

Impact of COVID-19 on life insurance mortality and underwriting

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This article examines early mortality experience related to COVID-19 and includes a discussion about the difficulties in using this data. The article will end with some ideas for changes to life insurance underwriting to help cope with COVID-19.

Introduction

To understand mortality related to COVID-19, there are a number of unique characteristics that need to be considered:

- **Contagiousness:** COVID-19 appears to be more contagious than most other viruses.
- **Public response:** This involves quarantine and confinement, testing, wearing masks, and social distancing. How quickly and thoroughly quarantine and confinement are implemented, the level of testing, and population adherence all impact mortality.
- **Medications/vaccine:** They are being worked on, but not currently ready.
- **Availability of sufficient healthcare:** In some locations, there are not enough hospital beds to care for the ill.
- **Second-order deaths:** This can include, e.g., those with other impairments who cannot get treatment and suicides from anxiety and depression brought on by circumstances related to the virus.
- **Will the virus come back again?**

Mortality

The purpose of this section of the article is to provide you with some current mortality data related to COVID-19 that may help you better understand how it could impact your current mortality assumptions. It should be said up-front that you will not be able to use the data provided directly, but hopefully it will give you some initial ideas on the various relationships in the data.

This section will cover the following topics and then provide some concluding thoughts.

- Measurement of mortality
- Determining mortality rates
- Mortality impacts
- Confirmed cases and case fatality rate (CFR, defined below) by age and country

MEASUREMENT OF MORTALITY

It is likely going to be a fairly long time before accurate numbers of cases and deaths will be available. And the real rates may never be known because of difficulties in obtaining accurate incidence rates. As there are multiple measures, it is important to understand the measure used:

- **Crude mortality rate:** This is the number who have died divided by the total population. This will not be known until some point in time after the virus has run its course.
- **Case fatality rate (CFR):** This is the number who have died divided by the number who were infected. This is the measure most commonly used during the pandemic and will be what is shown in the analysis below. It has its shortcomings, as explained in the next section.
- **The number who have died divided by the number who have recovered.** These numbers will generally be very high as deaths occur early and recoveries may not be known for some time.

DETERMINING MORTALITY RATES

Before any further discussion, it is important to recognize that the numbers about to be provided cannot be directly used to estimate the extra mortality a life insurance company may experience. As mentioned above, the CFR, i.e., the expected mortality rate among those infected, will be provided below. However, the CFR is overstated, and potentially vastly overstated, because many mild cases have not been identified and therefore are not considered officially confirmed cases. With these cases missing from the denominator, the numbers are not accurate.

Also, the accuracy of the reporting of the cause of death is questionable; it may be inaccurate in both directions. Some may classify a death as due to COVID-19 if the individual is a confirmed case, even if the death was from another cause. Other COVID-19 deaths may be classified as due to pneumonia or the flu. It is also not clear how non-hospitalized COVID-19 deaths are being recorded. It may be that the only way we know the real impact is by comparing total deaths in one period to the next.

So why then is the mortality data being provided? There are several answers to this.

- This is the best source of early mortality data.
- They can give you an idea of the relative mortality involved, by age, gender, country, etc. For example, when comparing by country, recognize that countries are at different stages of the pandemic, have implemented different procedures at different stages, and there are different measures of deaths, e.g., some countries only measure deaths in hospitals. Another difference is in the testing protocols in each country.¹
- If you are able to estimate the unreported milder cases, you could adjust the denominator to arrive at a more accurate CFR.

MORTALITY IMPACTS

There are a number of characteristics in an individual with COVID-19 that have been found to have an impact on mortality. These include age, gender, body mass index (BMI) level, and medical impairment (particularly as it relates to the immune system). Each of these will be discussed in this section, along with the early mortality impacts that have been seen so far.

Age

The oldest individuals have been most impacted so far. Figure 1 shows CFRs by age from a report by JAMA.² Figure 1 shows the results for Italy and China at two different dates. While Italy has a much higher overall CFR, the CFRs by age are remarkably close. The China figures were developed by the Chinese Center for Disease Control and Prevention (CDC), released on February 17, and published in the Chinese Journal of Epidemiology. These results have also been reported in an article in The Lancet on March 30, 2020.³

The reason for Italy's higher overall CFR is because of its distribution by age versus that from China. Likewise, life insurance companies may have different impacts from COVID-19, based on their distributions of business by age.

