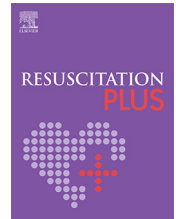


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Clinical paper

No apparent effect of the COVID-19 pandemic on out-of-hospital cardiac arrest incidence and outcome in Western Australia

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Abstract

Background: We examined the incidence, patient and arrest characteristics, and survival outcomes of out-of-hospital cardiac arrest (OHCA) in Western Australia (WA) in the first wave of the COVID-19 pandemic.

Methods: Adult OHCA cases attended by St John WA Emergency Medical Service (EMS) between 16th March and 17th May 2020 ('COVID-19 period') were compared with those for the same period in 2017-9. We calculated crude OHCA incidence for all OHCA cases and modelled the effect of the 'COVID-19 period' on 30-day survival for OHCA cases with EMS attempted resuscitation; comparing our results with those published for Victoria (Australia), which had a higher incidence of COVID-19.

Results: In WA there was no significant difference between the 2020 'COVID-19 period' (n = 423) and the same period in 2017-9 (n = 1,334) in the OHCA incidence in adults (117.9 vs 126.1 per 100,000 person-years, p = 0.23). In OHCA cases with EMS-resuscitation attempted, there was no change in bystander cardiopulmonary resuscitation rates. Despite an increase in EMS response time, neither the crude nor risk-adjusted odds ratio (aOR) for 30-day survival in 2020 was significantly different to 2017-9 (11.7% vs 9.6%; p = 0.45) (aOR = 1.19, 95% confidence interval 0.57-2.51, p = 0.65). This contrasts with a significant reduction in survival to hospital discharge reported in Victoria.

Conclusion: In WA, with a relatively low incidence of COVID-19, OHCA incidence and survival was not significantly different during the initial wave of the COVID-19 pandemic compared to the three previous years. Our study suggests that OHCA survival may be more closely related to the incidence of COVID-19 in the community, rather than COVID-19 restrictions per se.

Keywords: Out of hospital cardiac arrest, COVID-19, Incidence, Survival

Introduction

Fatalities from the novel coronavirus disease 2019 (COVID-19) pandemic are thought to extend well beyond the many deaths directly attributable to the virus (Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)).^{1,2} There have been numerous reports of the

impact of COVID-19 on time-critical emergencies, such as out-of-hospital cardiac arrest (OHCA).²⁻⁴ A recent systematic review reported an overall two-fold increase in OHCA incidence, longer ambulance response times, and a 33% decrease in the odds of survival of OHCA cases associated with the pandemic period, relative to previous years.³

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There are several possible mechanisms for indirect impacts of COVID-19 on OHCA.^{1,3} It has been proposed that increased incidence could arise from patients being less likely to report to hospital for acute medical care,^{5,6} including for cardiac issues, increasing the risk of cardiac arrest occurring outside of hospital.^{2,3,7–10} In terms of OHCA survival, societal restrictions on movement may lead to OHCA being less likely to occur in a public place, and therefore less likely to receive bystander cardiopulmonary resuscitation (CPR) and community defibrillation prior to ambulance arrival.³ There may also be important changes in ambulance availability and procedures – for example, effects on ambulance response time due to changes to overall emergency medical services (EMS) case load, and delays in patient treatment due to requirements for COVID-19 personal protective equipment (PPE) to be donned by paramedics.¹

Initial studies on the impacts of COVID-19 on OHCA focussed on jurisdictions with a high incidence of COVID-19, such as New York City,¹¹ Italy,⁷ France,⁵ and Spain¹² where the effect of COVID-19 on OHCA could be expected to be substantial. However, it remains unclear how strong those effects might be for jurisdictions with lower COVID-19 incidence.

In this paper, we measured the effect of COVID-19 on OHCA in a jurisdiction that experienced a relatively low incidence of COVID-19: Western Australia (WA). We examined whether there was a change in the incidence, patient and arrest characteristics, and survival outcomes of OHCA in WA during the period of the most stringent initial COVID-19 lockdown restrictions (16th March – 17th May 2020), relative to previous years. We compared the WA results against the published results from Victoria, which has been the worst COVID-19 affected state in Australia; accounting for more than two thirds of all COVID cases and 90% of all deaths in Australia.¹³

Methods

Design

We conducted a retrospective cohort study of all OHCA cases attended by St John WA Emergency Medical Service (EMS) in patients aged 16 years and over, between 16th March and 17th May in 2020, (hereafter referred to as the “COVID-19 period”) compared to the same period in 2017–9.

