Mortality and Longevity

Impact of COVID-19 and Other Causes of Death on Future U.S. Mortality

Expert Opinion Survey 3

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SOA Research INSTITUTE

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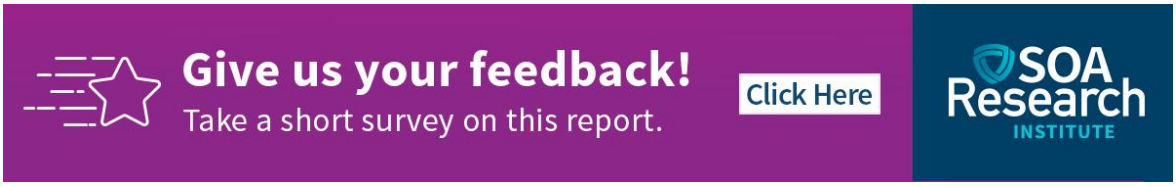

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Executive Summary

On May 11, 2023, the U.S. Health and Human Services issued a press release on the end of the COVID-19 public health emergency[1]. Since then, new variants continue to emerge in the U.S. and abroad with XEC being the latest variant du jour. The Society of Actuaries (SOA) Research Institute's Mortality and Longevity Strategic Research Program Steering Committee (MLPSC) decided to revisit its earlier expert opinion COVID-19 surveys[2] to see how views on the disease's impact on future U.S. mortality may have changed. Additionally, the MLPSC was interested in how other causes of death may be influencing future mortality.

To gather insights into what the future may hold, a multidisciplined panel of experts, composed predominantly of actuaries, medical professionals, researchers, academics and demographers, participated in a survey during May through September 2024 examining how COVID-19 might affect future U.S. general population mortality. The panel also considered how future U.S. mortality for the life insured, annuitant and pension plan populations might differ from the general U.S. population. Four years were examined: 2024, 2025, 2030 and 2035 and for ages: 25, 45, 65 and 85.

Participants were asked to provide excess mortality estimates. They were instructed to assume 2019 levels for each age as the starting point for expected mortality calculations and adjust as necessary to trend forward to the appropriate projection period. Total excess mortality estimates were requested with and without COVID-19 as a cause of death for each projection year and age combination. Historical mortality information from 2019-2022 was provided as well as sample calculations for determining excess mortality. The participants also provided thoughts on factors influencing their excess mortality estimates.

Besides excess mortality, respondents opined on the most important current age groups to track over time and monitor in future experience as a result of the COVID-19 pandemic.

Twenty-nine individuals participated in the survey. Most of the responses focused on the U.S. general population. Results were aggregated and analyzed. Participants had diverse opinions on how COVID-19 would impact future mortality. Unless otherwise noted, the analysis and comments presented in this paper are based on the average excess mortality estimates of the respondents and the most predominant responses selected by the participants. Based on this approach, observations for U.S. general population future mortality are as follows:

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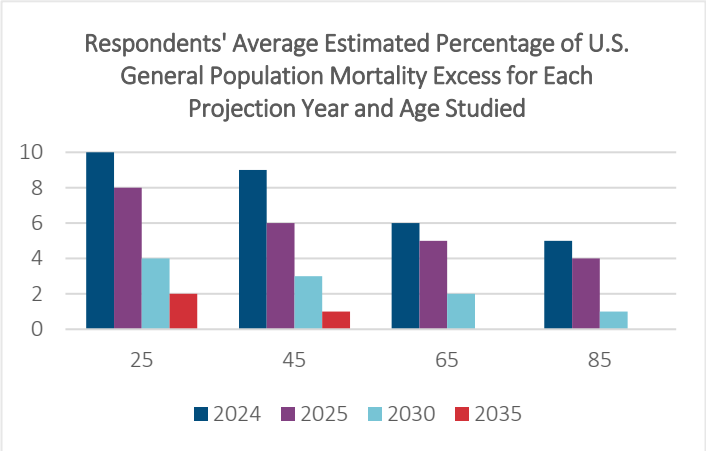
[1] HHS Press Office. May 11, 2023. HHS Secretary Xavier Becerra Statement on End of the COVID-19 Public Health Emergency. https://www.hhs.gov/about/news/2023/05/11/hhs-secretary-xavier-becerra-statement-on-end-of-the-covid-19-public-health-emergency.html (Accessed December 1, 2024)

[2] The MLPSC initial survey (https://www.soa.org/resources/research-reports/2022/covid-19-short-term-impact-us-mort/) was released in August 2022 and captured views from mortality experts during March 2022. The second survey was released in January 2023 and closed in March 2023. https://www.soa.org/resources/research-reports/2023/covid-impact-future-mortality-us/

1. **Excess mortality is expected to occur for all years studied with amounts varying by year and age.**

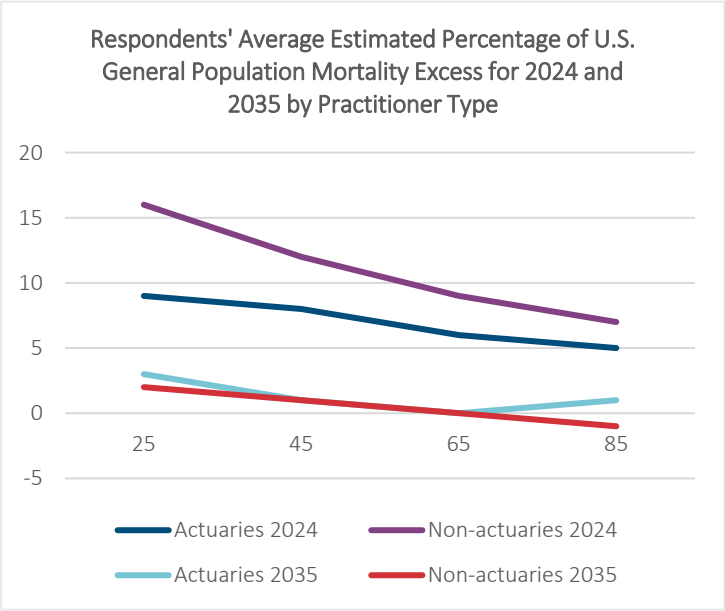
Although the largest mortality excess numbers for the U.S. general population are foreseen for 2024, excess mortality is expected to continue through 2035, decline in years 2025 and 2030 and near expected levels by 2035.

Excess mortality for 2024 ranges from 10% for age 25 to 5% for age 85. For 2025, the range narrows with excess mortality at age 25 being 8% and falling to 4% for age 85. By 2035, excess mortality is projected to be 1–2% for the younger ages, while the older ages are projected to return to expected levels (0%).



2. **Actuaries and non-actuaries have differing views on excess mortality.**

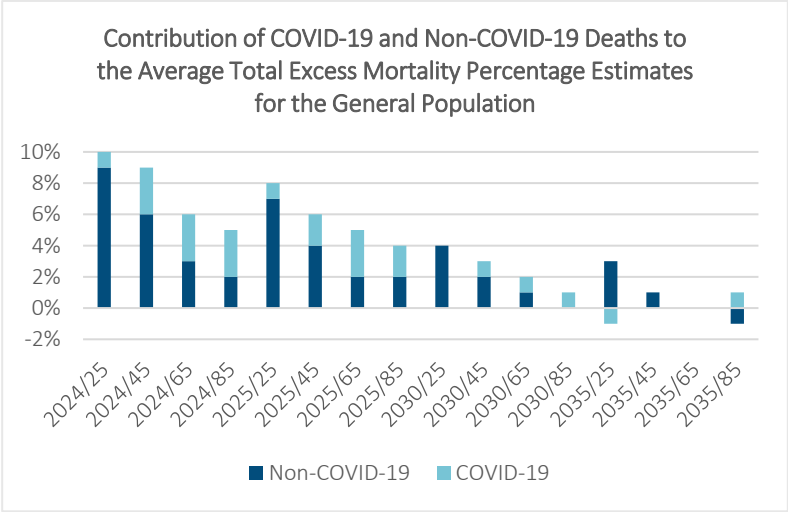
Approximately 75% of the respondents were actuaries and 25% were non-actuaries. In comparing the aggregate responses for actuaries to those of non-actuaries, the average of the excess mortality percentages estimated by actuaries are expected to be lower than the average of those estimated by non-actuaries. Contrary to survey 2, a general narrowing of the gap between the two groups is also seen as the projection year increases. For example, the average actuarial projected excess mortality level for age 25 in 2024 is 9% compared to 16% by non-actuaries. By 2035, there is not much difference in the estimates between the two groups.



The differences in estimates can partially be explained by examining the key drivers from each group. For 2024, actuaries anticipate higher immunity due to vaccination, infection/reinfection, increased access to current or future new COVID-19 medical treatments and a less healthy population than pre-pandemic. Non-actuaries also identified higher immunity due to vaccination and infection/reinfection, but they also expected lower virulence in current and future COVID-19 strains and the population to exhibit unhealthier behavior than expected. By 2035, actuaries and non-actuaries agreed on the top drivers, except non-actuaries continued to think the general population would exhibit unhealthier behavior than expected and actuaries expected lower virulence of current and future COVID-19 strains.

3. **Non-COVID-19 causes of death contribute more to total excess mortality than COVID-19 for younger ages. For older ages, COVID-19 is driving excess mortality.**

Examining the differences in respondents' estimates of excess mortality with and without COVID-19 as a cause of death provides insights into how much of the total excess is directly attributable to COVID-19 as a cause of death. For ages 25 and 45, non-COVID-19 causes are expected to contribute most of the excess deaths. However, COVID-19 has a larger impact on total projected excess deaths at 65 and 85 in most years. For example, in 2024, for age 25, the average total estimated percentage of excess mortality is 10%, of which respondents estimate only 1% of the excess is due to COVID-19 deaths. At age 85, the average total excess mortality percentage is 5%, with the majority of this (3%) due to COVID-19 deaths. By 2035, deaths from non-COVID-19 causes compose the majority of the total excess mortality at ages 25 and 45. For age 85, there is excess mortality due to COVID-19 but it is offset by mortality improvement from non-COVID-19 causes bringing the total mortality excess to 0%.



4. **For the general population, respondents continue to expect mortality deterioration from drug overdoses to be a top factor in driving excess mortality in all years studied for ages 25 and 45. But, cardiovascular disease, cancer, diabetes and other metabolic disorders, and Alzheimer's disease are the top non-COVID-19 causes being considered in the excess mortality estimates for ages 65 and 85.**

5. **Average excess mortality percentages for the U.S. general population younger ages are expected to be higher than for the life insurance and pension plan populations for all years studied. However, for ages 65 and 85, the U.S. general population excess mortality percentages are generally lower than that of the life insurance population. The U.S. general population is also lower than the excess mortality percentages of the pension plan population for age 85 in years 2030 and 3035.**

6. **The U.S. general population average excess mortality estimates are generally lower than survey 2 results for the common years studied.**

   For survey 2, 39 responses were collected from January through March 2023, which was during the 2023 COVID-19 winter wave. In the current survey (survey 3), 29 individuals responded during the May through September 2024 period when COVID weekly deaths were much lower than the prior survey period.

Section 1: Introduction

To help actuaries and others model future mortality and mortality improvement, the Society of Actuaries Research Institute's Mortality and Longevity Strategic Research Program Steering Committee (MLPSC) assembled a panel of experts to gather opinions and insights about the possible impact of COVID-19 on future mortality and how their views might change over time. Potential panelists were identified through recommendations from MLPSC members, actuarial volunteers overseeing this project (Project Oversight Group [POG]), SOA staff and an open call for panel members. After a vetting process, individuals were invited to participate. Twenty-nine prospects of varying backgrounds accepted the opportunity to participate in survey 3.

The MLPSC defined the third activity of the expert panel, a follow-up survey that updates expectations for U.S. excess mortality of insured, annuitant, pension and general populations over the short term (less than 10 years) and medium term (at 11 years). The MLPSC delegated the execution of the study to the POG and SOA Research Institute staff.

Much of the structure and text is the same as that used in the August 2023 Survey 2 report[3] to allow for easier comparison between the two studies. When the same question appears in all surveys, the results from the prior surveys are also included in this report. A refreshed questionnaire, found in Appendix A, was developed and included two sections:

1. Demographics captured the characteristics of the respondents, including practitioner and employer type, number of years of experience and area of expertise among the four U.S. mortality populations studied—U.S. general population, U.S. life insurance industry, U.S. annuity industry and U.S. private and public pension plans.

2. Future changes in U.S. all-cause mortality generated estimates for all-cause excess mortality with and without COVID-19 as a cause of death for each population for 2024, 2025, 2030 and 2035. Four ages were also studied for each year: 25, 45, 65 and 85. In addition to the estimates, respondents provided thoughts on factors and mortality changes that influenced their estimates from year to year.

   This section included views on changes in all-cause mortality and future mortality for ten (improvement and deterioration) individual causes of death; cardiovascular disorders, cancer, Alzheimer's and other dementias, other mental conditions, flu/pneumonia/other respiratory, drug overdoses, accidents excluding drug overdoses, suicides, diabetes and other metabolic disorders, and gastrointestinal/liver disease.

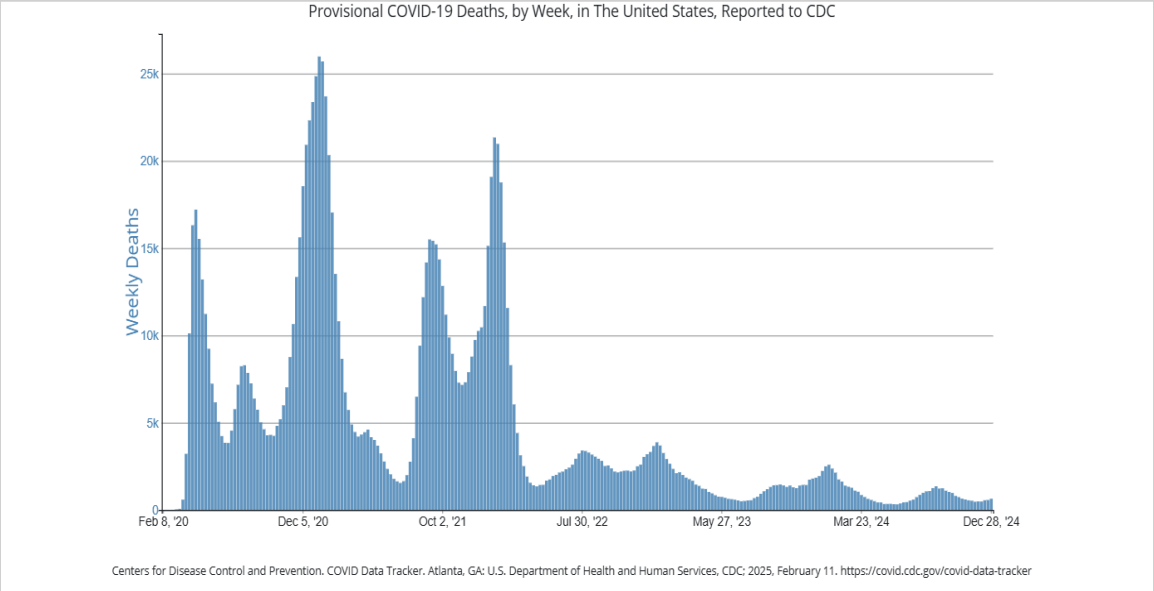
   The section also captured perspectives about the current age groups that should be tracked over time and monitored in future mortality analysis as a result of the COVID-19 pandemic.

Unlike the past two surveys, the 2024 online survey opened May 15, 2024, when COVID-19 deaths had fallen to under 500 deaths per week and closed September 18, 2024, during a summer COVID-19 wave when deaths had climbed to over 1,000 deaths per week (Figure 1).

[3] This report is available on the SOA website at: https://www.soa.org/resources/research-reports/2023/covid-impact-future-mortality-us/

Figure 1

WEEKLY TRENDS IN THE NUMBER OF COVID-19 DEATHS IN THE U.S. (PROVISIONAL)



Source: CDC's COVID Data Tracker as of February 11, 2025.
https://covid.cdc.gov/covid-data-tracker/#trends_weeklydeaths_select_00

Some analysis has been done comparing this survey with the past two studies. Approximately 70% of this year's respondents indicated participating in the 2023 study. While data is not available to examine whether these individuals also participated in the initial 2022 study, it is likely that some of them did. Therefore, results of these studies could be biased as the study may not be capturing broader perspectives on the topics posed.

Section 2: Results

Access to the individual responses was limited to the research team that was responsible for aggregating and analyzing them, with the POG providing guidance and peer review. Participants had diverse opinions on how COVID-19 would impact future mortality. Unless otherwise noted, the analysis and comments presented in this paper are based on the average excess mortality estimates of the respondents and the most predominant responses selected by the participants. This section summarizes the expert panel views from the survey. Full results from the survey can be found in Appendix A, which includes additional analysis to better understand the distribution of the submitted excess mortality estimates.

2.1 DEMOGRAPHICS OF EXPERT PANEL SURVEY PARTICIPANTS

Although the entire mortality expert panel was invited to participate, roughly 35% (29 individuals) submitted responses. Five of the participants did not provide responses to the questions about COVID-19 and the impact on future mortality so they were dropped from the study. Of the 24 who completed the Section 2 survey questions, 75% indicated being actuaries and 25% selected other practitioner types, with medical professionals being the most prevalent type represented in the latter category.

Respondents were generally employed by consulting firms, insurers and reinsurers. However, 37% of the total worked for academic/research institutions, government agencies, pension plans, reinsurance brokers, longevity analytics firms or they classified themselves as being self-employed.