FIGURE 1: CFRS BY AGE

	ITALY AS OF MARCH 17, 2020			CHINA AS OF FEBRUARY 11, 2020		
	DEATHS	% OF TOTAL	CFR	DEATHS	% OF TOTAL	CFR
ALL	1,625	100%	7.2%	1,023	100%	2.3%
AGE						
0-9	0	0.0%	0.0%	0	0.0%	0.0%
10-19	0	0.0%	0.0%	1	0.1%	0.2%
20-29	0	0.0%	0.0%	7	0.7%	0.2%
30-39	4	0.3%	0.3%	18	1.8%	0.2%
40-49	10	0.6%	0.4%	38	3.7%	0.4%
50-59	43	2.7%	1.0%	130	12.7%	1.3%
60-69	139	8.6%	3.5%	309	30.2%	3.6%
70-79	578	35.6%	12.8%	312	30.5%	8.0%
80+	850	52.3%	20.0%	208	20.3%	14.8%

¹ Covid-19: What is the UK's testing strategy?, BMJ 2020; 368 doi: <https://doi.org/10.1136/bmj.m1222> (published March 26, 2020), BMJ 2020;368:m1222, Can also be found at <https://www.bmj.com/content/368/bmj.m1222>.

² Onder G, Rezza G, Brusaferro S. Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. JAMA. Published online March 23, 2020. doi:10.1001/jama.2020.4683.

³ Verity, R. et al. (March 30, 2020). Estimates of the severity of coronavirus disease 2019: A model-based analysis. The Lancet. Retrieved April 3, 2020, from <https://www.thelancet.com/action/showPdf?pii=S1473-3099%2820%2930243-7>.

Figure 1 indicates that there have been no deaths for ages 0 to 9, but that is no longer true. The following describes what is known about children and COVID-19.

There was a study⁴ of 2,143 cases of children under 18 that were reported to the Chinese CDC as of February 8. The researchers indicated three reasons they thought so many children emerged unscathed from the pandemic:

- The receptor or protein in human cells that viral particles bind to, called the ACE2 receptor, is not expressed as prominently in young children or may be a different shape.
- Most children have healthier lungs, having not been exposed to as much pollution as adults over their lives.
- Children's immune systems don't rev up to attack the virus as much as adult immune systems do, with the aggressive response causing destructive inflammation in the body's organs.

The conclusion of the study was that children are likely infected at rates comparable to adults, but at much lower severity levels. Reports that indicate that children have lower infection rates are likely driven by the limited testing in children who do not have more extreme conditions.

Gender

South Korea provided some statistics by age and gender.⁵ Figure 2 shows the results.

FIGURE 2: SOUTH KOREA MORTALITY BY AGE AND GENDER (STATISTICS AS OF MARCH 25, 2020)

AGE	CONFIRMED CASES			DEATHS			CFR		
	FEMALE	MALE	TOTAL	FEMALE	MALE	TOTAL	FEMALE	MALE	TOTAL
0-9	46	59	105	0	0	0	0.0%	0.0%	0.0%
10-19	225	250	475	0	0	0	0.0%	0.0%	0.0%
20-29	1,337	1,136	2,473	0	0	0	0.0%	0.0%	0.0%
30-39	534	409	943	0	1	1	0.0%	0.2%	0.1%
40-49	880	366	1,246	0	1	1	0.0%	0.3%	0.1%
50-59	1,207	517	1,724	5	5	10	0.4%	1.0%	0.6%
60-69	719	435	1,154	7	13	20	1.0%	3.0%	1.7%
70-79	358	253	611	16	23	39	4.5%	9.1%	6.4%
80+	281	125	406	34	21	55	12.1%	16.8%	13.5%
Total	5,587	3,550	9,137	62	64	126	1.1%	1.8%	1.4%
Distribution	61%	39%		49%	51%				

There were more female cases than male cases, but the CFR for males was higher for all age groups and overall. It could be speculated that males smoke more or were otherwise less healthy than females, but the reason for this difference is not known. The other important item to note is that the overall CFRs are slightly lower, but comparable to the death rates observed in China provided immediately above.

Italy also provided statistics⁶ as of March 30, 2020. They are shown in Figure 3.

