Excess Mortality in Australia

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Summary

The authors have been analysing excess mortality in Australia throughout the pandemic. Results are summarised as follows:

- In 2020, despite 900 COVID deaths, total deaths were 3% lower than predicted (-4,500). The driver was lower deaths from respiratory disease. This was due to measures introduced to limit COVID, such as lockdowns, border closures and social distancing. The measures directly reduced respiratory deaths and had secondary impacts on other causes of death, primarily dementia.
- In 2021, total deaths were 2% higher than predicted (+3,200). The excess included almost 1,400 COVID deaths. Respiratory deaths were again much lower than predicted, as were dementia deaths. All other causes except cancer were higher than predicted.
- For the first six months of 2022, total deaths were 13% higher than predicted (+11,200). There were 5,600 COVID deaths, representing just over half of the excess. Respiratory deaths continued to be lower than expected, however deaths from all other causes were significantly higher.

In July to September 2022, there were approximately 5,300 COVID deaths. Reported COVID deaths in July and August were the highest yet reported in the pandemic.

Of the possible explanations for non-COVID excess deaths in Australia in 2022, we believe that post-COVID sequelae and interactions with other causes of death are likely to be the most significant factor.

Methods

The Appendix goes into some detail on the available data and our approach.

In brief, Australian data on deaths is released monthly, based on date of death, with a three-month lag. It is categorised into high level causes of death based on the primary/underlying cause. We've used this data to build a model of expected deaths in the absence of the pandemic for 2020, 2021 and 2022, allowing for changes in population size and age distribution, and mortality improvements.

We used all the 2015-2021 data to build our models for most causes of death, but we have excluded 2020 and 2021 for respiratory causes and dementia on the basis that deaths from these causes in these years were too greatly affected by pandemic defence measures.

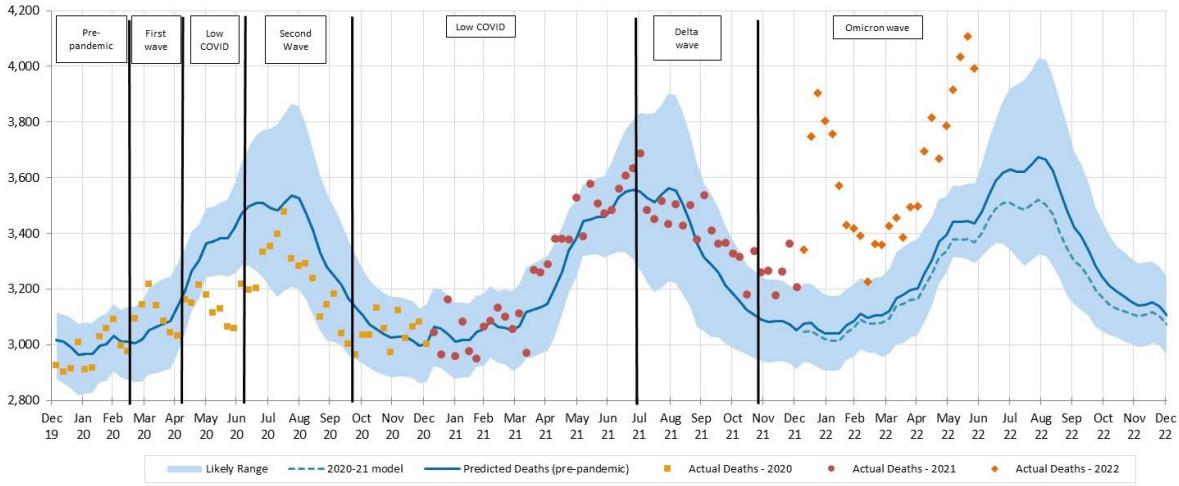
Detailed Results

All cause excess deaths to 30 June 2022

Figure 1 summarises our analysis from the start of 2020 until 30 June 2022. The graph shows weekly all-cause mortality. The blue line shows our predicted values and the blue shaded area is the 95% confidence interval. The yellow/red/orange dots are the actual number of deaths each week. We have also indicated the timing of the various COVID waves in Australia.

In 2020, deaths were close to or lower than predicted for most weeks. Deaths were significantly lower during winter. In 2021, deaths were close to predicted for most weeks until near the end of the year. So far, all but one week of 2022 has been above the 97.5th percentile.