Given that respondents were experts in their respective fields, a high level of experience was expected. Ninety-six percent of the respondents had 10 or more years of experience, with the majority (67%) specifying 25 or more years of experience.

Most of the survey focused on the impact of COVID-19 on future U.S. general population mortality. Participants were asked to provide estimates of COVID-19's impact on future excess mortality over the period 2024–2035 based on their indicated area of skills. Table 1 provides the respondents' self-selected expertise breakdown, with the majority reporting to have knowledge of U.S. mortality for the general populations. Even though 34% of the respondents designated themselves as experts with the U.S. life insurance industry, not all provided estimates.

In developing the questions, the POG felt the majority of the expert panel members would have a good understanding of U.S. general population mortality. Therefore, all survey participants had the opportunity to weigh in and provide opinions about future U.S. general population mortality. Therefore, the number of excess mortality estimates submitted for the U.S. general population is higher than the number of participants indicating expertise in this area.

Table 1
SURVEY RESPONDENTS' AREA OF EXPERTISE (*N* = 29)

Area of Expertise	No. Responding*	Percentage of Respondents* (%)	Percentage of Respondents* (%) in Survey 2	Percentage of Respondents* (%) in Survey 1	No. of Excess Mortality Estimates Submitted
U.S. general population mortality	20	69	82	66	24
U.S. life insurance industry insured population mortality	10	34	46	54	8
U.S. annuity industry annuitant population mortality	3	10	21	10	3
U.S. private and public pension plan population mortality	7	24	23	25	7
Dropped from study	5	17	0	2	0

*Respondents were asked to select all that apply. Therefore, some respondents provided more than one area of expertise.

As shown in Table 1, only three individuals submitted mortality estimates for the U.S. annuity industry annuitant population. Consequently, no analysis from the current survey for this population is included in this report.

2.2 CHANGES IN FUTURE EXCESS MORTALITY ESTIMATES

Once the skills of the participants were determined, they were asked to provide their opinions on future all-cause excess mortality with and without COVID-19 as a cause of death for each combination of ages 25, 45, 65 and 85 and years 2024, 2025, 2030 and 2035. The survey explained that excess mortality with COVID-19 was determined by examining projected mortality, including deaths that are directly or indirectly attributed to COVID-19 for a specific period, over pre-pandemic expectations for that period.

Non-COVID-19 excess mortality had the same definition as excess mortality with COVID-19 except that projected mortality did not include COVID-19 as a cause of death.

The participants were given historical mortality information for the U.S. general and life insurance insured populations along with simple examples for calculating excess mortality. This information is found in Appendix B.

2.2.1 EXCESS MORTALITY ESTIMATES WITH AND WITHOUT COVID-19

In examining the average of the excess all-cause mortality estimates submitted (Table 2), the average excess mortality estimated values were highest for the U.S. general population and lowest for the private and public pension plan population. They also varied by age for each population, with the highest average excess mortality value generally occurring at age 25. The average excess mortality value generally drops with each subsequent age following the same pattern as the historical excess mortality examples given in the survey.

In looking at the year-by-year estimates in Table 2, the estimated values with COVID-19 relative to expected values declined each year so that, by 2035, the projected mortality was nearing the expected mortality levels for all populations. This was especially true for the U.S general and pension plan populations.

The excess mortality wear-off pattern over time for the U.S. life insurance industry insured population was different from the general and private and public pension plan populations. The average of the excess mortality estimates still showed mortality deterioration in 2035 at all ages.

Table 2

AVERAGE ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH AND WITHOUT COVID-19 AS A CAUSE OF DEATH BY POPULATION AND AGE

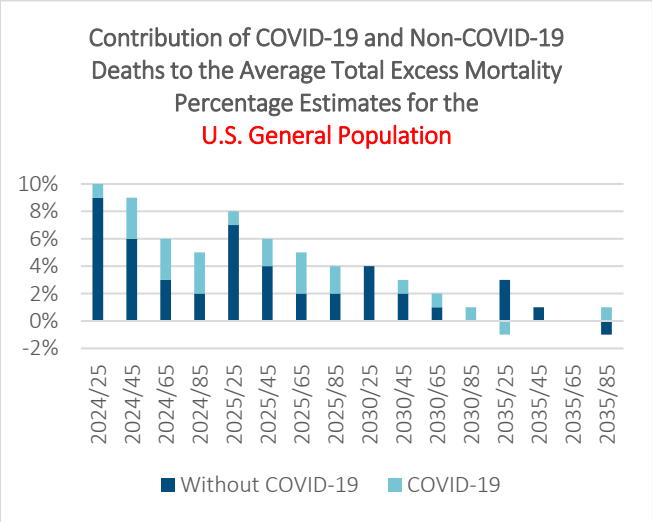
U.S. Population (No. of Responses)*	Age	2024 (%)		2025 (%)		2030 (%)		2035 (%)	
		With COVID-19	Non COVID-19	With COVID-19	Non COVID-19	With COVID-19	Non COVID-19	With COVID-19	Non COVID-19
General (N=24)	25	10	9	8	7	4	4	2	3
	45	9	6	6	4	3	2	1	1
	65	6	3	5	2	2	1	0	0
	85	5	2	4	2	1	0	0	-1
Life Insurance Industry Insured (N=8)	25	4	6	3	5	2	4	1	3
	45	5	4	4	4	2	2	1	3
	65	6	4	4	4	2	2	2	2
	85	6	4	5	3	2	1	1	1
Private and Public Pension Plan (N=7)	25	3	2	2	1	0	-1	-1	-2
	45	3	2	2	0	0	-1	0	-1
	65	3	1	2	1	1	0	0	0
	85	3	1	3	1	2	1	1	1

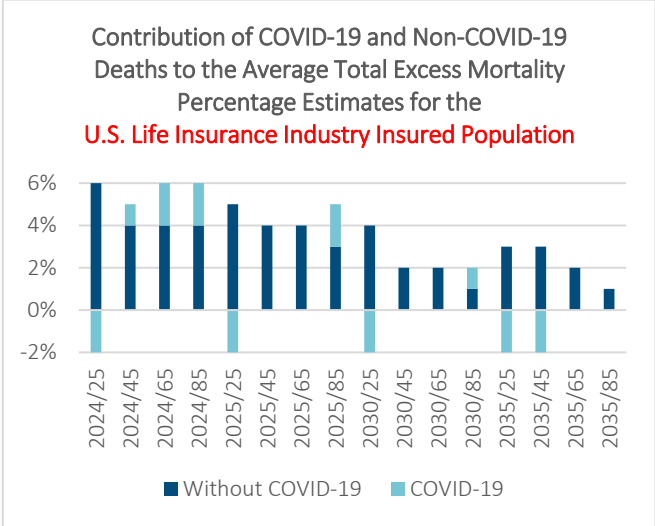
*U.S. Annuity Industry Annuitant Population is excluded due to low number of responses.

Comparing the average excess mortality estimates with COVID-19 to the non-COVID-19 average excess mortality estimates, the excess mortality percentages with COVID-19 are generally higher. By subtracting the two, participants' insights into how much of the total average excess mortality estimates is due to COVID-19 were obtained. This can be seen in Figure 2, which shows the contribution of deaths from COVID-19 and non-COVID-19 causes to the average total excess mortality percentage estimates.

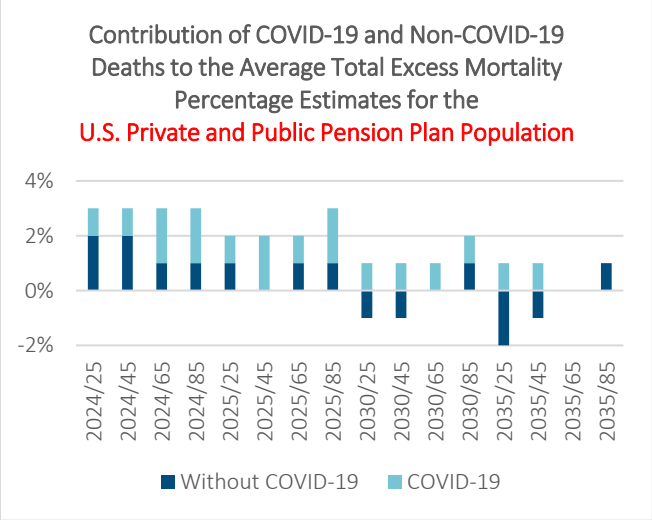
Figure 2

CONTRIBUTION OF COVID-19 AND NON-COVID-19 DEATHS TO THE AVERAGE TOTAL EXCESS MORTALITY PERCENTAGE ESTIMATES BY POPULATION, AGE, AND YEAR*





*U.S. Annuity Industry Annuitant Population is excluded due to low number of responses.



Generally, at ages 25 and 45, non-COVID-19 causes contribute the most to total excess mortality estimates but, for ages 65 and 85, COVID-19 has a larger impact. This can be seen especially for the 2024 estimates in all populations. But as COVID-19 mortality excess dissipates over time, we see excess mortality from non-COVID-19 linger for most of the ages in 2030 and 2035. This applies to both the general and life insurance industry populations. For the private and public pension plan population, COVID-19 is the contributor for the mortality excess in 2030 and 2035 except for age 85. At this age for these years, non-COVID causes also is a contributing factor in the average total excess mortality percentage estimates.

2.2.2 COMPARISON OF CURRENT EXCESS MORTALITY ESTIMATES TO PAST SURVEY RESULTS

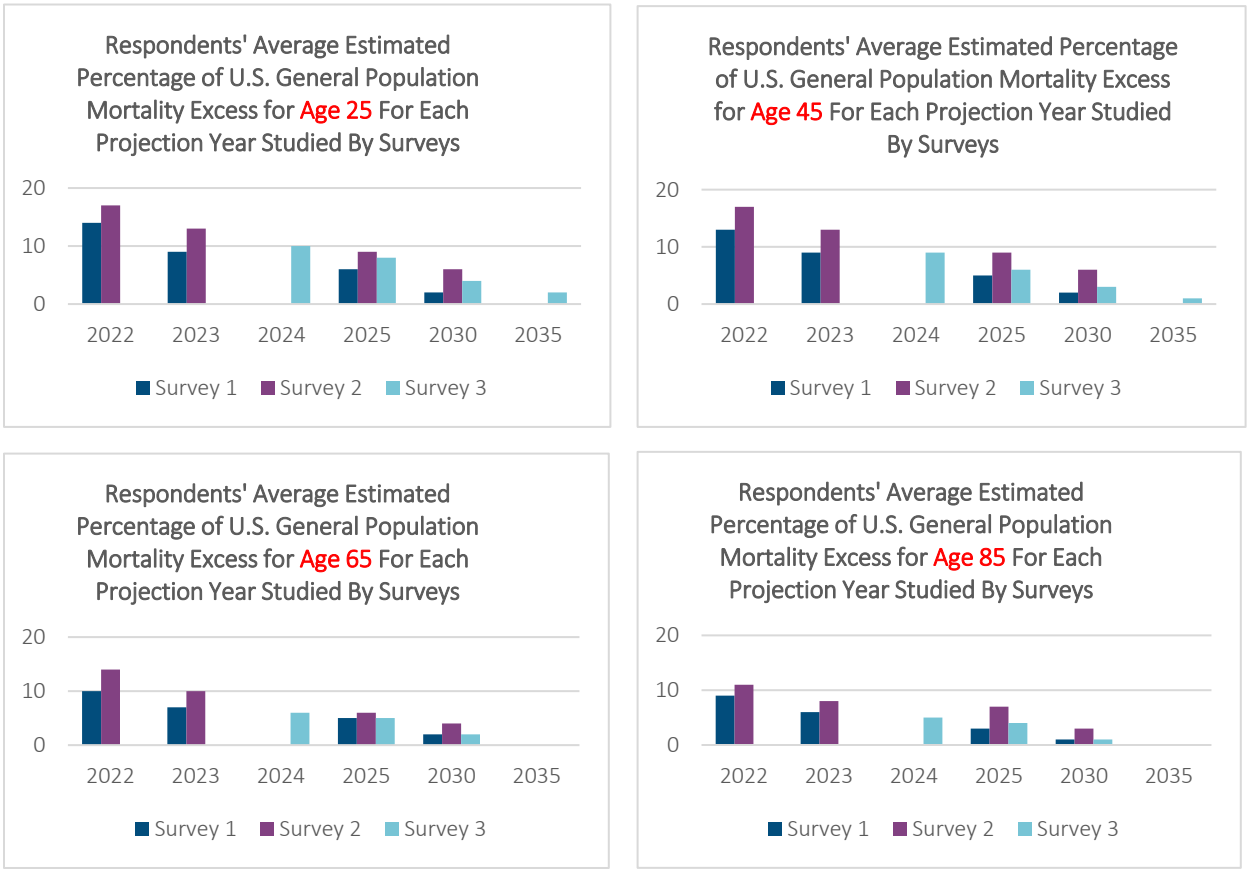
There have been three surveys in the series. The first survey was collected from March 11 to March 31, 2022. The second survey opened nearly a year later on January 24 and closed on March 24, 2023. These surveys examined years 2022, 2023, 2025, and 2030, so only years 2025 and 2030 overlap with the current survey.

Comparing the results of the three surveys, first for estimates of excess mortality with COVID-19 and the general population (Figure 3a), 2024 estimates from the current survey are generally 4-8% lower than years 2022 and 2023 from the prior two surveys. However, the 2024 estimates are very similar to the 2023 estimates from survey 1, only differing by plus or minus 1%.

In looking at the common years studied in all three surveys, current survey estimates are 0-2% higher than survey 1 estimates with much of the difference occurring at age 25. Current survey estimates are 1-3% lower than survey 2 for all ages.

Figure 3a

COMPARISON OF AVERAGE ALL-CAUSE EXCESS U.S. GENERAL POPULATION MORTALITY ESTIMATES WITH COVID-19 AS A CAUSE OF DEATH BY AGE, YEAR AND SURVEY

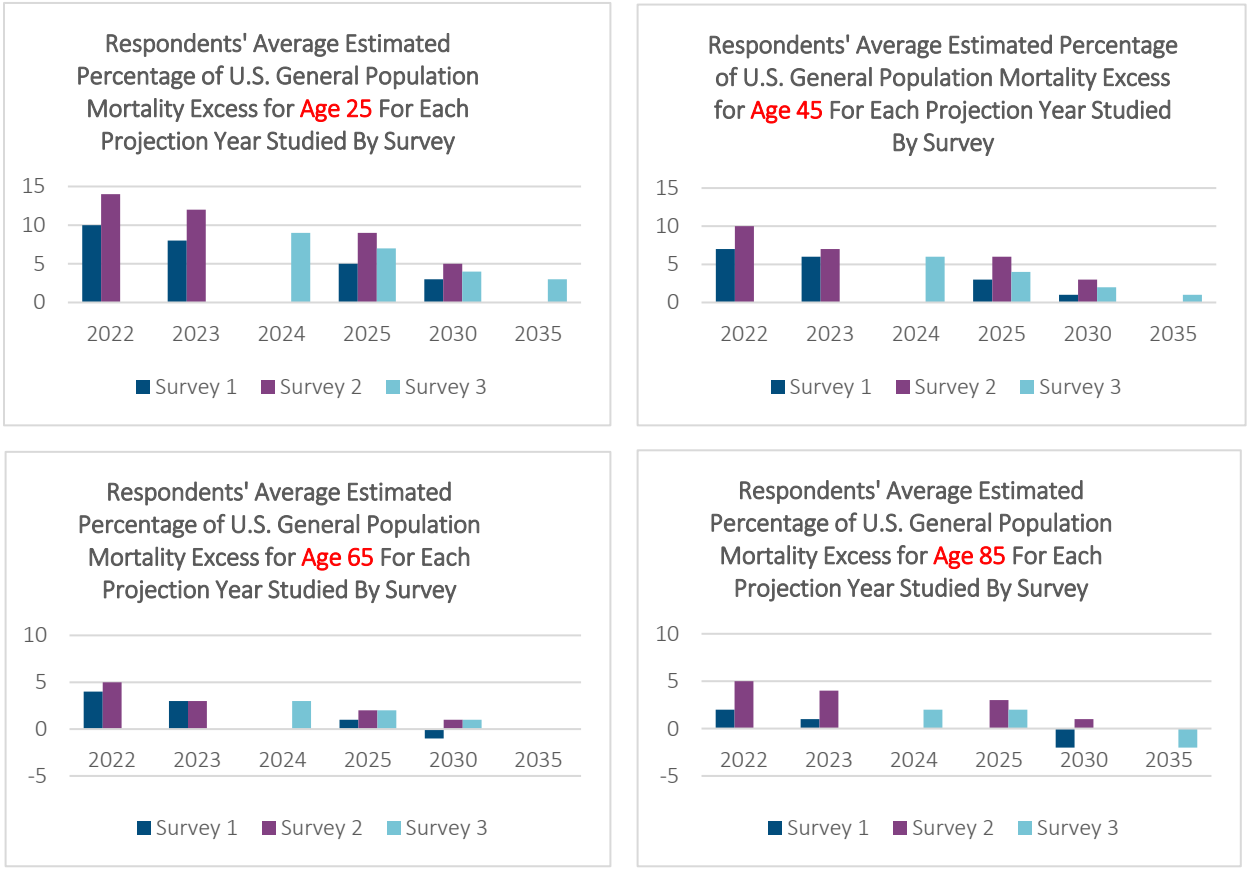


However, for the life insurance industry insured and public and private pension plan populations, there is more variability between the current estimates and the past estimates than the general population. As shown in Appendix C, for 2025, current estimates are 0-4% higher than survey 1 and generally 0-4% lower than survey 2. For 2030, estimates are 1-5% higher than survey 1 and generally 0-2% lower than survey 2.