Setting

WA has a land area of 2.5 million square kilometres, with a population (at 30 June 2020) of 2.7 million people, of which 2.1 million (79.8%) live in the capital city, Perth.^{14,15} St John WA (SJWA) is the sole provider of road EMS within the state. OHCA cases in Perth are attended by a minimum of two ambulance vehicles staffed by two paramedics per vehicle. In larger regional areas, OHCA cases are attended by mixed crews of qualified paramedics and volunteer Emergency Medical Technicians (EMTs). Smaller regional and remote areas are attended by volunteer EMTs only. SJWA attend over 2500 OHCA cases annually.¹⁶ As from 22 January 2020, St John WA applied strict PPE (surgical/P2/N95 mask or reusable respirator, coverall, gloves and eye protection) for any suspected/confirmed COVID-19 patients.

COVID-19 in Australia

On 16 March 2020, the WA government declared a State of Emergency, and between 25 March 2020 and 17 May 2020, all community, recreational and entertainment venues were closed; cafes/

restaurants were permitted to operate takeaway and delivery services only; and citizens were advised to stay at home unless shopping for essentials, exercising, or travelling to and from work or study (where it was not possible to work or study from home).^{17,18}

In the two months from the 16th of March 2020 there were 475 confirmed COVID-19 cases in WA,¹⁹ corresponding to a crude incidence of 107 cases per 100,000 person-years. This contrasts with 1,453 cases of COVID-19 in Victoria⁴ (Australia) between the 16th March 2020 (State of Emergency declared) and 12th May 2020 (Stage 3 restrictions lifted) - an incidence of 159 per 100,000 person-years.

Data source

Data on all SJWA-attended OHCA cases are captured in the SJWA OHCA database,¹⁶ which is maintained by the Prehospital, Resuscitation and Emergency Care Research Unit (PRECRU) at Curtin University. Data are sourced from the electronic patient care records (ePCR) completed by attending EMS officers (paramedics or EMTs), with survival outcomes ascertained from the WA Death Registry²⁰ (or the WA Cemetery Records).²¹

Statistical analysis

We calculated the crude OHCA incidence rate using the WA population data from the Australian Bureau of Statistics¹⁴ for June of the preceding year. The characteristics of OHCA cases with EMS-attempted resuscitation (including bystander Automated External Defibrillator (AED) shock delivered) during the ‘COVID-19 period’ were compared to those occurring during the same period in 2017–9; as well as comparing EMS response times during and before the pandemic and interventions such as mechanical CPR, endotracheal intubation and drug administration. We compared three patient outcomes: prehospital return of spontaneous circulation (ROSC), pulse present on arrival at hospital and 30-day survival (primary outcome). We utilised an independent t-test for normally distributed, continuous data, a Wilcoxon rank-sum test for non-parametric data, and a Chi-squared test for categorical data. We constructed a multi-variable logistic regression model for 30-day survival, adjusting for factors known to influence patient outcome²² such as age, sex, EMS response time, initial arrest rhythm, cardiac aetiology, public arrest location, bystander-witnessed arrest and bystander CPR, to assess the association of time period (COVID-19 or pre-COVID-19) on OHCA survival. We reported risk-adjusted odds ratios (aOR) and 95% confidence intervals (CIs).

In order to ascertain if overall EMS caseload changed during the ‘COVID-19 period’ we predicted weekly caseload in 2020 using an autoregressive integrated moving average model based on caseload between 2017 and 2019.²³ Weeks before the first week and after the 51st week were excluded from the analysis because the numbers of days were less than seven days. As a result, 51 weeks were included in each year. This analysis was conducted using pmdarima library version 1.8.2 and statsmodels library version 0.12.2 on Python ver 3.6.12.

All other analyses were performed in IBM SPSS version 26 (IBM, Armonk, NY). We utilised an alpha value of 0.05 to determine statistical significance.

Ethics approval for this study was obtained from the Curtin University Human Research Ethics Committee— as a sub-study of the “Western Australian Pre-hospital Care Record Linkage Project”: HR128/2013.

