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# Real-time suicide mortality data from police reports in Queensland, Australia, during the COVID-19 pandemic: an interrupted time-series analysis

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## Summary

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**Background** Deaths by suicide can increase during infectious disease outbreaks. This study analysed suspected suicide rates in 2020 relative to 2015–19 to assess any early effects of the COVID-19 pandemic in Queensland, Australia.

**Methods** We analysed data from the interim Queensland Suicide Register (iQSR), a state-wide real-time suicide surveillance system, using an interrupted time-series design. The data source for the iQSR is the Form 1 police report of a death to a coroner. Two QSR staff independently classed the probability of a death by suicide as possible, probable, or beyond reasonable doubt. The analysis included the probable or beyond reasonable doubt categories as suspected suicides. The primary outcome was the monthly suspected suicide rate. We applied Poisson and negative binomial regressions to assess whether Queensland's Public Health Emergency Declaration on Jan 29, 2020, affected suspected suicides from Feb 1 to Aug 31, 2020. Secondary outcomes included absolute or relative changes in police-reported motives of recent unemployment, financial problems, domestic violence, and relationship breakdown.

**Findings** 3793 suspected suicides were recorded with an unadjusted monthly rate of 14·85 deaths per 100 000 people (from Jan 1, 2015, to Jan 31, 2020) before the declaration, and 443 suspected suicides were recorded with an unadjusted monthly rate of 14·07 deaths per 100 000 people (Feb 1, 2020, onwards) after the declaration. An interrupted time-series Poisson regression model unadjusted (rate ratio [RR] 0·94, 95% CI 0·82–1·06) and adjusted for overdispersion, seasonality, and pre-exposure trends (RR 1·02, 95% CI 0·83–1·25) indicated no evidence of a change in suspected suicide rates. We found no absolute or relative increases in the motives for suspected suicides, including recent unemployment, financial problems, relationship breakdown, or domestic violence from February to August, 2020, compared with the pre-exposure period.

**Interpretation** There does not yet appear to be an overall change in the suspected suicide rate in the 7 months since Queensland declared a public health emergency. Despite this, COVID-19 has contributed to some suspected suicides in Queensland. Ongoing community spread and increasing death rates of COVID-19, and its impact on national economies and mental health, reinforces the need for governments to maintain the monitoring and reporting of suicide mortality in real time.

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## Introduction

Previous evidence has shown that deaths by suicide can increase during infectious disease outbreaks. Suicides increased during the 1918–20 influenza pandemic in the USA,<sup>1</sup> and suicide rates increased among adults aged 65 years and older during the severe acute respiratory syndrome (SARS) outbreak in Hong Kong.<sup>2–4</sup> In Australia, dynamic modelling has indicated a 25–50% increase in suicides annually that could increase current nationwide suicides from 3000 to 3750–4500 deaths per annum in the next 5 years.<sup>5</sup> The second monthly suicide data report of the Coroners Court of Victoria, released on Oct 5, 2020, indicated that the number of deaths by suicide in the state of Victoria, Australia, in 2020, was four less than those reported on Sept 30, 2019.<sup>6</sup>

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that causes COVID-19 and the associated COVID-19 pandemic might increase deaths by suicide by affecting vulnerable groups and the economy.<sup>7–9</sup> Specifically, mechanisms might include increased anxiety, depression, alcohol use, or entrapment due to increased isolation, uncertainty, domestic violence, economic hardship, and reduced social opportunities.<sup>9</sup> However, there is little evidence that being infected with a coronavirus directly influences suicidal behaviour.<sup>10</sup> Monitoring and reporting the effect of the COVID-19 pandemic on real-time suicide mortality is an important research priority.<sup>7,11</sup> Although suicide rates could rise, this is not inevitable because of the public health responses that might mitigate suicide risk.<sup>7</sup>

Australia first reported SARS-CoV-2 in the state of Victoria on Jan 25, 2020. The state of Queensland in

## Research in context

### Evidence before this study

Evidence before the study included analysis of suicide count and rate changes during the 1918–20 Spanish flu pandemic and the 2003 severe acute respiratory syndrome outbreak in Hong Kong. We searched PubMed on Sept 18, 2020, for “COVID” and “suicid\*” in the title or abstract and obtained 171 results. No language restrictions were applied to the search. The empirical articles on COVID-19 and suicide mortality thus far are mostly case studies. We did not locate any real-time analyses of suicide mortality data in 2020. Other published articles on suicide and COVID-19 have been modelling studies of suicide counts and rates, editorials, and commentaries.