Comparing surveys for the general population without COVID-19 as a cause of death (Figure 3b) gives results that are very similar to that shown in Figure 3a. For 2024, current estimates range 1% below to 1% above 2022 and 2023 survey 1 estimates at all ages but are generally 0-5% lower than survey 2. For 2025 and 2030, current results are 1-2% higher than survey 1 and 0-2% lower than survey 2 at all ages.

Figure 3b

COMPARISON OF AVERAGE ALL-CAUSE EXCESS U.S. GENERAL POPULATION MORTALITY ESTIMATES WITHOUT COVID-19 AS A CAUSE OF DEATH BY AGE, YEAR AND SURVEY



For the current life insured population, current estimates without COVID-19 are 2-4% higher than survey 1 and differs from survey 2 by -1% to 2% for years 2025 and 2030. For the pension plan population, a different pattern is seen. For 2025 and 2030, current estimates without COVID-19 for the younger ages are generally 0-3% lower than survey 1 and 2 estimates. But the older ages are 0-5% higher than past average estimates. For 2030, current estimates are 0-5% higher.

The average estimates of mortality excess for all surveys can be found in Appendix C.

2.2.3 DRIVERS AND FACTORS FOR THE EXCESS MORTALITY ESTIMATES

The survey participants were also asked about the top 3 drivers for their excess mortality estimates with COVID-19 from the lists shown in Tables 3a, 3b and 3c. A score was assigned to each response. A driver with a response of rank 1 received a score of 3; a driver with a response of rank 2 received a score of 2; and a driver with a response of rank 3 received a score of 1. Comparing the total scores for each driver, the top drivers among all the respondents for each area of expertise were identified and are the bold numbers in the tables. The number of responses is much lower for the annuity population and is not split out. More details can be found in Appendix A.

For the current survey, higher immunity due to vaccination, infection/reinfection, increased access to current or future new COVID-19 medical treatments, and a less healthy population than pre-pandemic are

among the top drivers for the general population estimates for most of the years studied. The ranking changed in 2030 when lower virulence of current or future COVID-19 strains was added to the top grouping and continued into 2035.

For the life insurance industry insured population, the top drivers were generally the same as those for the general population, but lower virulence of current or future COVID-19 strains/variants replaced less healthy population than pre-pandemic in the top driver list for all years.

For the private and public pension plan population, the top drivers were the same as the general population but included higher virulence of current or future COVID-19 strains/variants in 2024.

Comparing the three surveys for these drivers and the general population reflects knowledge gained since the first survey was completed. In 2022, the drivers focused on expected lower virulence, vaccinations and treatments. In 2023, lower virulence moved out to 2030 before joining the top 3 overall, replaced by higher immunity due to vaccination and infection/reinfection. In 2024, lower virulence moved to the top driver in 2030 and continues into 2035 as the less healthy population than pre-pandemic driver falls from the 2035 top list.

Table 3a

DRIVER SCORES FOR ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY YEAR (SURVEY 3)

Factor	2024	2025	2030	2035
General Population				
Healthy Behavior	5	5	12	10
Unhealthy Behavior	12	10	14	14
Implementation or Changes to Government programs/policies	0	0	1	2
Increase in socioeconomic difference	3	4	7	7
Reduction in socioeconomic difference	0	0	0	0
Treatment Access - Increased access to current or future new COVID-19 medical treatments	**23**	**23**	**21**	**22**
Treatment Access - Decreased access to current or future new COVID-19 medical treatments	1	1	1	1
Population Health Status - Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	14	13	15	14
Population Health Status - Less healthy population than pre-pandemic as older, less healthy individuals die from COVID-19	**19**	**21**	**16**	15
Immunity – Higher immunity due to vaccination, infection/reinfection	**36**	**38**	**33**	**31**
Immunity – Lower immunity due to vaccination, infection/reinfection	3	3	0	0
Virulence – Higher virulence of current or future COVID-19 strains/variants	7	7	0	3
Virulence – Lower virulence of current or future COVID-19 strains/variants	17	14	**16**	**16**
Other 1: Social Distancing	1	1	1	1
Other 2: Medical Progress	0	0	0	1
Life Insurance Industry Insured Population				
Healthy Behavior	3	3	5	5
Unhealthy Behavior	5	5	3	2

Factor	2024	2025	2030	2035
Implementation or Changes to Government programs/policies	0	0	0	1
Increase in socioeconomic difference	1	1	4	4
Reduction in socioeconomic difference	2	2	2	2
Treatment Access - Increased access to current or future new COVID-19 medical treatments	**7**	**7**	**6**	**6**
Treatment Access - Decreased access to current or future new COVID-19 medical treatments	1	1	1	1
Population Health Status - Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	1	0	2	2
Population Health Status - Less healthy population than pre-pandemic as older, less healthy individuals die from COVID-19	6	6	3	3
Immunity – Higher immunity due to vaccination, infection/reinfection	**12**	**9**	**9**	**9**
Immunity – Lower immunity due to vaccination, infection/reinfection	1	1	1	1
Virulence – Higher virulence of current or future COVID-19 strains/variants	0	0	0	0
Virulence – Lower virulence of current or future COVID-19 strains/variants	**9**	**7**	**6**	**6**
Private and Public Pension Plan Population				
Healthy Behavior	1	1	4	4
Unhealthy Behavior	4	4	1	1
Implementation or Changes to Government programs/policies	0	0	0	0
Increase in socioeconomic difference	2	2	2	2
Reduction in socioeconomic difference	0	0	0	0
Treatment Access - Increased access to current or future new COVID-19 medical treatments	2	2	**6**	**6**
Treatment Access - Decreased access to current or future new COVID-19 medical treatments	2	2	0	0
Population Health Status - Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	0	0	0	0
Population Health Status - Less healthy population than pre-pandemic as older, less healthy individuals die from COVID-19	**6**	**6**	**6**	**6**
Immunity – Higher immunity due to vaccination, infection/reinfection	**9**	**10**	**8**	**7**
Immunity – Lower immunity due to vaccination, infection/reinfection	3	3	3	3
Virulence – Higher virulence of current or future COVID-19 strains/variants6	**6**	5	3	4
Virulence – Lower virulence of current or future COVID-19 strains/variants	**7**	**7**	**9**	**9**

Table 3b

DRIVER SCORES FOR ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY YEAR (SURVEY 2)

Driver	2022	2023	2025	2030
General Population				
Higher immunity due to vaccination, infection/reinfection	**53**	**61**	**49**	**49**
Increased access to current or future new COVID-19 medical treatments	**38**	**39**	**41**	**42**
Less healthy population than pre-pandemic due to long COVID and indirect COVID-19 impacts	19	**34**	**29**	24
Lower virulence of current or future COVID-19 strains/variants	17	24	27	**28**
Higher virulence of current or future COVID-19 strains/variants	**24**	17	16	16
Lower immunity due to vaccination, infection/reinfection	11	8	11	10
Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	11	4	9	15
Increased deferral of health care and treatment due to COVID-19	15	9	4	5
Decreased use of social distancing and isolation	6	5	5	5
Decreased deferral of health care and treatment due to COVID-19	3	4	5	7
Decreased use of masks	6	7	1	1
Increased use of masks	8	1	1	0
Increased use of social distancing and isolation	0	0	1	1
Decreased access to current or future new COVID-19 medical treatments	0	0	0	0
Life Insurance Industry Insured Population				
Higher immunity due to vaccination, infection/reinfection	**24**	**26**	**27**	**25**
Increased access to current or future new COVID-19 medical treatments	**11**	**13**	**14**	**18**
Less healthy population than pre-pandemic due to long COVID and indirect COVID-19 impacts	7	6	8	7
Lower virulence of current or future COVID-19 strains/variants	**10**	**11**	**12**	**13**
Higher virulence of current or future COVID-19 strains/variants	6	6	6	6
Lower immunity due to vaccination, infection/reinfection	5	3	3	3
Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	6	4	4	4
Increased deferral of health care and treatment due to COVID-19	8	6	0	0
Decreased use of social distancing and isolation	4	4	4	4
Decreased deferral of health care and treatment due to COVID-19	0	2	6	4
Decreased use of masks	0	0	0	0
Increased use of masks	0	0	0	0
Increased use of social distancing and isolation	0	0	0	0
Decreased access to current or future new COVID-19 medical treatments	0	0	0	0
Annuity Industry Annuitant Population				
Higher immunity due to vaccination, infection/reinfection	**14**	**15**	**15**	**14**
Increased access to current or future new COVID-19 medical treatments	**7**	**8**	**8**	**8**

Driver	2022	2023	2025	2030
Less healthy population than pre-pandemic due to long COVID and indirect COVID-19 impacts	5	6	6	5
Lower virulence of current or future COVID-19 strains/variants	1	2	2	4
Higher virulence of current or future COVID-19 strains/variants	5	5	5	5
Lower immunity due to vaccination, infection/reinfection	2	3	3	3
Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	1	1	1	1
Increased deferral of health care and treatment due to COVID-19	6	1	0	0
Decreased use of social distancing and isolation	4	4	4	4
Decreased deferral of health care and treatment due to COVID-19	0	0	1	1
Decreased use of masks	0	0	0	0
Increased use of masks	0	0	0	0
Increased use of social distancing and isolation	0	0	0	0
Decreased access to current or future new COVID-19 medical treatments	0	0	0	0
Private and Public Pension Plan Population				
Higher immunity due to vaccination, infection/reinfection	9	9	7	8
Increased access to current or future new COVID-19 medical treatments	9	8	7	7
Less healthy population than pre-pandemic due to long COVID and indirect COVID-19 impacts	2	3	3	3
Lower virulence of current or future COVID-19 strains/variants	1	0	6	6
Higher virulence of current or future COVID-19 strains/variants	9	9	9	9
Lower immunity due to vaccination, infection/reinfection	4	4	4	4
Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	1	2	2	2
Increased deferral of health care and treatment due to COVID-19	3	2	0	0
Decreased use of social distancing and isolation	0	0	0	0
Decreased deferral of health care and treatment due to COVID-19	0	0	0	0
Decreased use of masks	0	3	0	0
Increased use of masks	3	0	0	0
Increased use of social distancing and isolation	1	1	1	1
Decreased access to current or future new COVID-19 medical treatments	0	0	0	0

Table 3c

DRIVER SCORES FOR ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY YEAR (SURVEY 1)

Driver	2022	2023	2025	2030
General Population				
Lower virulence of current or future COVID-19 strains	**56**	**61**	**60**	**78**
Change in vaccination/booster rate	**54**	**42**	32	28
New COVID-19 treatments	**54**	**66**	**84**	**81**
Higher virulence of current or future COVID-19 strains	52	38	22	16
Public deferral of health care treatment due to COVID-19	28	31	21	11
Worse mortality from long COVID	23	31	**37**	26
Better mortality as less healthy individuals die from COVID-19	21	20	23	**29**
Change in public behavior for masking	10	10	3	5
Life Insurance Industry Insured Population				
Lower virulence of current or future COVID-19 strains	**28**	**25**	**25**	**27**
Public deferral of health care treatment due to COVID-19	**28**	16	13	7
New COVID-19 treatments	**26**	**41**	**42**	**45**
Higher virulence of current or future COVID-19 strains	23	14	9	6
Change in vaccination/booster rate	21	18	14	14
Worse mortality from long COVID	18	**28**	**24**	12
Better mortality as less healthy individuals die from COVID-19	6	10	18	**19**
Change in public behavior for masking	4	3	2	7
Annuity Industry Annuitant Population				
Lower virulence of current or future COVID-19 strains	**11**	**5**	**7**	3
New COVID-19 treatments	**7**	**8**	**11**	**8**
Change in vaccination/booster rate	**7**	**6**	3	**7**
Public deferral of health care treatment due to COVID-19	4	**5**	2	0
Worse mortality from long COVID	3	4	5	2
Change in public behavior for masking	2	2	0	0
Better mortality as less healthy individuals die from COVID-19	1	2	**7**	**9**
Higher virulence of current or future COVID-19 strains	0	0	0	2
Private and Public Pension Plan Population				
Change in vaccination/booster rate	**20**	**19**	**13**	11
Lower virulence of current or future COVID-19 strains	**12**	**11**	**13**	**13**
Better mortality as less healthy individuals die from COVID-19	**12**	**13**	**13**	**16**
Higher virulence of current or future COVID-19 strains	9	10	5	6
Public deferral of health care treatment due to COVID-19	6	6	2	0
New COVID-19 treatments	5	5	**15**	***17***
Worse mortality from long COVID	5	5	1	2
Change in public behavior for masking	2	2	2	2

For the non-COVID-19 excess mortality estimates, participants were asked to provide their top 3 influential mortality changes impacting their estimates. The mortality changes shown were both improvement and deterioration for cardiovascular disorders, cancer, flu/pneumonia/other respiratory, Alzheimer's and other dementias, accidents excluding drug overdoses, and drug overdoses. They could also respond with other

mortality changes. In the current survey, the list has expanded and also includes other mental conditions, suicides, diabetes and other metabolic disorders, and gastrointestinal/liver disease.

The current survey asked participants to provide their thoughts about mortality changes impacting their population excess mortality estimates for each age studied. In the prior surveys, respondents provided their top 3 mortality changes impacting their estimates for all ages studied for a population.

Similar to the driver scores in Tables 3a, 3b, and 3c, a mortality change with a response of rank 1 received a score of 3; a mortality change with a response of rank 2 received a score of 2; and a mortality change with a response of rank 3 received a score of 1. Comparing the total scores for each mortality change, we were able to identify the top 3 mortality changes for each population and projection year, which are shown in Tables 4a through 4d.

For age 25 (Table 4a), the U.S. general population's top mortality change was mortality deterioration from drug overdoses for all years studied. Mortality deterioration from accidents excluding drug overdoses was the second ranked mortality change for 2024 and 2025. Suicide mortality deterioration was the third ranked mortality change for the early years but was the second ranked mortality change for 2030 and 2035. For these later years, mortality improvement from drug overdoses and cancer rounded out the top 3 mortality changes.

For the life insured population at this age, mortality deterioration from drug overdoses and accidents excluding drug overdoses were the top 2 mortality changes in each projection year. In 2030 drug overdose and suicide mortality improvement as well as cancer mortality deterioration joined the top ranks. Other mental conditions mortality deterioration also was among the leaders in 2024 and 2035.

Similar to the other populations, mortality from drug overdoses was a top mortality change for all years for the private and public pension plan population.

Table 4a

RESPONDENTS' TOP 3 MORTALITY CHANGES DRIVING ALL-CAUSE EXCESS MORTALITY ESTIMATES WITHOUT COVID-19 AS A CAUSE OF DEATH BY YEAR FOR AGE 25 (SURVEY 3)

Change in Mortality	2024 Top 3 Age 25	2025 Top 3 Age 25	2030 Top 3 Age 25	2035 Top 3 Age 25
General Population				
Cancer Mortality Improvement				3
Other Mental Conditions Mortality Deterioration	3			
Accidents Excluding Drug Overdoses Mortality Deterioration	2	2		
Drug Overdoses Mortality Improvement			3	
Drug Overdoses Mortality Deterioration	1	1	1	1
Suicide Mortality Deterioration	3	3	2	2
Life Insurance Industry Insured Population				
Cancer Mortality Deterioration			3	3
Other Mental Conditions Mortality Deterioration	3			3
Accidents Excluding Drug Overdoses Mortality Improvement				3
Accidents Excluding Drug Overdoses Mortality Deterioration	1	1	1	1
Drug Overdoses Mortality Improvement			2	3
Drug Overdoses Mortality Deterioration	2	2	1	1
Suicide Mortality Improvement			3	2
Other: Combined Mortality Deterioration From Accidents, Drug Overdoses, and Suicides		3	2	2
Private and Public Pension Plan Population				
Flu/Pneumonia/Other Respiratory Mortality Deterioration			3	3
Other Mental Conditions Mortality Improvement			3	3
Other Mental Conditions Mortality Deterioration	2	2		
Accidents Excluding Drug Overdoses Mortality Deterioration	3			
Drug Overdoses Mortality Improvement			1	1
Drug Overdoses Mortality Deterioration	1	1	2	2
Suicide Mortality Deterioration	3	3	2	2

In examining Table 4b for the U.S. general population, age 45, there is more variability in the responses. Similar to age 25, mortality deterioration from drug overdoses appears in the top 3 influential mortality changes for all years studied. It is either ranked first or second over the study period. Mortality changes from cardiovascular disorders also appears in the top 3 mortality changes but, for 2024 and 2030, there is not agreement among the respondents in the direction of the mortality change. For these years, both mortality improvement and mortality deterioration are in the top 3.

For the life insured population, diabetes and other metabolic disorders, cardiovascular disorders, and cancer mortality deterioration are in the top 3 for all years. Drug overdoses mortality deterioration is the top mortality change in 2024 and 2025 but is replaced in 2030 and 2035 by drug overdoses mortality improvement.

The private and public pension plan population also has many of the same top mortality changes as the other populations. A top mortality change for this age in all years studied that is unique to this population is flu/pneumonia/other respiratory mortality deterioration.

