

ORIGINAL ARTICLE

Paediatric presentations to Christchurch Hospital Emergency Department during COVID-19 lockdown

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Aim: To describe the variation in volumes and types of paediatric presentations to a tertiary emergency department in New Zealand during the national level 4 lockdown for COVID-19.

Methods: A retrospective, comparative cohort study in Christchurch Hospital Emergency Department, New Zealand.

Results: There was a 37% reduction in all emergency presentations during the 33-day lockdown period. Paediatric presentations reduced significantly more than non-paediatric presentations (53% paediatric vs. 34% non-paediatric, $P < 0.00001$). The decrease in both overall and paediatric presentations was significantly different than similar periods in 2019 and 2018 ($P < 0.00001$). The proportion of New Zealand European paediatric presentations during lockdown increased by 6.09% ($P = 0.01$), while Pacific peoples decreased by 3.36% ($P = 0.005$). The proportion of <1-year-old presentations increased by 5.56% ($P = 0.001$), while 11–15 years decreased by 7.91% ($P = 0.0001$). Respiratory-related paediatric presentations decreased by 30% and proportional decreased by 4.92% ($P = 0.001$).

Conclusion: This study has identified a significant reduction in paediatric presentations to a tertiary emergency department in New Zealand during the national Alert Level 4 Lockdown for COVID-19. The proportional increase in the <1-year-old group may suggest a greater need for community-based child health services during the COVID-19 pandemic. Mental health support services may also need to adapt and expand to provide adequate psychological support for children during this crisis. Recognising the needs of these vulnerable groups will be critical during the ongoing COVID-19 pandemic in addition to informing response plans for similar events in the future.

Key words: COVID-19; emergency; paediatrics; SARS-CoV-2.

What is already known on this topic

- 1 It is thought that children have less severe disease with COVID-19 infection than adults with fewer complications.
- 2 During lockdown, emergency presentations reduced significantly.
- 3 It is important we understand the impact of COVID-19 on the paediatric population.

What this paper adds

- 1 Total paediatric emergency presentations dropped by 53% at Christchurch Hospital Emergency Department during lockdown.
- 2 The proportion of respiratory-related paediatric presentations decreased by 4.92% ($P = 0.001$) during lockdown. Injury remained the leading causes of paediatric presentations during lockdown.
- 3 The proportion of presentations by <1-year-olds increased by 5.56% ($P = 0.001$) while that of individuals aged 11–15 years decreased by 7.91% ($P = 0.0001$).

COVID-19, caused by the novel coronavirus SARS-CoV-2, has rapidly become a world-wide threat to travel, commerce and health. This virus is believed to have originated in Wuhan, China, and is highly infectious.¹ Children of all ages appear susceptible to COVID-19; however, the clinical manifestation of the virus appears to be less severe for children

compared to adults, with better prognosis and lower mortality.^{2–4}

On 28 February 2020, New Zealand reported its first case of COVID-19. Over the next 3 weeks, there was a steady increase of cases. On 19th of March, indoor gatherings were limited to 100 people and the country's borders were closed. People were instructed to stay home, while schools and other educational facilities were instructed to close from 24 March. On 25 March, New Zealand moved into Alert Level 4 'Lockdown'.⁵ This included limiting domestic travel, cancelling all public gatherings, closing public venues, educational facilities and all non-essential businesses. Supermarkets, pharmacies, clinics, petrol stations and lifeline utilities remained open with COVID-19 precautions.

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People were instructed to stay at home in their 'bubble', supplies were rationed and health services re-prioritised.⁶

These measures had a significant impact on the health system. Non-essential operations and outpatient appointments were postponed, while face-to-face primary care consultations were reduced by 70%.^{7–9} For the paediatric population, this included New Zealand's community-based child health service (Plunket) closing all clinics, playgrounds, parenting groups and toy libraries, and shifting home visits by nurses to online phone and video calls.¹⁰

Previous infectious disease outbreaks have caused a reduction in total emergency presentations. A 33% decrease in total emergency presentations and 45% decrease in non-trauma presentations by the <18-year-old group was reported during the SARS outbreak in Taiwan in 2005.¹¹ A 2006 Toronto-based study showed a 21% decline in total ED visits, with a 69% reduction in ED visits for infant and toddlers.¹² Likewise, during the 2015 MERS outbreak, a South Korean-based study by Paek *et al.* showed paediatric ED visits declined by up to 42.3%. This was significantly greater than the decrease in presentations by adults.¹³

To date there is limited literature regarding changes to emergency department paediatric presentations and characteristics during the COVID-19 outbreak. This project aims to quantify and describe the change in paediatric presentations to Christchurch Hospital Emergency Department, New Zealand, during the COVID-19 lockdown period.

