaths between January 25 and May 9, 2020. COVID-19 has been cited as a COD in approximately 50% of the total COVID-19 plus flu and pneumonia deaths for ages 35 and above.

Figure 5

U.S. COVID-19 AND PNEUMONIA/INFLUENZA/COVID-19 DEATHS FROM JANUARY 25 TO MAY 9, 2020



Data source: CDC, Accessed 5/20/2020

Section 5: COVID-19 County and Income Level Analysis

The CDC is beginning to provide COVID-19 mortality data at a county level. As of this writing, the CDC has provided COVID-19 deaths and deaths for all causes for 366 counties. These 366 counties represent 11.7% of all U.S. counties and only 6.5% of the U.S. population. This is a relatively small sample and, therefore, one should be cautious about making conclusions from it.

As this data continues to grow, one could group counties based on various characteristics. In the following example analysis, each of these 366 counties was assigned to a population-based quintile group, where the counties were ranked by median household income. The results of this grouping and the deaths associated with each quintile group are shown in Table 2. The deaths are from January 25, 2020 through May 9, 2020. Median household income by county was obtained from the U.S. Census Bureau's Small Area Income and Poverty Estimates Program[2].

The results in Table 2 do not make intuitive sense. Generally, higher socio-economic status equates to lower mortality. Here, the highest percentage of COVID-19 deaths occurs in the highest median county income quintile. Other potential influences such as social-distancing strategies, policies for recording COD on death certificates, and population density are not included here and could be considered in future analyses as additional county level data emerges.

Table 2

U.S. COVID-19 AND DEATHS FROM ALL CAUSES BY INCOME COUNTY GROUPING FROM JANUARY 25 TO MAY 9, 2020

Income Percentile Group	# of Counties	Counties Average Median Household Income	Average County Population	COVID-19 Deaths	Deaths from All Causes	COVID-19 Deaths / All Cause Deaths
0-20%	68	38,012	235,288	6,720	58,425	11.5%
20-40%	77	44,955	467,605	8,725	117,881	7.4%
40-60%	78	50,973	514,820	6,972	113,325	6.2%
60-80%	57	58,054	801,009	9,551	116,342	8.2%
80-100%	86	77,328	586,135	20,552	136,267	15.1%
All	366	54,594	514,279	52,520	542,240	9.7%

Data source: CDC, Accessed 5/20/2020. U.S. Census Bureau.

[2] U.S. Census Bureau, Small Area Estimates Branch. *https://www.census.gov/data/datasets/2008/demo/saipe/2008-state-and-county.html* and *https://www.census.gov/data/datasets/2009/demo/saipe/2009-state-and-county.html.*

Section 6: COVID-19 Comorbidities

Table 3 shows all the CODs listed on the death certificate for 49,770 deaths where COVID-19 was listed as a COD. Using this information, one can analyze the various comorbidities associated with COVID-19 deaths. Flu and pneumonia were present in 43.4% of the 49,770 COVID-19 deaths and respiratory failure was present in 33.7% of the deaths. Hypertension, adult respiratory distress syndrome, cardiac arrest and diabetes were cited as additional CODs in 20.2%, 17.1%, 14.6% and 14.3% of the COVID-19 deaths, respectively.