Table 4b

RESPONDENTS' TOP 3 MORTALITY CHANGES DRIVING ALL-CAUSE EXCESS MORTALITY ESTIMATES WITHOUT COVID-19 AS A CAUSE OF DEATH BY YEAR FOR AGE 45 (SURVEY 3)

Change in Mortality	2024 Top 3 Age 45	2025 Top 3 Age 45	2030 Top 3 Age 45	2035 Top 3 Age 45
General Population				
Cardiovascular Disorders Mortality Improvement	3		2	3
Cardiovascular Disorders Mortality Deterioration	2	2	2	
Cancer Mortality Improvement		3	1	1
Drug Overdoses Mortality Deterioration	1	2	1	2
Diabetes and Other Metabolic Disorders Mortality Deterioration	3	3	2	
Life Insurance Industry Insured Population				
Cardiovascular Disorders Mortality Deterioration	3	3	3	3
Cancer Mortality Deterioration	2	2	1	1
Drug Overdoses Mortality Improvement			2	2
Drug Overdoses Mortality Deterioration	1	1		
Diabetes and Other Metabolic Disorders Mortality Deterioration	2	3	1	1
Private and Public Pension Plan Population				
Cardiovascular Disorders Mortality Improvement			2	2
Cardiovascular Disorders Mortality Deterioration	1	1	3	3
Cancer Mortality Deterioration		3	2	2
Other Mental Conditions Mortality Improvement			2	2
Diabetes and Other Metabolic Disorders Mortality Improvement			3	3
Diabetes and Other Metabolic Disorders Mortality Deterioration		3		
Flu/Pneumonia/Other Respiratory Mortality Deterioration	3	2	1	1
Accidents Excluding Drug Overdoses Mortality Improvement			3	3
Drug Overdoses Mortality Improvement			2	2
Drug Overdoses Mortality Deterioration	2	1	3	3
Suicide Mortality Deterioration			2	2

For age 65 (Table 4c) for the U.S. general population, cancer mortality improvement is the top mortality change driving the mortality estimates without COVID-19 in all projection years. Cardiovascular disorders mortality improvement is number two for all the years studied. However, cardiovascular disorders mortality deterioration is also in the top 3 for these years.

For the life insurance population, respondents selected cardiovascular disorders and diabetes and other metabolic disorders mortality deterioration in the upper ranks for all projection years. Unlike the general population, Alzheimer's and other dementias mortality deterioration was also included in the top list and increased in rank as the projection year increased. Also, cardiovascular disorder mortality improvement was not much of a factor, although it did appear in the top 3 in projection year 2030. As expected for this age, cancer mortality was a factor in respondents' estimates beginning in 2025, but there was no consensus in the direction of the mortality change.

Similarly, cancer and cardiovascular mortality both improvement and deterioration drove the excess mortality estimates without COVID-19 in all projection years for the private and public pension plan

population. Flu/pneumonia/other respiratory mortality deterioration was also a factor for the 2030 and 2035 estimates.

Table 4c

RESPONDENTS' TOP 3 MORTALITY CHANGES DRIVING ALL-CAUSE EXCESS MORTALITY ESTIMATES WITHOUT COVID-19 AS A CAUSE OF DEATH BY YEAR FOR AGE 65 (SURVEY 3)

Change in Mortality	2024 Top 3 Age 65	2025 Top 3 Age 65	2030 Top 3 Age 65	2035 Top 3 Age 65
General Population				
Cardiovascular Disorders Mortality Improvement	2	2	2	2
Cardiovascular Disorders Mortality Deterioration	1	1	3	3
Cancer Mortality Improvement	1	1	1	1
Cancer Mortality Deterioration	3			
Accidents Excluding Drug Overdoses				
Drug Overdoses Mortality Deterioration				
Diabetes and Other Metabolic Disorders Mortality Deterioration	2	3		
Life Insurance Industry Insured Population				
Cardiovascular Disorders Mortality Improvement			3	
Cardiovascular Disorders Mortality Deterioration	2	1	1	1
Cancer Mortality Improvement		3	2	3
Cancer Mortality Deterioration		3	2	3
Alzheimer's and Other Dementias Mortality Deterioration	3	2	1	1
Diabetes and Other Metabolic Disorders Mortality Deterioration	1	2	1	2
Private and Public Pension Plan Population				
Cardiovascular Disorders Mortality Improvement	2	2	1	1
Cardiovascular Disorders Mortality Deterioration	1	1	3	3
Cancer Mortality Improvement			2	2
Cancer Mortality Deterioration	3	3		
Flu/Pneumonia/Other Respiratory Mortality Deterioration			3	3

For age 85 (Table 4d), the top causes of death driving the all-cause excess mortality estimates are generally consistent among the three populations. They are Alzheimer's and other dementias, cardiovascular disorders, cancer, and diabetes/other metabolic disorders. Additionally, at this age, Alzheimer's and other dementias mortality deterioration jumps to the top mortality change for most projection years. For the private and public pension plan population, cardiovascular disorders mortality improvement is the leading mortality change influencing the estimates.

Table 4d

RESPONDENTS' TOP 3 MORTALITY CHANGES DRIVING ALL-CAUSE EXCESS MORTALITY ESTIMATES WITHOUT COVID-19 AS A CAUSE OF DEATH BY YEAR FOR AGE 85 (SURVEY 3)

Change in Mortality	2024 Top 3 Age 85	2025 Top 3 Age 85	2030 Top 3 Age 85	2035 Top 3 Age 85
General Population				
Cardiovascular Disorders Mortality Improvement	3	2	2	1
Cardiovascular Disorders Mortality Deterioration	1	1	3	
Cancer Mortality Improvement	2	2	2	3
Cancer Mortality Deterioration				
Alzheimer's and Other Dementias Mortality Deterioration	1	1	1	2
Diabetes and Other Metabolic Disorders Mortality Deterioration		3		
Life Insurance Industry Insured Population				
Cardiovascular Disorders Mortality Deterioration	2	2	2	2
Cancer Mortality Improvement	3			
Cancer Mortality Deterioration				
Alzheimer's and Other Dementias Mortality Deterioration	1	1	1	1
Diabetes and Other Metabolic Disorders Mortality Deterioration	3	3	3	3
Private and Public Pension Plan Population				
Cardiovascular Disorders Mortality Improvement	1	1	1	1
Cardiovascular Disorders Mortality Deterioration	2	2		
Cancer Mortality Improvement			2	2
Cancer Mortality Deterioration	3	3		
Alzheimer's and Other Dementias Mortality Improvement			3	3

A comparison of current results to results from the prior two surveys is not provided. Although participants provided their thoughts on the causes of death that were driving their excess mortality estimates without COVID-19 in the past surveys, they did not provide the information by age.

2.2.4 ACTUARIAL EXCESS MORTALITY ESTIMATES COMPARED TO NONACTUARIES' ESTIMATES

Table 5 shows, for the current and prior surveys, the average future excess mortality estimates with COVID-19 split by practitioner type. Only the U.S. general population is included in the analysis. Other populations are excluded from the analysis due to poor response rates.

Other practitioner types of average excess mortality estimates are higher than that of actuaries in projection years 2024 and 2025 with the greatest differences occurring at the younger ages. At age 25, the differences in the estimates were 4-7% higher than the actuarial estimates. The magnitude of the difference narrowed as the ages increased. For years 2030 and 2035, the average estimates for all ages were very consistent between the responding actuaries and non-actuaries.

Table 5

AVERAGE ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH COVID-19 SPLIT BY PRACTITIONER TYPE FOR U.S. GENERAL POPULATIONS (SURVEY 3/SURVEY 2/SURVEY 1)

U.S. Population (No. of Responses)	Current Age	2022 (%)	2023 (%)	2024 (%)	2025 (%)	2030 (%)	2035 (%)
	Total Respondents						
General (*N* = 24/39/56)	25	NA/17/14	NA/13/9	10/NA/NA	8/9/6	4/6/2	2/NA/NA
	45	NA/17/13	NA/13/9	9/NA/NA	6/9/5	3/6/2	1/NA/NA
	65	NA/14/10	NA/10/7	6/NA/NA	5/6/5	2/4/2	0/NA/NA
	85	NA/11/10	NA/8/4	5/NA/NA	4/7/2	1/3/0	0/NA/NA
	Actuaries Only						
General (*N* = 18/27/45)	25	NA/17/13	NA/13/9	9/NA/NA	7/8/5	4/4/1	3/NA/NA
	45	NA/17/13	NA/12/8	8/NA/NA	6/6/4	3/3/1	1/NA/NA
	65	NA/13/10	NA/9/5	6/NA/NA	4/4/3	2/2/0	0/NA/NA
	85	NA/11/9	NA/7/5	5/NA/NA	3/4/2	2/1/–1	1/NA/NA
	Other Practitioner Types Only						
General (*N* = 6/12/11)	25	NA/16/15	NA/15/13	16/NA/NA	11/11/9	5/8/6	2/NA/NA
	45	NA/17/15	NA/15/14	12/NA/NA	8/12/9	3/11/7	1/NA/NA
	65	NA/15/12	NA/13/15	9/NA/NA	6/10/13	3/10/11	0/NA/NA
	85	NA/13/12	NA/11/10	7/NA/NA	4/13/7	1/5/6	-1/NA/NA

There is a difference in the perspectives on the drivers for the actuarial estimates. For actuaries, the top 3 drivers in rank order are higher immunity, increased treatment access and less healthy population than pre-pandemic for years 2024 and 2025. For these years, non-actuaries agreed that higher immunity was the top driver but indicated lower virulence to current and future COVID-19 strains and unhealthier behavior as their second and third place drivers. By 2035, both groups had higher immunity and increased access to treatment in their top ranks, but actuaries included lower virulence as a top driver compared to unhealthier behavior for non-actuaries.

2.2.5 CURRENT AGE GROUPS TO MONITOR

A new question for this iteration of the survey gathered opinions about the top 3 current age groups that should be tracked over time and monitored in future mortality analysis as a result of the COVID-19 pandemic. There were ten age groups considered by the participants. A score was assigned to each response. An age group with a response of rank 1 received a score of 3; an age group with a response of rank 2 received a score of 2; and an age group with a response of rank 3 received a score of 1. Comparing the total scores for each age group, the top 3 age groupings among all the respondents for each population were identified and are the bold numbers in Table 6. The youngest age group among the top groupings for both the general and life insurance industry insured populations is the 36-45 age group. The number of

responses is much lower for the annuity population and is excluded from the analysis. More details can be found in Appendix A.

Table 6

CURRENT AGE GROUPINGS TO MONITOR IN FUTURE MORTALITY ANALYSIS AS A RESULT OF COVID-19 WEIGHTED SCORES BY POPULATION

Age Grouping	General Population	Life Insurance Industry Insured Population	Private and Public Pension Plan Population
0-15	5	0	0
16-25	11	3	1
26-35	14	3	0
36-45	**19**	**13**	0
46-55	12	**8**	1
56-65	14	4	4
66-75	**20**	**6**	**14**
76-85	**21**	4	**16**
86-95	16	4	**6**
95+	0	0	0

Due to a low number of responses, the annuity population is excluded from the analysis

Section 3: Conclusion

Overall, the takeaway from this study is that, on average, respondents expect excess mortality for the U.S. general and life insurance populations to continue into 2035, especially at the younger ages driven by non-COVID-19 causes such as accidents, drug overdoses, and suicides. Prolonged excess mortality for the U.S. general population has also been suggested by other studies.[4]

Unlike the other populations, the private and pension plan population participants anticipate mortality for most ages to return to expected levels by 2035. Given uncertainty remains about the long-term impact of the COVID-19 pandemic, more research on post pandemic future mortality is being planned. Please email your ideas for future research on this topic to Research-ML@soa.org.

[4] Meier, Daniel, Patkee, Prachi, and Strange, Adam, The Future of Excess Mortality After COVID-19. Swiss Re Institute, September 2024. https://www.swissre.com/institute/research/topics-and-risk-dialogues/health-and-longevity/covid-19-pandemic-synonymous-excess-mortality.html

Section 4: List of Survey Participants

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Aaron Rosenberg*

Max Rudolph

Scott Rushing

Mark Spong

Justin Struby

William M. Tilford*

Kerry Worgan

There were five additional participants from the expert panel who responded to section 1 of the survey but did not provide excess mortality estimates in section 2, so they were dropped from the study.

*Participant is not an actuary.

Section 5: Acknowledgments

The author's deepest gratitude goes to those without whose efforts this project could not have come to fruition: the volunteers who generously shared their wisdom, insights, advice, guidance and arm's-length review of this study prior to publication. Any opinions expressed may not reflect their opinions nor those of their employers. Any errors belong to the author alone.

The 29 mortality expert panel members who provided responses to the survey.

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Appendix A: Survey and Responses

Impact of COVID-19 and Other Causes of Death on Future U.S. Mortality Survey 3

Introduction

Since the start of the pandemic, great strides have been made in understanding how COVID-19 has impacted mortality with additional data becoming available for assessing recent mortality outcomes. Yet, uncertainty remains about future mortality given the nature of the virus to mutate, public response to COVID-19 mitigation methods, the potential for medical advances to prevent or treat COVID-19, the emergence of unexpected mortality trends at younger ages and other factors. This Society of Actuaries Research Institute study seeks your opinions and insights on the impact of COVID-19 and other causes of death on future mortality for four populations:

1. U.S. General Population
2. U.S. Life Insurance Industry Insured Population
3. U.S. Annuity Industry Annuitant Population
4. U.S. Private and Public Pension Plan Population

The survey is composed of two sections in which several future time periods are explored. You will respond to questions for those populations you choose based on your areas of mortality knowledge.

As you complete the two sections of the survey (Demographics and Future Changes in U.S. All-Cause Mortality), keep in mind that you cannot use the "back" button in your browser to review prior answers. Use the "GO BACK" button at the bottom of each page to navigate back to already answered questions. Upon completion of the survey, you will be provided a printable report of your survey responses. If you are having challenges entering information in the survey, please clear the browsing history as it may resolve the issue. **Please respond no later than September 13, 2024.**

A copy of the survey questions can be found here. It may be helpful to print the questions and use as a reference as you go through the online survey especially for Section 2.

Responses will be kept anonymous, and results will be summarized in a report to be published on the SOA website at www.soa.org.

Your name and email address are requested below to contact you should we have questions about your submission and to send you a copy of the report prior to publication.

Name:

Email Address:

May we list your name as a participant in the summary report to be published on the SOA Research Institute website? Responses will not be identifiable by individual participant name or company in the report. _____YES _____NO

Section 1: Demographics

1-1. Practitioner Type (Please select all that apply.): **(Number responding)**

- Academic **(2)**
- Actuary **(18)**
- Data Scientist **(0)**
- Demographer **(2)**
- Epidemiologist **(1)**
- Medical professional **(4)**
- Regulator **(1)**
- Researcher **(3)**
- Retirement professional **(1)**
- Risk manager **(1)**
- Underwriter **(1)**
- Other **(1) Freelance writer**

1-2. Number of years of experience (Please select one.): **(Number Responding)**

- 1-4 **(0)**
- 5-9 **(1)**
- 10-14 **(4)**
- 15-19 **(3)**
- 20-24 **(0)**
- 25+ **(16)**

1-3. Employer type (Please select the primary one.): **(Number Responding)**

- Academic/Research Institution **(2)**
- Bank/Investment Management/Financial Services Company **(0)**
- Consulting **(7)**
- Insurer **(3)**
- Government Agency **(2)**
- Pension Plan **(1)**
- Rating Agency **(0)**
- Reinsurer **(5)**
- Self Employed **(2)**
- Retired **(0)**
- Other **(2) Longevity Analytics Company; Reinsurance Broker**

1-4. Did you participate in the February 2023 survey? 17 YES 7 NO

1-5. Area of Mortality Knowledge (Please select all that apply). Questions received are based on your selection. **(Number responding)**

- U.S. General Population Mortality **(If selected, respond to Section 2, question 1.) (20)**
- U.S. Life Insurance Industry Insured Population Mortality **(If selected, respond to Section 2, questions 1 and 2.) (10)**
- U.S. Annuity Industry Annuitant Population Mortality **(If selected, respond to Section 2, questions 1 and 3.) (3)**
- U.S. Private and Public Pension Plan Population Mortality **(If selected, respond to Section 2, questions 1 and 4.) (7)**
- None of the above **– (If selected, thank you for participating. Please submit your response.)**

Section 2: Future Changes in U.S. All-Cause Mortality

In this section we are interested in understanding your thoughts on future changes in all-cause mortality for each of four populations: U.S. General Population, U.S. Life Insurance Industry Insured Population, U.S. Annuity Industry Annuitant Population, and U.S. Private and Public Pension Plan Population.

Excess mortality, including deaths that are directly or indirectly attributed to COVID-19 for a specific period, over pre-pandemic expectations will be explored for four future time periods.

Using historical information and your knowledge of COVID-19 and other recent mortality trends and their impact on mortality, please provide your thoughts on how much total excess mortality there will be in future years. Total excess mortality estimates with and without COVID-19 as a cause of death for four time periods, 2024, 2025, 2030, and 2035 and four ages: 25, 45, 65, and 85 are requested.

In responding to the questions in this section, please assume 2019 mortality levels for each age as the starting point for your expected mortality calculation and adjust as necessary to trend forward to the appropriate projection period. Do not consider direct or indirect COVID-19 in the calculation. For example, if examining historical information to establish trend assumptions such as mortality improvement, demographic changes in the population or other factors to apply to the 2019 mortality levels to produce expected levels, use 2019 or earlier data. Projected mortality with and without COVID-19 will be compared to the same estimated expected level to determine mortality excess.

In addition to the excess mortality estimates, you will be asked for your thoughts on what is driving your responses.

Your responses will help us understand your thoughts on Covid-19 and other causes of death and their impact on future mortality.

All participants will receive U.S. General Population Mortality questions.

Historical Information and Sample Excess Mortality Calculations are provided in Appendix B It will be helpful to print the data and excess mortality calculations to use as a reference as you go through Section 2.

