



ORIGINAL RESEARCH

Emergency department presentations in the Southern District of New Zealand during the 2020 COVID-19 pandemic lockdown

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Abstract

Objective: To assess changes in presentations to EDs during the COVID-19 pandemic lockdown in the Southern Region of New Zealand.

Methods: We conducted a retrospective audit of patients attending EDs in the Southern District Health Board (SDHB), from 1 March to 13 May 2020. We made comparisons with attendances during the same period in 2019. The 2020 study period included ‘pre-lockdown’ (1 March–25 March), ‘level 4 (strict) lockdown’ (26 March–27 April) and ‘level 3 (eased) lockdown’ (28 April–13 May).

Results: Patient volumes reduced in all SDHB EDs during levels 4 and 3, mostly representing a loss of low acuity patients (Australasian Triage Scale 3, 4 and 5), although high-acuity presentations also declined. Average patient age increased by 5 years; however, the proportions of

sexes and ethnicities did not change. Presentations of cerebrovascular accidents and appendicitis did not change significantly. Trauma, mental health, acute coronary syndrome and infectious respiratory presentations decreased significantly during level 4, and infectious respiratory presentations decreased further in level 3.

Conclusions: Within the SDHB, patient volumes reduced during levels 4 and 3 of our lockdown, with reduced low-acuity presentations. High-acuity patient numbers also declined. Trauma, mental health, alcohol-related, infectious respiratory and acute coronary syndrome presentations declined while cerebrovascular accident and appendicitis numbers showed little to no change.

Key words: *acute coronary syndrome, COVID-19, emergency department, mental health, New Zealand, respiratory infection.*

Key findings

- Patient volumes decreased in all Southern Region EDs during the COVID-19 pandemic lockdown.
- Trauma, mental health, alcohol-related, infectious respiratory and acute coronary syndrome presentations declined.
- Cerebrovascular accident and appendicitis presentations showed little to no change.

Introduction

A cluster of cases of pneumonia reported in Wuhan, China, in late 2019 was later identified as being due to a novel coronavirus, ‘SARS-CoV-2’ (Severe Acute Respiratory Syndrome Coronavirus 2). The disease caused by the virus was termed ‘COVID-19’ (Coronavirus Disease 2019).¹ COVID-19 was declared a pandemic by the World Health Organization on 11 March 2020. As of 9 February 2021, there had been 106 million confirmed cases of COVID-19 worldwide, including more than 2 300 000 deaths.

The first case of COVID-19 in New Zealand (NZ) was notified on 28 February in Auckland. The strategy of the NZ Government was to eliminate SARS-CoV-2 by closing our borders and stopping transmission from and within clusters. A four-level COVID-19 alert system

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Accepted 10 February 2021

was announced; with higher levels representing stricter limits on everyday life (e.g. limiting travel, face-to-face contact and non-essential business operations). On 25 March at 11.59 pm, NZ entered level 4. At alert level 4, most New Zealanders who were non-essential workers remained in strict isolation at home, all non-essential businesses and education facilities were closed, there were severe travel restrictions, and there was major re-prioritisation of healthcare services. NZ stepped down to level 3 on 27 April at 11.59 pm. At alert level 3, working from home was encouraged, businesses were allowed to reopen with strict physical distancing requirements for staff, retail businesses reopened for contactless/online business, and education facilities up to year 10 were allowed to open. We moved to level 2 on 13 May at 11.59 pm and to level 1 on 8 June. At level 1, life within NZ returned to near-normal, but border controls remained.

By 15 June, 23 days had elapsed with no new diagnoses; then on 16 June, two new cases were announced; they had recently arrived from the UK. Additional cases in returnees to NZ were subsequently reported; they were in managed isolation and quarantine facilities (set up to manage risks from returnees). On 11 August, four cases of COVID-19 from an unknown source were reported in Auckland. This prompted a temporary return to alert level 3 for Auckland and to level 2 for the rest of the country. A few other new 'community clusters' have since been reported and contained. Currently (as at 9 February 2021) the whole of NZ is at alert level 1. From the beginning of the pandemic until 9 February 2021, NZ has had 1966 confirmed COVID-19 cases and 25 deaths.