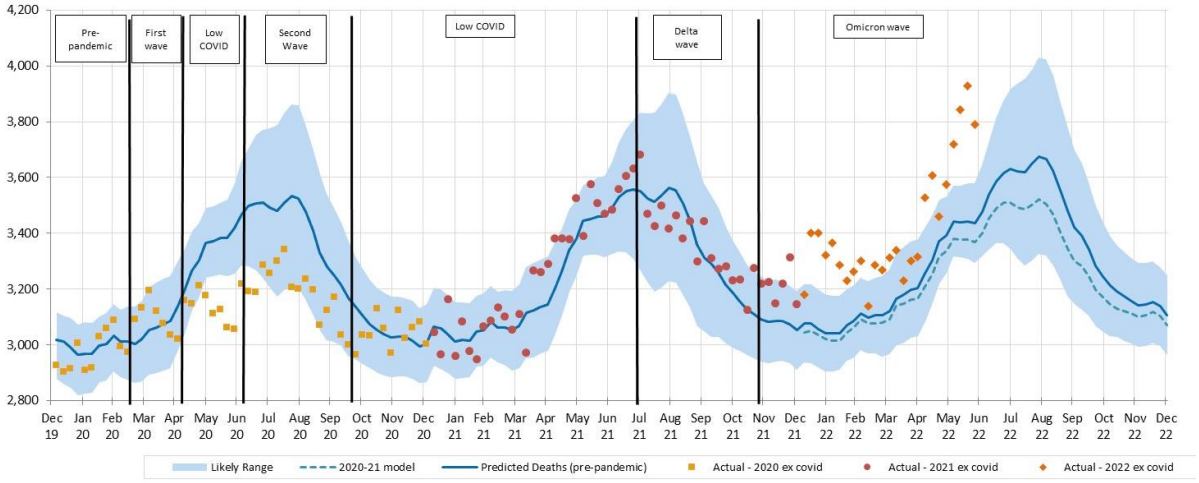
Figure 1 – Weekly actual and predicted deaths in Australia – All Causes



2020-2022 actuals include allowance for late reporting
Predicted deaths and ranges come from the fitted trend in each week's standardised death rate

Figure 2 shows the same information but with actual deaths excluding deaths from COVID-19. After excluding COVID deaths, most weeks in 2022 remain well above the 97.5th percentile.

Figure 2 – Weekly actual and predicted deaths in Australia – All Causes excluding deaths from COVID-19



2020-2022 actuals include allowance for late reporting
Predicted deaths and ranges come from the fitted trend in each week's standardised death rate

Excess deaths by cause

Table 1 shows the actual deaths, predicted values, excess and percentage excess for each cause of death for 2020, 2021 and the first six months of 2022. Note that Australia was only just entering the usual peak of winter deaths in June (the highest months for deaths are usually July to September). Cells coloured green or red are those where actual deaths are outside the 95th percentile.

2020

Despite 900 COVID deaths, total deaths were 3% lower than predicted (-4,500), driven by lower deaths from respiratory disease. This statistically significant outcome is due to measures introduced to limit covid, such as lockdowns, border closures and social distancing. The measures directly reduced respiratory deaths, and had secondary impacts on other causes, primarily dementia (pre-pandemic around 20% of dementia deaths had influenza/pneumonia as a contributory cause).

Diabetes deaths were higher than predicted, noting diabetes is associated with COVID. Much of the excess occurred during the first wave when testing was limited – we think that at least some of this excess is probably undiagnosed COVID deaths during that first wave.

Cancer deaths were only a little lower than expected, but this was statistically significant. Deaths from other causes were consistent with our prediction.

Table 1 - Excess deaths in Australia for 2020, 2021, and first half of 2022

Cause of Death	2020 (53 weeks)				2021 (52 weeks)				Jan to Jun 2022			
	Actual	Predicted	Excess	% Excess	Actual	Predicted	Excess	% Excess	Actual	Predicted	Excess	% Excess
COVID-19												
Doctor-certified	855	-	855	**100%**	1,242	-	1,242	**100%**	5,340	-	5,340	**100%**
Coroner-referred	51	-	51	**100%**	120	-	120	**100%**	280	-	280	**100%**
All COVID-19	**906**	**-**	**906**	**100%**	**1,362**	**-**	**1,362**	**100%**	**5,620**	**-**	**5,620**	**100%**
Doctor-certified other respiratory disease												
Influenza	45	750	(700)	**-94%**	2	800	(800)	**-100%**	200	120	70	60%
Pneumonia	2,140	3,030	(890)	**-29%**	2,140	3,110	(970)	**-31%**	1,050	1,320	(280)	**-21%**
Lower respiratory	6,850	8,100	(1,250)	**-15%**	7,300	8,110	(810)	**-10%**	3,630	3,640	(10)	0%
Other respiratory	3,280	3,800	(520)	**-14%**	3,770	3,880	(110)	-3%	1,750	1,790	(40)	-2%
All doctor-certified respiratory	**12,310**	**15,670**	**(3,360)**	**-21%**	**13,220**	**15,900**	**(2,690)**	**-17%**	**6,620**	**6,880**	**(250)**	**-4%**
Doctor-certified other diseases												
Cancer	48,750	49,430	(680)	**-1%**	49,580	49,390	190	0%	25,120	24,670	440	**2%**
Ischaemic heart disease	13,780	13,870	(90)	-1%	13,990	13,150	840	**6%**	7,290	6,390	900	**14%**
Cerebrovascular disease	9,160	9,230	(70)	-1%	9,180	8,850	330	**4%**	4,610	4,290	320	**7%**
Diabetes	5,020	4,630	390	**8%**	5,000	4,620	380	**8%**	2,690	2,390	300	**13%**
Dementia	14,760	15,580	(820)	**-5%**	15,550	16,080	(530)	**-3%**	8,520	7,760	760	**10%**
Other unspecified diseases	39,600	40,210	(610)	-2%	42,960	40,500	2,470	**6%**	22,440	20,010	2,430	**12%**
All other doctor-certified disease	**131,060**	**132,950**	**(1,890)**	**-1%**	**136,260**	**132,580**	**3,680**	**3%**	**70,670**	**65,530**	**5,140**	**8%**
Non-COVID-19 coroner-referred	**20,530**	**20,640**	**(100)**	**-1%**	**21,390**	**20,470**	**910**	**4%**	**10,930**	**10,320**	**610**	**6%**
Total	**164,800**	**169,300**	**(4,500)**	**-3%**	**172,200**	**169,000**	**3,200**	**2%**	**93,900**	**82,700**	**11,200**	**13%**