2-1. U.S. GENERAL POPULATION MORTALITY

The following questions relate to **U.S. General Population** mortality. Historical information

2-1.1 Assuming 2019 mortality levels trended forward with mortality improvement or deterioration for future expected mortality, as described above, please indicate the total level of excess mortality you expect from all causes **including COVID-19 deaths** for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond:

From the **U.S. General Population excess mortality example provided in Table 3 of Appendix B** for age 25-34, the level of excess in 2022 in relation to 2022 expected mortality levels, is 23% (first row of Table 3, Column I).

- If you believe the level of excess mortality for age 25 will remain at the same level for 2024 as the U.S. General Population 25-34 historical information for 2022, code the 23% level as ".23".
- If you believe the excess mortality for age 25 will be reduced, e.g., to a level of 15% excess mortality, code ".15".
- If you believe that excess mortality for age 25 will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

Please use the "Tab" button on your keyboard to advance from cell to cell.

U.S. GENERAL POPULATION (N=24)

AGGREGATION OF RESPONSES FOR ALL CAUSE EXCESS MORTALITY WITH COVID-19 U.S. GENERAL POPULATION[5]

Current Age		Total Excess Mortality with COVID-19 Estimates			
		2024	2025	2030	2035
25	Average	0.10	0.08	0.04	0.02
	Median	0.09	0.05	0.01	0.00
	25th percentile	0.05	0.03	0.00	0.00
	75th percentile	0.16	0.13	0.06	0.03
	Min	0.00	0.00	-0.05	-0.06
	Max	0.25	0.27	0.30	0.25
	No. of responses	23	23	24	24
45	Average	0.09	0.06	0.03	0.01
	Median	0.08	0.05	0.01	0.00
	25th percentile	0.05	0.02	0.00	0.00
	75th percentile	0.12	0.09	0.05	0.01
	Min	-0.01	-0.04	-0.08	-0.12
	Max	0.19	0.20	0.18	0.16
	No. of responses	23	23	24	24
65	Average	0.06	0.05	0.02	0.00
	Median	0.05	0.02	0.00	0.00
	25th percentile	0.03	0.01	0.00	-0.02
	75th percentile	0.10	0.07	0.04	0.01
	Min	-0.02	-0.03	-0.08	-0.12
	Max	0.16	0.15	0.12	0.12
	No. of responses	23	23	24	24
85	Average	0.05	0.04	0.01	0.00
	Median	0.05	0.02	0.00	0.00
	25th percentile	0.02	0.01	0.00	-0.02
	75th percentile	0.08	0.06	0.03	0.01
	Min	-0.04	-0.05	-0.07	-0.10
	Max	0.13	0.12	0.11	0.10
	No. of responses	23	23	24	24

[5] Although both median and mean are calculated, in surveys the median is typically used for analytics to lower the weight of any outliers.

2-1.2 What are the top 3 COVID-19 drivers, for each year listed, influencing your future total excess mortality **including COVID-19 Deaths** estimates? "1" is the most influential COVID-19 driver.

Driver	Ranking	2024	2025	2030	2035
Healthy Behavior	1	0	0	2	2
	2	2	2	3	2
	3	1	1	0	0
	TS	5	5	12	10
Unhealthy Behavior	1	1	1	3	3
	2	3	2	2	2
	3	3	3	1	1
	TS	12	10	14	14
Implementation or Changes to Government programs/policies	1	0	0	0	0
	2	0	0	0	1
	3	0	0	1	0
	TS	0	0	1	2
Increase in socioeconomic difference	1	0	0	1	0
	2	1	2	2	3
	3	1	0	0	1
	TS	3	4	7	7
Reduction in socioeconomic difference	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	TS	0	0	0	0
Treatment Access-Increased Access to current or future new COVID-19 medical treatments	1	4	4	4	4
	2	4	4	3	4
	3	3	3	3	2
	TS	23	23	21	22
Treatment Access-Decreased Access to current or future new COVID-19 medical treatments	1	0	0	0	0
	2	0	0	0	0
	3	1	1	1	1
	TS	1	1	1	1
Population Health Status - Healthier population than pre-pandemic as older, less healthy individuals die from COVID-19	1	2	1	2	2
	2	3	3	1	1
	3	2	4	7	6
	TS	14	13	15	14
Population Health Status - Less healthy population than pre-pandemic as older, less healthy individuals die from COVID-19	1	5	5	3	3
	2	0	1	3	2
	3	4	4	1	2
	TS	19	21	16	15
Immunity – Higher immunity due to vaccination, infection/reinfection	1	9	10	7	7
	2	3	3	4	3
	3	3	2	4	4
	TS	36	38	33	31

Driver	Ranking	2024	2025	2030	2035
Immunity – Lower immunity due to vaccination, infection/reinfection	1	0	0	0	0
	2	1	1	0	0
	3	1	1	0	0
	TS	3	3	0	0
Virulence – Higher virulence of current or future COVID-19 strains/variants	1	1	1	0	1
	2	2	2	0	0
	3	0	0	0	0
	TS	7	7	0	3
Virulence – Lower virulence of current or future COVID-19 strains/variants	1	2	1	1	1
	2	4	4	5	5
	3	3	3	3	3
	TS	17	14	16	16
Other 1: Social Distancing	1	0	0	0	0
	2	0	0	0	0
	3	1	1	1	1
	TS	1	1	1	1
Other 2: Medical Progress	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	1
	TS	0	0	0	1

2-1.3 Assuming 2019 mortality levels trended forward with mortality improvement or deterioration for future expected mortality, as described above, please indicate the level of excess mortality from all causes except those deaths directly attributed to COVID-19 that you expect for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond:

From the U.S. General Population excess mortality example provided in Table 4 of Appendix B for age 25-34, the level of excess for non-COVID-19 causes of deaths in 2022 in relation to 2022 expected mortality levels, is 20% (first row of Table 4, Column I).

- If you believe the level of excess mortality for age 25 will remain at the same level for 2024, as the U.S. General Population 25-34 historical information for 2022, code the 20% level as ".20".
- If you believe the excess mortality will be reduced, e.g., to a level of 15% excess mortality, code ".15".
- If you believe that excess mortality will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

U.S. General Population (N=24)

AGGREGATION OF RESPONSES FOR ALL CAUSE EXCESS MORTALITY WITHOUT COVID-19 U.S. GENERAL POPULATION

Current Age		Excess Mortality (Without Deaths Directly Attributable To COVID-19) Estimates			
		2024	2025	2030	2035
25	Average	0.09	0.07	0.04	0.03
	Median	0.07	0.06	0.03	0.01
	25th percentile	0.04	0.03	0.00	0.00
	75th percentile	0.13	0.10	0.06	0.05
	Min	0.00	0.00	-0.04	-0.08
	Max	0.24	0.26	0.29	0.24
	No. of responses	23	23	24	24
45	Average	0.06	0.04	0.02	0.01
	Median	0.05	0.04	0.02	0.00
	25th percentile	0.03	0.01	0.00	0.00
	75th percentile	0.09	0.06	0.05	0.02
	Min	-0.03	-0.06	-0.08	-0.12
	Max	0.14	0.16	0.13	0.10
	No. of responses	23	23	24	24
65	Average	0.03	0.02	0.01	0.00
	Median	0.03	0.02	0.00	0.00
	25th percentile	0.00	0.00	0.00	-0.01
	75th percentile	0.05	0.04	0.02	0.00
	Min	-0.04	-0.05	-0.07	-0.12
	Max	0.10	0.09	0.08	0.07

Current Age		Excess Mortality (Without Deaths Directly Attributable To COVID-19) Estimates			
		2024	2025	2030	2035
	No. of responses	23	23	24	24
85	Average	0.02	0.02	0.00	-0.01
	Median	0.01	0.01	0.00	0.00
	25th percentile	0.00	0.00	0.00	-0.01
	75th percentile	0.05	0.04	0.00	0.00
	Min	-0.06	-0.07	-0.07	-0.10
	Max	0.09	0.09	0.09	0.08
	No. of responses	23	23	24	24

2-1.4.a What are the top 3 changes in future causes of death mortality **for age 25**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 25									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	0	0	0	0	0	0	0	0
	2	1	0	1	0	2	0	3	0
	3	2	2	2	2	2	1	1	1
	TS	4	2	4	2	6	1	7	1
Cancer	1	2	0	2	0	3	0	4	0
	2	1	1	1	2	0	0	1	0
	3	0	2	0	1	0	1	0	1
	TS	8	4	8	5	9	1	**14**	1
Flu/Pneumonia/Other Respiratory	1	1	0	1	0	0	0	0	0
	2	1	0	1	0	2	0	1	0
	3	0	0	0	0	0	0	1	0
	TS	5	0	5	0	4	0	3	0
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other Mental Conditions	1	0	1	0	0	0	0	0	0
	2	0	2	0	2	1	1	1	2
	3	0	4	0	4	0	4	0	3
	TS	0	**11**	0	8	2	6	2	7
Accidents Excluding Drug Overdoses	1	1	2	1	2	2	0	2	0
	2	2	3	2	1	1	2	1	1
	3	2	4	2	5	3	3	3	5
	TS	9	**16**	9	**13**	11	7	11	7
Drug Overdoses	1	1	14	1	13	4	10	4	11
	2	0	2	0	2	0	3	0	1
	3	1	0	1	0	0	1	0	2
	TS	4	**46**	4	**43**	**12**	**37**	12	**37**
Suicides	1	0	0	0	0	0	1	0	1
	2	3	4	3	4	2	4	2	5
	3	0	3	0	2	1	3	0	2
	TS	6	**11**	6	**10**	5	**14**	4	**15**
Diabetes and Other Metabolic Disorders	1	0	0	0	0	0	0	0	0
	2	1	1	1	1	1	1	1	1
	3	0	0	0	0	0	0	0	0
	TS	2	2	2	2	2	2	2	2

Age 25									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	1	0	0
	3	1	0	1	0	1	0	1	0
	TS	1	0	1	0	1	2	1	0
Other 1: War/Conflict-Deterioration	1	0	0	0	1	0	1	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	3	0	3	0	0
Other 2: Combined Non-medical	1	0	1	0	1	0	1	0	1
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	3	0	3	0	3	0	3

2-1.4.b What are the top 3 changes in future causes of death mortality **for age 45**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 45									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	0	3	0	3	2	0	3	0
	2	1	4	1	4	2	6	2	6
	3	2	2	1	1	2	0	1	0
	TS	4	**19**	3	**18**	**12**	**12**	**14**	12
Cancer	1	3	2	3	1	5	1	6	1
	2	1	3	1	3	2	1	2	0
	3	1	2	1	2	1	2	2	2
	TS	12	**14**	**12**	11	**20**	7	**24**	5
Flu/Pneumonia/Other Respiratory	1	1	0	1	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	1	1	1	1	1	1	1
	TS	4	1	4	1	1	1	1	1
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other Mental Conditions	1	0	2	0	1	0	1	0	1
	2	0	1	0	1	0	1	0	1
	3	0	2	0	2	0	2	0	2
	TS	0	10	0	7	0	7	0	7
Accidents Excluding Drug Overdoses	1	0	0	0	0	1	0	1	0
	2	1	4	1	2	0	1	1	1
	3	1	1	1	2	2	0	2	0
	TS	3	9	3	6	5	2	7	2
Drug Overdoses	1	1	7	2	7	2	5	1	5
	2	1	1	1	1	1	2	0	2
	3	1	1	0	1	0	1	1	1
	TS	6	**24**	8	**24**	8	**20**	4	**20**
Suicides	1	0	1	0	0	0	1	0	1
	2	2	0	2	1	2	0	2	0
	3	0	0	0	0	0	0	0	0
	TS	4	3	4	2	4	3	4	3
Diabetes and Other Metabolic Disorders	1	0	2	0	2	0	2	0	2
	2	0	3	0	2	1	2	1	2
	3	1	2	1	2	1	2	1	2
	TS	1	**14**	1	**12**	3	**12**	3	12

Age 45									
Gastrointestinal and Liver Disease	1	0	1	0	1	0	1	0	1
	2	0	0	0	0	0	0	0	1
	3	1	2	2	2	3	1	3	0
	TS	1	5	2	5	3	4	3	5
Other 1: Obesity Drugs	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	1	0	1	0
	TS	0	0	0	0	1	0	1	0

2-1.4.c What are the top 3 changes in future causes of death mortality **for age 65**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 65									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	3	7	3	7	4	3	4	3
	2	5	0	5	0	6	3	6	3
	3	1	0	1	0	0	1	1	0
	TS	**20**	**21**	**20**	**21**	**24**	**16**	**25**	**15**
Cancer	1	4	1	4	1	7	2	8	2
	2	4	4	4	3	4	0	4	0
	3	1	1	1	1	1	0	1	0
	TS	**21**	12	**21**	10	**30**	6	**33**	6
Flu/Pneumonia/Other Respiratory	1	1	0	1	0	0	0	0	0
	2	1	1	1	1	1	0	1	0
	3	2	4	2	4	3	4	3	4
	TS	7	6	7	6	5	4	5	4
Alzheimer's and Other Dementias	1	0	1	0	1	0	1	0	1
	2	0	1	0	1	0	1	1	1
	3	0	2	0	2	1	2	1	2
	TS	0	7	0	7	1	7	3	7
Other Mental Conditions	1	0	0	0	0	0	1	0	1
	2	0	1	0	1	0	0	0	0
	3	0	1	0	0	0	0	0	0
	TS	0	3	0	2	0	3	0	3
Accidents Excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	1	0	0	0
	3	1	0	1	0	0	0	0	0
	TS	1	0	1	0	2	0	0	0
Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	2	0	1	0	0	0	0	0
	3	0	1	0	1	0	1	0	1
	TS	4	1	2	1	0	1	0	1
Suicides	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	2	0	2	0	1	0	1
	TS	1	2	0	2	0	1	0	1
Diabetes and Other Metabolic Disorders	1	0	5	0	3	0	2	0	2
	2	1	1	1	1	1	2	2	2
	3	1	3	1	3	1	3	1	3
	TS	3	**20**	3	**14**	3	13	5	13

Age 65									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	1	0	1	0	1	0	1
	3	0	0	0	0	0	0	0	0
	TS	0	2	0	2	0	2	0	2
Other 1: Medical Progress	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	1	0	1	0
	TS	0	0	0	0	1	0	1	0

2-1.4.d What are the top 3 changes in future causes of death mortality **for age 85**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 85									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	2	5	2	5	4	3	4	3
	2	5	3	5	3	5	1	6	1
	3	1	1	0	1	0	3	0	3
	TS	17	**22**	**16**	**22**	**22**	**14**	**24**	14
Cancer	1	3	1	2	1	4	1	3	1
	2	3	1	3	1	4	0	4	0
	3	4	0	4	0	2	0	3	0
	TS	**19**	5	**16**	5	**22**	3	**20**	3
Flu/Pneumonia/Other Respiratory	1	2	1	2	1	0	0	0	0
	2	2	1	2	1	3	2	2	2
	3	2	1	2	1	3	1	3	1
	TS	12	6	12	6	9	5	7	5
Alzheimer's and Other Dementias	1	1	6	1	6	2	6	3	6
	2	1	1	1	1	1	2	1	2
	3	0	2	0	2	2	1	1	1
	TS	5	**22**	5	**22**	10	**23**	12	**23**
Other Mental Conditions	1	0	0	0	0	0	0	0	0
	2	0	1	0	0	0	0	0	0
	3	0	1	0	1	0	2	0	2
	TS	0	3	0	1	0	2	0	2
Accidents Excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	0	0	0	0
	TS	0	1	0	1	0	0	0	0
Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	0	0	0	0	0	0	0
	TS	1	0	0	0	0	0	0	0
Suicides	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Diabetes and Other Metabolic Disorders	1	0	2	0	2	0	2	0	2
	2	1	1	1	1	0	1	0	1
	3	1	5	1	5	3	2	3	2
	TS	3	13	3	13	3	10	3	10

Age 85									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	1	0	1	0	1	0	1
	3	0	0	0	0	0	0	0	0
	TS	0	2	0	2	0	2	0	2
Other 1: Multi-system Disease Frailty	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	0	1	0	1
	TS	0	1	0	1	0	1	0	1

2-1.5 Additional comments about future excess mortality or future mortality in the U.S. general population:

1. Future strains of the COVID-19 virus will have to be monitored closely. Also, it will be interesting to see the long-term impacts of the experimental mRNA on humans.
2. I worry about conflict/war that impacts the young. This could be internal to US or external.
3. First, wanted to make a point that we really struggled with question 2.1.2. It should probably vary by age, but the question does not. The question asks for all deaths, so it forces us to focus on the older ages (since that dominates the death count) instead of addressing how we feel the drivers would look quite different for younger versus older ages.
4. Regarding excess mortality, here are a few additional comments...
   1. The increase in cardiovascular deaths since the start of the pandemic is very troubling in both its persistence and its prevalence across age and sex. If a large share of these is simply miscoded COVID deaths and not a downstream impact from having survived COVID, that would likely be a good thing, but there is no way to know.
   2. There is added complexity in the post-COVID health status of older people who survived infection: They dramatically improved their chances of surviving subsequent infections of COVID, but will this ostensibly healthier cohort stay that way for long if the secondary effects of infection creates extra risk that would not have existed otherwise?
   3. Recent data gives reason for optimism for younger and middle ages, with external causes of death falling significantly for the younger group and cancer improvement (in particular) remaining strong in middle ages.
   4. GLP-1 RA drugs bring new optimism for improvements in CVD deaths, albeit there are several headwinds for this cause of death too.
   5. Multi-cancer early detection tests, new treatments (chemo, nanoparticles, biologics, mRNA vaccines etc.), personalized cancer medicine, and technological advances (including AI) all bode very well for improvements in cancer mortality – particularly in the middle and older age groups.

   it seems that society tends to overstate trends.....impact of COVID will fade over time until the next unpredictable crisis.
5. Mental health, which is closely related with cancer, cardiovascular outcomes will be a big determinant of future excess mortality. With all the changes brought about by AI, changes in job situation dealing with stress, relationships are all factors impacting mental health which is a comorbidity for a range of diseases.
6. It all comes down to money and the amount of money people have for retirement. The less money people have in their 50s and 60s, it will affect their behavior and access to healthcare. Tracking how well prepared the population is during this crucial pre-retirement period is a leading indicator for mortality mega-trends.

