

# Emergency department attendances during the COVID-19 pandemic: a retrospective analysis of attendances following Irish governmental pandemic measures

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## ABSTRACT

**Background** COVID-19 has resulted in the death of over 1 million people to date. Following government-implemented regulations, there has been concern over the apparent decline in emergency department (ED) attendances and the resultant health legacy. Therefore, we aimed to characterise the attendances to an Irish tertiary hospital ED following the implementation of these regulations during the COVID-19 pandemic.

**Methods** This retrospective observational study investigated all attendances to the Cork University Hospital ED from 15 February to 11 April in 2020 and 2017–2019. Attendances were stratified into four periods: Before COVID (BC) (15 February to 5 March), After COVID (AC) (6 March to 12 March), Educational Closure (EC) (13 March to 27 March) and Stay Home (SH) (28 March to 11 April), as per government regulations. Triage presentations of abdominal pain, shortness of breath, chest pain, headache and trauma were examined. Data were analysed by independent t-tests and  $\chi^2$  analysis.

**Results** There were 8261 attendances to the ED in the 2020 time period compared with a mean of 10389 attendances during the corresponding periods in 2017–2019. There was a significant decrease in daily attendances in 2020 compared with 2017–2019 in the AC (142 vs 188,  $p=0.02$ ), EC (122 vs 184,  $p<0.001$ ) and SH (121 vs 181,  $p<0.001$ ) periods, including significant decreases in abdominal pain (AC: 9 vs 22, EC: 10 vs 19, SH: 11 vs 18,  $p<0.001$ ), chest pain (AC: 9 vs 15, EC: 8 vs 15, SH: 9 vs 15,  $p<0.01$ ), headache (AC: 5 vs 11, EC: 4 vs 9, SH: 4 vs 9,  $p<0.01$ ) and trauma (AC: 3 vs 5, EC: 2 vs 6, SH: 3 vs 5,  $p<0.01$ ).

**Conclusion** Our findings suggest that the combination of government-imposed restrictions and perceived risk of attending an ED during a pandemic may contribute to reduced attendances. Public confidence in EDs is necessary to reduce collateral damage caused by failure to seek medical attention during a pandemic; adequate infrastructure to allow social distancing and isolation capacity in EDs is a necessity.

## INTRODUCTION

COVID-19, the clinical outcome of SARS-CoV-2 infection, represents the largest pandemic since the influenza pandemic of 1918.<sup>1</sup> It has affected over 43 million patients and has been associated with over

## Key messages

### What is already known on the subject

- COVID-19 is a serious public health emergency, having infected over 43 million people and resulting in the death of over 1.1 million people worldwide.

### What this study adds

- This retrospective study demonstrates that there was an overall decrease in emergency department (ED) attendances following the government-imposed regulations, which included reduction in patients presenting with abdominal pain, chest pain, headache and trauma.
- There was an increase in the admission rate of trauma patients, but no increase in the admission rate of patients with chest pain.
- Public confidence in EDs is necessary to prevent a postpandemic negative legacy effect caused by patients failing to seek prompt medical attention. Therefore, adequate infrastructure to allow social distancing and isolation capacity in EDs is a public necessity.

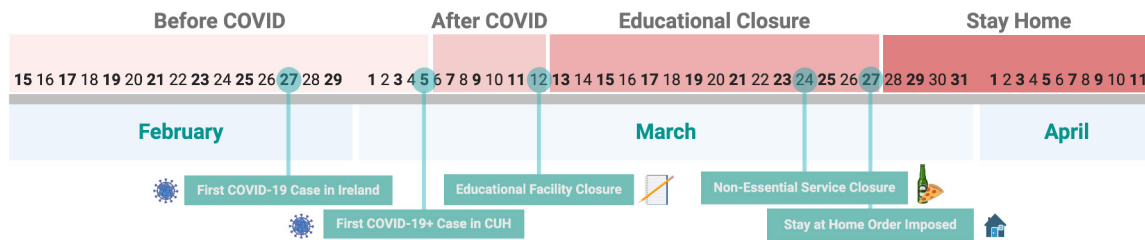
1.1 million deaths worldwide since being described in Wuhan, China, in December 2019.<sup>2</sup> The majority of cases are mild, although 32% of confirmed cases in Europe have required hospitalisation for respiratory failure or acute respiratory distress syndrome or have resulted in death.<sup>3</sup> Internationally, varying levels of social-distancing measures have been introduced to contain the spread of this highly contagious virus.

The first case emerged in Ireland on 29 February 2020, and cases were identified in all 26 counties by 22 March 2020 (figure 1A). The rapid spread prompted government-imposed social-distancing measures including nationwide educational closures and restriction of public gatherings. In the ensuing weeks, non-essential services were halted and a stay-at-home order was introduced on 27 March 2020.<sup>4</sup> Such restrictions may have potentially severe ramifications for at-risk populations, such as persons of low socioeconomic status, the elderly and individuals with chronic medical conditions,



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**Figure 1** Timeline of significant COVID-19-related events during the study period and evolution of COVID-19-related public interest.

due to reduced access to general practice surgeries, pharmacies and hospitals.<sup>5</sup> The threat of COVID-19 transmission therefore mounts increasing challenges to employment, education and the delivery of goods and services. Indeed, the Chief Medical Officer in Ireland expressed early concerns over emergency department (ED) aversion due to fear of COVID-19 infection.<sup>6</sup> These feelings were echoed in the UK as the President of the Royal College of Emergency Medicine acknowledged a 25% decrease in ED visits after a national lockdown.<sup>7</sup>