* Figures shaded green indicate that the observed values are below the 95% prediction interval while figures shaded red are above the 95% prediction interval

2021

Total deaths were 2% higher than predicted (+3,200), with the excess including almost 1,400 COVID deaths. Respiratory deaths were again much lower than predicted, as were dementia deaths.

Cancer deaths were as predicted. Other causes were 4% to 8% higher than predicted. It is unclear how much of this excess is due to pandemic-related impacts, how much may be an offset to the negative mortality displacement of 2020, and how much may be a slowdown in general mortality improvement.

2022 (first six months)

Total deaths were 13% higher than predicted (+11,200). There were 5,620 COVID deaths, representing just over 50% of the excess. COVID deaths in 2022 have far exceeded deaths from this cause earlier in the pandemic.

Respiratory deaths continue to be lower than expected (4% lower), despite influenza deaths in May and June – the first since April 2020.

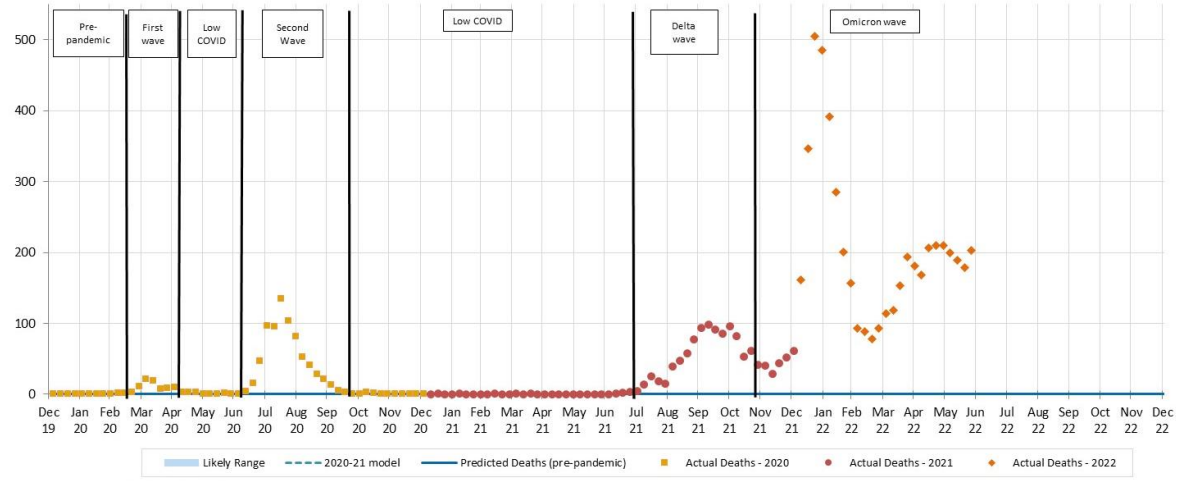
While cancer deaths are close to expected (2% higher), the difference is statistically significant.

Deaths from all other causes were significantly higher than predicted (by 6% to 14%). The "other diseases" category is a large catch-all, so it is difficult to infer the reason for this large increase. Historically, non-ischaemic heart diseases make up c25% of deaths from other unspecified causes.

Figure 3 to Figure 5 show weekly actual versus predicted deaths for selected causes. Interested readers can find the same charts for other causes of death at the end of our recent blog for the Actuaries Institute.