Table 3

CAUSE OF DEATH CITED IN U.S. COVID-19 DEATHS BY AGE GROUP FROM JANUARY 25 TO MAY 9, 2020

Condition	ICD-10_codes	All ages	All Ages % Total	0-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-84 years	85+ years
Coronavirus-19	U071	49,770	100.0%	68	354	893	2,547	6,118	10,505	13,556	15,727
Influenza and pneumonia	J09-J18	21,607	43.4%	29	163	374	1,140	2,770	4,604	5,946	6,580
Respiratory failure	J96	16,775	33.7%	21	122	261	818	2,035	3,659	4,824	5,034
Hypertensive diseases	I10-I15	10,063	20.2%	3	39	120	400	1,214	2,264	2,883	3,140
Adult respiratory distress syndrome	J80	8,521	17.1%	18	79	213	605	1,327	2,149	2,221	1,908
Cardiac arrest	I46	7,243	14.6%	13	52	144	434	975	1,614	1,883	2,128
Diabetes	E10-E14	7,104	14.3%	10	47	147	480	1,170	1,905	1,936	1,409
Ischemic heart disease	I20-I25	5,071	10.2%	1	2	25	91	419	1,011	1,567	1,955
Vascular and unspecified dementia	F01, F03	4,479	9.0%	0	0	1	9	59	384	1,339	2,687
Chronic lower respiratory diseases	J40-J47	3,848	7.7%	6	21	42	120	440	875	1,235	1,109
Renal failure	N17-N19	3,652	7.3%	4	41	59	236	491	914	1,012	895
Sepsis	A40-A41	3,598	7.2%	9	38	71	231	575	919	967	788
Heart failure	I50	2,756	5.5%	1	9	10	55	206	443	761	1,271
Cardiac arrhythmia	I44, I45, I47-I49	2,588	5.2%	0	8	9	49	192	449	755	1,126
Other diseases of the circulatory system	I00-I09, I26-I43, I51, I52, I70-I99	2,172	4.4%	9	18	47	94	271	463	568	702
Malignant neoplasms	C00-C97	2,074	4.2%	2	9	19	60	263	565	630	526
Cerebrovascular diseases	I60-I69	1,716	3.4%	1	6	11	48	197	366	539	548
Other diseases of the respiratory system	J00-J06, J20-J39, J60-J70, J81-J86, J90-J95, J97-J99, U04	1,415	2.8%	4	4	21	54	144	278	409	501
Obesity	E65-E68	1,317	2.6%	14	64	145	247	328	308	157	54
Alzheimer's disease	G30	1,237	2.5%	0	0	0	1	14	91	379	752
Intentional and unintentional injury, poisoning and other adverse events	S00-T98, V01-X59, X60-X84, X85-Y09, Y10-Y36, Y40-Y89, U01-U03	1,115	2.2%	4	22	24	61	134	196	280	394
Respiratory arrest	R09.2	1,112	2.2%	1	5	16	47	116	229	308	390

Data source: CDC, Accessed 5/20/2020

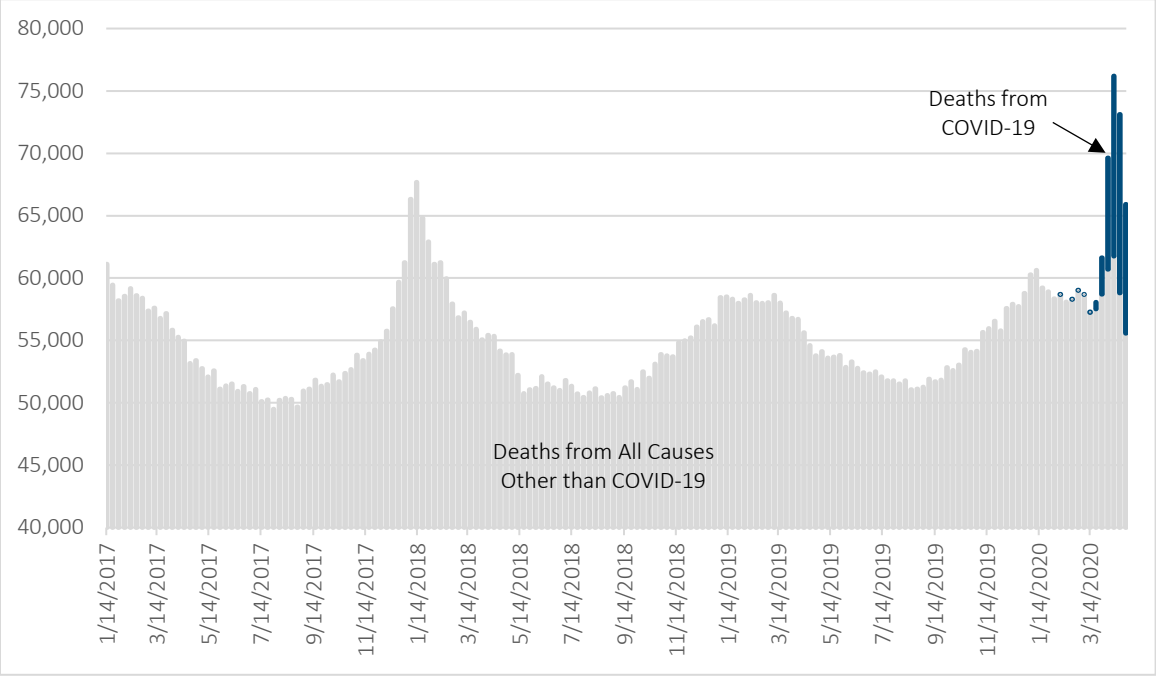
Section 7: COVID-19 Mortality Relative to All Causes of Death

The tracking of cause of death (COD) is not a precise science because of the inconsistencies in the way COD is assigned to deaths on death certificates. Many deaths due to COVID-19 may be assigned to other causes of death. Some entries of COVID-19 as a COD may occur in cases only when COVID-19 is confirmed through testing. Other deaths may be coded as COVID-19 in cases where COVID-19 is suspected even if not confirmed through testing. One method that helps to understand the impact of a particular COD is to look at deaths from all causes and compare those "total" deaths to "total" deaths from other periods of time.