Our study was conducted within the Southern District Health Board (SDHB), which covers the largest geographical area of any District Health Board in NZ (approximately 62 356 km²). It provides care to 330 000 residents.² The first case of COVID-19 in the SDHB region was reported on 15 March 2020 in

Queenstown, followed by Dunedin's first case on 17 March and Invercargill's on 18 March. The total number of COVID-19 cases in the SDHB region from the beginning of the pandemic till now (9 February 2021) was 216, including two deaths.

There is little published research about the effects of the pandemic and lockdown changes on the NZ health system. One NZ trauma centre study demonstrated a 43% decrease in trauma-related presentations within the first 14 days of lockdown compared to the 14 days pre-lockdown.³ Reductions were most dramatic among the categories of major injury (50% reduction), male sex (50% reduction) and children aged 0–14 years (48% reduction). Overseas, similar reductions in presentations during quarantine periods have been reported. For example, England saw an overall 25% reduction in attendees to EDs in the week after lockdown.⁴ This prompted the Royal College of Emergency Medicine to release a statement urging the public not to fear hospitals and to continue to seek medical attention during lockdown if needed.

At the outset of the present study, we predicted that COVID-19 and the measures to control it would have substantial effects on patient presentations and healthcare needs at EDs within our region.

Methods

We carried out a retrospective audit of all patients presenting to EDs in the SDHB, comprising Dunedin (DPH), Southland and Lakes District Hospitals. DPH ED is a public tertiary care facility and has approximately 45 000 presentations annually. It is the only ED in the city of Dunedin, which has a permanent population of over 130 000 people including 21 000 university students. Southland Hospital is in Invercargill and serves a catchment population of 108 000, with an ED seeing 39 900 presentations annually. Lakes District Hospital is in Queenstown, a popular tourist destination that normally has over

1 million visitors annually and a permanent population of approximately 35 000. Lakes District Hospital's ED has approximately 14 000 presentations annually.

The study included all patients seen in the three EDs from 1 March to 13 May 2020, and they were compared with patients seen over the same period in 2019.

Our primary aim was to investigate changes in ED presentations during alert levels 4 and 3 of NZ's national COVID-19 lockdown. The alert levels are as defined by the NZ Government on the official website <https://covid19.govt.nz/>. We collected data on the total numbers of patients presenting to the EDs, their acuity and presentations of interest. We chose the presentations of interest based on conditions mentioned in previous studies and professional interest. These were stroke, acute coronary syndrome (ACS), trauma, mental health, appendicitis, infectious respiratory illnesses and alcohol-related presentations (Appendices S1–S6 give details of what was included). Infectious respiratory tract infection presentations were classified from diagnostic codes suggestive of respiratory infections such as upper respiratory tract infection, lower respiratory tract infection, pharyngitis, bronchitis, croup and sinusitis. Symptom-based codes that included (for example) cough and sore throat were also aggregated within the umbrella of acute respiratory tract infection presentations (Appendix S6). Alcohol-related presentations were classified based on routinely collected information. Patient presentations were also grouped into 'high acuity' (Australasian Triage Scale 1–2) and 'low acuity' (Australasian Triage Scale 3–5) categories.

Our secondary aims were to assess changes to patient demographics (age, sex and ethnicity) and hospital admission rates during the lockdown period.

We obtained anonymised patient data from the SDHB patient management software (Wellsoft EDIS). This included ED discharge diagnosis, routinely collected data on alcohol screening, length of stay, demographics and discharge disposition. Discharge disposition included

whether patients were discharged home, admitted to a short stay/observation area, admitted to hospital (ward or ICU), or died during their ED stay.

This work, during our lockdown, was a clinical audit of routinely collected anonymised patient data, initiated as part of the emergency planning and quality assurance process. We had no contact with patients and were not supplied with any identifying data on patients.

We analysed the data using Microsoft Excel software, and used Welch's *t*- or χ^2 -tests to examine differences between levels of the 2020 lockdown and the same periods in 2019. Welch's unequal variances *t*-test is used to test the hypothesis that two populations have equal means, without assuming equal variances; this was appropriate for our data. Periods studied were: pre-lockdown: 1 March–25 March (25 days), level 4: 26 March–27 April (33 days), level 3: 28 April–13 May (16 days).