### Added value of this study

This research shows no immediate increase in suicide rates after the COVID-19 lockdown, in Queensland, Australia, a state that

has had a relatively low number of COVID-19 cases. To our knowledge, this is the first study reporting suicide rates in an analysis considering seasonality and pre-exposure trends.

### Implications of all the available evidence

Our findings are supported by the Coroners Court of Victoria’s recently released descriptive statistics of 2020 suicide counts by sex, age, and year for the state of Victoria in Australia showing no overall increase in 2020. These findings are not consistent with predictions of increases in deaths by suicide during the COVID-19 pandemic. However, COVID-19 appears to have been associated with some suicides, reinforcing that close monitoring of suicide mortality data and public mental health during the COVID-19 pandemic is a priority.

Australia first detected a case on Jan 29, 2020, and declared a public health emergency the same day. WHO characterised COVID-19 as a pandemic on March 11.<sup>12</sup> On April 2, the Queensland Government issued a directive restricting leaving principal residences only for essential needs, allowing outdoor gatherings of only two people or with household members, receiving only two visitors at residences, and prohibiting gathering in non-residences. On April 9, the Queensland Government prohibited non-essential business unable to be conducted remotely. These restrictions began to ease in three stages, from May 15, June 1, and July 3.

The most recent Australian causes of death data indicated that Queensland accounted for 23·6% of all deaths by suicide in Australia, and had the second highest count after New South Wales.<sup>13</sup> Queensland also has a notable proportion of Aboriginal and Torres Strait Islander people, who often have higher suicide rates than non-Aboriginal people.<sup>14,15</sup> They accounted for 4·6% of people residing in Queensland and 27·7% of Aboriginal and Torres Strait Islander people living in Australia in 2016.<sup>16</sup> These statistics emphasise the need to study real-time suicide mortality data in Queensland. The objective of this study was to assess the early effect of COVID-19 on suicide rates from February to August, 2020, in Queensland, Australia.

## Methods

### Study design

We used an interrupted time-series design to analyse data from Jan 1, 2015, to Aug 31, 2020. Interrupted time-series analyses have been used to assess whether exposure to recessions has increased suicides after accounting for seasonality and pre-exposure non-linear trends.<sup>17,18</sup> This study uses data from a state-wide real-time suicide surveillance system in Queensland, Australia. The interim Queensland Suicide Register (iQSR), established in 2011, is part of the Queensland Suicide Register, which contains all suspected suicides by Queensland residents

from 1990 onwards. The iQSR and QSR differ in data availability, years, and the number of variables. The iQSR has data for suspected suicides dating from 2011 to present day, is based only on the police reports, and reports data according to 107 variables. In addition to police reports, the QSR includes data from post-mortem, toxicology, and coroners’ finding reports, and reports data according to 519 variables. QSR has records from 1990 to 2016. All analyses in this study used iQSR data.

Numbers of suicides will increase slightly after being finalised by coroners and then moving from the iQSR to the QSR because of misclassification and obtaining suspected suicides not originally received from police or the Coroners Court of Queensland. We also identified additional suicides in other intent categories (ie, undetermined intent, unintentional, unlikely to be known) or case types (body not recovered) in the National Coronial Information System.

The Victorian Department of Justice and Community Safety Human Research Ethics Committee (application number CF/18/12771) and the Griffith University Human Research Ethics Committee (application number 2010\_537) approved this research. We protected data by storing it as de-identified data on secure network drives.