Methods

Study design

A retrospective, comparative cohort study was conducted on data from paediatric patients who were seen at the Emergency Department (ED) of Christchurch Hospital.

Setting

Christchurch Hospital is a tertiary level hospital in the South Island of New Zealand, which covers a region with a population of approximately 550 000. The Christchurch Hospital ED is the only major acute referral centre in the region making it one of the busiest in Australasia, with over 100 000 attendances each

year.¹⁴ New Zealand has had very few COVID-19 cases compared to other countries. As of 23 June 2020, there were only 10 confirmed cases <10 years of age and no hospital admissions in this age group (Email communication Ministry of Health in July 2020).

Participants

The two cohorts compared in this study consisted of patients aged younger than 16 years, presenting during the 33 days of Alert Level 2 before lockdown, 15 February–18 March 2020 (cohort 1, 'pre-lockdown'), and during the 33 days of Alert Level 4 Lockdown, 26 March–28 April 2020 (cohort 2, 'lockdown'). The week of 19 March to 25 March 2020 was excluded from the data to allow analysis of a presumed steady state of community behaviour within pre- and during-lockdown phases when alert levels were rapidly escalating, and community behaviour was changing dramatically in anticipation of the Alert Level 4 Lockdown.

Data sources

Data were extracted from routinely collected administrative data from Christchurch Hospital's electronic medical record system. Emergency presentations are coded using the SNOMED CT classification system.¹⁵ These codes represent clinician-coded patient diagnoses, which are a compulsory part of a patient's emergency record.

Analysis

The total number of paediatric and non-paediatric presentations in 2020, 2019, and 2018 were compared to show trends in pre-lockdown and lockdown periods across 3 years. Simple descriptive statistical analysis was undertaken to enable comparison of the demographics across the two cohorts in 2020. Patients within each cohort were grouped according to gender, ethnicity, age and triage codes. Patient diagnoses were grouped for comparison and key diagnostic groups and sub-groups were created (Table S1, Supporting Information).

Table 1 Total and paediatric emergency department presentation 2018–2020

	Cohort 1		Cohort 2		% change	P value of χ^2
	15 February–18 March		26 March–28 April			
Total						
2020	9460		5950		–37.10	< 0.00001
2019	9074		8963		–9.88	
2018	9620		8903		–7.45	
Paediatric						
2020	1415		669		–52.72	< 0.00001
2019	1327		1189		–10.40	
2018	1534		1302		–15.12	

Table 2 Total paediatric and non-paediatric emergency department presentations 2020

	Pre-lockdown	Lockdown	% change	P value of χ^2
Paediatric	1415	669	-52.72	<0.00001
Non-paediatric	8045	5281	-34.36	

Statistical methods

Descriptive statistics were calculated using Microsoft Excel 365. Calculations of proportions of presentations were performed using MedCalc for Windows, version 15.0 (MedCalc Software, Ostend, Belgium).¹⁶

Results

A total of 2084 paediatric patients presented to the emergency department during the study period. Of these, 1415 were during the 33-day pre-lockdown period and 669 were during the 33-day lockdown period. This is an overall reduction in paediatric presentations by 53%, which was greater than the 10% and 15% reduction observed in 2019 and 2018, respectively ($P < 0.00001$) (Table 1). Non-paediatric presentations reduced by only 34% during the lockdown period in 2020 (Table 2).

Overall, a total of 15 410 patients presented to the emergency department during the study period: 9460 during the 33-day pre-lockdown period and 5950 during the 33-day lockdown period. This is an overall reduction in presentations by 37%, which was greater than the 10% and 7% reduction observed in 2019 and 2018, respectively (Table 1).