Results

Between 16 March to 17 May in 2020 (the 'COVID-19 period'), a total of 423 adult (≥ 16 years) OHCA cases were attended by SJWA EMS, with 1,334 OHCA cases for the same date range in 2017-9. The adult-specific incidence rates were 117.9 OHCA cases per 100,000 person-years in the 2020 'COVID-19 period' and 126.1 OHCA cases per 100,000 person-years in 2017-9. While this represented a 6.5% decrease in OHCA incidence, this difference was not statistically significant ($p = 0.23$). Figure 1 shows a significant drop in the week-by-week total EMS caseload during the 2020 'COVID-19 period' compared to that predicted based on the 2017-9 data; whereas the OHCA caseload remained relatively stable.

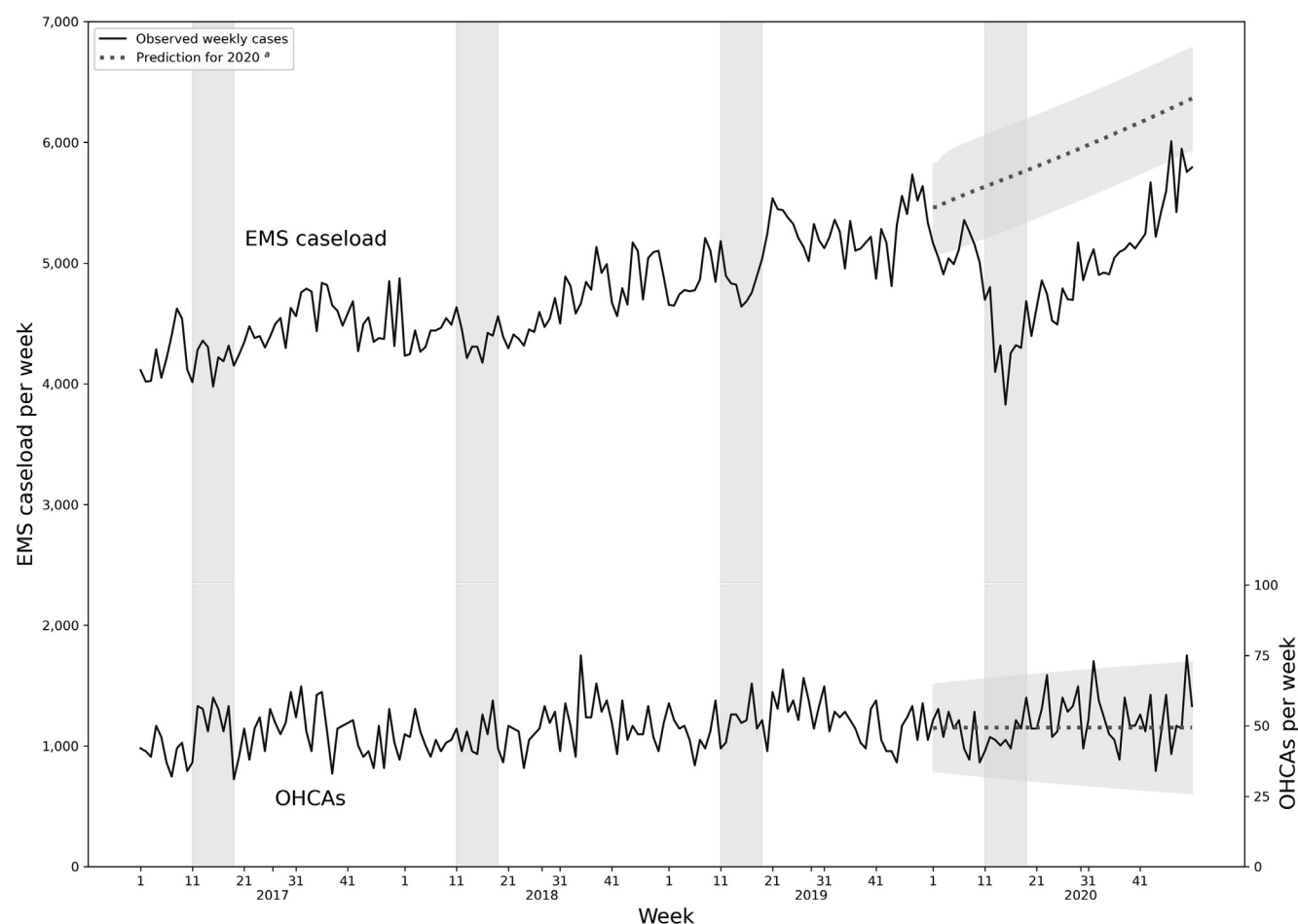
Selection of the final study cohort, comprising those who received EMS resuscitation (excluding EMS-witnessed arrests) is shown in Figure 2. EMS resuscitation was attempted in 145/398 (36.4%) of cases in the 2020 'COVID-19 period' compared to 501/1234 (40.6%) during the same period in 2017-9; this difference was not statistically significant ($p=0.16$). None of the OHCA cases attended by SJWA were known COVID-19 positive cases.