### Procedures

The sole data source for the iQSR is the Form 1 police report of a death to a coroner. These reports inform coroners of the circumstances of the death and characteristics of decedents, to assist forensic pathologists and coroners in determining the cause of death and potential intent of the deceased. The police reports include information from next of kin, friends, family, or acquaintances of the decedent. Two QSR staff independently class the probability of the death being a suicide as possible, probable, or beyond reasonable doubt.<sup>11</sup> The analysis included the probable or beyond reasonable doubt categories as suspected suicides and

	2015 to Jan 28, 2020	Jan 29 to Aug 31, 2020
<b>COVID-19 demographics</b>		
Active cases	NA	27
COVID-19 infections (recovered)	NA	1122*
COVID-19 PCR tests	NA	895789
COVID-19 deaths	NA	6
Estimated (2017) or projected (2020) population at the period midpoint	5 026 827†	5 290 158‡
<b>Suspected suicides</b>		
Men	2888/3793 (76.1%)	344/443 (77.7%)
Women	905/3793 (23.9%)	99/443 (22.3%)
Age, years	44.37 (17.83)	43.25 (18.29)
Data are mean (SD) or n/N (%), unless otherwise indicated. NA=not applicable. *1084 people recovered from COVID-19. †June, 2017. ‡May, 2020.		
<b>Table 1: COVID-19 counts and suspected suicides in the interim Queensland Suicide Register before and after the emergence of the pandemic</b>		

was limited to Queensland residents because ethical approval to retain data on non-residents was only obtained in 2019. Excluded suicides (categorised as possible) might also be other sudden deaths due to accident, illness, or homicide.

The iQSR receives police forms of suspected suicides from police officers as they email their reports to coroners. A cross-check with the Coroners Court of Queensland occurred monthly to obtain missed cases.

The end month for the analysis was the most recent month with the cross-check finalised (August, 2020). SL, KK, and DC had full access to the database to conduct the analyses. We cross-checked missing demographic information with the National Coronial Information System. The iQSR methodology is discussed in detail elsewhere.<sup>19</sup> We limited demographic effect modifiers of rates to sex.

### Outcomes

The primary outcome was the monthly suspected suicide rate. We added the log-transformed age-standardised population (in person-years) as an offset variable in analyses to convert the count into a rate and adjust for population changes over time. We obtained quarterly population estimates by single year of age, by sex, for Queensland, from the Australian Bureau of Statistics.<sup>20</sup> We used these estimates to interpolate linearly to obtain figures for intervening months. These figures ranged from an estimated resident population of 4 828 860 in 2016 to a projected population of 5 304 969 in August, 2020 (a 9.86% increase). Relative effect size measures were rate ratios (RRs) with 95% CIs. Demographic effect modifiers of rates were limited to sex.

Secondary outcomes of interest included absolute or relative changes in the police-reported motives<sup>12</sup> of recent unemployment, financial problems, domestic violence, and relationship breakdown, as COVID-19 might exacerbate these motives.<sup>5,13</sup>

We ran negative binomial regressions as sensitivity analyses to assess the effects of overdispersion and autocorrelation. We assessed the effects of autocorrelation by setting the scale parameter to  $\times 2$  in the negative binomial regression. For the free-text incident summaries of police reports, we did an inductive thematic analysis of suspected suicides in which police officers mentioned COVID-19. This involved using and abstracting the descriptions given by police officers into major themes.

### Statistical analysis

We proposed a level change a priori as an impact model. Although modelling interventions (in this case an exposure) implemented gradually as a gradual (slope) change is possible,<sup>21</sup> we did not expect the Queensland Government declaring a public health emergency in Queensland on Jan 29, 2020, to increase suicide rates immediately. However, we did expect it to increase anxiety and stress that could contribute to increased suspected suicides in subsequent months. There is well known seasonality in suicidal behaviour, with peaks in spring and summer.<sup>22–24</sup> Thus, we would also typically expect decreases in suicide counts, and rates, heading into autumn and winter in Queensland (March to July data), which we hypothesised would be less pronounced because of the COVID-19 pandemic.