Demographics

The total number of paediatric presentations decreased across all genders, ethnicities and age groups. The proportion of presentations by New Zealand European individuals increased by 6.09% ($P = 0.01$) and that of Pacific peoples decreased by 3.36% ($P = 0.005$) (Table 3). The proportion of presentations by <1-year-olds increased by 5.56% ($P = 0.001$) while that of individuals aged 11–15 years decreased by 7.91% ($P = 0.0001$). The total number of presentations among <3-month olds reduced by

Table 3 Demographics of paediatric presentations in COVID-19 pre-lockdown and lockdown

	Frequency of pre-lockdown presentations (%)	Frequency of lockdown presentations (%)	Change in proportion (%)	(95% CI), P value†
Total Presentations	9460	5950		
Paediatric presentations	1415 (14.96%)	669 (11.24%)	-3.72	(-4.79, -2.63), P = < 0.0001
Gender				
Female	624 (44.10%)	300 (44.84%)	0.74	(-3.81, 5.32), P = 0.75
Male	790 (55.83%)	369 (55.16%)	-0.67	(-3.88, 5.25), P = 0.77
Not specified	1 (0.07%)	0 (0.00%)	-0.07	(-0.50, 0.40), P = 0.49
Ethnicity				
Maori	296 (20.92%)	125 (18.68%)	-2.24	(-1.50, 5.78), P = 0.23
Pacific Peoples	113 (7.99%)	31 (4.63%)	-3.36	(-5.40, -1.08), P = 0.005
NZ European	800 (56.54%)	419 (62.63%)	6.09	(1.57, 10.52), P = 0.01
Asian	164 (11.59%)	71 (10.61%)	-0.98	(-2.02, 3.74), P = 0.51
Other	42 (2.97%)	23 (3.44%)	0.47	(-1.06, 2.31), P = 0.56
Age				
< 1	209 (14.77%)	136 (20.33%)	5.56	(2.09, 9.22), P = 0.001
1–4	459 (32.44%)	232 (34.68%)	2.24	(-2.06, 6.63), P = 0.31
5–10	341 (24.10%)	162 (24.22%)	0.12	(-3.73, 4.14), P = 0.95
11–15	406 (28.69%)	139 (20.78%)	-7.91	(-3.94, -11.68), P = 0.0001
Triage				
Triage 1	8 (0.57%)	2 (0.30%)	-0.27	(-0.56, 0.86), P = 0.41
Triage 2	103 (7.28%)	58 (8.67%)	1.39	(-1.02, 4.07), P = 0.27
Triage 3	818 (57.81%)	397 (59.34%)	1.53	(-3.02, 6.01), P = 0.51
Triage 4	445 (31.45%)	197 (29.45%)	-2.00	(-2.28, 6.14), P = 0.36
Triage 5	41 (2.90%)	15 (4.07%)	1.17	(-0.44, 3.10), P = 0.16
Admitted				
Yes	650 (45.94%)	331 (49.48%)	3.54	(-1.05, 8.12), P = 0.13
No	765 (54.06%)	338 (50.52%)	-3.54	(-1.05, 8.12), P = 0.13

†P values are based on difference using $n-1 \chi^2$ for difference in proportions.

Table 4 Diagnostic categories and subcategories comparison between pre-lockdown and lockdown