⁴ Dong Y, Mo X, Hu Y, et al. Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. *Pediatrics*. 2020; doi: 10.1542/peds.2020-0702. Can also be found at <https://pediatrics.aappublications.org/content/pediatrics/early/2020/03/16/peds.2020-0702.full.pdf>.

⁵ The updates on COVID-19 in Korea as of 25 March, KCDC, Press Release no. 213.

⁶ Prodotto dall'Istituto Superiore di Sanità, Roma (March 30, 2020). *Epidemia COVID-19*. Retrieved April 3, 2020, from https://www.epicentro.iss.it/coronavirus/bollettino/Bollettino-sorveglianza-integrata-COVID-19_30-marzo-2020.pdf.

FIGURE 3: ITALY MORTALITY BY AGE AND GENDER (STATISTICS AS OF MARCH 30, 2020)

AGE	CONFIRMED CASES			DEATHS			CFR		
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
0-9	324	260	584	0	0	0	0.0%	0.0%	0.0%
10-19	392	371	763	0	0	0	0.0%	0.0%	0.0%
20-29	1,631	2,132	3,763	1	1	2	0.1%	0.0%	0.1%
30-39	3,105	3,352	6,457	18	2	20	0.6%	0.1%	0.3%
40-49	5,802	6,198	12,000	66	23	89	1.1%	0.4%	0.7%
50-59	10,068	8,495	18,563	294	74	368	2.9%	0.9%	2.0%
60-69	10,744	5,584	16,328	923	236	1,159	8.6%	4.2%	7.1%
70-79	11,236	6,142	17,378	2,597	854	3,451	23.1%	13.9%	19.9%
80-89	7,630	6,504	14,134	2,603	1,378	3,981	34.1%	21.2%	28.2%
90+	1,160	2,404	3,564	424	514	938	36.6%	21.4%	26.3%
Total	52,092	41,442	93,534	6,926	3,082	10,008	13.3%	7.4%	10.7%
Distribution	56%	44%		69%	31%				

For Italy, there were more male cases than female. However, the male CFR was also higher than for females for all age groups and overall. The CFRs by age are similar to those in South Korea (Figure 2) and China (Figure 1); however, the overall CFRs are higher because of a larger distribution at the older ages in Italy.

The Worldometer report⁷ also had data by gender. It is based on data from China and is not split by age; it shows a higher overall CFR than in the South Korea data, as can be seen in Figure 4, but also shows a higher CFR for males than females.

FIGURE 4: CFRs BY GENDER

SEX	CASES	
	ALL	CONFIRMED
Male	2.8%	4.7%
Female	1.7%	2.8%

BMI

One study⁸ looked at the percentage of confirmed COVID-19 cases by BMI levels of patients who were admitted to critical care in comparison to the percentage by BMI level of those who were admitted with viral pneumonia between 2017 and 2019 without COVID-19. Figure 5 shows the results.

FIGURE 5: CRITICAL CARE BY BMI

BMI LEVEL	% OF PATIENTS	
	COVID-19 FOR CRITICAL CARE	NON-COVID-19 2017-19 FOR VIRAL PNEUMONIA
< 18.5	1.3%	5.5%
18.5-<25	26.6%	33.9%
25-<30	34.4%	30.0%
30-<40	31.0%	23.6%
40+	6.7%	7.0%

⁷ Worldometer (February 29, 2020). Age, Sex, Existing Conditions of COVID-19 Cases and Deaths. Retrieved April 3, 2020, from <https://www.worldometers.info/coronavirus/coronavirus-age-sex-demographics/>.

⁸ Intensive Care National Audit and Research Center (March 27, 2020). ICNARC Report on COVID-19 in Critical Care. Retrieved April 3, 2020, from <https://www.icnarc.org/DataServices/Attachments/Download/b5f59585-5870-ea11-9124-00505601089b> (PDF download).

Figure 5 shows a higher percentage of overweight and obese individuals being hospitalized for COVID-19 than for viral pneumonia.

The same study compared the number of deaths in critical care by BMI level. The fatality rate of COVID-19 is higher than that of viral pneumonia at all BMI levels. However, the biggest difference is between the group with BMI of 30 and higher, where 61% of the cases in critical care with COVID-19 died, while only 19% for the group with viral pneumonia died, a ratio of over 3 to 1. At other BMI levels, the ratio was less than 2 to 1.