Results

This audit included 13 671 patients presenting to the ED in the 2020 periods, compared to the equivalent periods in 2019 with 19 841 patient presentations (Table 1). There were similar sex proportions with approximately 50% of patients being female and approximately 50% male in both years (Appendix S7). Ethnicity data collected during this audit included NZ European, Māori, European other, Asian, Pasifika, Middle Eastern, African, Latin American/Hispanic and Melanesian groups. The proportions of ethnicities were similar in 2019 and 2020, with no changes over any lockdown periods (Appendix S8). The average age of patients increased significantly during level 4 and level 3 lockdown periods compared to 2019 (level 4 – 2019 40.3 ± 0.3 vs 2020 45.1 ± 0.7 , $P = 0.0003$; level 3 – 40.3 ± 0.4 vs 44.8 ± 0.9 , $P = 0.0009$). There was a particular loss of 0–25-year-olds during level 4 and level 3 lockdown (Appendix S9).

Patient numbers

After notification of the first case of COVID-19 in our region on 15 March, daily data showed that the total ED presentations began to decrease in all three EDs in the pre-lockdown period (Fig. 1). The largest decrease occurred during the level 4 lockdown period when presentations overall reduced to 55% of 2019 numbers. In each hospital, the reductions in proportion from the same period in 2019 were as follows: DPH ED to 53%, Southland to 58% and Lakes District to 32% (Table 1). Patient presentations fell to a minimum on 7 April (following the peak of NZ's COVID-19 cases) and then they slowly increased late in level 4 and during level 3. During level 3, the proportional reduction of presentations was: DPH at 68%, Southland at 76% and Lakes District at 79% of total ED presentations during the same study period in 2019. Absolute numbers of admissions and discharges are in Table 1.

Patient acuity

The numbers of low acuity patients decreased far more than numbers of high acuity patients over the 2020 lockdown levels 4 and 3, as compared to both 2019 periods and to the 2020 pre-lockdown period. Figure 2 shows the number of high and low acuity patients per day across all sites: decreased numbers in ED were primarily losses of lower acuity presentations, while higher acuity patients largely still attended ED (data included in Appendix S10). That said, a decline in presentations for triage level 1–2 patients was sufficiently marked to be evident in Figure 2, especially in level 4. In absolute terms, the number of presentations for Australasian Triage Scale levels 1–2 was down from 987 to 654 in level 4 (34% lower) and from 478 to 400 in level 3 (16% lower). These proportions are from comparisons with 2019 equivalents and the relevant data are in Appendix S10. While the absolute numbers of patients admitted to wards or ICU decreased during the 2020 level 3 and level 4 lockdown periods, the proportion of patients with these

more serious dispositions increased slightly, supporting the findings based on triage acuity (Table 1).

Presentations and diagnoses

During the 2019 period studied, ACS occurred at an average of 1.41 (95% CI 1.16–1.66) presentations per day. Within the 2020 level 4 lockdown period, this fell to 0.85 (95% CI 0.55–1.15) per day ($P = 0.049$), a significant decrease compared to the level 4 period in 2019.

For cerebrovascular accidents, we found no statistically significant differences in average daily presentations between any of the time periods. In 2019, there was an average of 0.80 presentations per day (95% CI 0.61–0.99). During pre-lockdown, there were 1.1 presentations per day (95% CI 0.74–1.50), during level 4 there were 0.79 presentations per day (95% CI 0.49–1.08, $P = 0.79$ vs level 4 lockdown period 2019) and in level 3 there was an average of 0.8 per day (95% CI 0.37–1.26).

Regarding infectious respiratory presentations (Fig. 3), there was a statistically significant reduction during level 4 (5.30 per day; 95% CI 5.01–5.60) compared to the equivalent 2019 period (10.12 per day; 95% CI 9.00–11.25; $P < 0.00001$). There was a further statistically significant reduction in respiratory presentations during 2020 level 3 (to 2.88 per day; 95% CI 1.91–3.84, $P < 0.00001$ when compared with 2019).