Descriptive statistics produced included a scatterplot of pre-exposure trends and summary statistics before and after the exposure. We expected and observed overdispersed count outcome data ( $M=62.42$  and variance= $76.07$ ). Therefore, we set the scale parameter to  $\times 2$  in the Poisson regression model to allow the variance to be proportional to the mean. We adjusted for seasonality by including Fourier terms consisting of four sine/cosine pairs (one fundamental plus three harmonic). We used restricted cubic splines based on five knots and placed at the fifth, 27.5th, 50th, 72.5th, and 95th percentiles to address non-linearities in pre-exposure trends.<sup>25</sup>

We calculated the risk ratio for police-reported motives and triggers for suspected suicides by using the cohort study risk-ratio calculator in Stata, requesting test-based 95% CIs and Fisher's exact p values.

We did all analyses in Stata Version 13.1. The Stata code and raw aggregated data used for analysis are presented in the appendix (pp 9–19).

### Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. All authors had full access to all the data in the study and all had responsibility for the decision to submit for publication.

### Results

Suspected suicides increased by 13 (1.8%) in 2015 and by 16 (2.36%) in 2016 after moving from the iQSR to the QSR (2017 data were still in the iQSR). This increase

See Online for appendix

justified relying solely on iQSR data for analyses. The subsequent analysis of iQSR data included 4236 suspected suicides, excluding 152 deaths classed as possible suicides and 36 deaths of people from other states or countries. Before the Public Health Emergency Declaration on Jan 29, 2020, in Queensland, the iQSR recorded 3793 suspected suicides (table 1) with unadjusted monthly rates (including the full month of January) of 14.85 suspected suicides per 100 000 people, and after the declaration it recorded 443 suspected suicides with unadjusted monthly rates (from February onwards) of 14.07 deaths per 100 000 people. The breakdown by sex and mean age was similar before and after the exposure (table 1). The counterfactual indicated that continuation of the pre-exposure trend would have resulted in a slightly higher RR after the exposure (appendix p 3). Similarly, the unadjusted and seasonally adjusted trends (figure) indicated that there was a slight decrease in the suspected suicide rate after the first case of COVID-19 in Queensland. As of Aug 31, 2020, 27 active cases of COVID-19 were identified, along with 895789 COVID-19 tests done, 1122 cumulative cases, 1084 recovered cases, and six deaths attributed to COVID-19 in Queensland.

The first unadjusted Poisson regression indicated no change in suicides after the Public Health Emergency Declaration (RR 0.94, 95% CI 0.82–1.06; table 2). Adjusting for seasonality moved the RR following the declaration closer to parity (RR 0.96, 95% CI 0.86–1.08; table 2) with the expected trend. Adjusting for pre-exposure non-linearity increased the COVID-19 Public Health Emergency Declaration RR slightly (RR 1.02, 95% CI 0.83–1.25; table 2).

We stratified the interrupted time-series analysis by sex with stratum-specific counts. There were null findings for the main Poisson models (table 2). The RR for men was 1.08 (95% CI 0.84–1.38) and for women was 0.84 (95% CI 0.53–1.32; table 2). Sensitivity analyses assessing the effect of the COVID-19 Public Health Emergency Declaration on suspected suicide rates in negative binomial regressions also produced null findings (table 2).

Compared with the pre-COVID-19 period from Jan 1, 2016, to Jan 31, 2020, there was no evidence that the counts from February to August, 2020, for police-reported motives or triggers for suspected suicides were different for recent unemployment, financial problems, relationship breakdown, or domestic violence (table 3).

For the thematic analysis of the free-text incident summaries of police reports from February to August, 2020, reporting police officers mentioned COVID-19 in 41 forms. In five reports, police officers described circumstantial information (eg, self-isolating, travel restricted, unable to see a partner, or working from home) and it was unclear if these circumstances influenced suspected suicides. In 36 other mentions, COVID-19 appeared to influence suspected suicides, through affecting mood, coping, stress,