Medical impairment

COVID-19 is more prevalent among those with impairments and those who have impaired immune systems. Figure 6 shows the CFRs for several impairments. This data comes from the same source⁹ as used above.

FIGURE 6: CFR BY PRE-EXISTING CONDITION

PRE-EXISTING CONDITON	CASES	
	ALL	CONFIRMED
Cardiovascular disease	10.5%	13.2%
Diabetes	7.3%	9.2%
Chronic respiratory disease	6.3%	8.0%
Hypertension	6.0%	8.4%
Cancer	5.6%	7.6%
No pre-existing condition	0.9%	

As can be seen, the CFRs for these impairments are higher than the CFRs shown in Figure 1 above for all but the oldest ages.

All of the CFRs are likely to change as more data comes in. Also, it is still too soon to know how long the mortality impacts will be felt, and whether there will be multiple rounds or seasonality impacts.

As mentioned above, the mortality will vary based on the specific response to the crisis and its success. For example, the first goal is to reduce the number of people contracting the virus. This can be done through expanding the testing (including asymptomatic people), quarantine, social distancing, wearing masks, and washing hands frequently (particularly washing them after touching a possibly contaminated surface and before touching one's face, as the virus is generally introduced through a person's mouth, nose, or eyes). However, if someone has contracted the virus and needs hospital attention, success is then often determined by the availability of hospital beds and treatment.

Will there be differences between insured and population mortality? There likely will be, primarily because of different distributions of the most affected individuals. Mortality results will also vary by product, as there is typically a different mix of people with life insurance, annuities, and pensions. In terms of differences in mortality rates themselves, we would expect them to be close for now, with a potential difference being that some insured lives may have better access to medical care than the overall population. And as a vaccine or other treatment becomes available, the gap may widen for the same reason.

One other potential item for life insurers to keep in mind is that if COVID-19 causes more deaths in those with cardiovascular disease, diabetes, chronic respiratory disease, etc., then they will likely be reported as COVID-19 deaths and the number of deaths directly related to cardiovascular disease, diabetes, chronic respiratory disease, etc. will be reduced.

While the impacts are not yet known, there could also be an impact on long-term care and critical illness products.

⁹ Worldometer, op cit.

CONFIRMED CASES AND CFR BY AGE AND COUNTRY

The graphs in Figures 7 and 9 below come from a dashboard¹⁰ produced by Johns Hopkins. As this dashboard changes multiple times during the day, the numbers used here came from a tool¹¹ provided by SCOR that utilizes the data sets from Johns Hopkins. The purpose of Figures 7 and 9 is to show the growth in confirmed cases and deaths for the 10 countries with the most confirmed cases as of March 31, 2020, plus South Korea (whose experience has leveled off) and Singapore (whose experience has remained relatively low). The growth shown is over the three-week period between March 10 and March 31; four points in time are plotted (March 10, 17, 24, and 31). Figures 8 and 10 provide the numbers used in these graphs. Keep in mind that the number of confirmed cases is driven to a large extent by the testing done in that country.