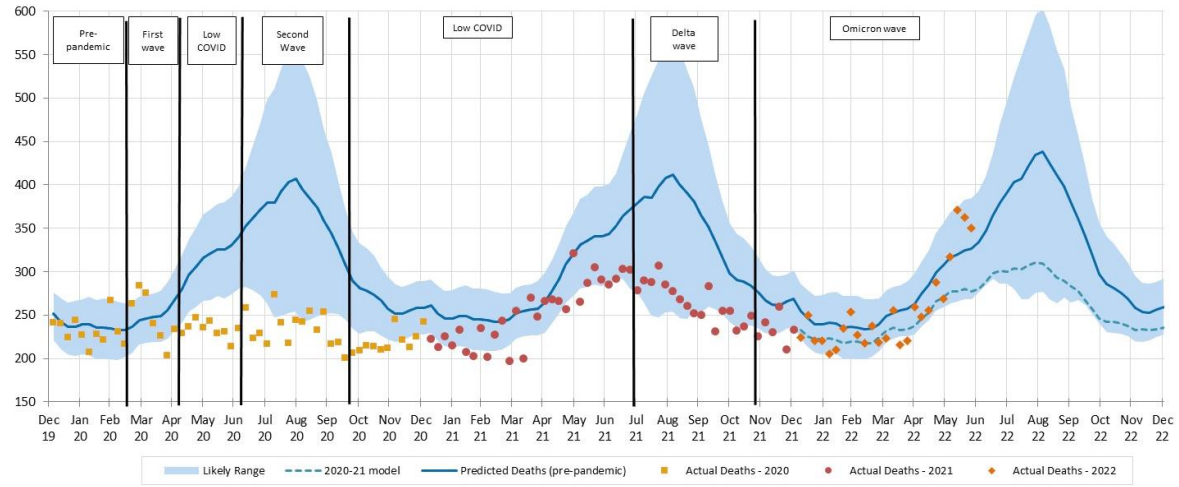
Figure 4 clearly shows the much lower than usual levels of respiratory disease in 2020 and 2021, with a lack of the usual winter hump. With flu again circulating in 2022 and the removal of almost all preventative measures, it remains to be seen what will happen in the remainder of winter 2022.

Figure 3 – Weekly actual and predicted deaths – Doctor-certified COVID deaths



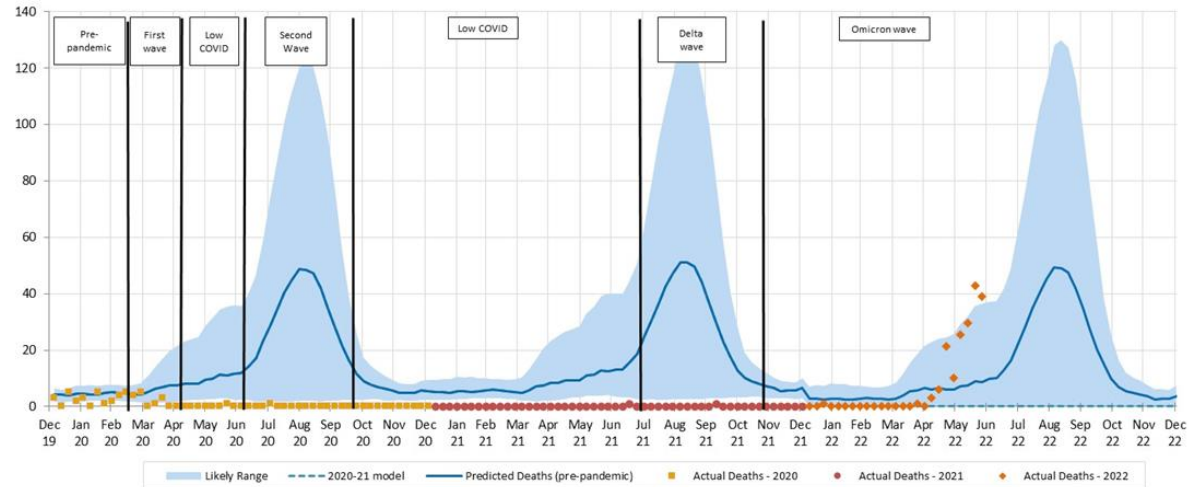
2020-2022 actuals include allowance for late reporting
Predicted deaths and ranges come from the fitted trend in each week's standardised death rate

Figure 4 – Weekly actual and predicted deaths – Doctor-certified deaths from respiratory disease



2020-2022 actuals include allowance for late reporting
Predicted deaths and ranges come from the fitted trend in each week's standardised death rate

Figure 5 – Weekly actual and predicted deaths – Doctor-certified deaths from influenza