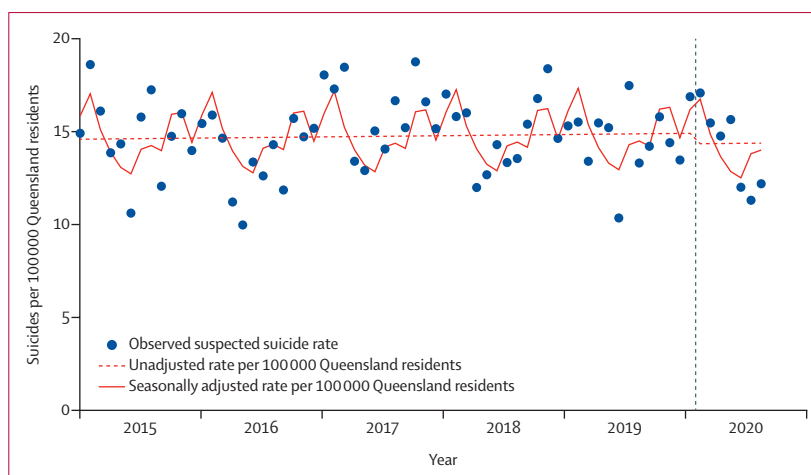


Figure: Monthly suspected suicide rate per 100 000 Queensland residents

	RR (95% CI)	p value
Unadjusted Poisson	0.94 (0.83–1.05)	0.27
Poisson, with scale parameter set to $\times 2$ to account for overdispersion	0.94 (0.82–1.06)	0.32
Poisson, adjusted for overdispersion and seasonality	0.96 (0.86–1.08)	0.50
Poisson, adjusted for overdispersion and pre-exposure non-linear trends	1.00 (0.79–1.26)	0.97
Poisson, adjusted for overdispersion, seasonality, and pre-exposure non-linearities	1.02 (0.83–1.25)	0.85
Negative binomial regression, adjusted for seasonality and pre-exposure non-linearities	1.02 (0.17–6.28)	0.98
Negative binomial regression, adjusted for autocorrelation, seasonality, and pre-exposure non-linearities	1.02 (0.83–1.26)	0.85
Poisson, adjusted for overdispersion, seasonality, and pre-exposure non-linearities in men	1.08 (0.84–1.38)	0.56
Poisson, adjusted for overdispersion, seasonality, and pre-exposure non-linearities in women	0.84 (0.53–1.32)	0.44

RR=rate ratio.

**Table 2: Poisson and negative binomial regressions assessing the effect of the COVID-19 Public Health Emergency Declaration on suspected suicide rates from Jan 1, 2015, to Aug 31, 2020**

and anxiety (n=20); employment (n=16); health care (n=5); social isolation (n=5); financial problems (n=2); and relationship breakdown (n=1). These suspected suicides totalled 49, with some people, for instance, losing employment, which subsequently affected mood and levels of isolation.

## Discussion

This study using a real-time suicide surveillance system in Australia showed that the COVID-19 pandemic had no effect on suspected suicide rates for the first 7 months after the Public Health Emergency Declaration in Queensland (February to August, 2020).

Using an interrupted time-series analysis design, Poisson and negative binomial models unadjusted and adjusted for overdispersion, seasonality, and pre-exposure trends indicated no evidence of a change in the suspected suicide rate after the Public Health Emergency

	Number		Risk		Risk difference (95% CI)	Risk ratio (95% CI)	p value*
	Pre-COVID-19†	Post-COVID-19‡	Pre-COVID-19	Post-COVID-19			
Recent unemployment	184/3063	32/434	0.06	0.07	0.01 (-0.01 to 0.04)	1.23 (0.85 to 1.76)	0.29
Financial problems	304/3063	41/434	0.10	0.10	-0.01 (-0.04 to 0.03)	0.95 (0.70 to 1.30)	0.80
Relationship breakdown	719/3063	95/434	0.24	0.22	-0.02 (-0.06 to 0.03)	0.93 (0.77 to 1.13)	0.51
Domestic violence	137/3063	24/434	0.05	0.06	0.01 (-0.01 to 0.03)	1.24 (0.81 to 1.89)	0.33

Pre-COVID-19 and post-COVID-19 refer to before and after the declaration of a public health emergency in Queensland on Jan 29, 2020. January, 2020, is included in the pre-COVID-19 data as most of January occurred before the declaration. \*Two-sided Fisher's exact p value. †Cases from 2015 excluded because data on these motives were not collected. ‡Data reported from February, 2020, to August, 2020, excluding nine suspected deaths that occurred Jan 29–31, 2020.

