



Supporting Information

Supplementary methods

**This appendix was part of the submitted manuscript and has been peer reviewed.
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Appendix to: Sweeny AL, Keijzers G, Marshall A, et al. Emergency department presentations during the COVID-19 pandemic in Queensland (to June 2021): interrupted time series analysis. *Med J Aust* 2023; doi: 10.5694/mja2.51819.

Supplementary methods

1. Data cleaning

To prepare data for analysis, data cleaning was required to exclude patients presenting for coronavirus disease 2019 (COVID-19) testing only. These attendances were recorded in the Emergency Data Collection but reflect 'fever clinic' presentations rather than emergency department (ED) presentations. To identify these atypical patient presentations in our dataset we consulted colleagues from other EDs regarding their registration processes for patients requiring COVID-19 testing. As a result, a combination of low urgency triage categories (ATS 4 or 5) and International Classification of Disease, 10th revision, Australian modification (ICD-10-AM) codes (e.g., viral infection unspecified (B34.9), persons with feared complaint (Z71.1), or special screening examination (Z11.5)) was used to screen for and exclude these presentations from our dataset for all 105 sites' post-pandemic declaration data.

Table 1. Classification of diagnostic conditions

Series	Major criteria	Examples of conditions included
Cardiac conditions	Major diagnostic category = 05	Pericarditis, valvular disease, heart failure, hypertension, myocardial infarction, cardiomyopathy, arrhythmias, atrial flutter, aortic aneurysm, peripheral vascular disease
Respiratory conditions	Major diagnostic category = 04	Pneumonia (bacterial or viral), pulmonary embolism, bronchitis, neoplasms of respiratory tract, lower respiratory tract infection, chronic obstructive pulmonary disease, pulmonary oedema, asthma
Mental health conditions	Major diagnostic category = 19, plus ICD-10-AM codes X64-X84	Depression, schizophrenia, bipolar disorder, panic disorder, eating disorders, autism, anxiety, intentional self-harm
Injury	Major diagnostic category = 21A and 21B	Fractures, dislocations, sprains, concussions, penetrating wounds, superficial wounds, crushing injuries, frostbite, overdose, traumatic shock
Stroke	ICD-10-AM codes only (I61 - I69.8)	Intracerebral haemorrhage, cerebral infarction, stroke not otherwise specified, nontraumatic subdural or extradural haemorrhage
Sepsis	ICD-10-AM codes only (A41-A41.9)	Sepsis unspecified, sepsis due to <i>Staphylococcus aureus</i> , streptococcal sepsis, sepsis due to unspecified gram-negative organisms, other sepsis

ICD-10-AM: International classification of disease, 10th revision, Australian modifications.

Table 2. Timeline of notifications, public health directions, and proportional decline in emergency department presentations following declaration of the COVID-19 pandemic in Queensland, by week

Seven –day period from	New cases ¹	Changes in school activities ^{2,3}	Changes in businesses ³	Changes in movement & gatherings ³	Observed v expected (95% CI)
March 11, 2020	60	Normal	Normal	Normal	-2.9% (-6.6 to 1.1)
March 18, 2020	319	Normal	Restaurants, pubs, clubs & gyms close on March 23.	Australian borders close to non –residents on March 20. No guests at weddings and 10 attendees at funerals from March 24.	-16.2% (-19.4 to -12.9)
Sustained decrease in emergency department presentations begins					
March 25, 2020	292	Online learning begins on March 30.		QLD borders close on March 26. Hotel quarantine starts March 28.	-28.7% (-31.4 to -25.7)
April 1, 2020	245	Online learning continues		Stay at home restrictions introduced on April 2, limiting residents from leaving home for non –essential purposes.	-30.5% (-33.2 to -27.5)
April 8, 2020	60	School holidays	Non –essential businesses close on April 9.	Most restrictive stage starts April 11, border passes required and self – quarantine.	-26.6% (-29.6 to -23.3)
April 15, 2020	30	School holidays			-26.4% (-29.3 to -23.3)
April 22, 2020	9				-25.6% (-28.4 to -22.4)
April 29, 2020	10			Restrictions ease on May 2 with limitations, no outings further than 50km. Public health messaging campaign from May 5 – continue medical appointments or ED if urgent.	-23.7% (-26.7 to -20.5)
May 6, 2020	8	Back to school for Kindergarten, Prep, Grades 1, 11 & 12 on May 11		Restrictions ease on May 7 – two households can meet.	-23.7% (-26.7 to -20.5)
Normalisation of numbers of triage category 2 presentations and presentations with cardiac conditions					
May 13, 2020	6		Stage 1 – Some restrictions ease from May 15 for hospitality venues, 10 patrons permitted	Stage 1 – Some restrictions ease from May 15, gatherings up to 10 people, 20 people at funerals, recreational travel within 150km from home permitted	-19.8% (-23.0 to -16.3)
May 20, 2020	0	Back to school for Grades 2 –10 on May 25			-21.2% (-24.5 to -17.8)