Trauma presentations were significantly reduced in the 2020 levels 3 and 4 lockdown periods compared to 2019 and the pre-lockdown period. In the 2019 study period, there was an average of 90.2 (95% CI 86.94–93.39) presentations per day. During the 2020 level 4 lockdown, there were 38.06 per day (95% CI 37.76–38.36; $P < 0.00001$ as compared with 2019). In level 3, this increased to 55.31 trauma presentations per day (95% CI 50.45–60.18; $P < 0.00001$).

Mental health presentations were significantly reduced during level 4 lockdown compared to both 2019 level 4 ($P < 0.00001$) and 2020

TABLE 1. Total patient numbers, average patient numbers per day and patient discharge destination from ED for the lockdown periods in 2020, compared with 2019

	Pre-lockdown (25 days)		Level 4 (33 days)		Level 3 (16 days)		Total (74 days)	
	2019	2020	2019	2020	2019	2020	2019	2020
Total ED presentations	6923	5911	8773	4789	4145	2971	19 841	13 671
Average ED presentations per day (mean \pm 95% CI)	277 \pm 7	240 \pm 20	266 \pm 7	145 \pm 7	259 \pm 6	186 \pm 8	268 \pm 4	180 \pm 10
Discharge from ED	4953 (72%)	4209 (71%)	6306 (72%)	3343 (70%)	2881 (69%)	2101 (71%)	14 183 (71%)	9653 (71%)
Short stay/observation unit	648 (9.4%)	529 (9.0%)	801 (9.1%)	268 (5.6%)	443 (11%)	173 (5.8%)	1892 (9.5%)	970 (7.1%)
Ward admission	1280 (18%)	1134 (19%)	1622 (18%)	1143 (24%)	798 (19%)	681 (23%)	3717 (19%)	2958 (22%)
HDU/ICU admission	40 (0.58%)	27 (0.46%)	38 (0.43%)	26 (0.54%)	20 (0.48%)	13 (0.44%)	98 (0.49%)	66 (0.48%)
Transfer to hospital outside SDHB	0 (0.0%)	10 (0.17%)	3 (0.03%)	7 (0.15%)	1 (0.02%)	3 (0.10%)	4 (0.02%)	20 (0.15%)
Patient death	2 (0.03%)	2 (0.03%)	3 (0.03%)	2 (0.04%)	2 (0.05%)	0 (0.0%)	7 (0.04%)	4 (0.03%)

Where not labelled as average, numbers represent absolute ED attendees and percentages represent the proportion of total ED presentations within relevant time period. CI, confidence interval; HDU, high dependency unit; ICU, intensive care unit; SDHB, Southern District Health Board.

pre-lockdown ($P \leq 0.0001$). During the pre-lockdown period, there was an average of 5.44 mental health presentations per day (95% CI 5.06–5.82). In level 4, this halved to 2.88 per day (95% CI 2.58–3.18; $P < 0.00001$). Then in level 3, the average number of mental health presentations increased to 4.06 per day, although this was still a relatively low level in comparison with 2019 and pre-lockdown 2020.

Appendicitis presentations showed no statistically significant change during any of the study periods. In 2019, there was an average of 0.93 presentations per day (95% CI 0.71–1.15). In the 2020 pre-lockdown period, there was an average of 1.16 presentations per day (95% CI 0.78–1.54). In level 4 lockdown, there was a similar number of presentations per day at 0.88 (95% CI 0.58–1.18) and then in level 3 lockdown there was an average of 1.06 (95% CI 0.43–1.69) presentations per day.

Alcohol-related presentations declined in both 2020 study periods compared to 2019. The numbers of levels 4 and 3 alcohol-related presentations were also reduced compared to the 2020 pre-lockdown period. During level 4 lockdown, there was an average of 2.61 presentations per day (95% CI 2.31–2.90; $P \leq 0.00001$) compared with the 2019 comparable period average of 8.12 per day (95% CI 6.33–10.09). In level 3, the number went up to 3.69 (95% CI 2.32–5.06; $P = 0.01$ vs 2019 level 3 lockdown). This was still less than half the average number per day (7.31) in the comparable 2019 period.