FIGURE 7: CONFIRMED CASES BY COUNTRY MARCH 10-31, 2020

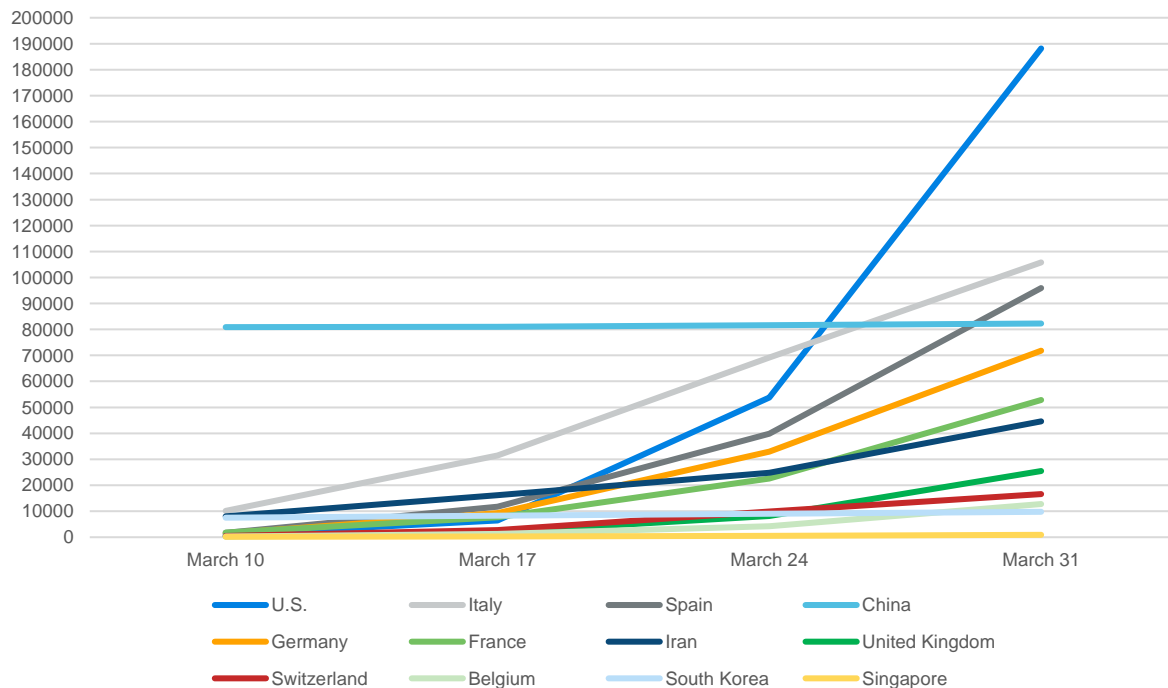


Figure 7 shows that while the level of China cases is high, being the first country with the virus, it saw very little additional growth, 2%, or less than 2,000 cases, from March 10 to March 31. A number of other countries in the top 10 are showing rapid growth over this three-week period, led by the United States (19,500%), the United Kingdom (6,500%), Spain (5,500%), Germany (4,800%), Belgium (4,700%), and Switzerland (3,300%). The top three countries in confirmed cases as of March 31 are the United States (188,000), Italy (106,000), and Spain (96,000).

¹⁰ The Center for Systems Science and Engineering at Johns Hopkins.

¹¹ SCOR. COVID Trends App. Retrieved April 3, 2020, from <http://domino.scor.com/u/mpascariu/COVID-19-Production/app>.

Figure 8 shows the numbers used in the graph in Figure 7 along with the three-week growth rates.

FIGURE 8: CONFIRMED CASES FOR TOP 10 COUNTRIES PLUS SOUTH KOREA AND SINGAPORE (MARCH 10-31, 2020)

COUNTRY	MARCH 10	MARCH 17	MARCH 24	MARCH 31	3-WEEK GROWTH %
U.S.	959	6,421	53,740	188,172	19,522
Italy	10,149	31,506	69,176	105,792	942
Spain	1,695	11,748	39,885	95,923	5,559
China	80,887	81,058	81,591	82,279	2
Germany	1,457	9,257	32,986	71,808	4,828
France	1,794	7,715	22,622	52,827	2,845
Iran	8,042	16,169	24,811	44,605	455
United Kingdom	384	1,960	8,164	25,481	6,536
Switzerland	491	2,700	9,877	16,605	3,282
Belgium	267	1,243	4,269	12,775	4,685
Total Top 10	104,983	163,874	324,811	641,406	511
South Korea	7,513	8,320	9,037	9,786	30
Singapore	160	266	558	926	479