Figure 6 shows U.S. population deaths by week since January 2017 as reported by the CDC analysis of death certificates. Deaths with COVID-19 indicated as a COD on a death certificate have also been added to this graph. Because of the 1- to 2-week lag in death certificate data, only data through April 25 is shown. On April 11, 2020, the number of weekly deaths was 13% higher than the peak of the 2017–2018 flu season on January 13, 2018.

Figure 6

WEEKLY DEATHS IN THE U.S., JANUARY 14, 2017–APRIL 25, 2020



Data source: CDC, Accessed 5/20/2020

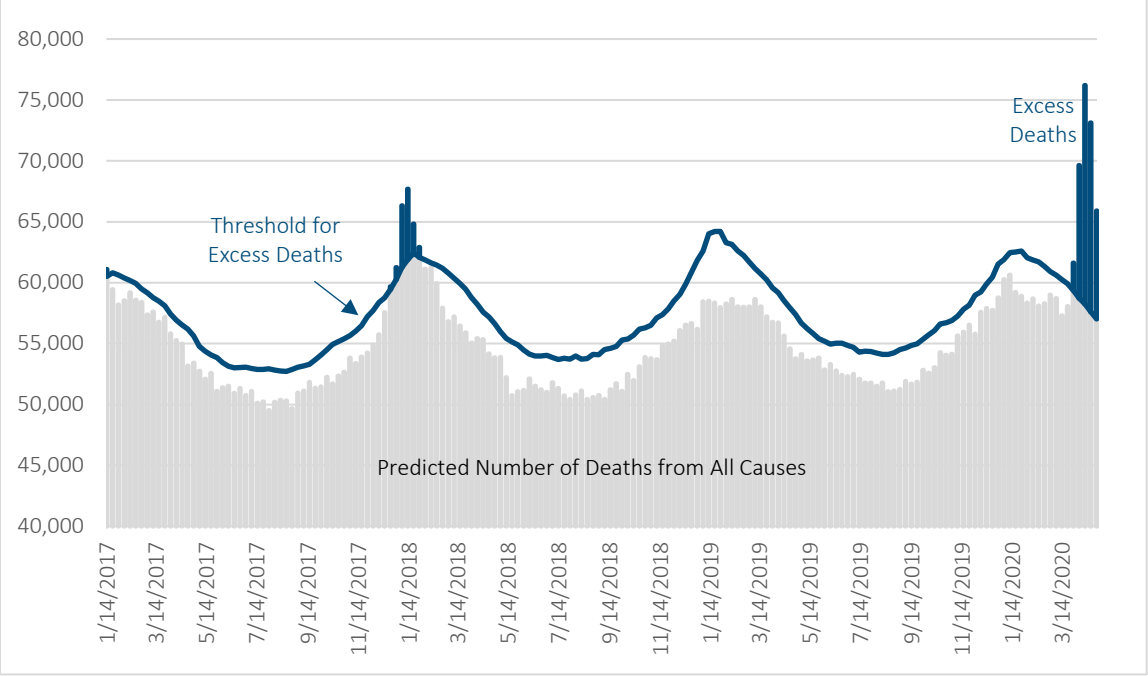
Section 8: Excess Mortality

An analysis of excess mortality is useful to understand the mortality impact of the current pandemic and can help to overcome potentially misleading results due to inconsistencies in the reporting of COD. In an excess mortality analysis, total deaths are compared to an "expected" level of deaths. The CDC's analysis of excess deaths during COVID-19 is now updated on a regular basis. The CDC has determined a set of expected death counts and the upper bound of the 95% confidence interval (CI) of these expected counts. The expected deaths will equal the actual deaths when all the death certificate information is received. The upper bound of the CI is used as a threshold to estimate excess mortality. For more information on the methodology used to determine expected deaths and the upper bound, see the CDC website. [3]

Figure 7 shows the CDC's predicted deaths from all causes compared to this CDC threshold from January 14, 2017 through April 25, 2020. Excess deaths did appear during the 2017–2018 flu season. The highest percentage of excess deaths to the threshold prior to 2020 was 9.4% during the week of January 13, 2018. In 2020, excess deaths began appearing during the week of March 28, 2020. The highest excess of deaths during the COVID-19 pandemic as a percent of threshold occurred during the week of April 11, 2020 and was 30.8%. Cumulative 2020 excess deaths as of April 25, 2020 totaled 55,549 or 0.017% of the U.S. July 1, 2019 population. This percentage will likely increase as the pandemic continues. As a comparison point, excess mortality during the 1918 pandemic was about 0.5%.

Figure 7

CDC EXCESS DEATH ANALYSIS FROM JANUARY 2017 THROUGH APRIL 25, 2020



Data source: CDC, Accessed 5/20/2020

[3] See the Technical Notes section on *https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm* for detailed information on how the predicted deaths and the threshold were determined.

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