Seven –day period from	New cases ¹	Changes in school activities ^{2,3}	Changes in businesses ³	Changes in movement & gatherings ³	Observed v expected (95% CI)
May 27, 2020	2	Normal	Stage 2 – Further easing of restrictions from June 1 for hospitality venues, 20 patrons permitted	Stage 2 – Further easing of restrictions from June 1, gatherings up to 20 people, unlimited recreational travel within QLD permitted	-12.5% (-16.0 to -8.6)
Normalisation of presentations with injuries					
June 3, 2020	3	Normal			-13.3% (-16.8 to -9.6)
June 10, 2020	3	Normal		Stage 2 – Restrictions ease for funerals from June 16, 100 people permitted	-11.0% (-14.6 to -7.1)
June 17, 2020	1	Normal		Stage 2 – Restrictions ease for aged care from June 18 and sports stadiums from June 20	-13.1% (-16.8 to -9.2)
June 24, 2020	1	Normal			-14.6% (-18.2 to -10.7)
July 1, 2020	0	Normal	Stage 3 – Further easing of restrictions from July 3, increased numbers of patrons permitted based on 4 square metre rule, office –based workers can return to work, more public events permitted	Stage 3 – Restrictions ease further from July 3, gatherings up to 100 people, weddings and funerals permitted to have 100 people, 4 people per 1 square metre at indoor venues.	-13.1% (-16.8 to -9.2)
Normalisation of numbers of triage category 1 presentations					
July 8, 2020	4	Normal		QLD borders open on July 10 to people other than from VIC.	-12.5% (-16.0 to -8.6)
July 15, 2020	1	Normal			10.1% (-13.8 to -6.0)

Seven –day period from	New cases ¹	Changes in school activities ^{2,3}	Changes in businesses ³	Changes in movement & gatherings ³	Observed v expected (95% CI)
July 22, 2020	4	Normal	Some restrictions on venues re – instated (need to be seated to eat and drink) from July 24		-12.0% (-15.6 to -8.1)
July 29, 2020	9	Normal		Some restrictions to entering certain aged care facilities within Brisbane southside from July 31	-8.9% (-12.5 to -4.9)
August 5, 2020	3	Normal		QLD borders close to NSW and ACT on 8 August	-11.0% (-14.7 to -6.9)
Normalisation of numbers of triage category 3 presentations					
August 12, 2020	4	Normal			-7.7% (-11.6 to -3.5)
August 19, 2020	13	Normal		Greater Brisbane restrictions from Aug 22 – gatherings restricted to 10 people. Hospitals, residential aged care and disability accommodation facilities restrict visitors and increase personal protective equipment. Gatherings restricted to 30 people outside Greater Brisbane.	-10.6% (-14.4 to -6.5)
August 26, 2020	17	Normal	Venues and events that follow COVID Safe Industry Plans can continue operating as of Aug 28.	Greater Brisbane restrictions extended to Gold Coast from Aug 29 and Darling Downs region from Aug 31.	-10.9% (-14.7 to -6.7)
September 2, 2020	11	Normal			-10.2% (-14.2 to -5.8)
September 9, 2020	16	Normal			-10.5% (-14.6 to -6.1)
Normalisation of triage category 4 presentations					
September 16, 2020	4	Normal		Gathering restrictions ease for the Gold Coast and Darling Downs from Sept 17.	-8.3% (-12.6 to -3.6)
September 23, 2020	4	Normal		QLD borders open to ACT on Sept 25. Restrictions ease in Greater Brisbane from Sept 25 – gatherings up to 30 people allowed. Visitors allowed at hospitals and aged care facilities.	-7.3% (-11.8 to -2.4)
September 30, 2020	3	Normal	Outdoor businesses can increase patron numbers from Oct 1.	Stage 4 – from Oct 1 increased attendees permitted at events with a COVID Safe Checklist, including outdoor events, stadiums, amphitheatres, and outdoor performance venues. QLD border zone expands to include Northern NSW.	4.3% (-8.9 to 0.7)