Admissions

Patient admissions from EDs to hospital wards showed a marked decline during the lockdown periods, more so in level 4 than level 3 (Table 1). In 2020 level 4, there were 1143 patients who were transferred from ED to a ward, and in level 3 there were 681. There were 1622 and 798, respectively, in the equivalent 2019 periods (Table 1). Thus, the number of ward admissions (from the EDs) was down by 30% in level 4, and by 15% in

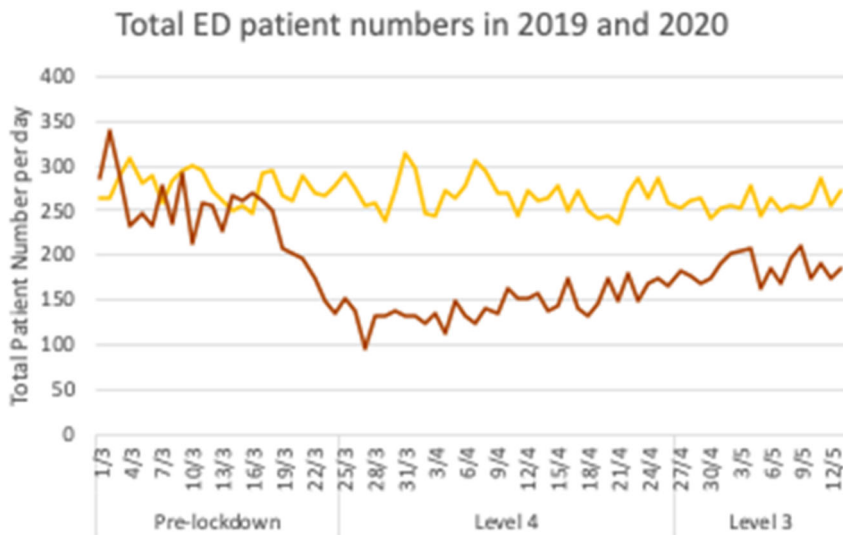


Figure 1. Total numbers of patients per day presenting to EDs across the SDHB of New Zealand in 2019 and 2020. (—), 2019; (—), 2020.

level 3, as compared with the equivalent 2019 periods.

Discussion

During the 2020 study period, there were significant reductions in

presentations of low acuity, trauma, alcohol-related, mental health, acute coronary syndrome and infectious respiratory presentations. High-acuity patient numbers also declined. We did not find statistically significant changes in presentations of

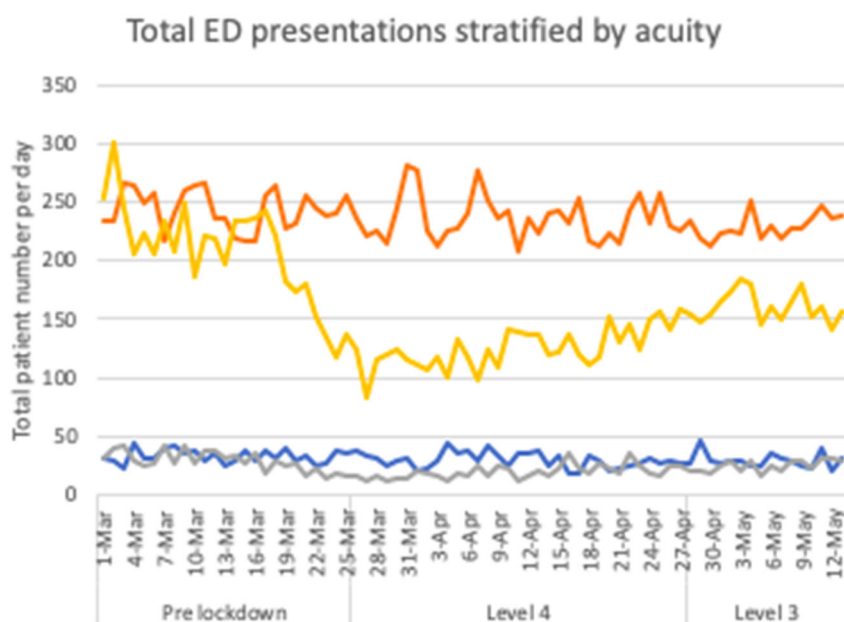


Figure 2. Total ED presentations per day stratified by acuity across 2019 and 2020 study periods for the entire SDHB region. (—), 2019 – ATS 1 or 2; (—), 2019 – ATS 3, 4 or 5; (—), 2020 – ATS 1 or 2; (—), 2020 – ATS 3, 4 or 5.

appendicitis or cerebrovascular accident. The numbers of patients admitted to hospital wards from the EDs declined.