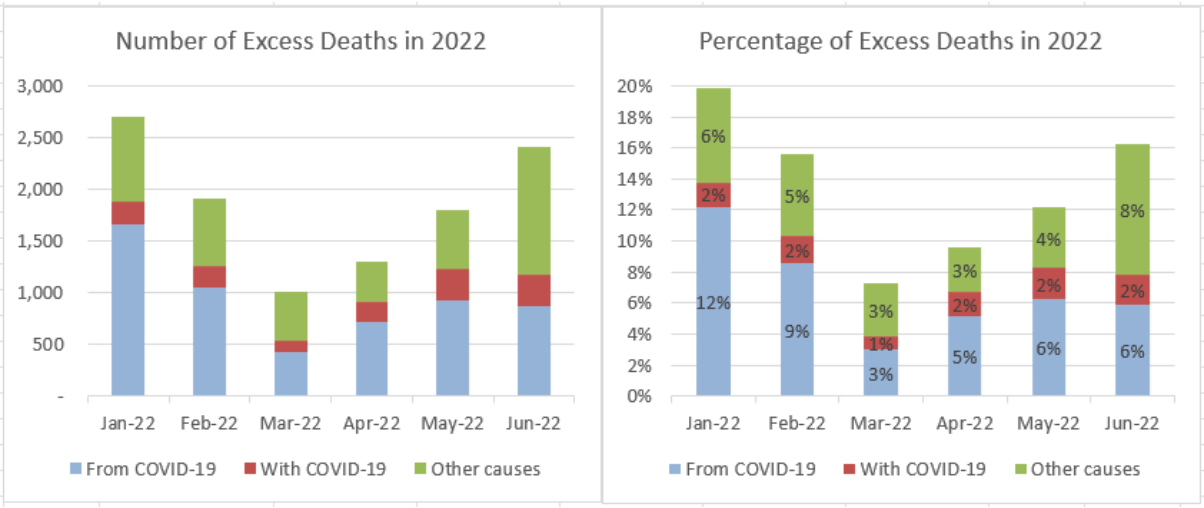
2020-2022 actuals include allowance for late reporting
Predicted deaths and ranges come from the fitted trend in each week's standardised death rate

There has been much interest in the Australian flu season in the hope that it will provide indications of what is to come in the northern hemisphere winter. Influenza surveillance reporting indicates that the flu season in Australia was earlier in the year than usual and that deaths peaked in July. Therefore, we expect that the higher deaths in June 2022 are a shift in timing rather than an indication of high excess mortality over the whole of 2022.

"From COVID" versus "With COVID" versus "Non-COVID"

Figure 6 shows the breakdown of excess deaths in the first six months of 2022 into those due to COVID, those with COVID (but with another primary cause of death), and those where COVID does not appear on the death certificate. We have shown both numbers of excess deaths and the percentage excess. June 2022 has the highest number of excess deaths not involving COVID-19.

Figure 6 – Excess Deaths by Involvement of COVID-19



Excess for July to September 2022

COVID Deaths

While the ABS Provisional Mortality Statistics data is only available up to the end of June 2022, surveillance COVID deaths are available up to the end of September 2022. Figure 7 shows the number of such deaths in each month since January 2020. The adjustment in September is to reflect missing days at the end of the month (due to changing from daily to weekly reporting).

In the three months to 30 September 2022, there have been approximately 5,300 COVID deaths. Reported deaths in July and August were the highest yet reported of the pandemic, with September considerably lower.

The ABS article COVID-19 Mortality in Australia shows the proportion of death certificates mentioning COVID-19 where it was the underlying cause. Figure 8 shows the proportion of registered COVID-related deaths that were "from" rather than "with" COVID.

The proportion of registered COVID deaths "from COVID" has reduced in 2022, from 88% in January, to 75% in May to July, and 70% in August. Many deaths are still to be registered in August, so this point is shown as a preliminary estimate.

Based on this analysis, we have estimated that 3,900 (74%) of the 5,300 COVID-deaths reported in July to September 2022, are "from COVID" rather than "with COVID". Our prediction model suggests that, without the pandemic, there would have been a total of around 47,200 deaths in the three months July to September 2022. Thus, COVID deaths represent around 8% extra mortality in that quarter.