For the OHCA cases where EMS resuscitation was attempted (or bystander AED shock delivered), we compared the patient and arrest characteristics and survival outcomes for the 2020 'COVID-19 period' with the same period in 2017-9 (Table 1).

We found longer response times (median 9.68 in 2020 vs. 8.85 minutes in 2017-9, $p=0.017$), a higher proportion of OHCA due to drug overdose (9.7% vs. 3.6%, $p=0.006$), a lower rate of intubation (8.3% vs. 23.8%, $p<0.001$), less frequent use of mechanical CPR (25.5% vs. 36.3%, $p=0.015$) and a significantly higher proportion of patients declared dead on scene (48.3% vs. 33.9%; $p=0.002$). There was no significant difference in the percentage of patients who achieved prehospital ROSC (24.1% vs. 24.4%, $p=0.958$), the percentage with a pulse present upon arrival at hospital (18.9% vs. 19.6%, $p=0.856$), or in the percentage who survived 30 days (11.7% in 2020 vs. 9.6% in 2017-9, $p=0.450$).

Following adjustment for factors known to influence OHCA survival, there was no significant difference in the odds of 30-day survival during the 2020 'COVID-19 period' compared to the same period in 2017-9 (aOR (95% CI): 1.19 (0.57, 2.51); $p=0.645$) (Table 2A). A similar result was seen when analysis was restricted to only those cases with a shockable initial rhythm (aOR (95% CI): 0.93 (0.37, 2.34), $p=0.876$) (Table 2B).

Table 3 highlights the similarities and differences in OHCA patient characteristics, clinical management and survival outcomes during the 'COVID-19 period' for WA compared to the results reported by Ambulance Victoria.⁴ Of note, in both jurisdictions, there was a sig-



a: prediction based on periodic changes and long-term trend between 2017 and 2019

Vertical shaded areas indicate 11th to 19th week (approximating study period) of a year. A shaded area along the prediction in 2020 indicates 95% confidence interval.

Fig. 1 – Week-by-week total EMS caseload and OHCA caseload during the 2020 'COVID-19 period' compared to that predicted based on the same period in 2017-9.

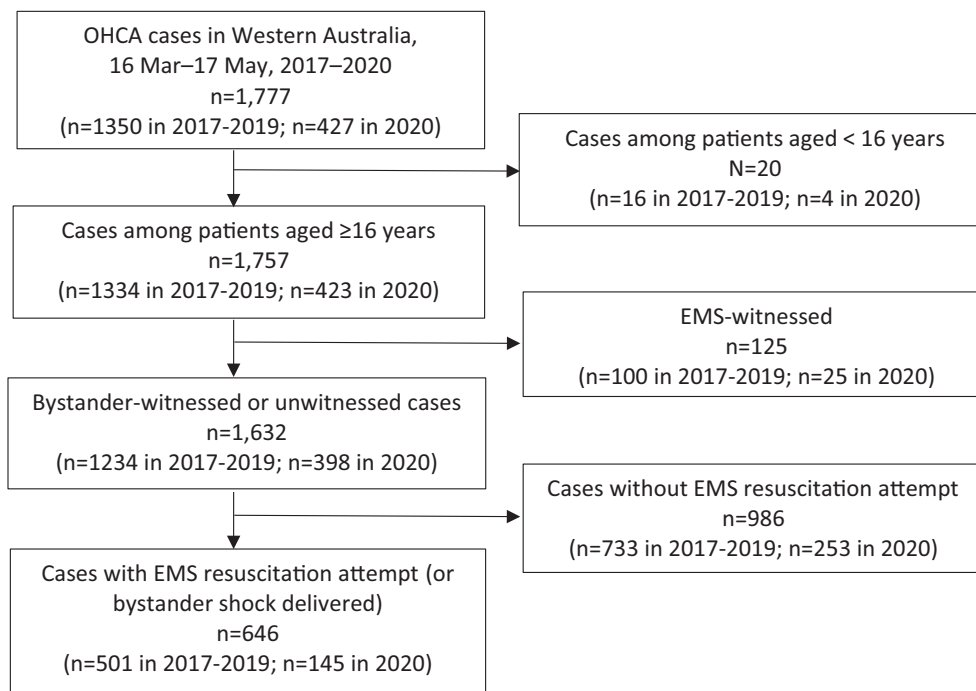


Fig. 2 – Flow chart showing selection of cohort for analysis.