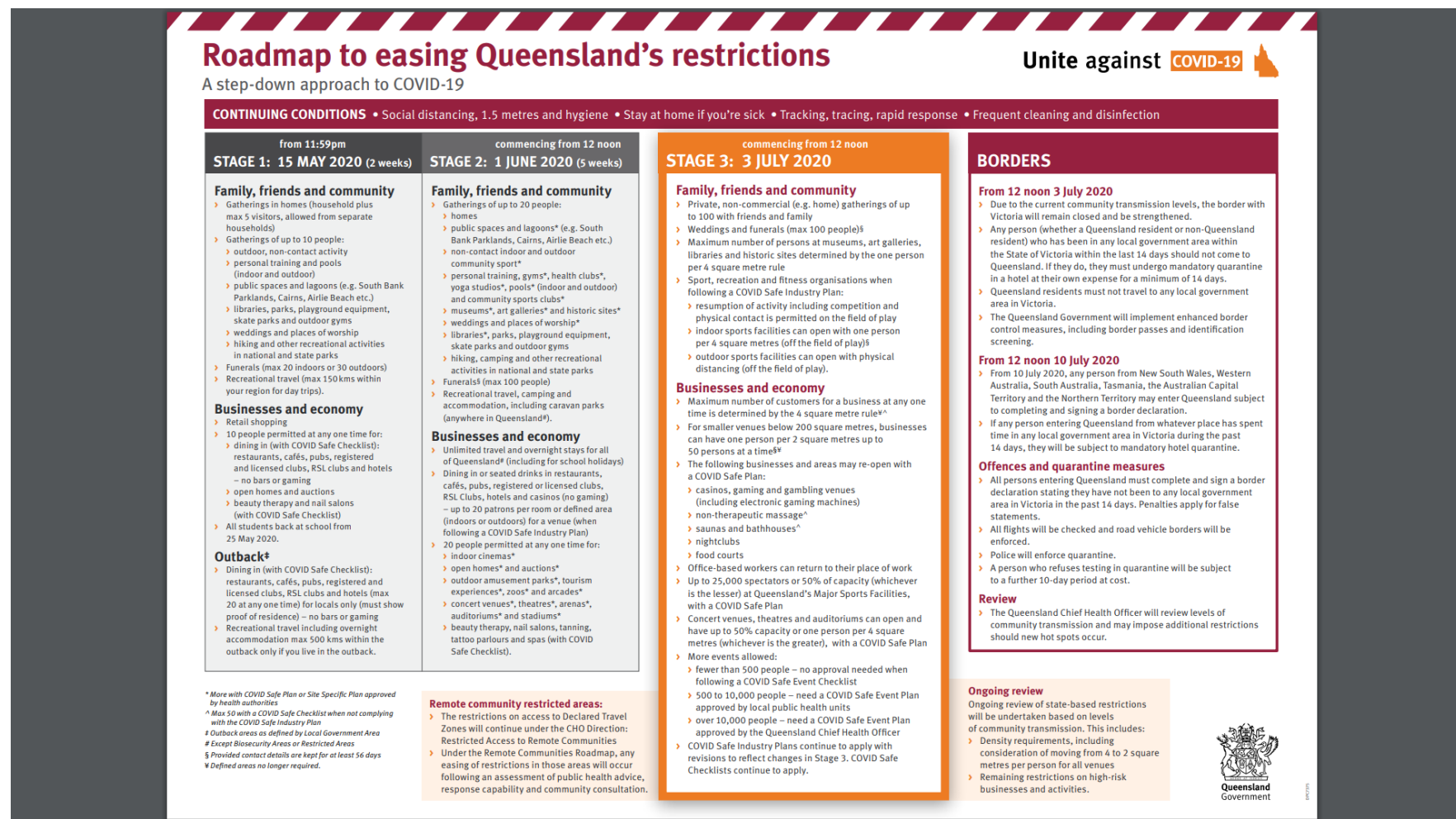
Seven –day period from	New cases ¹	Changes in school activities ^{2,3}	Changes in businesses ³	Changes in movement & gatherings ³	Observed v expected (95% CI)
October 7, 2020	1	Normal			-1.4% (-6.2 to 4.0)
October 14, 2020	3	Normal		Further easing of restrictions for gatherings, weddings and dancing from Oct 16	-3.9% (-8.7 to 1.4)
October 21, 2020	3	Normal			-4.9% (-9.8 to 0.4)
October 28, 2020	8	Normal		QLD remains closed to VIC and Greater Sydney. People from hotspots in the past 14 days will not be allowed to enter QLD.	-2.0% (-7.0 to 3.8)
November 4, 2020	2	Normal			-3.7% (-8.7 to 2.0)
November 11, 2020	9	Normal		QLD borders close to parts of SA from Nov 16. Further easing of restrictions from Nov 17 for gatherings, indoor venues, outdoor events, weddings and funerals.	-3.9% (-9.0 to 1.7)
November 18, 2020	11	Normal		Gathering restrictions ease further from Nov 23.	-3.3% (-8.6 to 2.4)
November 25, 2020	8	Normal		QLD reopens to VIC and Greater Sydney from Dec 1. Gathering restrictions ease further from Nov 28.	-2.6% (-8.0 to 3.5)
December 2, 2020	16	Normal		Stadiums and indoor venues allow full capacity from Dec 14. Gathering restrictions ease further from Dec 8.	-1.3% (-7.0 to 5.2)
December 9, 2020	7	Normal		QLD borders open to Adelaide and NZ from Dec 12.	-5.3% (-10.8 to 1.0)
December 16, 2020	8	Normal		QLD closes borders to anyone from Greater Sydney	-1.2% (-6.9 to 5.2)
December 23, 2020	14	Normal			2.6% (-3.5 to 9.4)