	Frequency of pre-lockdown presentations (%)	Frequency of lockdown presentations (%)	Change in proportion (%)	95% CI P value†
Gastrointestinal	161 (11.38%)	91 (13.60%)	2.22	(−0.75, 5.43), <i>P</i> = 0.15
Abdominal pain	94 (6.64%)	59 (8.82%)	2.18	(−0.21, 4.85), <i>P</i> = 0.07
NVD	49 (3.46%)	24 (3.59%)	0.13	(−1.46, 2.02), <i>P</i> = 0.88
Other	18 (1.27%)	8 (1.20%)	−0.07	(−1.17, 1.01), <i>P</i> = 0.89
Respiratory	188 (13.29%)	56 (8.37%)	−4.92	(−7.56, −2.04), <i>P</i> = 0.001
Cough	39 (2.76%)	19 (2.84%)	0.08	(−1.34, 1.80), <i>P</i> = 0.92
Shortness of breath	119 (8.41%)	25 (3.74%)	−4.67	(−6.64, −2.49), <i>P</i> = 0.0001
Sore throat	14 (0.99%)	5 (0.75%)	−0.24	(−0.83, 1.03), <i>P</i> = 0.59
Other	16 (1.13%)	7 (1.05%)	−0.08	(−1.10, 0.96), <i>P</i> = 0.87
Fever	115 (8.13%)	54 (8.07%)	−0.06	(−2.60, 2.45), <i>P</i> = 0.96
Injury	514 (36.33%)	231 (34.53%)	−1.80	(−2.63, 6.13), <i>P</i> = 0.42
Head and neck	124 (8.76%)	56 (8.37%)	−0.39	(−2.32, 2.84), <i>P</i> = 0.77
Limb	299 (21.13%)	119 (17.79%)	−3.34	(−0.36, 6.83), <i>P</i> = 0.08
Torso	18 (1.27%)	9 (1.35%)	0.08	(−0.89, 1.36), <i>P</i> = 0.88
Other	73 (5.16%)	47 (7.03%)	1.87	(−0.26, 4.30), <i>P</i> = 0.09
Mental Health	25 (1.77%)	10 (1.49%)	−0.28	(−1.08, 1.35), <i>P</i> = 0.64
Other	20 (1.41%)	4 (0.60%)	−0.81	(−0.24, 1.65), <i>P</i> = 0.11
Self-harm	0 (0.00%)	6 (0.90%)	0.90	(0.34, 1.95), <i>P</i> = 0.0004
Suicidal thoughts	5 (0.35%)	0 (0.00%)	−0.35	(−0.26, 0.82), <i>P</i> = 0.13
Neurology	58 (4.10%)	30 (4.48%)	0.38	(−1.38, 2.44), <i>P</i> = 0.69
Other	354 (25.02%)	197 (29.45%)	4.43	(0.37, 8.61), <i>P</i> = 0.03

†*P* values are based on difference using $n-1 \chi^2$ for difference in proportions.

NVD, nausea or vomiting or diarrhoea.

40%, 26% among 3 to 6 month olds, and 33% among 6 to 12 month olds. The reductions in the <1-year old sub-categories were not statistically significant. The proportions of each triage code and admission rates did not change significantly for paediatric patients during lockdown (Table 3).

Injury remained the leading causes of paediatric presentations during lockdown. Total injury-related paediatric presentations reduced by 55% during lockdown. This reduction in injury-related presentations was greatest for those aged 11–15 years (Table S2, Supporting Information). The proportion of respiratory-related paediatric presentations decreased by 4.92% (*P* = 0.001) during lockdown. There were six presentations due to self-harm and none due to suicidal ideation during lockdown (Table 4).

Discussion

Total paediatric emergency presentations dropped by 53% at Christchurch Hospital Emergency Department during lockdown. This decrease is consistent with previous infectious disease outbreaks and similar reductions have been reported elsewhere during COVID-19.^{11–13,17,18} The reduction in paediatric emergency presentations has several possible explanations. The implementation of restrictions to reduce the transmission of COVID-19 in the community may have prevented the usual transmission and incidence of several other infectious diseases among the paediatric population. The closure of kindergartens and schools may

partially explain the significant reduction in respiratory-related paediatric emergency presentations reported in this study.

The anxiety and uncertainty associated with the COVID-19 pandemic may have influenced presentations to clinics and hospitals for concern of contracting coronavirus.¹⁹ This may have encouraged patients and their caregivers to stay home with illnesses that they would otherwise present to the emergency department for. This is a concern as it may represent a group with delayed presentation and therefore more serious illness such as cancer, endocrine disorders (e.g. diabetes) and surgical conditions (e.g. appendicitis).¹⁹ Lazzarini *et al.* postulate that fear may be a reason children and their caregivers are not presenting to emergency departments; however, this study is based on a small number of case reports and it is worth noting that the cause of decreased presentations may be multifactorial and not simply attributable to fear.¹⁹