During our level 4 lockdown, restrictions were placed on all travel, including local travel for recreational activities to reduce movement and social interaction in order to contain the spread of the virus. Our results show a significant reduction in trauma-related presentations to the ED during this time period, which could be attributed to the restrictions on travel during lockdown. A positive consequence of reduced trauma presentations was reduced strain on hospital resources. Alcohol-related presentations were noticeably reduced in level 4 lockdown, which was most prominent in Dunedin. This may be due to the reduced student population at this time, closed bars and premises, and alcohol intake at home. These trauma and alcohol-related results suggest the restrictive measures taken were effective and could be considered necessary for future lockdowns if a secondary goal of lockdown was to reduce impact on EDs.

Reduced emergency presentations have been reported elsewhere, for example in England there was a 49% reduction in ED visits after the COVID-19 lockdown.⁴ Stroke presentations to the ED were reduced in the UK and a reduction in ischaemic strokes was observed in Italy.^{4,5} Delayed contact for ST-Elevation Myocardial Infarction patients was seen in Hong Kong.⁶ Austrian cardiac centres saw a 39.4% reduction in ACS presentations⁷ and there were reduced ACS-related hospitalisation rates in Northern Italy⁸ and California.⁹ A reduced suicide rate was reported in Japan,¹⁰ but there are sparse data about the incidence of mental health problems during the COVID-19 pandemic.¹¹ Declines in emergency mental health presentations have also been reported in the USA and Germany.^{12,13}

In Melbourne, adult presentations to two EDs were much lower than expected for a range of non-COVID conditions, particularly low acuity presentations. Mental health presentations declined to about 70% of expected.¹⁴ In Victoria, paediatric

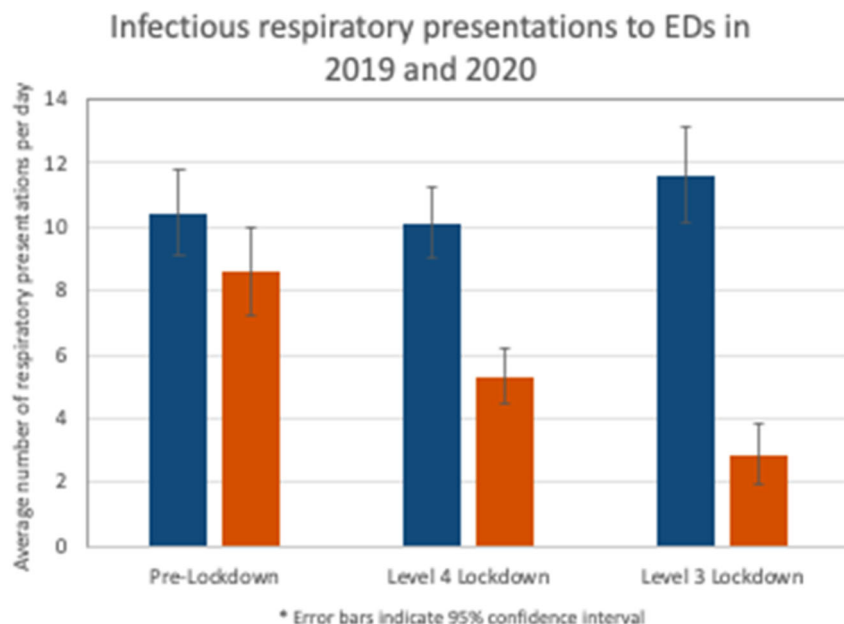


Figure 3. Average infectious respiratory presentations per day. Each point represents the average number of infectious respiratory patients across the SDHB region, and the error bars represent a 95% confidence interval. (■), 2019; (■), 2020.

presentations halved in total, while mental health diagnoses increased by 35%.¹⁵ In New South Wales, lockdown ED presentations were almost 25% lower than expected.¹⁶ Presentation numbers for ACS in the 2020 period were similar to those 2019, while those for stroke were lower and those for mental health issues were higher.