QLD: Queensland; ACT: Australian Capital Territory; NSW: New South Wales; VIC: Victoria; SA: South Australia; COVID-19: coronavirus disease 2019; NZ: New Zealand

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Figure 1. Queensland government roadmap to easing restrictions*



* Source: Queensland Government. Roadmap to easing restrictions. Snapshots March 8th 2020 – June 20, 2021.
<https://webarchive.nla.gov.au/awa/20200628140046>/<https://www.covid19.qld.gov.au/government-actions/roadmap-to-easing-queenslands-restrictions> (viewed Feb 2022).

Table 3. Summary of multisite and population-based studies of impact of COVID-19 on overall emergency department presentations

Author (year), country	Sample and comparison periods	Main results pertaining to emergency department (ED) utilisation and urgency (if applicable)	Time to nadir (since declaration of pandemic)
Baugh et al. (2021), USA ¹	ED presentation data from 5 EDs Mar 1-Apr 30 2020 vs same period 2019	Presentations decreased by 30.9% in 2020 compared to 2019. Average acuity, (based on the Emergency Severity Index) of ED presentations increased.	Not reported
Bergrath et al. (2021), Germany ²	ED presentation data from 4 EDs Jan 20 to Jun 14 2020 vs same period 2019	Presentations decreased between 38% and 48%. The maximum of reduced ED visits was found in week 14 of 2020 and at the end of the study period ED visits were 17% lower compared to the corresponding week in 2019.	3 weeks
Boserup et al. (2020), USA ³	ED registry data from 3,415 EDs Mar 15-Apr 5 2020 vs Dec 15 2019-5 Jan 2020	Average weekly ED visits for the previous four weeks to Apr 5, 2020 (1.42 million) was 39% lower than the four weeks prior (average = 2.31 million). ED visits per week began to decline during the week of March 8, 2020 reaching a nadir during the week of April 5, 2020 (last week studied).	3 weeks
Cheng (2021), Taiwan ⁴	ED presentation data from 3 EDs Feb 2020 - Jan 2021 and same period year prior	Declines of 20% to 25% were observed for all 3 hospitals. Statistically significant decline in total ED volume in all triage categories was observed except triage category 1 for one hospital and category 5 for another.	Not reported
Collyer et al. (2021), Australia ⁵	Time series comparison of observed vs forecasted ED presentations at 2 Melbourne EDs Jan 2016 to Feb 2020 used to forecast; forecasted vs observed compared Mar 1-Sept 20, 2020	Presentations dipped below the 95% lower confidence interval of forecasted presentation levels during both COVID-19 waves. By triage category, presentations persisted within forecasted levels for categories 1 and 5, with clear reductions in categories 2–4.	Not reported
Dudevich & Froot (2021), Canada ⁶	Canadian Institute for Health Information's national report (administrative data) Mar-Jun 2020 compared to same period in 2019	Visits to EDs across Canada declined by almost 25,000 patients a day (approx. half the usual number) in mid-April 2020. By late June, visits remained 16% lower than those in 2019.	Not reported