2-1.6 What are the **top 3** current age groups that should be tracked over time and monitored in future mortality analysis as a result of the direct/indirect consequences of the COVID-19 pandemic?

Drag and drop your choices from the list on the left to the box on the right. " 1" is the most important current age group to track over time and monitor in future mortality analysis. If an age group is **not** in your top 3, please do not move it.

Age Grouping	Ranking	No. of Responses
0-15	1	1
	2	1
	3	0
	TS	5
16-25	1	3
	2	1
	3	0
	TS	11
26-35	1	3
	2	2
	3	1
	TS	14
36-45	1	3
	2	3
	3	4
	TS	19
46-55	1	2
	2	1
	3	4
	TS	12
56-65	1	1
	2	4
	3	3
	TS	14
66-75	1	4
	2	2
	3	4
	TS	20
76-85	1	1
	2	7
	3	4
	TS	21
86-95	1	4
	2	1
	3	2

Age Grouping	Ranking	No. of Responses
	TS	16
95+	1	0
	2	0
	3	0
	TS	0

Comments on one or more age groups:

1. All age groups have been impacted
2. I wonder about the group about 20 today that had no high school graduation and civil protests and unrest since then, along with very young/old with isolation/loneliness/social skills. The middle ages deaths of despair should be studied - too many suicides and alcohol related deaths. Mental illness and AI seem a bad combo for this group.
3. It is important to track a range of ages starting with current adolescents who entered their teens during pandemic to analyze the impact of vaccination / infection on their long term health. Are they more susceptible to diseases on entering middle age or can the pandemic be forgotten as a bad dream?
4. This is assuming that drug overdoses are included among the indirect consequences of the pandemic (for age group 36-45 years)
5. The pandemic was especially hard at the oldest ages, so it would make sense to pay close attention to the three oldest age groups. With that in mind, the trends are very different by age. We opted to select three very different age groups to monitor how things will progress.

2-2. U.S. Life Insurance Industry Insured Population Mortality

The following questions relate to **U.S. Life Insurance Industry Insured Population** mortality.

2-2.1 Assuming 2019 mortality levels trended forward such as with mortality improvement or deterioration for future expected mortality, please indicate the total level of excess mortality you expect from all causes **including COVID-19 deaths** for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond (consistent with General Population instructions):

In this example, U.S. individual life insurance industry historical mortality with COVID-19 information is used. From the **U.S. individual life insurance industry historical information provided** for ages <45, the level of excess in 2022 in relation to 2022 expected mortality levels, is .06% (in first row of Table 5, Column K).

- If you believe the U.S. life insurance industry insured population level of excess mortality, for age 25, will remain at the same level for 2024 as the U.S. individual life insurance industry <45 historical information for 2022, code the 6% level as ".06".
- If you believe the excess mortality will be reduced, e.g., to a level of 3% excess mortality, code ".03".
- If you believe that excess mortality will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

Please use the "Tab" button on your keyboard to advance from cell to cell.

U.S. Life Insurance Industry Insured Population (N=8)

AGGREGATION OF RESPONSES FOR ALL-CAUSE EXCESS MORTALITY WITH COVID-19 U.S. LIFE INSURANCE INDUSTRY INSURED POPULATION

Current Age		All Cause Excess Mortality With COVID-19 Estimates			
		2024	2025	2030	2035
25	Average	0.04	0.03	0.02	0.01
	Median	0.04	0.03	0.02	0.01
	25th percentile	0.04	0.03	0.00	0.00
	75th percentile	0.05	0.04	0.02	0.02
	Min	0.03	0.01	0.00	-0.01
	Max	0.05	0.05	0.04	0.03
	No. of responses	8	8	8	8
45	Average	0.05	0.04	0.02	0.01
	Median	0.05	0.04	0.01	0.01
	25th percentile	0.03	0.02	0.00	0.00
	75th percentile	0.06	0.05	0.03	0.02
	Min	0.02	0.00	-0.01	-0.01
	Max	0.07	0.07	0.06	0.06
	No. of responses	8	8	8	8
65	Average	0.06	0.04	0.02	0.02
	Median	0.05	0.04	0.01	0.00
	25th percentile	0.05	0.02	0.00	0.00
	75th percentile	0.06	0.05	0.03	0.03
	Min	0.03	0.02	0.00	-0.01
	Max	0.11	0.10	0.09	0.08
	No. of responses	8	8	8	8
85	Average	0.06	0.04	0.02	0.02
	Median	0.05	0.04	0.01	0.00
	25th percentile	0.05	0.02	0.00	0.00
	75th percentile	0.06	0.05	0.03	0.03
	Min	0.03	0.02	0.00	-0.01
	Max	0.11	0.10	0.09	0.08
	No. of responses	8	8	8	8

2-2.2 What are the top 3 COVID-19 drivers, for each year listed, influencing your future total excess mortality **including COVID-19 Deaths** estimates? "1" is the most influential COVID-19 driver.

Driver	Ranking	2024	2025	2030	2035
Healthy Behavior	1	0	0	1	1
	2	1	1	0	0
	3	1	1	2	2
	TS	3	3	5	5
Unhealthy Behavior	1	0	0	0	0
	2	2	2	1	1
	3	1	1	1	0
	TS	5	5	3	2
Implementation or Changes to Government Programs/Policies	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	1
	TS	0	0	0	1
Increase in Socioeconomic Difference	1	0	0	1	1
	2	0	0	0	0
	3	1	1	1	1
	TS	1	1	4	4
Reduction in Socioeconomic Difference	1	0	0	0	0
	2	1	1	1	1
	3	0	0	0	0
	TS	2	2	2	2
Treatment Access-Increased Access to Current or Future New COVID-19 Medical Treatments	1	1	1	1	1
	2	1	1	1	1
	3	2	2	1	1
	TS	7	7	6	6
Treatment Access-Decreased Access to Current or Future New COVID-19 Medical Treatments	1	0	0	0	0
	2	0	0	0	0
	3	1	1	1	1
	TS	1	1	1	1
Population Health Status - Healthier Population than Pre-pandemic as Older, Less Healthy Individuals Die from COVID-19	1	0	0	0	0
	2	0	0	1	1
	3	1	0	0	0
	TS	1	0	2	2
Population Health Status - Less Healthy Population than Pre-pandemic as Older, Less Healthy Individuals Die from COVID-20	1	2	2	1	1
	2	0	0	0	0
	3	0	0	0	0
	TS	6	6	3	3
Immunity – Higher Immunity due to Vaccination, Infection/Reinfection	1	4	3	3	3
	2	0	0	0	0
	3	0	0	0	0
	TS	12	9	9	9

Driver	Ranking	2024	2025	2030	2035
Immunity – Lower Immunity due to Vaccination, Infection/Reinfection	1	0	0	0	0
	2	0	0	0	0
	3	1	1	1	1
	TS	1	1	1	1
Virulence – Higher Virulence of Current or Future COVID-19 Strains/Variants	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	TS	0	0	0	0
Virulence – Lower Virulence of Current or Future COVID-19 Strains/Variants	1	1	1	0	0
	2	3	2	3	3
	3	0	0	0	0
	TS	9	7	6	6

2-2.3 Assuming 2019 mortality levels trended forward such as with mortality improvement or deterioration for future expected mortality, please indicate the level of excess mortality from all causes except those deaths directly attributed to COVID-19 that you expect for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond (consistent with General Population instructions):

No historical U.S. life insurance industry insured population mortality information is provided. In this example, the U.S. General Population excess mortality example provided in Table 4 for age 25-34, the level of excess mortality for non-COVID-19 causes of death in 2022 in relation to 2022 expected mortality levels, is 20%.

- If you believe the U.S. life insurance industry insured population level of excess mortality, for age 25, will remain at the same level for 2024 as the U.S. individual life insurance industry 25-34 historical information for 2022, code the 20% level as ".20".
- If you believe the excess mortality will be reduced, e.g., to a level of 15% excess mortality, code ".15".
- If you believe that excess mortality will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

U.S. LIFE INSURANCE INDUSTRY INSURED POPULATION MORTALITY (N=8)

AGGREGATION OF RESPONSES FOR ALL CAUSE EXCESS MORTALITY WITHOUT COVID-19 U.S. LIFE INSURED POPULATION

Current Age		Excess Mortality (Without Deaths Directly Attributable To COVID-19) Estimates			
		2024	2025	2030	2035
25	Average	0.06	0.05	0.04	0.03
	Median	0.03	0.03	0.01	0
	25th percentile	0.03	0.02	0	0
	75th percentile	0.05	0.04	0.02	0.01
	Min	0.02	0.01	0	0
	Max	0.20	0.20	0.20	0.20
	No. of responses	8	8	8	8
45	Average	0.04	0.04	0.02	0.03
	Median	0.03	0.02	0.01	0
	25th percentile	0.03	0.02	0	0
	75th percentile	0.05	0.04	0.02	0.01
	Min	0.01	0	-0.01	-0.01
	Max	0.12	0.12	0.12	0.20
	No. of responses	8	8	8	8
65	Average	0.04	0.04	0.02	0.02
	Median	0.03	0.01	0	0
	25th percentile	0.03	0.01	0	0
	75th percentile	0.05	0.05	0.02	0.02
	Min	0.02	0.01	0.00	-0.01
	Max	0.11	0.12	0.13	0.13
	No. of responses	8	8	8	8
85	Average	0.04	0.03	0.01	0.01
	Median	0.04	0.02	0	0
	25th percentile	0.03	0.01	0	0
	75th percentile	0.05	0.04	0.02	0.01
	Min	0.01	0.00	-0.01	-0.02
	Max	0.07	0.06	0.07	0.07
	No. of responses	8	8	8	8

2-2.4.a What are the top 3 changes in future causes of death mortality **for age 25**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 25									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	0	1	0	1
	TS	0	1	0	1	0	1	0	1
Cancer	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	1	0	1
	3	0	1	0	1	0	0	0	0
	TS	0	1	0	1	0	2	0	2
Flu/Pneumonia/Other Respiratory	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other Mental Conditions	1	0	1	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	1	0	1	0
	TS	0	**4**	0	1	1	0	1	0
Accidents Excluding Drug Overdoses	1	0	2	0	2	0	2	0	2
	2	0	2	0	2	1	0	1	0
	3	0	2	0	1	0	1	0	1
	TS	0	**12**	0	**11**	**2**	**7**	2	**7**
Drug Overdoses	1	0	2	0	2	1	1	1	1
	2	1	2	0	2	0	2	0	2
	3	0	0	0	0	0	0	0	0
	TS	2	**10**	0	**10**	**3**	**7**	**3**	**7**
Suicides	1	0	0	0	0	0	0	0	0
	2	1	0	1	0	1	0	1	0
	3	0	1	0	1	0	1	0	1
	TS	2	1	2	1	2	1	2	1
Diabetes and Other Metabolic Disorders	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	1	0	1
	TS	0	0	0	0	0	1	0	1

Age 25									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other 1: Combined	1	1	0	1	0	1	0	1	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	3	0	**3**	0	**3**	0	**3**	0

2-2.4.b What are the top 3 changes in future causes of death mortality **for age 45**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 45									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	0	1	0	1	0	1	0	1
	2	0	1	0	1	0	0	0	0
	3	0	0	0	0	0	1	0	1
	TS	0	**5**	0	**5**	0	**4**	0	**4**
Cancer	1	0	2	0	2	0	2	0	2
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	**6**	0	**6**	0	**6**	0	**6**
Flu/Pneumonia/Other Respiratory	1	0	0	0	0	0	0	0	0
	2	0	1	0	1	0	1	0	1
	3	0	0	0	0	0	0	0	0
	TS	0	2	0	2	0	2	0	2
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other Mental Conditions	1	0	1	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	1	0	1	0
	TS	0	4	0	1	1	0	1	0
Accidents Excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	1	0	1	1	0	1	0
	3	0	1	0	1	0	1	0	1
	TS	0	3	0	3	2	1	2	1
Drug Overdoses	1	0	1	0	1	1	0	1	0
	2	1	2	0	2	1	1	1	1
	3	0	1	0	1	0	1	0	1
	TS	2	**8**	0	**8**	**5**	3	**5**	3
Suicides	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Diabetes and Other Metabolic Disorders	1	0	1	0	1	0	1	0	1
	2	0	0	0	0	0	1	0	1
	3	0	3	0	2	0	1	0	1
	TS	0	**6**	0	**5**	0	**6**	0	**6**

Age 45									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0

2-2.4.c What are the top 3 changes in future causes of death mortality **for age 65**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 65									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	0	2	0	2	0	2	0	2
	2	1	0	1	0	1	0	1	0
	3	0	1	0	1	0	0	0	0
	TS	2	**7**	2	**7**	2	**6**	2	**6**
Cancer	1	1	0	1	0	1	0	1	0
	2	0	2	0	2	0	2	0	2
	3	1	0	1	0	1	0	1	0
	TS	4	4	**4**	**4**	**4**	**4**	**4**	**4**
Flu/Pneumonia/Other Respiratory	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	1	0	1
	TS	0	0	0	0	0	1	0	1
Alzheimer's and Other Dementias	1	0	1	0	1	0	1	0	1
	2	0	1	0	1	0	1	0	1
	3	0	1	0	1	0	1	0	1
	TS	0	**6**	0	**6**	0	**6**	0	**6**
Other Mental Conditions	1	0	1	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	3	0	0	0	0	0	0
Accidents Excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	0	0	0	0	0	0	0
	TS	1	0	0	0	0	0	0	0
Suicides	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Diabetes and Other Metabolic Disorders	1	0	1	0	1	0	1	0	1
	2	0	2	0	1	0	1	0	1
	3	1	1	1	1	1	1	1	0
	TS	1	**8**	1	**6**	1	**6**	1	**5**

Age 65									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0

2-2.4.d What are the top 3 changes in future causes of death mortality **for age 85**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 85									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	1	1	1	1	1	1	1	1
	2	0	2	0	2	0	1	0	1
	3	0	0	0	0	0	1	0	1
	TS	3	**7**	3	**7**	3	**6**	3	**6**
Cancer	1	0	0	0	0	0	0	0	0
	2	1	0	1	0	1	0	1	0
	3	2	0	1	0	1	0	1	0
	TS	**4**	0	3	0	3	0	3	0
Flu/Pneumonia/Other Respiratory	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	1	0	1
	3	0	2	0	2	0	1	0	1
	TS	0	2	0	2	0	3	0	3
Alzheimer's and Other Dementias	1	0	3	0	2	0	2	0	2
	2	0	2	0	2	0	2	0	2
	3	0	0	0	0	0	0	0	0
	TS	0	**13**	0	**10**	0	**10**	0	**10**
Other Mental Conditions	1	0	1	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	3	0	0	0	0	0	0
Accidents Excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Suicides	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Diabetes and Other Metabolic Disorders	1	0	1	0	1	0	1	0	1
	2	0	0	0	0	0	0	0	0
	3	1	1	1	1	1	1	1	1
	TS	1	**4**	1	**4**	1	**4**	1	**4**

Age 85									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0

2-2.5 Additional comments about future excess mortality or future mortality in the U.S. life insurance industry insured population: None were given.

2-2.6 What are the **top 3** current age groups that should be tracked over time and monitored in future mortality analysis as a result of the direct/indirect consequences of the COVID-19 pandemic?

Drag and drop your choices from the list on the left to the box on the right. "1" is the most important current age group to track over time and monitor in future mortality analysis. If an age group is **not** in your top 3, please do not move it.

Age Grouping	Ranking	No. of Responses
0-15	1	0
	2	0
	3	0
	TS	0
16-25	1	1
	2	0
	3	0
	TS	3
26-35	1	1
	2	0
	3	0
	TS	3
36-45	1	0
	2	3
	3	1
	TS	13
46-55	1	2
	2	1
	3	0
	TS	8
56-65	1	0
	2	1
	3	4
	TS	4
66-75	1	2

Age Grouping	Ranking	No. of Responses
	2	1
	3	1
	TS	6
76-85	1	0
	2	1
	3	0
	TS	4
86-95	1	1
	2	0
	3	1
	TS	4
95+	1	0
	2	0
	3	0
	TS	0

Comments on one or more age groups: None were given.

2-3. U.S. ANNUITY INDUSTRY ANNUITANT POPULATION MORTALITY

No responses are included for these questions since only three individuals responded to this part of the survey.

The following questions relate to **U.S. Annuity Industry Annuitant Population** mortality.

2-3.1 Assuming 2019 mortality levels trended forward such as with mortality improvement or deterioration for future expected mortality, please indicate the total level of excess mortality you expect from all causes **including COVID-19 deaths** for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond (consistent with General Population instructions):

No historical U.S. annuity industry annuitant population mortality information is provided. In this example, the U.S. General Population simplified example provided at the beginning of Section 2 is used. From the **U.S. General Population excess mortality example provided in Table 3 of Appendix B**, for age 25-34, the level of excess in 2022 in relation to 2022 expected mortality levels, is 23% (first row of Table 3, Column I).