FIGURE 9: GROWTH IN DEATHS BY COUNTRY MARCH 10-31, 2020

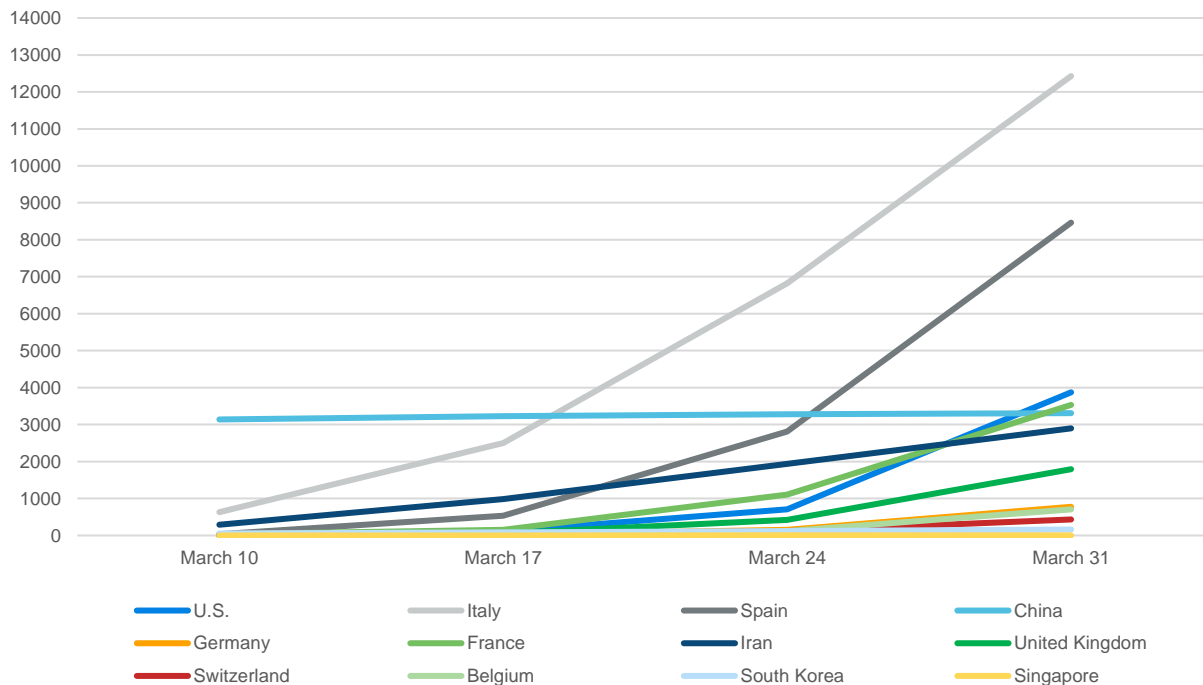


Figure 9 shows a small increase in deaths of 5% for China over the period March 10 to March 31. Besides China, the percentage growth in deaths is very large because there were so few deaths in many countries, only three weeks earlier on March 10. Italy now has the largest number of deaths with over 12,000. However, the largest percentage increases in deaths over this period came from Germany (almost 39,000% from only two deaths on March 10), the United Kingdom (almost 30,000% from only six deaths on March 10), and Spain (24,000% from 35 deaths). Other increases over 10,000% included Switzerland (14,000% from three deaths), the United States (almost 14,000% from 28 deaths), and France (10,000% from 33 deaths). Over the three-week period, Belgium grew from no deaths to over 700 deaths. While difficult to see in the graph, Figure 9 shows that Singapore has had less than five deaths.

Figure 10 shows the numbers used in the graph in Figure 9 along with the three-week growth rates.

FIGURE 10: NUMBER OF DEATHS TOP 10 COUNTRIES PLUS SOUTH KOREA AND SINGAPORE (MARCH 10-31, 2020)

COUNTRY	MARCH 10	MARCH 17	MARCH 24	MARCH 31	3-WEEK GROWTH %
U.S.	28	108	706	3,873	13,732
Italy	631	2,503	6,820	12,428	1,870
Spain	35	533	2,808	8,464	24,083
China	3,139	3,230	3,281	3,309	5
Germany	2	24	157	775	38,650
France	33	149	1,102	3,532	10,603
Iran	291	988	1,934	2,898	896
United Kingdom	6	56	423	1,793	29,783
Switzerland	3	27	122	433	14,333
Belgium	0	10	122	705	N/A
Total Top 10	4,159	7,535	16,808	35,279	748
South Korea	54	81	120	162	200
Singapore	0	0	2	3	N/A

China, and South Korea to a lesser extent, appear to be growing at slower rates. The large numbers speak to the contagiousness of COVID-19, but these slowdowns are likely due to governmental intervention and also the actions of the individuals within each of these countries.

CONCLUDING THOUGHTS ON MORTALITY

Mortality appears to be highest for the older ages and those with impairments, particularly related to respiratory and immune systems. Mortality appears to be higher for males than females and those with higher BMIs.

Mortality is still increasing and it appears that the sooner action is taken the better for containing COVID-19. Interventions include quarantines, social distancing, wearing masks, and more frequent testing.

In any work you might do as a life insurer using the relative numbers presented here, remember to consider the second-order deaths and likely less accidental deaths during confinement.