Injury was the most common cause of paediatric emergency presentations in this study. The reduction in the total number of injury-related paediatric presentations may be partially explained by restrictions on outdoors activities and closure of schools. Christey *et al.* report a similar reduction in injury-related emergency presentations during the first 2 weeks of lockdown among those aged 0–14 years in Waikato, New Zealand.²⁰ Hamill and Sawyer report total trauma admissions were at a 5-year low at Starship Children's Hospital, New Zealand's only specialist paediatric hospital. Of the trauma admissions during lockdown, 72% occurred at home compared to an average of 32% in previous years. The proportion of bicycle-related trauma increased to a

5-year high of 19% compared to an average of 3.6% in previous years.²¹

Prior to COVID-19, Māori and Pacific Peoples already faced inadequate and inequitable access to health-care services compared to New Zealand Europeans.²² This study found that the proportion of paediatrics presentations by New Zealand Europeans increased, but presentations by Pacific peoples decreased. This discrepancy may be due to a difference in accessibility to health care, which may have been exacerbated by the COVID-19 pandemic. The closure of public transport services may have made it more difficult to reach general practice clinics, and subsequently reduced referrals and presentations to ED. There was no significant change in New Zealand Māori presentations. This raises the question of whether there are other factors specific to the Pacific population, which resulted in decreased emergency presentation during COVID-19. Vulnerable groups such as Māori and Pacific Peoples in New Zealand already face inequities in health-care provision and this gap may be widened during pandemics.^{23,24}

Despite an overall reduction in total numbers across all age groups, there was an increase in the proportion of <1-year-old presentations during the lockdown period. Similar increase in presentations of these vulnerable populations was found in Australia.²⁵ This may be influenced by increased parental anxiety, disruption to social supports and change in community-based child health services. Parental concern about issues such as fever and feeding problems may have increased emergency department attendances, which otherwise may have been addressed by community-based services. The proportion of presentations for those aged 11–15 years decreased significantly compared to other age groups. This may relate to increased parental supervision and limitation of outdoor activities resulting in fewer injuries.

There is concern that the COVID-19 pandemic may worsen child mental health due to the associated anxiety and uncertainty, social isolation and economic recession.²³ Although the numbers are small in this study, the increase in self-harm presentations and decrease in suicidal ideation presentations during the lockdown period may represent a shift from a contemplative to an action phase. Patients may have been discouraged from attending unless a non-discretionary concern such as physical injury had occurred. This suggests that there may be children needing mental health care but not seeking it.

Strengths and limitations

The study has a robust study design that collected all presenting patient data allowing for novel comparison and statistical analysis to occur. However, this is a single centre study with a single set of comparative groups. Christchurch Hospital's data coding system changed in 2019 resulting in 2020 data being unable to be compared to previous years in the same time periods. Table 1 shows a multi-year comparison, but a more in-depth analysis could not be done due to the change in data coding system. We have reported proportional changes to identify key trends in paediatric emergency presentations to inform our clinical practice. It is important to note that proportional changes do not give reasons for why these trends appear. Our discussion is based on previous literature and postulates reasons for these trends. Future

qualitative work could explore further the reasons for these changes.

Emergency presentations are coded using the SNOMED CT classification system by clinicians in the emergency department, whereas the presentations for patients admitted to hospital are coded by professional medical coders.¹⁵ Emergency diagnostic codes are often symptom-based, therefore the diagnostic categories presented in Table 4 may not represent the underlying pathology.

Conclusion

This study has identified a significant reduction in paediatric presentations to a tertiary emergency department in New Zealand during the national Alert Level 4 Lockdown for COVID-19. The proportional increase in the <1-year-old group may be suggestive of a greater need for community-based child health services during the COVID-19 pandemic. Mental health support services may also need to adapt and expand to provide adequate psychological support for children during this crisis. Recognising the needs of these vulnerable groups will be critical during the ongoing COVID-19 pandemic in addition to informing response plans for similar events in the future.

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Ethical Approval

This study has been granted ethical approval under the 'Minimal Risk Health Research' University of Otago Human Ethics Application HD20/049.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Diagnostic categories and sub-categories for paediatric presentation.

Table S2. Injury-related paediatric presentations categorised by age groups, triage codes and admission rates where proportions are of total injury.