Author (year), country	Sample and comparison periods	Main results pertaining to emergency department (ED) utilisation and urgency (if applicable)	Time to nadir (since declaration of pandemic)
Golinelli et al. (2021), Italy ⁷	Population study using ED presentation data from all 12 EDs in one city Mar 9-May 3 2020 & Oct 18-Dec 31 2020 compared to same periods year prior	Presentation numbers were stable until week 8 then dropped abruptly by 58.8% in the first wave, followed by a slow increase until reaching levels closer to those of 2019. In the second wave, there was a second decline in ED visits of 38.7%. Low priority triage codes had a more marked decrease.	2 Weeks
Hartnett et al. (2020), USA ⁸	National Syndromic Surveillance Program data using all participating EDs' data Mar 29- Apr 25 2020 vs same period year prior	Visits to EDs across USA were 42% lower overall. ED presentations remained 26% below the corresponding week in 2019 for the last study week (Apr 25 2020).	5 weeks
Hughes et al. (2020), UK ⁹	ED Syndromic Surveillance System data from 109 EDs Mar 12- Apr 26 2020 vs same period year prior	Presentations decreased across all age groups, all acuity levels, on all days and times. The greatest percentage reductions were seen in school age children (5 - 14 years). By acuity, the greatest reduction occurred in the less severe presentations.	Not reported
Jaehn et al. (2020), Germany ¹⁰	ED presentation data from 6 EDs Dec 2 2019 – Jun 30 2020 vs same period year prior	The largest decrease in presentations occurred between 26 Mar and 8 Apr (- 30%, 95% CI - 33% to - 27%). The largest decrease was among people aged 0–17 years.	2 Weeks
Jeffrey et al.(2020), USA ¹¹	ED presentation data from 24 EDs was used to predict the next days' expected numbers. Jan 1-Apr 30 2020. Observed compared to short-term predicted presentations	At 24 EDs across 5 states in the USA, the decrease in observed ED visits ranged from 41.5% to 63.5% (depending on the state). Weeks with the most rapid rates of decrease were in March 2020, which corresponded with national public health messaging about COVID-19.	Not reported
Kam et al. (2020), Australia (Sydney) ¹²	ED presentation data from 4 EDs Mar 29-May 31 2020 vs same period year prior	Presentations were 25% lower. Presentation numbers in all triage categories were lower except category 1 which increased by 14%.	Not reported