nificant increase in ambulance response time, an increase in patients pronounced dead at the scene; with a reduction in the proportion of OHCA occurring in public locations, intubation, and mechanical CPR rates. However, unlike Victoria, which reported a significant reduction in survival to hospital discharge (6.1% in 2020 vs. 11.7% in 2017-9, $p=0.002$; a difference of -5.6%, 95% CI -8.6% to -2.5%), there was no reduction in 30-day survival outcomes in WA (11.7% in 2020 vs. 9.6% in 2017-9, $p=0.450$; a difference of 2.1%, 95% CI -3.7% to 8.0%).

Discussion

There was no significant difference in either the OHCA incidence, prehospital ROSC or 30-day survival in WA during the 2020 'COVID-19 period' (16th March – 17th May 2020) compared to the same period in previous years (2017-9). Relative to other locations in Australia¹³ and internationally,²⁴ WA experienced a relatively low burden of COVID-19 infections. The incidence rate of COVID-19 cases during this initial wave was 107 cases per 100,000 person-years in WA compared to 159 per 100,000 in Victoria.⁴ However, Australia as a whole had fewer COVID-19 confirmed cases than many other countries.²⁴ For the period 16 Mar to 17 May 2020, Australia had 258.92 cases per million population, compared to 3,336.01 cases per million population in the United Kingdom; 3,270.88 cases per million population in Italy; and 4,479.62 cases per million population in the USA.²⁴

All Australian states were subject to similar government restrictions, such as travel, social isolation, mask wearing and cancellation of elective surgery.^{17,25} Likewise, all Australian ambulance services implemented similar COVID-19 protocols – including the (time-consuming) use of personal protective equipment (PPE).²⁶ While Victoria did not see a significant difference in their OHCA incidence rate, there was a 50% decrease in survival to hospital discharge.⁴ In

contrast, WA did not see any decrease in OHCA survival over the same time period. Decreases in OHCA survival during the initial 'COVID-19 period' have also been reported elsewhere: Italy;⁷ France;⁵ Spain;¹² New York¹¹ – all with much higher incidence of COVID-19 cases than WA. Comparing the WA results (no decrease in OHCA survival in the context of low COVID-19 incidence) with other locations (large decrease in OHCA survival in the context of high(er) COVID-19 incidence), suggests that the impacts of COVID-19 on OHCA survival may be affected by the local incidence of COVID-19.

We did however observe several differences in OHCA patient characteristics and arrest management. We found that despite a decrease in ambulance caseload during the COVID study period, the median ambulance response time (from call to scene) was significantly higher (9.7 vs 8.8 minutes) in the 2020 'COVID-19 period' compared to the same period in 2017-9. These findings mirror those reported in Victoria⁴ and internationally.^{3,5,7} It has been proposed that the requirement for paramedics to don additional PPE is a key contributor to longer response times.² Furthermore, in WA, there was more questioning of the caller during the emergency call about possible COVID-19 symptoms, prior to triggering dispatch. As reported elsewhere²⁷ this delay from call to dispatch can increase overall ambulance response time. Another possible reason for the apparent paradox of increased response time despite a reduced overall caseload was that increased requirements during the 'COVID-19 period' for cleaning ambulances between cases (as prescribed by SJWA, and as reported elsewhere³) decreased the availability of ambulances, with the net effect of increasing response times.

Despite an increase in ambulance response time during the COVID-19 period, neither WA (nor Victoria)⁴ reported a significant difference in the proportion of cases with a shockable initial rhythm. In contrast, international studies,^{3,5,11} commonly observed a decrease in the proportion of arrests with a shockable initial rhythm

Table 1 – Characteristics of adult OHCA patients with EMS attempted resuscitation (excluding EMS witnessed events), 16 March – 17 May 2020 compared to 16 March – 17 May 2017 – 2019 in Western Australia.