- If you believe the level of excess mortality for age 25 will remain at the same level for 2024 as the U.S. General Population 25-34 historical information for 2022, code the 23% level as ".23".
- If you believe the excess mortality for age 25 will be reduced, e.g., to a level of 15% excess mortality, code ".15".
- If you believe that excess mortality for age 25 will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

U.S. Annuity Industry Annuitant Population

Current Age	Total Excess Mortality (Including COVID-19 Deaths) Estimates			
	2024	2025	2030	2035
25				
45				
65				
85				

2-3.2 What are the top 3 COVID-19 drivers, for each year listed, influencing your future total excess mortality **including COVID-19 Deaths** estimates? "1" is the most influential COVID-19 driver.

Drivers	Total Excess Mortality (Including COVID-19 Deaths) Estimates			
	2024	2025	2030	2035
Healthier Behavior				
Unhealthier Behavior				
Implementation or Changes to Government Programs/Policies				
Increase in Socioeconomic Differences				
Reduction in Socioeconomic Difference				
Treatment Access – Increased Access to Current or Future New COVID-19 Medical Treatments				
Treatment Access – Decreased Access to Current or Future New COVID-19 Medical Treatments				
Population Health Status - Healthier Population than Pre-pandemic as Older, Less Healthy Individuals Die from COVID-19				
Population Health Status - Less Healthy Population than Pre-pandemic due to Long COVID and Indirect COVID-19 Impacts				

Drivers	Total Excess Mortality (Including COVID-19 Deaths) Estimates			
	2024	2025	2030	2035
Immunity – Higher Immunity due to Vaccination, Infection/Reinfection				
Immunity – Lower Immunity due to Vaccination, Infection/Reinfection				
Virulence – Higher Virulence of Current or Future COVID-19 Strains/Variants				
Virulence – Lower Virulence of Current or Future COVID-19 Strains/Variants				
Other 1_____				
Other 2_____				
Other 3_____				

2-3.3 Assuming 2019 mortality levels trended forward such as with mortality improvement or deterioration for future expected mortality, please indicate the level of excess mortality from all causes except those deaths directly attributed to COVID-19 that you expect for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond (consistent with General Population instructions):

No historical U.S. annuity industry annuitant population mortality information is provided. In this example, the U.S. General Population simplified example provided at the beginning of Section 2 is used. From the U.S. General Population excess mortality example provided in Table 4 of Appendix B, for age 25-34, the level of excess mortality for non-COVID-19 causes of deaths in 2022 in relation to 2022 expected mortality levels, is 20% (first row of Table 4, Column I).

- If you believe the level of excess mortality for age 25 will remain at the same level for 2024, as the U.S. General Population 25-34 historical information for 2022, code the 20% level as ".20".
- If you believe the excess mortality will be reduced, e.g., to a level of 15% excess mortality, code ".15".
- If you believe that excess mortality will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

U.S. Annuity Industry Annuitant Population

Current Age	Excess Mortality (Without Deaths Directly Attributed To COVID-19) Estimates			
	2024	2025	2030	2035
25				
45				
65				
85				

2-3.4.a What are the top 3 changes in future causes of death mortality for age 25, for each year listed, largely influencing your future total excess mortality Without Deaths Directly Attributed To COVID-19 responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Change in Mortality From	2024		2025		2030		2035	
	IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders								
Cancer								
Flu/Pneumonia/Other Respiratory								

Change in Mortality From	2024		2025		2030		2035	
	IMP	DET	IMP	DET	IMP	DET	IMP	DET
Alzheimer's and Other Dementias								
Other Mental Conditions								
Accidents Excluding Drug Overdoses								
Drug Overdoses								
Suicides								
Diabetes and Other Metabolic Disorders								
Gastrointestinal /Liver Disease								
Other 1_____								
Other 2_____								
Other 3_____								

2-3.4.b What are the top 3 changes in future causes of death mortality **for age 45**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Change in Mortality From	2024		2025		2030		2035	
	IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders								
Cancer								
Flu/Pneumonia/Other Respiratory								
Alzheimer's and Other Dementias								
Other Mental Conditions								
Accidents Excluding Drug Overdoses								
Drug Overdoses								
Suicides								
Diabetes and Other Metabolic Disorders								
Gastrointestinal/Liver Disease								
Other 1_____								
Other 2_____								
Other 3_____								

2-3.4.c What are the top 3 changes in future causes of death mortality **for age 65**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Change in Mortality From	2024		2025		2030		2035	
	IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders								
Cancer								
Flu/Pneumonia/Other Respiratory								
Alzheimer's and Other Dementias								
Other Mental Conditions								
Accidents Excluding Drug Overdoses								
Drug Overdoses								
Suicides								
Diabetes and Other Metabolic Disorders								
Gastrointestinal/Liver Disease								
Other 1_____								
Other 2_____								
Other 3_____								

2-3.4.d What are the top 3 changes in future causes of death mortality **for age 85**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Change in Mortality From	2024		2025		2030		2035	
	IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders								
Cancer								
Flu/Pneumonia/Other Respiratory								
Alzheimer's and Other Dementias								
Other Mental Conditions								
Accidents Excluding Drug Overdoses								
Drug Overdoses								
Suicides								
Diabetes and Other Metabolic Disorders								
Gastrointestinal/Liver Disease								
Other 1_____								
Other 2_____								
Other 3_____								

2-3.5 Additional comments about future excess mortality or future mortality in the U.S. annuity industry annuitant population: _____

2-3.6 What are the **top 3** current age groups that should be tracked over time and monitored in future mortality analysis as a result of the direct/indirect consequences of the COVID-19 pandemic?

Drag and drop your choices from the list on the left to the box on the right. "1" is the most important current age group to track over time and monitor in future mortality analysis. If an age group is **not** in your top 3, please do not move it.

Age Group	Ranks 1 - 3
0-15	
16-25	
26-35	
36-45	
46-55	
56-55	
66-75	
76-85	
86-95	
Over 95	

Comments on one or more age groups:

2-4. U.S. PUBLIC AND PRIVATE PENSION PLAN POPULATION MORTALITY

The following questions relate to **U.S. Public and Private Pension Plan Population** mortality.

2-4.1 **Assuming 2019 mortality levels trended forward such as with mortality improvement or deterioration for future expected mortality**, please indicate the total level of excess mortality you expect from all causes **including COVID-19 deaths** for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond (consistent with General Population instructions):

No historical U.S. public and private pension plan population mortality information is provided. In this example, U.S. General Population simplified example provided at the beginning of Section 2 is used. From the **U.S. General Population excess mortality example provided in Table 3 of Appendix B**, for age 25-344, the level of excess in 2022 in relation to 2022 expected mortality levels, is 23% (first row of Table 3, Column I).

- If you believe the level of excess mortality for age 25 will remain at the same level for 2024 as the U.S. General Population 25-34 historical information for 2022, code the 23% level as ".23".

- If you believe the excess mortality for age 25 will be reduced, e.g., to a level of 15% excess mortality, code ".15".
- If you believe that excess mortality for age 25 will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

U.S. Public and Private Pension Plan Population (N=7)

AGGREGATION OF RESPONSES FOR ALL CAUSE EXCESS MORTALITY WITH COVID-19 U.S. PUBLIC AND PRIVATE PENSION PLAN POPULATION

Current Age		All Cause Excess Mortality With COVID-19 Estimates			
		2024	2025	2030	2035
25	Average	0.03	0.02	0.00	-0.01
	Median	0.03	0.02	0.00	0.00
	25th percentile	0.01	0.01	0.00	0.00
	75th percentile	0.05	0.03	0.00	0.00
	Min	0.00	0.00	-0.03	-0.08
	Max	0.05	0.03	0.01	0.01
	No. of responses	7	7	7	7
45	Average	0.03	0.02	0.00	0.00
	Median	0.03	0.02	0.00	0.00
	25th percentile	0.02	0.01	0.00	0.00
	75th percentile	0.04	0.02	0.00	0.00
	Min	0.00	0.00	-0.01	-0.04
	Max	0.05	0.03	0.01	0.01
	No. of responses	7	7	7	7
65	Average	0.03	0.02	0.01	0.00
	Median	0.03	0.02	0.00	0.00
	25th percentile	0.02	0.01	0.00	0.00
	75th percentile	0.05	0.03	0.01	0.01
	Min	0.00	0.00	-0.01	-0.02
	Max	0.05	0.05	0.03	0.01
	No. of responses	7	7	7	7
85	Average	0.03	0.03	0.02	0.01
	Median	0.02	0.02	0.00	0.00
	25th percentile	0.02	0.01	0.00	0.00
	75th percentile	0.05	0.04	0.03	0.02
	Min	0.00	0.00	-0.01	-0.02
	Max	0.08	0.08	0.08	0.07
	No. of responses	7	7	7	7

2-4.2 What are the top 3 COVID-19 drivers, for each year listed, influencing your future total excess mortality **including COVID-19 Deaths** estimates? "1" is the most influential COVID-19 driver.

Driver	Ranking	2024	2025	2030	2035
Healthy Behavior	1	0	0	1	1
	2	0	0	0	0
	3	1	1	1	1
	TS	1	1	4	4
Unhealthy Behavior	1	1	1	0	0
	2	0	0	0	0
	3	1	1	1	1
	TS	4	4	1	1
Implementation or Changes to Government Programs/Policies	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	TS	0	0	0	0
Increase in Socioeconomic Difference	1	0	0	0	0
	2	1	1	1	1
	3	0	0	0	0
	TS	2	2	2	2
Reduction in Socioeconomic Difference	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	TS	0	0	0	0
Treatment Access-Increased Access to Current or Future New COVID-19 Medical Treatments	1	0	0	1	1
	2	0	0	1	1
	3	2	2	1	1
	TS	2	2	6	6
Treatment Access-Decreased Access to Current or Future New COVID-19 Medical Treatments	1	0	0	0	0
	2	1	1	0	0
	3	0	0	0	0
	TS	2	2	0	0
Population Health Status - Healthier Population than Pre-pandemic as Older, Less Healthy Individuals Die from COVID-19	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	TS	0	0	0	0
Population Health Status - Less Healthy Population than Pre-pandemic as Older, Less Healthy Individuals Die from COVID-20	1	2	2	1	1
	2	0	0	1	1
	3	0	0	1	1
	TS	6	6	6	6
Immunity – Higher Immunity due to Vaccination, Infection/Reinfection	1	1	2	1	0
	2	3	2	2	3
	3	0	0	1	1
	TS	9	10	8	7

Driver	Ranking	2024	2025	2030	2035
Immunity – Lower Immunity due to Vaccination, Infection/Reinfection	1	0	0	1	1
	2	1	1	0	0
	3	1	1	0	0
	TS	3	3	3	3
Virulence – Higher Virulence of Current or Future COVID-19 Strains/Variants	1	1	0	0	1
	2	1	2	1	0
	3	1	1	1	1
	TS	6	5	3	4
Virulence – Lower Virulence of Current or Future COVID-19 Strains/Variants	1	2	2	2	2
	2	0	0	1	1
	3	1	1	1	1
	TS	7	7	9	9

2-4.3 Assuming 2019 mortality levels trended forward such as with mortality improvement or deterioration for future expected mortality, please indicate the level of excess mortality from all causes except those deaths directly attributed to COVID-19 that you expect for each of the years and ages listed below. Please express all numbers in decimal form. Here are three examples on how to respond (consistent with General Population instructions):

No historical U.S. public and private pension plan population mortality information is provided. In this example, U.S. General Population simplified example provided at the beginning of Section 2 is used. From the U.S. General Population excess mortality example provided in Table 4 of Appendix B, for age 25-34, the level of excess mortality for non-COVID-19 causes of deaths in 2022 in relation to 2022 expected mortality levels, is 20% (first row of Table 4, Column I).

- If you believe the level of excess mortality for age 25 will remain at the same level for 2024, as the U.S. General Population 25-34 historical information for 2022, code the 20% level as ".20".
- If you believe the excess mortality will be reduced, e.g., to a level of 15% excess mortality, code ".15".
- If you believe that excess mortality will go away and there will be additional mortality improvement of, for example 5%, express the 5% mortality improvement as a negative number, "-.05".

U.S. Public and Private Pension Plan Population* (N=7)

AGGREGATION OF RESPONSES FOR ALL CAUSE EXCESS MORTALITY WITHOUT COVID-19 U.S. PUBLIC AND PRIVATE PENSION PLAN POPULATION

Current Age		All Cause Excess Mortality Without COVID-19 Estimates			
		2024	2025	2030	2035
25	Average	0.02	0.01	-0.01	-0.02
	Median	0.02	0.01	0.00	0.00
	25th percentile	0.01	0.00	0.00	0.00
	75th percentile	0.03	0.01	0.00	0.00
	Min	0.00	-0.01	-0.06	-0.10
	Max	0.03	0.02	0.00	0.00
	No. of responses	7	7	7	7
45	Average	0.02	0.00	-0.01	-0.01
	Median	0.02	0.00	0.00	0.00
	25th percentile	0.00	0.00	0.00	0.00
	75th percentile	0.03	0.01	0.00	0.00
	Min	0.00	-0.01	-0.04	-0.07
	Max	0.03	0.02	0.00	0.00
	No. of responses	7	7	7	7
65	Average	0.01	0.01	0.00	0.00
	Median	0.00	0.00	0.00	0.00
	25th percentile	0.00	0.00	0.00	0.00
	75th percentile	0.01	0.01	0.00	0.00
	Min	0.00	0.00	-0.01	-0.03
	Max	0.03	0.02	0.00	0.00
	No. of responses	7	7	7	7
85	Average	0.01	0.01	0.01	0.01
	Median	0.00	0.00	0.00	0.00
	25th percentile	0.00	0.00	0.00	0.00
	75th percentile	0.02	0.02	0.00	0.00
	Min	0.00	0.00	0.00	0.00
	Max	0.07	0.07	0.07	0.06
	No. of responses	7	7	7	7

2-4.4.a What are the top 3 changes in future causes of death mortality **for age 25**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 25									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	1	0	1
	3	0	1	0	1	0	0	0	0
	TS	0	1	0	1	0	2	0	2
Cancer	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	1	0	1
	TS	0	0	0	0	0	1	0	1
Flu/Pneumonia/Other Respiratory	1	0	1	0	1	0	1	0	1
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	3	0	3	0	**3**	0	**3**
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other Mental Conditions	1	0	0	0	0	0	0	0	0
	2	0	2	0	2	1	1	1	1
	3	0	2	0	2	1	0	1	0
	TS	0	**6**	0	**6**	**3**	2	**3**	2
Accidents excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	2	0	2	1	1	1	1
	3	0	0	0	0	0	0	0	0
	TS	0	**4**	0	4	2	2	2	2
Drug Overdoses	1	0	4	0	3	2	1	2	1
	2	0	0	0	1	0	0	0	0
	3	0	0	0	0	0	1	0	1
	TS	0	**12**	0	**11**	**6**	**4**	**6**	**4**
Suicides	1	0	0	0	1	0	1	0	1
	2	0	1	0	0	0	0	0	0
	3	0	2	0	2	1	1	1	1
	TS	0	**4**	0	**5**	1	**4**	1	**4**
Diabetes and Other Metabolic Disorders	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0

Age 25									
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0

2-4.4.b What are the top 3 changes in future causes of death mortality **for age 45**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 45									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	0	2	0	2	1	0	1	0
	2	0	0	0	0	0	1	0	1
	3	0	0	0	0	0	0	0	0
	TS	0	**6**	0	**6**	**3**	2	**3**	2
Cancer	1	0	0	0	0	0	1	0	1
	2	0	1	0	1	0	0	0	0
	3	0	1	0	1	1	0	1	0
	TS	0	3	0	**3**	1	**3**	1	**3**
Flu/Pneumonia/Other Respiratory	1	0	1	0	1	0	1	0	1
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	0	1	0	1
	TS	0	**4**	0	**4**	0	**4**	0	**4**
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other Mental Conditions	1	0	0	0	0	0	0	0	0
	2	1	0	1	0	1	0	1	0
	3	0	1	0	1	1	0	1	0
	TS	2	1	2	1	**3**	0	**3**	0
Accidents excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	1	0	1	1	0	1	0
	3	0	0	0	0	0	0	0	0
	TS	0	2	0	2	2	0	2	0
Drug Overdoses	1	0	1	0	2	1	0	1	0
	2	0	1	0	0	0	1	0	1
	3	0	0	0	0	0	0	0	0
	TS	0	**5**	0	**6**	**3**	2	**3**	2
Suicides	1	0	1	0	0	0	1	0	1
	2	0	0	0	1	0	0	0	0

Age 45									
	3	0	0	0	0	0	0	0	0
	TS	0	3	0	2	0	**3**	0	**3**
Diabetes and Other Metabolic Disorders	1	0	0	0	0	0	0	0	0
	2	0	1	0	1	1	0	1	0
	3	0	1	0	1	0	1	0	1
	TS	0	3	0	**3**	2	1	2	1
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	0	1	0	1
	TS	0	1	0	1	0	1	0	1

2-4.4.c What are the top 3 changes in future causes of death mortality **for age 65**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 65									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	2	3	2	3	3	0	3	0
	2	1	0	1	0	1	2	1	2
	3	0	0	0	0	0	0	0	0
	TS	**8**	**9**	**8**	**9**	**11**	**4**	**11**	**4**
Cancer	1	1	0	1	0	2	1	2	1
	2	1	3	1	3	2	0	2	0
	3	0	0	0	0	0	0	0	0
	TS	**5**	**6**	**5**	**6**	**10**	3	**10**	3
Flu/Pneumonia/Other Respiratory	1	0	0	0	0	0	0	0	0
	2	0	1	0	1	0	1	0	1
	3	0	2	0	2	0	2	0	2
	TS	0	4	0	4	0	**4**	0	**4**
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Other Mental Conditions	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	0	1	0	1	0	1	0
	TS	1	0	1	0	1	0	1	0
Accidents excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0

Age 65									
Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Suicides	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Diabetes and Other Metabolic Disorders	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	1	1	1	2	0	2	0
	TS	1	1	1	1	2	0	2	0
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0

2-4.4.d What are the top 3 changes in future causes of death mortality **for age 85**, for each year listed, largely influencing your future total excess mortality **Without Deaths Directly Attributed To COVID-19** responses? "1" is the most influential change. In the table below "IMP" means mortality improvement and "DET" means mortality deterioration.