Will the mortality associated with the COVID-19 impact your life insurance business? The short answer is yes, but by how much depends on the many factors mentioned above as well as your exposure to the more at-risk individuals.

What we don't know is whether the virus will come back again after confinement is eased or be seasonal and whether the vaccines or medications developed will be available for the new version. We also don't know how long it takes for one to no longer be contagious and whether those who recover will have possible immunity or long-term breathing issues and possibly reduced lung capacity.

It is recommended that you follow the outbreak and causes of death coming in this year to help better understand your business and be able to take any needed action. There are many good sources of data for you to follow; some are contained in the references in this paper. Hopefully, we can learn from the current situation and be stronger and more prepared for the next time.

Underwriting

Underwriting is an important component for a company to help protect itself with respect to mortality from future business written during this pandemic, a reoccurrence of COVID-19, or any other pandemic that may follow.

Applications and products may need to be changed, but the discussion here is going to be on what can be done in the short term. The following are some ideas to help companies better protect themselves during these turbulent times. This list is not meant to be all inclusive and some of the items may not be relevant or appropriate to your specific circumstances.

- Look at the early causes of death on guaranteed issue business and if you find you are being selected against from the pandemic, suspend sales of this product until the pandemic is over.
- “Current” medical records may not be available because of closings or the priority of treating patients. Medical and paramedical exams may not be able to be conducted. Therefore, you will likely need to rely more on the information from your vendors, but you could also consider using the algorithm within your accelerated underwriting to help assess applicants.
- Underwriters are probably more important now than ever, so don’t move to automating more decisions at this point.
- A supplemental COVID-19 questionnaire would be recommended. This could involve the usual questions about countries visited and exposure to COVID-19, potential symptoms, and whether one has been tested, but it could also include questions regarding items such as working at home and local travel to places where an infection may occur. However, note that a question about exposure may be difficult to answer because many people do not honestly know whether or not they have been exposed. A question about following recommended CDC practices, or even knowledge about them, could be helpful.
- More tele-underwriting interviews are likely needed. For example, if you write business on a simplified issue or non-medical basis without the tele-underwriting interviews, consider adding them. The term “tele-underwriting interview” was purposely used here to distinguish it from confirmation of information through a phone call. The latter should be kept if that is part of your normal underwriting process, but what is being suggested here is adding an interview with appropriate questions.
- If a tele-underwriting interview is not part of your accelerated underwriting program, consider adding one or suspending the waiving of underwriting requirements until the pandemic is over.
- You may want to add a few extra questions for the elderly applicants or those with impairments more likely to be impacted by the virus (i.e., cardiovascular disease, diabetes, chronic respiratory disease, high blood pressure, and cancer) during the tele-underwriting interview. These questions could include a deeper dive into possible exposure.
- Consider postponing those who have contracted the virus.
- While not allowed in all states, a catch-all type question could be a good one to have in the application. This would need to wait until your next application filing, but maybe states will be more open to this in light of the pandemic.
- Have a resource available to answer questions and address concerns specifically from the applicants.

The ideas above should allow for the continued issuance of appropriately priced profitable business and to help mitigate concerns about the pandemic. It is possible that you might find these changes to be good business practices for the future, rather than just short-term changes. Learn from this and make any necessary changes in your next filing.

Finally, if your company is not already doing it, this would be a great time to set up a monitoring program, to identify and later study everything that is found in the underwriting process and by what method, i.e., application, tele-underwriting call, other vendor, as well as synching up the cause of death with the underwriting information received. This information could be invaluable, even beyond the current situation.

In a crisis, clarity can be elusive. When the new normal bears little resemblance to the past, and data and information for decision making are in short supply, organizations turn to their trusted advisors to help them find a way forward. For more than 70 years, Milliman has been among the most trusted of those advisors to the Life insurance industry.

Our ongoing efforts are helping our clients understand, anticipate, and respond to the full range of possible impacts from this public health crisis. Milliman is advising the full spectrum of stakeholders to help them answer important business questions. We are:

- helping insurers make certain they have **adequate financial reserves and sufficient capital**
- supporting insurers with the adjustment of their **enterprise risk management and ORSA frameworks**
- measuring how this crisis affects **life insurance products' design, pricing, valuation, and reinsurance**

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