Characteristic	Arrests 16 Mar – 17 May 2020 COVID Study Period (n = 145)	Arrests 16 Mar – 17 May 2017-2019 (n = 501)	p value
Female, n (%)	44 (30.3%)	156 (31.1%)	0.856
Median age, years (IQR)	61 (46-74)	60 (46-74)	0.992
Aged ≥ 75 years, n (%)	36 (24.8%)	116 (23.2%)	0.676
Median response time², mins (IQR)	9.68 (7.53, 12.80)	8.85 (6.65, 12.03)	0.017*
Presumed aetiology, n (%)			0.021*
<i>Presumed cardiac</i>	105 (72.4%)	389 (77.6%)	0.231
<i>Drug overdose</i>	14 (9.7%)	18 (3.6%)	0.006*
<i>Trauma</i>	20 (13.8%)	80 (16.0%)	0.612
<i>Other medical</i>	6 (4.1%)	14 (2.8%)	0.582
Public location of arrest, n (%)	28 (19.3%)	131 (26.1%)	0.092
Bystander witnessed, n (%)	80 (55.2%)	243 (48.5%)	0.157
Bystander CPR, n (%)	108 (74.5%)	368 (73.5%)	0.804
Initial arrest rhythm VF/VT, n (%) ³	42 (30.0%)	120 (24.0%)	0.145
Shocked by PAD, n (%)	5 (3.4%)	22 (4.4%)	0.617
Intubation, n (%)⁴	12 (8.3%)	119 (23.8%)	<0.001*
Mechanical CPR, n (%)	37 (25.5%)	182 (36.3%)	0.015*
Amiodarone, n (%) ⁴	17 (11.7%)	61 (12.2%)	0.883
Adrenaline, n (%) ⁴	104 (71.7%)	391 (78.0%)	0.113
Survival outcomes, n (%)			
ROSC at any time, on scene or during transport	35 (24.1%)	122 (24.4%)	0.958
Died at scene	70 (48.3%)	170 (33.9%)	0.002*
Pulse present at hospital ⁵	27 (18.9%)	98 (19.6%)	0.856
Survived 30 days	17 (11.7%)	48 (9.6%)	0.450
VF/VT and survived 30 days	11 (26.2%)	41 (34.2%)	0.341

CPR = cardiopulmonary resuscitation; IQR = interquartile range; PAD = public access defibrillator; ROSC = return of spontaneous circulation; VF = ventricular fibrillation; VT = ventricular tachycardia; *Statistically significant, $\alpha = 0.05$.

Notes:

¹ Time from when call was received by dispatcher to arrival of first ambulance crew on scene.

² n = 4 cases with missing data for aetiology in 2017-2019.

³ n = 5 cases with missing data for initial arrest rhythm.

⁴ If there was missing data, assume it was missing because the procedure was not performed / drug not administered.

⁵ n = 2 cases with missing data for pulse present at hospital.

during the pandemic. This could be because unlike the aforementioned studies from elsewhere in the world, none of the OHCA cases in WA (nor Victoria)⁴ were due to COVID-19. It has been reported that OHCA precipitated by hypoxic respiratory failure due to COVID-19²⁸⁻³⁰ has a lower likelihood of presenting as a shockable rhythm.^{1,31} Furthermore, conditions associated with COVID-19 infection, including massive myocardial infarction and pulmonary emboli, may also decrease the likelihood of shockable initial rhythms.^{11,32-34}

The lack of effect of the reduced response time in WA on initial shockable rhythm could also be because we did not see any reduction in the proportion of patients who received bystander CPR or AED use; which was contrary to what we might have expected due to increased OHCA in private residences and bystanders' fear of infection.^{35,36} However, as shown by recent systematic reviews, the impact of the COVID-19 pandemic on bystander CPR in other jurisdictions has been variable,^{2,3} with reduced bystander CPR rates reported in Europe,^{5,12} and in some USA locations,³⁷ but not in New York City;¹¹ which was heavily impacted by COVID-19 (having reported 17,118 confirmed and probable deaths due to COVID-19 by April 25, 2020).¹¹ Furthermore, the public's willingness to perform CPR doesn't appear to have changed in Australia.³⁸