Figure 7 – COVID deaths in Australia, reported from surveillance systems

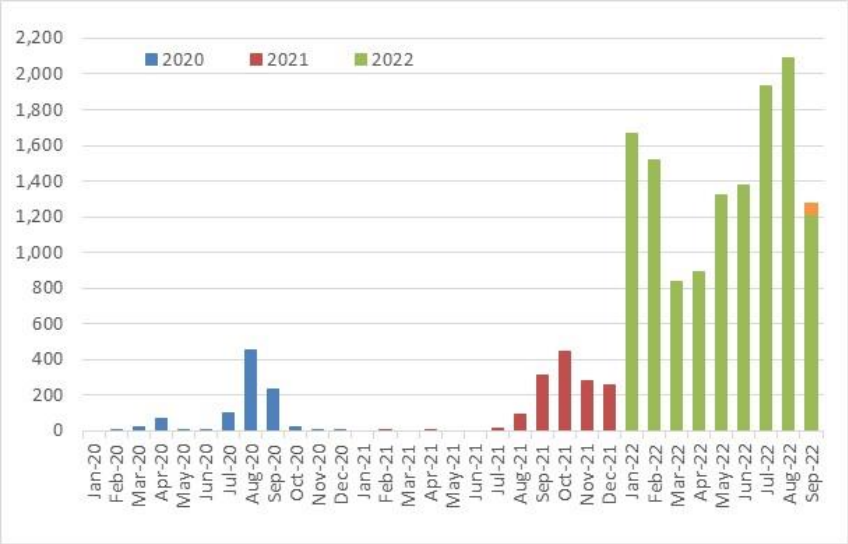
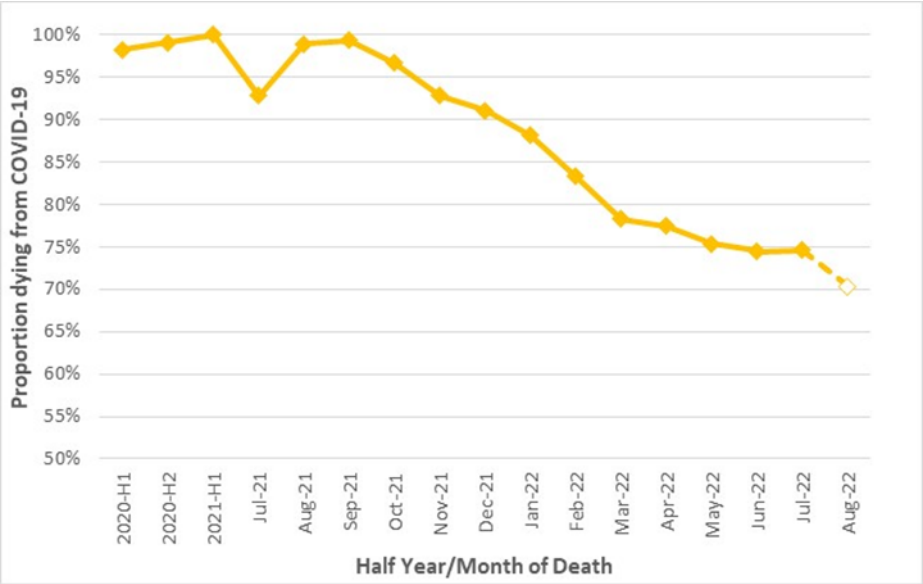


Figure 8 – Proportion of surveillance COVID deaths "from" COVID



Non-COVID deaths

There have been fewer deaths from respiratory diseases in this period than our pre-pandemic predictions. However, we consider it likely that mortality from non-COVID, non-respiratory causes will be higher than our pre-pandemic predictions, given the much higher-than expected mortality in the first half of 2022, and that this will outweigh the benefit from respiratory disease. Therefore, we expect that total excess mortality in July to September 2022 will have been higher than the 8% estimated COVID impact.

What could be causing the non-COVID-19 excess deaths?

The measurement of higher numbers of deaths than predicted does not tell us why this is occurring. There are a few reasons hypothesised around the world (where non-COVID excess is arising to a greater or lesser extent). It isn't possible to identify from death counts alone what is causing the non-COVID excess, but we have listed below the most likely explanations.

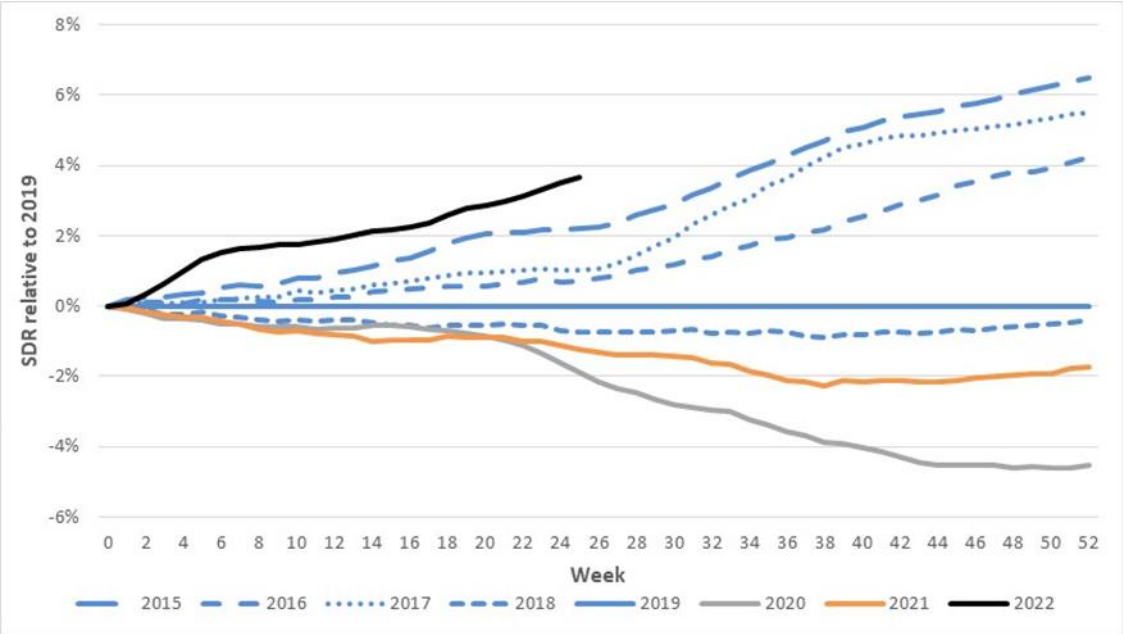
We note that multiple factors are likely in play, and different factors may be more or less pronounced at various times. The following indicates which factors, in our view, are likely to be having a greater or lesser impact on Australian excess mortality in 2022.