Author (year), country	Sample and comparison periods	Main results pertaining to emergency department (ED) utilisation and urgency (if applicable)	Time to nadir (since declaration of pandemic)
Kuitunen et al. (2020), Finland ¹³	ED presentation data from 3 EDs 1 Feb -Apr 30 2020 (6 weeks before and 6 weeks after lockdown on 16 March 2020)	Visits decreased 16% after the lockdown on 16 March.	Not reported
Lucero et al. (2020), USA ¹⁴	Timeseries-like analysis using ED billing data from 141 EDs Jan 1 2017- Mar 15 2020 with lockdown periods specific to each region as an intervention variable (start dates varied, all ended Apr 20 2020)	ED visits overall decreased by 39.6% compared to expected volume. Emergent encounters decreased by 35.8%, while non-emergent encounters decreased by 52.1%.	Not reported
Melnick et al. (2021), USA ¹⁵	Registry data from 500+ EDs 1 January to 31 December 2020 vs 1 January to 31 December 2019	Presentations fell rapidly in early March 2020 and reached -47% in early May. EDs then began regaining volume from early May until mid-July, where it stabilized in the range of -18% to -21% below pre-COVID-19 levels. ED visit volumes decreased again in mid-December, falling to -30% below pre-COVID-19 levels by December 31, 2020, and averaged -25% below pre-COVID-19 levels for the month of December 2020.	8 Weeks
Morello et al. (2021), Italy ¹⁶	ED presentation data from 5 EDs Jan-Aug 2020 vs same period prior year	At five EDs in Torino, Italy, during the first wave peak (31 March to 13 April), visits were reduced by 66.4% (p < 0.001). Critical triage codes were unchanged. Reductions were found for all non-COVID-19 diagnoses. In the early (16 to 29 June 2020), mid (14 to 27 July 2020), and late (18 to 31 August 2020) post-wave periods, visits were reduced by 25.4%, 25.3% and 23.5% (all p < 0.001) respectively.	4 Weeks
Rennert-May et al. (2021), Canada ¹⁷	Population study of all ED presentations in Alberta, Canada Mar 16-Sept 23 2020 vs same period prior year	The incident rate ratio of ED presentations was 0.65 for 2020 compared to 2019, suggesting about a 35% decrease in ED presentations.	Not reported
Reschen et al. (2021), UK ¹⁸	ED presentation data from 2 EDs Mar 7-May 31 2020 vs same periods year prior and year after	Presentations fell by 37% during the first wave but returned to normal within a year. Decreases only significant for low severity presentations. Mortality in ED or an associated admission increased significantly from 1.2% to 2.9%	Not reported

Author (year), country	Sample and comparison periods	Main results pertaining to emergency department (ED) utilisation and urgency (if applicable)	Time to nadir (since declaration of pandemic)
Richardson et al. (2021), Australia ¹⁹	Administrative data from 121 EDs reporting to the Australasian College for Emergency Medicine June 2020 & September 2020 vs same months year prior	There was a 12.6% decrease between June 2019 and June 2020 surveys. ED numbers were at normal levels by September 2020, apart from in Victoria and at paediatric referral hospitals.	Not reported
Santi et al. (2021), Italy ²⁰	A population-based study of ED presentation data from all EDs in Bologna (n=12) Dec 1 2019 - May 31 2020 and same period year prior	Overall, a 66.2% decrease occurred during lockdown with a 60-70% decrease in the less urgent categories (white, green and yellow), and 40% decrease in the emergency (red) category.	2 Weeks
Sutherland et al. (2020), Australia (NSW) ²¹	ED Syndromic Surveillance System data from 67 EDs Mar 1- Jun 30 2020 vs same period year prior	Visits decreased by 13.9% compared to prior year. The largest decrease in ED visits (29.6%) occurred in April 2020.	Not reported
Venkatesh et al. (2021), USA ²²	Clinical registry data from 164 EDs Jan 1 2019-Nov 15 2020, monthly comparison to average of all months year prior	Data from 164 EDs across 35 states showed largest declines occurred early in the pandemic, with a nadir in April 46% lower than the 2019 monthly average. By November, overall ED visit counts had increased, but remained 23% lower than year prior.	Approximately 1 month
Wai et al. (2021), Hong Kong ²³	Population-based study of ED presentations to all Hong Kong EDs (n=18) Jan 1-Aug 31 2020 compared to same period year prior	Visits decreased 27% and 28-day all-cause mortality following an ED visit increased (OR 1.26 (95% CI 1.24 to 1.28).	Not reported

COVID 19: coronavirus disease 2019; CDC: Centres for Disease Control and Prevention; ED: emergency department; LOWESS: locally weighted scatterplot smoothing; UK: United Kingdom; USA: United States of America; OR: odds ratio; CI: confidence interval.

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