Similar to Victoria,⁴ WA reported a decrease in arrests of presumed cardiac aetiology, from 78% in 2017-9, to 72% in 2020, however this was not a statistically significant difference. In WA, but not in Victoria, this was accompanied by a significantly higher proportion of arrests classed as 'drug overdose' (9.7% vs. 3.6%; $p=0.006$). An increase in drug overdose during the COVID-19 pandemic has similarly been reported in the USA.^{39,40} Speculation as to why WA might see an increase in the proportion of drug overdose related OHCA might relate to the sudden drop in the availability of methamphetamine in Perth due to COVID-19 related border closures and travel restrictions, resulting in methamphetamine users resorting to taking other illicit drugs.⁴¹

Similar to other jurisdictions, our study showed that there were changes to OHCA clinical management associated with the COVID-19 period. The rate of endotracheal intubation was dramatically lower during the 'COVID-19 period' compared to 2017-9 (8.3% vs 23.8%, $p<0.001$). Lower rates of intubation during the COVID-19 pandemic were also reported in Victoria⁴ and by other international authors, as reported in a recent systematic review.³ This may have occurred as a result of changes to the respective EMS clinical practice guidelines, in light of the World Health Organi-

Table 2 – Adjusted odds ratio of the effect of the COVID-19 pandemic (time period: 16 March – 17 May 2020) on 30-day survival in OHCA patients with EMS attempted resuscitation in A) All OHCA patients with EMS attempted resuscitation and B) OHCA patients presenting in a shockable initial rhythm (VF/VT). Table 2A: All OHCA patients with EMS attempted resuscitation (n = 641¹). Table 2B: Patients presenting in a shockable initial rhythm (VF/VT) with EMS attempted resuscitation (n = 162).

	aOR (95%CI)	p value
2020 (vs. comparator period)	1.19 (0.57, 2.51)	0.645
Age (every year increase)	0.98 (0.96, 1.00)	0.023*
Male	1.40 (0.62, 3.16)	0.416
Response time (every minute increase)	0.82 (0.74, 0.90)	<0.001*
Shockable initial arrest rhythm	12.8 (5.95, 27.4)	<0.001*
Presumed cardiac aetiology	1.02 (0.40, 2.65)	0.963
Public arrest location	1.27 (0.66, 2.45)	0.474
Bystander-witnessed	3.14 (1.46, 6.76)	0.003*
Bystander CPR	3.07 (1.10, 8.59)	0.033*

	aOR (95%CI)	p value
2020 (vs. comparator period)	0.93 (0.37, 2.34)	0.876
Age (every year increase)	0.98 (0.95, 1.00)	0.076
Male	1.02 (0.35, 2.96)	0.971
Response time (every minute increase)	0.76 (0.66, 0.88)	<0.001*
Presumed cardiac aetiology	5.80 (1.03, 32.8)	0.047*
Public arrest location	1.66 (0.76, 3.64)	0.206
Bystander-witnessed	2.19 (0.84, 5.72)	0.109
Bystander CPR	8.41 (1.75, 40.4)	0.008*

aOR = adjusted odds ratio; CI = confidence interval; CPR = cardiopulmonary resuscitation; VF = ventricular fibrillation; VT = ventricular tachycardia.

¹ n = 5 cases excluded due to missing data); *Statistically significant, $\alpha = 0.05$.

Table 3 – Summary of patient and arrest characteristics, clinical management and survival outcomes for the 2020 COVID-19 study period (16 Mar to 17 May) compared to the same period in 2017-19 for WA and Vic (based on Ball et al, 2020)

Characteristic	WA COVID vs 2017-2019 (n = 145 vs n = 501)	Vic COVID vs 2017-2019 (n = 380 vs n = 1218)
Female (%)	ns	ns
Median age, years (IQR)	ns	ns
Aged ≥ 75 years (%)	ns	ns
Median response time, mins	Diff = +0.83mins*	Diff = +0.5mins*
Aetiology (%)		
Presumed cardiac	72.4% vs 77.6%	72.3% vs 77.9%*
Drug overdose	9.7% vs 3.6%*	4.7% vs 4.8%
Public location of arrest (%)	19.3% vs 26.1%	10.0% vs 20.8%*
Bystander witnessed (%)	ns	ns
Bystander CPR (%)	74.5% vs 73.5%	78.7% vs 73.0%*
Initial arrest rhythm VF/VT (%)	ns	ns
Shocked by PAD (%)	3.4% vs 4.4%	3.9% vs 6.9%*
Intubation (%)	8.3% vs 23.8%*	45.8% vs 48.8%*
Mechanical CPR (%)	25.5% vs 36.3%*	14.7% vs 14.5%
Amiodarone (%)	ns	ns
Atropine (%)	ns	ns
Adrenaline (%)	71.7% vs 78.0%	50.8% vs 60.9%*
<u>Survival outcomes (%)</u>		
ROSC any time – prehospital	ns	ns
Died at scene	48.3% vs 33.9%*	75.0% vs 67.9%*
Pulse present at hospital	18.9% vs 19.6%	24.3% vs 29.5%
Survived 30 days / STHD	11.7% vs 9.6%	6.1% vs 11.7%*
VF/VT and surv. 30 days / STHD	26.2% vs 34.2%	20.0% vs 36.7%*