Age 85									
Change in Mortality From	Ranking	2024		2025		2030		2035	
		IMP	DET	IMP	DET	IMP	DET	IMP	DET
Cardiovascular Disorders	1	3	2	3	2	4	0	4	0
	2	0	1	0	1	0	1	0	1
	3	0	0	0	0	0	1	0	1
	TS	**9**	**8**	**9**	**8**	**12**	3	**12**	3
Cancer	1	0	1	0	1	1	1	1	1
	2	2	1	2	1	2	0	2	0
	3	0	1	0	1	1	0	1	0
	TS	4	**6**	4	**6**	**8**	3	**8**	3
Flu/Pneumonia/Other Respiratory	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	3	0	3	0	3	0	3
	TS	0	3	0	3	0	3	0	3
Alzheimer's and Other Dementias	1	0	0	0	0	0	0	0	0
	2	1	1	1	1	2	1	2	1
	3	0	0	0	0	0	0	0	0
	TS	2	2	2	2	**4**	2	**4**	2
Other Mental Conditions	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0

Age 85									
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Accidents excluding Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Drug Overdoses	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Suicides	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	TS	0	0	0	0	0	0	0	0
Diabetes and Other Metabolic Disorders	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	1	0	1	0	1	0	1	0
	TS	1	0	1	0	1	0	1	0
Gastrointestinal and Liver Disease	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	1	0	1	0	0	0	0
	TS	0	1	0	1	0	0	0	0

2-4.5 Additional comments about future excess mortality or future mortality in the U.S. public and private pension plan population: No additional comments were submitted.

2-4.6 What are the **top 3** current age groups that should be tracked over time and monitored in future mortality analysis as a result of the direct/indirect consequences of the COVID-19 pandemic?

Drag and drop your choices from the list on the left to the box on the right. "1" is the most important current age group to track over time and monitor in future mortality analysis. If an age group is **not** in your top 3, please do not move it.

Age Grouping	Ranking	No. of Responses
0-15	1	0
	2	0
	3	0
	TS	0
16-25	1	0
	2	0
	3	1
	TS	1

Age Grouping	Ranking	No. of Responses
26-35	1	0
	2	0
	3	0
	TS	0
36-45	1	0
	2	0
	3	0
	TS	0
46-55	1	0
	2	0
	3	1
	TS	1
56-65	1	0
	2	2
	3	0
	TS	4
66-75	1	3
	2	2
	3	1
	TS	14
76-85	1	4
	2	2
	3	0
	TS	16
86-95	1	0
	2	1
	3	4
	TS	6
95+	1	0
	2	0
	3	0
	TS	0

Comments on one or more age groups:

1. Age 66-75 mortality is a huge driver of pension funding costs. It will be very interesting to see how the COVID-19 viruses and vaccine impact affect these individuals' future mortality.
2. 76-85 is 1. 66-75 is 2. 86-95 is three. This ranking is what drives retirement mortality.

Appendix B: Historical Information and Sample Excess Mortality Calculations

Following is the historical information and sample excess mortality calculations provided with the survey 3 questionnaire

The U.S. General Population is shown in Table 1.

Table 2

HISTORICAL U.S. GENERAL POPULATION ALL-CAUSE AND COVID-19 CRUDE DEATH RATES BY YEAR AND AGE

Current Age	A 2019 All Cause Deaths per 100,000	B 2020 All Cause Deaths per 100,000	C 2020 COVID-19 Deaths per 100,000+	D=B-C 2020 Deaths per 100,000 Without COVID-19 Deaths+	E 2021 All Cause Deaths per 100,000	F 2021 COVID-19 Deaths per 100,000+	G = E-F 2021 Deaths per 100,000 Without COVID-19 Deaths+	H 2022 All Cause Deaths per 100,000	I 2022 COVID-19 Deaths per 100,000+	J = H-I 2022 Deaths per 100,000 Without COVID-19 Deaths+
25-34	128.8	159.5	4.9	154.6	180.8	13.5	167.3	163.4	3.6	159.8
45-54	392.4	473.5	42	431.6	531	90.6	440.4	453.3	23.9	429.4
65-74	1,764.6	2,072.3	234.3	1,838.0	2,151.3	305.1	1,846.2	1978.7	124.5	1854.2
85+	13,228.6	15,210.9	1,645.0	13,565.9	15,743.3	1,354.4	14,388.9	14,389.6	818.2	13,571.4

Source: CDC Wonder: Provisional Multiple Cause of Death Data 2018-Latest Week (Accessed 4/26/24)

+Deaths from COVID-19 were identified using underlying cause-of-death codes U07.1 in the *International Classification of Diseases, Tenth Revision*.

Many methodologies exist for performing excess mortality analysis. A very **simple** example follows.

Table 2 shows the first step of the process for determining excess mortality. It is a **simplified example** for estimating U.S. General Population expected mortality for 2020, 2021 and 2022 in which only mortality improvement is applied to trend the 2019 levels forward. In Table 2, Columns A and B are user input items with 2019 all cause deaths coming from Table 1 and the mortality improvement assumption (deterioration if negative) in Column B from the SOA Research Institute's mortality improvement model, MIM-2021-v3.

Table 2

U.S. GENERAL POPULATION EXPECTED MORTALITY EXAMPLE

Current Age	A 2019 All Cause Deaths per 100,000	B Annual Mortality Improvement Assumption*	C=1-B Annual Mortality Improvement Factor	D=AxC Estimated 2020 Expected Mortality	E=DxC Estimated 2021 Expected Mortality	F=ExC Estimated 2022 Expected Mortality
25-34	128.8	-1%	1.01	130.1	131.4	132.7
45-54	392.4	0.75%	0.9925	389.5	386.6	383.6
65-74	1,764.60	1.50%	0.985	1,738.10	1,712.00	1686.4
85+	13,228.60	1.50%	0.985	13,030.20	12,834.70	12,642.20

Column A is from Table 1

*Source: MIM-2021-v3 Data Analysis Tool using 2000-2019 historical NCHS data, 2022 Society of Actuaries Research Institute

Continuing the simple example, using the expected mortality estimates for 2020, 2021 and 2022 from Table 2 and the actual crude death rates from Table 1, excess mortality for 2020, 2021 and 2022 can be determined. The calculations are shown in Table 3 and Table 4. The excess mortality estimates are shown in Columns C, F and I.

Table 3

U.S. GENERAL POPULATION TOTAL EXCESS MORTALITY EXAMPLE FOR 2020, 2021, AND 2022 WITH COVID-19 AS A CAUSE OF DEATH

Current Age	A Estimated 2020 Expected Mortality	B 2020 All Cause Deaths per 100,000	C=B/A-1 Estimated 2020 Total Excess Mortality	D Estimated 2021 Expected Mortality	E 2021 All Cause Deaths per 100,000	F=E/D-1 Estimated 2021 Total Excess Mortality	G Estimated 2022 Expected Mortality	H 2022 All Cause Deaths per 100,000	I=H/G-1 Estimated 2022 Total Excess Mortality
25-34	130.1	159.5	**23%**	131.4	180.8	**38%**	132.7	163.4	**23%**
45-54	389.5	473.5	**22%**	386.6	530.9	**37%**	383.6	453.3	**18%**
65-74	1,738.10	2,072.30	**19%**	1,712.00	2,151.00	**26%**	1,686.40	1978.7	**17%**
85+	13,030.20	15,210.90	**17%**	12,834.70	15,743.30	**23%**	12,642.20	14,389.6	**14%**

Columns A, D and G are from Table 2, Columns B, E and H are from Table 1.

Table 4

U.S. GENERAL POPULATION EXCESS MORTALITY EXAMPLE FOR 2020, 2021, AND 2022 WITHOUT COVID-19 AS A CAUSE OF DEATH

Current Age	A Estimated 2020 Expected Mortality	B 2020 Deaths per 100,000 Without COVID-19 Deaths+	C=B/A-1 Estimated 2020 Excess Mortality Without COVID-19 Deaths+	D Estimated 2021 Expected Mortality	E 2021 Deaths per 100,000 Without COVID-19 Deaths+	F=E/D-1 Estimated 2021 Excess Mortality Without COVID-19 Deaths+	G Estimated 2022 Expected Mortality	H 2022 Deaths per 100,000 Without COVID-19 Deaths+	I=H/G-1 Estimated 2022 Excess Mortality Without COVID-19 Deaths+
25-34	130.1	154.6	**19%**	131.4	167.3	**27%**	132.7	159.8	**20%**
45-54	389.5	431.6	**11%**	386.6	440.4	**14%**	383.6	429.4	**12%**
65-74	1,738.10	1,838.00	**6%**	1,712.00	1,846.20	**8%**	1,686.40	1,854.2	**10%**
85+	13,030.20	13,565.90	**4%**	12,834.70	14,388.90	**12%**	12,642.20	13,571.4	**7%**

Columns A, D and G are from Table 2, Columns B, E and H are from Table 1.

+Deaths from COVID-19 were identified using underlying cause-of-death codes U07.1 in the *International Classification of Diseases, Tenth Revision*.

Another excess mortality example is provided in Table 5 utilizing the same methodology as discussed for the U.S. General Population. Columns A, F, G and H are historical individual life insurance mortality data contributed by companies participating in the SOA Research Institute's COVID-19 industry studies. Columns C, D, and E are the estimated 2020-2022 expected number of deaths determined by trending the 2019 data forward. Columns I, J and K show the total excess mortality estimates for these years. In comparing the total excess mortality estimates in the two examples, the 2020, 2021 and 2022 excess mortality estimates are lower for the U.S. individual life insurance industry insured population (Table 5) than the total excess mortality estimates for the U.S. General Population shown in Table 3. Also, the U.S. Individual Life Insurance Industry's estimates do not have as much variability by age as the U.S. General Population example.

Table 5

HISTORICAL U.S. INDIVIDUAL LIFE INSURANCE INDUSTRY INSURED POPULATION
ALL-CAUSE MORTALITY

Current Age	A 2019 Number of Deaths per 100,000	B Annual Mortality Improvement Factor	C=(A*B) Estimated 2020 Expected Number of Deaths per 100,000	D=(C*B) Estimated 2021 Expected Number of Deaths per 100,000	E=(D*B) Estimated 2022 Expected Number of Deaths per 100,000	F 2020 Actual All Cause Deaths per 100,000	G 2021 Actual All Cause Deaths per 100,000	H 2022 Actual All Cause Deaths per 100,000	I=(F/C)-1 Estimated 2020 Total Excess Mortality	J= (G/D)-1 Estimated 2021 Total Excess Mortality	K= (H/E)-1 Estimated 2022 Total Excess Mortality
<45	66.4	1.01	67.06	67.7	68.4	76.1	84.4	72.8	**13%**	**25%**	**6%**
45-64	319.4	0.9875	315.41	311.5	307.6	357.0	399.8	330.4	**13%**	**28%**	**7%**
65-74	1212.5	0.985	1194.31	1176.4	1158.8	1380.4	1446.7	1286.8	**16%**	**23%**	**11%**
75-84	3709.7	0.985	3654.05	3599.2	3545.3	4207.0	4105.8	3779.6	**15%**	**14%**	**7%**
85+	12800.7	0.985	12608.69	12419.6	12233.3	14279.0	13436.3	13165.9	**13%**	**8%**	**8%**

Source: LIMRA, RGA, SOA Research Institute, TAI. 2023 Cause of Death Report Through Fourth Quarter 2022 – Tableau Dashboard. https://www.soa.org/resources/research-reports/2023/ind-life-covid-cod/

Appendix C: Comparison of Survey 3 with Survey 1 and Survey 2

Table 2a

AVERAGE ALL-CAUSE EXCESS MORTALITY ESTIMATES WITH COVID-19 BY POPULATION, AGE AND SURVEY (SURVEY 3/ SURVEY 2/SURVEY 1)

U.S. Population (No. of Responses)	Age	2022 (%)			2023 (%)			2024 (%)			2025 (%)			2030 (%)			2035 (%)		
		Survey			Survey			Survey			Survey			Survey			Survey		
		3	2	1	3	2	1	3	2	1	3	2	1	3	2	1	3	2	1
General (24/39/56)	25	NA	17	14	NA	13	9	10	NA	NA	8	9	6	4	6	2	2	NA	NA
	45	NA	17	13	NA	13	9	9	NA	NA	6	9	5	3	6	2	1	NA	NA
	65	NA	14	10	NA	10	7	6	NA	NA	5	6	5	2	4	2	0	NA	NA
	85	NA	11	9	NA	8	6	5	NA	NA	4	7	3	1	3	1	0	NA	NA
Life Insurance Industry Insured (7/14/29)	25	NA	10	10	NA	7	5	4	NA	NA	3	5	2	2	3	-1	1	NA	NA
	45	NA	11	10	NA	8	5	5	NA	NA	4	6	2	2	4	-1	1	NA	NA
	65	NA	10	9	NA	7	5	6	NA	NA	4	5	1	2	3	-1	2	NA	NA
	85	NA	7	7	NA	5	3	6	NA	NA	5	3	1	2	2	-1	1	NA	NA
Annuity Industry Annuitant (NA/7/6)	25	NA	13	5	NA	8	3	NA	NA	NA	NA	6	0	NA	3	-1	NA	NA	NA
	45	NA	10	5	NA	7	2	NA	NA	NA	NA	4	0	NA	2	-2	NA	NA	NA
	65	NA	9	5	NA	6	1	NA	NA	NA	NA	4	-1	NA	2	-3	NA	NA	NA
	85	NA	7	6	NA	5	1	NA	NA	NA	NA	3	-1	NA	1	-3	NA	NA	NA
Private and Public Pension Plan (6/7/15)	25	NA	12	8	NA	11	5	3	NA	NA	2	6	2	0	1	-1	-1	NA	NA
	45	NA	12	7	NA	11	5	3	NA	NA	2	6	2	0	2	-1	0	NA	NA
	65	NA	11	6	NA	8	4	3	NA	NA	2	4	1	1	1	-3	0	NA	NA
	85	NA	6	6	NA	5	4	3	NA	NA	3	3	0	2	1	-3	1	NA	NA

Table 2b

AVERAGE ALL-CAUSE EXCESS MORTALITY ESTIMATES WITHOUT COVID-19 AS A CAUSE OF DEATH BY POPULATION, AGE AND SURVEY

(SURVEY 3/SURVEY 2/SURVEY 1)

U.S. Population (No. of Responses)	Age	2022 (%)			2023 (%)			2024 (%)			2025 (%)			2030 (%)			2035 (%)		
		Survey			Survey			Survey			Survey			Survey			Survey		
		3	2	1	3	2	1	3	2	1	3	2	1	3	2	1	3	2	1
General (24/39/56)	25	NA	14	10	NA	12	8	9	NA	NA	7	9	5	4	5	3	3	NA	NA
	45	NA	10	7	NA	7	6	6	NA	NA	4	6	3	2	3	1	1	NA	NA
	65	NA	5	4	NA	3	3	3	NA	NA	2	2	1	1	1	-1	0	NA	NA
	85	NA	5	2	NA	4	1	2	NA	NA	2	3	0	0	1	-2	-2	NA	NA
Life Insurance Industry Insured (7/14/29)	25	NA	8	8	NA	6	5	6	NA	NA	5	4	2	4	3	0	3	NA	NA
	45	NA	7	5	NA	6	3	4	NA	NA	4	4	1	2	2	-1	3	NA	NA
	65	NA	5	3	NA	3	2	4	NA	NA	4	2	1	2	0	-1	2	NA	NA
	85	NA	4	2	NA	3	1	4	NA	NA	3	2	0	1	0	-1	1	NA	NA
Annuity Industry Annuitant (NA/7/6)	25	NA	10	3	NA	6	1	NA	NA	NA	NA	4	-1	NA	3	-3	NA	NA	NA
	45	NA	7	3	NA	4	1	NA	NA	NA	NA	2	-2	NA	1	-4	NA	NA	NA
	65	NA	5	1	NA	2	-1	NA	NA	NA	NA	0	-3	NA	-1	-5	NA	NA	NA
	85	NA	4	1	NA	2	-1	NA	NA	NA	NA	0	-3	NA	-1	-6	NA	NA	NA
Private and Public Pension Plan (6/7/15)	25	NA	7	5	NA	6	3	2	NA	NA	1	4	2	-1	1	-1	-2	NA	NA
	45	NA	5	5	NA	4	3	2	NA	NA	0	2	1	-1	1	-2	-1	NA	NA
	65	NA	2	2	NA	1	1	1	NA	NA	1	0	-1	0	0	-4	0	NA	NA
	85	NA	1	2	NA	1	1	1	NA	NA	1	0	-2	1	-1	-4	1	NA	NA

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