**Table 3: Proportions of post-COVID counts for motives or triggers potentially exacerbated by COVID-19 compared with 2016 up to January, 2020**

Declaration from February onwards. Similarly, the Coroners Court of Victoria recently reported no increase in counts in 2020 in Victoria, including data from Jan 1, 2016, to Sep 30, 2020, in their analysis.<sup>6</sup>

COVID-19 has been directly associated with 36 suspected suicides in Queensland from February to August, 2020. However, whether COVID-19 was the sole precipitant of the suspected suicide remains unclear. We found that an effect on mood, stress, coping, and anxiety was most frequently cited as a motive, indicating that mental health support is warranted, especially for those with pre-existing mental health conditions or those who remain unemployed as the pandemic persists. As most deaths by suicide linked to COVID-19 were associated with psychological and psychosocial factors and precipitants, we might expect an increased effect of COVID-19 on suicides in countries and regions with more COVID-19 infections and deaths.

Current political decisions are crucial to influencing long-term effects as longer duration of unemployment is associated with an increased risk of suicide.<sup>26</sup> The Queensland and Australian Governments have implemented several economic interventions that might offset potential increases in suicide.<sup>27</sup> Active labour market programmes mitigate the adverse effects of unemployment on suicide during economic downturns.<sup>28</sup> Additionally, proactive outreach and supports for people with psychiatric disorders and other vulnerable groups who might experience worsening mental health during COVID-19, should be a public mental health priority.<sup>29</sup>

Strengths of this analysis include real-time data, monthly cross-checks with the state coroners court to obtain missing cases, and scrutiny of all suspected suicides by two independent reviewers to assess the probability of deaths being suicides. Additionally, quantitative variables on risk factors that might be exacerbated by COVID-19, and narrative information on COVID-19, provide specific insights into how COVID-19 might have affected the nature or incidence of suspected suicides.

Data availability bias might exist due to the varying completeness of police reports. Misclassification bias

might exist because we might not classify deaths involving overdoses of medications or substances as a probable suicide until autopsies are available. After moving iQSR 2015 and 2016 data to the QSR, the number of suicides increased by a small degree each year. These increases are due to some misclassification and locating additional suspected suicides through searching the National Coronial Information System.

Other limitations include that the estimated population rise in Queensland of almost 10% is considerable, and if overestimated, might underestimate current rates. Additionally, more extended pre-exposure and post-exposure periods are desirable. However, for the pre-exposure period, we have only back-coded probability ratings (ie, possible, probable, or beyond reasonable doubt) for data from 2015 onwards. The analysis also excluded suspected suicides of people from other states and countries; however, we received ethical approval to record these in 2019, meaning future analyses of the iQSR assessing the effect of COVID-19 might be able to include them.

Although these findings provide some short-term reassurance about the effect of lockdowns and stay-at-home orders, they do not give relief about long-term effects or information about other states or countries with more coronavirus cases and deaths. Further investigation is needed in other states and countries with real-time surveillance systems to confirm generalisability and assess the differential effects of COVID-19 compared with Queensland, where total cases have been relatively low. Future research with more power requires analyses stratified by age group, such as the analyses of suicides in older people during the SARS pandemic.<sup>2-4</sup>

Our findings underline the importance of a proactive approach towards mental health promotion and suicide prevention during the COVID-19 pandemic. Further monitoring and reporting in real-time suicide surveillance systems is necessary to determine short-term and long-term consequences of COVID-19.

**Contributors**

SL did the literature review, data cleaning, data analysis, and figure and manuscript preparation. EA and DC identified relevant literature.

KK and EA advised about the data analysis framework. DdL was involved in interpreting data and making critical intellectual revisions to the manuscript. All authors interpreted data and made critical intellectual revisions to the manuscript.

#### Declaration of interests

We declare no competing interests.

#### Data sharing

We have made available our raw data and programming code for replication in Stata or other statistical software. Readers interested in the data source can view the [template](#).

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