IQR = interquartile range; CPR = cardiopulmonary resuscitation; VF = ventricular fibrillation; VT = ventricular tachycardia; PAD = public access defibrillator; ROSC = return of spontaneous circulation; STHD = survived to hospital discharge; *Statistically significant difference, $\alpha = 0.05$; ns = no statistically significant difference.

zation's designation of intubation as an aerosol generating procedure.⁴² The SJWA Clinical Practice Guideline (CPG) for cardiac arrest recommends a supraglottic airway device as the first line adjunct in cardiac arrest, in preference to endotracheal intubation.⁴³

In relation to the 'COVID-19 period' in 2020 in WA we did not observe any significant reduction in the proportion of adult OHCA where paramedics attempted resuscitation. This contrasts with a significant reduction in Victoria.⁴ However, in both States there was a significant increase in the proportion of OHCA patients declared dead at the scene. Not surprisingly due to a change in practice, we also observed a significant decrease in the use of mechanical CPR, which is commonly used during transport of OHCA patients without ROSC to hospital. Early 2020 also coincided with a revision of the St John WA Clinical Practice Guideline permitting resuscitation to be terminated in specified occasions where resuscitation efforts could be considered futile,⁴⁴ and a de-emphasis on mechanical CPR being used prior to a decision re transport to hospital. It is likely that these updates had an effect on the proportion of patients declared dead on scene versus those transported to the emergency department; although it is difficult to uncouple this from any potential effects due to COVID-19. Ambulance Victoria also reported a significant increase in the proportion of OHCA patients who were declared dead at the scene during the 'COVID-19 period' (75% vs 68%, $p=0.009$).⁴ There is no mention that Victoria's termination-of-resuscitation rules changed during this time.⁴

Limitations

Our study has several limitations. Firstly, as an observational study there is always a risk of bias; including the possibility that unmeasured differences between both EMS systems and other changes in policy/practice that occurred at the same time, independent of the COVID-19 pandemic lockdown, could account for differences observed in OHCA survival rates between WA and Vic. Secondly, unlike the Victorian study,⁴ we only measured response time (from call to scene) but not the time that paramedics arrived at the patient's side. As such, we did not capture all COVID-19 related delays, such as those associated with donning of PPE, potentially under-estimating the increase in response time during the COVID-19 period. While data on time-to-patient's side can help further understand the system impacts of COVID-19, there was no change in survival in our study. Finally, the statistical power of our study (to detect changes between the 'COVID-19 period' in 2020 and previous years) is likely to be lower than that of similar studies to date from larger jurisdictions.^{4,11,12}

Conclusion

The initial wave of the COVID-19 pandemic did not appear to affect OHCA incidence or outcomes in Western Australia. The incidence of OHCA, the rate of ROSC and 30-day survival from OHCA did not differ significantly between the 2020 'COVID-19 period' and the same period in the preceding three years. WA experienced two months of strict COVID-19 lockdown in the initial wave of the pandemic, but the incidence of COVID-19 and the number of COVID-19-related deaths has remained relatively low. By comparing our results to other jurisdictions, our study suggests that OHCA survival may be more closely related to the incidence COVID-19 in the community rather than the presence of COVID-19 restrictions per se.

Conflicts of Interest

Some of the authors are affiliated with St John WA as follows: Paul Bailey (Medical Director); Deon Brink (Executive Director Ambulance Operations); Dan Rose (Resuscitation Improvement Coordinator); Stephen Ball (Adjunct Research Fellow); Judith Finn (Adjunct Research Professor & recipient of St John WA research funding).

CRediT authorship contribution statement

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