The NZ response to the COVID-19 pandemic has been very different from that in most places in the world, with a successful Government strategy to 'go hard, go early'. Our findings are more comparable to parts of the world with a similar strategy and experience of the epidemic, for example Australia and Taiwan.

Further research should explore in more detail the reasons for the dramatic changes to the ED presentations. Other questions to answer in the near future are: was there a catch-up in certain presentations post-lockdown, and were health outcomes poorer for people who delayed and/or avoided seeking help by not attending EDs?

Limitations

Whole systems within our hospitals and multiple aspects of life in NZ

changed during the pandemic, so it is difficult to be sure of the reasons for some of the changes. There were some population changes during the study period, which we are unable to quantify and which would have affected ED presentations, for example students leaving Dunedin and tourists leaving Queenstown. There were limitations as data were collected using diagnostic codes without chart review. Another limitation was that we compared 2019 and 2020 without knowing more about any underlying trends. However, these were consecutive years, and no existing trend could make a material contribution to the overwhelming downward changes seen after lockdown. Although a more complex statistical analysis may have been more robust, such as interrupted time series regression, our trends are so profound that they must be corollaries of the COVID-19 lockdown. Our data are also mostly coherent with the studies in other countries.

Conclusions

EDs in the SDHB region of NZ saw large reductions in patient volumes during the COVID-19 pandemic

lockdown. We might expect that some patients who delayed getting medical attention during lockdown would present later, and some might suffer adverse consequences. For the future, if this type of event occurs again, we implore a greater focus on educating the public that EDs remain operational, and that patients can safely seek help.

Acknowledgements

The authors are grateful to the staff of the Southern District EDs for their assistance as we went about this work at a difficult time. We thank NZ's 'Team of 5 Million' who each played their part in keeping COVID-19 at bay during our lockdown and beyond.

Competing interests

None declared.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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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:
- Appendix S1.** Mental Health Codes/Diagnoses included in analysis, with numbers of ED diagnoses included in the 2019 and 2020 study periods.
- Appendix S2.** Trauma Codes/Diagnoses included in analysis, with numbers of ED diagnoses included in the 2019 and 2020 study periods.
- Appendix S3.** Appendicitis Codes/Diagnoses included in analysis, with numbers of ED diagnoses included in the 2019 and 2020 study periods.
- Appendix S4.** Acute Coronary Syndrome (ACS) Codes/Diagnoses included in analysis, with numbers of ED diagnoses included in the 2019 and 2020 study periods.
- Appendix S5.** Cerebrovascular Accident (CVA) Codes/Diagnoses included in analysis, with numbers of ED diagnoses included in the 2019 and 2020 study periods.
- Appendix S6.** Infectious Respiratory Codes/Diagnoses included in analysis, with numbers of ED diagnoses included in the 2019 and 2020 study periods.
- Appendix S7.** Sex of ED attendees. Numbers represent absolute patient numbers through all SDHB EDs in each time period, and percentages refer to proportion of each sex presenting in the relevant time period.
- Appendix S8.** Ethnicity of ED attendees. Numbers represent absolute patient numbers through all SDHB EDs in each time period, and percentages refer to proportion of each ethnicity presenting in the relevant time period.
- Appendix S9.** Age of ED attendees. Numbers represent absolute patient numbers through all SDHB EDs in each time period, percentages refer to proportion of each age range presenting in the relevant time period, and *P*-values were calculated using Welch’s *t*-tests of daily patient numbers stratified by age range, comparing 2019 and 2020 data for each time period.
- Appendix S10.** Changes in acuity of ED attendees. Numbers represent absolute patient numbers through all SDHB EDs in each time period, and percentages refer to proportion of each acuity category presenting in the relevant time period.