- **Post-COVID sequelae or interactions with other causes of death:** Studies have shown that COVID is associated with higher subsequent mortality risk from heart disease and other causes, but certifying doctors would generally not identify a **causative** link several months after recovery. Therefore, it seems likely that there would be more of these deaths than identified.
  Likely impact in Australia: **High**
- **Delayed deaths from other causes (mortality displacement):** Australia had negative mortality displacement (i.e. less deaths than expected) in the first year or so of the pandemic, resulting from the absence of many respiratory diseases. As such, some of the excess we have seen in 2021 and 2022 may be catch-up. People who otherwise may have died in those years had their systems been stressed by respiratory disease may now be succumbing to their underlying illnesses.
  Likely impact in Australia: **Moderate, likely to reduce over time**
- **Delay in emergency care:** Pressure on the health, hospital and aged care systems, including ambulance ramping and bed block, could lead to people not getting the care they require, either as they avoid seeking help, or their care is not as timely as in pre-pandemic times.
  Likely impact in Australia: **Low to Moderate**
- **Delay in routine care:** Opportunities to diagnose or treat non-COVID diseases (such as cancer) were missed for various reasons including fear and lack of opportunity. While delays in diagnostic testing do not yet appear to be resulting in higher cancer deaths, it may be a factor in higher deaths from other causes, such as heart disease and diabetes.
  Likely impact in Australia: **Low to Moderate, likely to increase over time**
- **Pandemic-influenced lifestyle changes:** There is evidence from the UK that a higher proportion of people made unhealthy lifestyle choices during lockdowns (e.g. drinking more alcohol and exercising less), and that these practices have continued. It is currently unclear to what extent similar factors may be affecting mortality in Australia in 2022. Typically, deaths directly caused by drug and/or alcohol abuse are relatively low, compared with those from other causes, but there would be an indirect impact.
  Likely impact in Australia: **Low**
- **Vaccine-related deaths:** while there have been deaths in Australia caused by the administration of COVID vaccines, the number of such deaths has been small. Of the 939 reports of death following vaccination, only 14 were found to have been caused by the administration of the vaccine, with the remainder being coincidental deaths from other causes.
  Likely impact in Australia: **Negligible**
- **Undiagnosed COVID-19:** Some of the excess deaths could be from unidentified COVID. This was apparent early in the pandemic, but seems less likely in 2022, particularly as post-mortem testing occurs where COVID is suspected.
  Likely impact in Australia: **Negligible.**

Standardised Mortality Rates

Figure 9 shows the cumulative standardised mortality rates (SDRs) for 2015 to 2022, expressed relative to the rate for 2019. The SDRs are from the Provisional Mortality Statistics, with allowance for late-reported deaths. This graph uses the same methodology as that produced by the UK's Continuous Mortality Investigation (CMI).

Figure 9 - Cumulative standardised mortality rate relative to 2019



The graph shows that:

- mortality rates improved over 2015 to 2019. Note that 2017 and 2019 were bad influenza years, with higher than usual deaths both from and related to influenza.
- 2020 mortality was considerably lower than 2019, reflecting the lower number of respiratory and respiratory-related deaths due to measures introduced to curb COVID-19.
- 2021 mortality was higher than 2020, with deaths from COVID during the Delta wave and excess mortality from other causes of death.
- mortality experience for the first half of 2022 is higher than for any other year shown.

Final thoughts

COVID-19 is expected to be the third leading cause of death in Australia in 2022, behind dementia and ischaemic heart disease, but ahead of strokes, lung cancer and colon cancer. The non-COVID excess mortality that commenced in 2021 is continuing to be significant throughout 2022, and it is hard to see how Australia can avoid double-digit excess mortality in the third quarter of 2022.

The outlook for the final quarter of 2022 is uncertain:

- COVID cases have been falling since early August in all jurisdictions and are currently at the lowest point so far in 2022, although case ascertainment is likely to have fallen considerably
- COVID hospitalisations have also been falling since early August
- We are not yet seeing the uptick in cases and hospitalisations observed throughout much of Europe in the last few weeks, although Australia usually follows the rest of the world
- Since 14 October, it is no longer mandatory to isolate if COVID-positive, and mask mandates have recently been removed in all settings other than health and aged care
- The vaccination program has stalled. While we have high coverage (>95%) of the 16plus population for the primary series, only 70% have had a first booster and 25% a second booster. Around 75% of 12-15yrs and 40% of 5-11yrs have completed the primary series, with boosters unavailable to these groups, and vaccines are only available to immunocompromised 0-4yrs. There may be a bump in vaccination rates with the roll-out of the bivalent booster this week, however, only around 25% of the population has had a vaccination within the last six months.

With uncertainty over the possible causes of non-COVID excess mortality, it is difficult to predict trends in these deaths. We will be continuing to monitor trends closely as more data (by cause, age and other categories) becomes available.

If you would like regular updates of Australian excess mortality you can follow Karen (@KarenCutter4) and Jennifer (@Actuarialeye) on Twitter.

18 October 2022

APPENDIX

Available data

Pre-pandemic, mortality statistics for Australia were released with quite some delay after deaths occurred. For example, death statistics for 2019 were released in mid-October 2020, and this only covered deaths notified by the end of 2019. With around 6% of deaths being reported after the year of occurrence, it would not be until October 2021 that complete data for the 2019 year of occurrence was available.

With the pandemic driving interest in mortality, the Australian Bureau of Statistics (ABS) started releasing Provisional Mortality Statistics in June 2020 to provide some data in a more timely manner. In some ways, this data is richer than the annual reporting (e.g. it includes weekly numbers of deaths), but many metrics are summarised. The ABS reports deaths in total and broken down by:

- nine major causes of death for doctor-certified deaths, with coroner-referred deaths shown separately. Categorisation is based on the primary/underlying cause of death;
- gender and age, grouped into five broad age bands; and
- state/territory.

Age-standardised death rates (SDRs) are also provided by cause and gender.

Importantly, the data is compiled by date of death (rather than by date of registration). While this makes the task of lining up with significant events much easier, it also means that the ABS delays providing the data until the bulk of late registrations have been received. For example, the data to 30 June 2022 was released on 30 September 2022.

Approach

What are we trying to measure?

Excess deaths are the difference between actual and predicted deaths. How we define predicted deaths is essential to this comparison, particularly as the excess is the difference between two large numbers. The excess can change substantially, depending on what is used as the predicted value.

We have defined predicted deaths as the number of deaths that we would expect if there were no pandemic and pre-pandemic mortality improvement had continued.

This allows us to clearly attribute excess deaths, either directly or indirectly, to the pandemic.

A "driver-based" approach

We describe our approach as a "driver-based" approach. That is, we want to understand not only how many excess deaths there may be but also why excess deaths are occurring.

Our analysis is built up from prediction models for each of the major causes of death. Cause is the most useful driver available to us in the published data. The other available subdivisions (age/gender or state/territory) are less explanatory, as they are for all causes combined. The breakdown by cause helps us to answer questions about why mortality may have changed.

Our approach also makes explicit allowance for population growth and ageing. In Australia, the increase in deaths from these sources is greater than the benefit of mortality improvement, so the number of deaths increases each year. Without this allowance, we would overstate excess mortality.

Specifically, we have:

- based our modelling on SDRs for each cause reported by the ABS, thus automatically dealing with the impact of population and age changes
- normalised the data to allow for seasonality
- fitted weekly linear regression models to the normalised data
- applied forecast reconciliation techniques to ensure that the sum of our individual cause of death models "added up" with appropriately
- adjusted actual SDRs for an expected small number of late-registered deaths, based on past reporting patterns
- compared adjusted actual and predicted SDRs
- for ease of communication, re-expressed findings in terms of numbers of deaths.

Which historical years to use?

Other analyses of excess deaths base predicted values on some sort of average (or trend). For 2020, we did this too. We used the 2015-19 years to derive our trend of SDRs.

We felt that it was not appropriate to include 2020 in deriving expected 2021 deaths in the absence of the pandemic. There had clearly been an impact on non-COVID causes of death in 2020 (for example, as we shall see later, respiratory deaths and dementia were lower than expected). So, for 2021, we also used 2015-19 to set the baseline, noting that that would differ from the 2020 baseline because of trends and demographic changes.

We felt that we should vary this approach for 2022, because the 2015-19 years were now getting a little old. After much careful consideration, for 2022:

- We decided to use the 2015-19 years to form our predictions for respiratory deaths and dementia on the basis that 2020 and 2021 experience for these causes was materially affected by the pandemic. We have also shown the average experience in 2020-21, for reference, when analysing mortality from these causes.
- For the other causes, we used the 2015-21 years to form our predictions, on the basis that it is likely that 2020 and 2021 experience more closely reflects a slow-down in underlying mortality improvement than the impacts of the pandemic.

This approach results in a higher baseline for deaths from respiratory disease and dementia than would be the case if we had included 2020 and 2021 data in determining the trend. Including 2020 and 2021 in determining the trend for other cases (excluding COVID-19) has also increased the baseline relative to the 2015-19 trend. However, we consider it to be our best estimate of expected 2022 deaths in the absence of a pandemic.

The baseline for our estimates of excess deaths remains "in the absence of the pandemic" for each of the three years 2020 to 2022. We have not included any COVID deaths in the baseline, as these would not exist in the absence of the pandemic.