COVID-19 has resulted in hospital resources being at an unprecedented premium, forced to balance the delivery of high-quality care with the ever-present threat of a surge in COVID-19 presentations. We previously established that major weather events could impose significant restrictions on unwell patients attending the ED due to transportation difficulties.<sup>8</sup> Similarly, public fear of SARS-CoV-2 infection may be prompting these individuals to inappropriately adhere to stay-at-home orders, even when they are suffering from a serious medical illness (eg, myocardial infarction (MI), stroke).<sup>9</sup> The healthcare implications of this pandemic are thus both immediate and far-reaching.

Therefore, the primary objective of this study was to characterise the volume of attendances to a tertiary hospital ED in Ireland following the population-based regulations imposed by the Irish government during the COVID-19 pandemic. The secondary objective was to assess whether there was a disproportionate change in the classification of presentations (ie, composition) or the inferred acuity of the presentations (ie, postassessment destination) during the study period when compared with the corresponding period in preceding years. Ultimately, we hypothesise that the pandemic and ensuing government-imposed public restrictions may deter individuals who require medical attention from attending the ED, thereby resulting in potential harms to community health.

## METHODS

### Design and setting

This is a retrospective observational study of attendances to the ED at Cork University Hospital, a large tertiary care hospital and the only level 1 trauma centre in Ireland. The hospital receives approximately 70 000 attendances per year with a catchment area of approximately 1.1 million adults and children. Ethical approval was granted by the National Research Ethics Committee for COVID-19-related Research (20-NREC-COV-013). The Strengthening the Reporting of Observational Studies in Epidemiology guidelines were followed in the reporting of this study.<sup>10</sup>

### Patient and public involvement

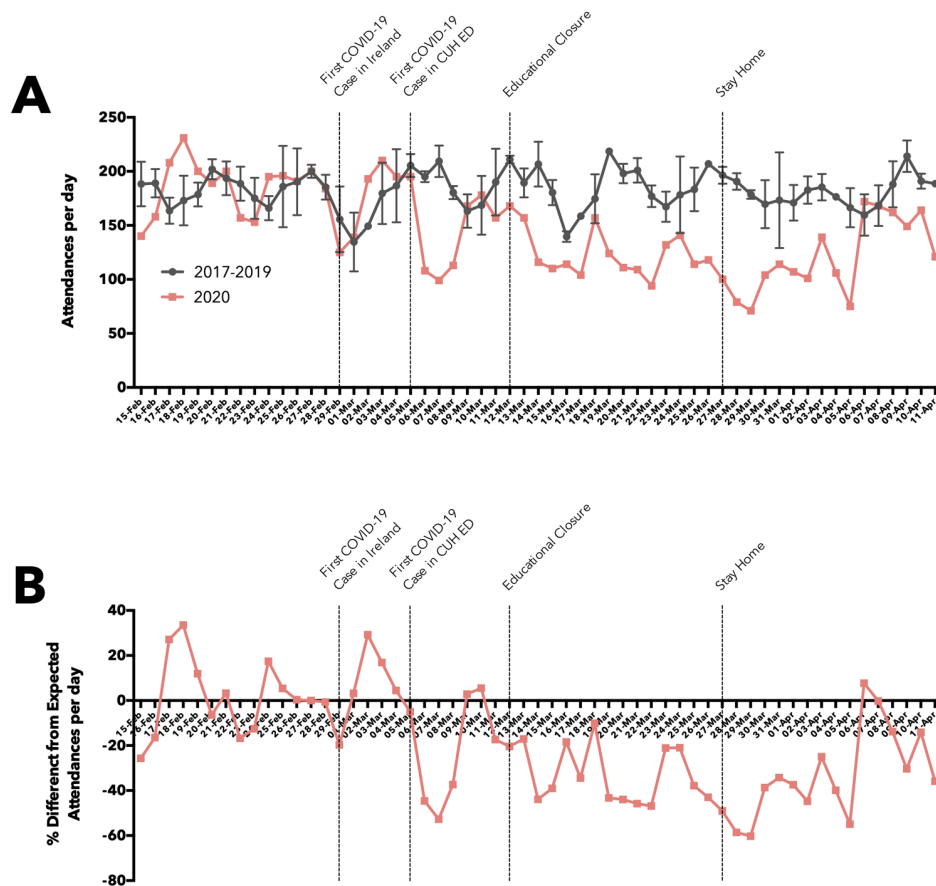
Patients or the public were not involved in the design, conduct, reporting or dissemination plans of our study.

### Data collection and stratification

Retrospective data on attendances to the ED were retrieved from 15 February to 11 April for 2017, 2018, 2019 and 2020 from the ED Integrated Patient Management System. These data were stratified into four time periods for data analysis based on the key COVID-19-related public health events outlined in figure 1. The first group, 'Before COVID (BC)', includes all data from 15 February to 5 March (date of first case of COVID-19 in hospital). The second group, 'After COVID (AC)', includes all attendances from 6 March to 12 March (date that the Prime Minister of Ireland announced closure of all educational institutions). The third group, 'Educational Closure (EC)', includes all attendances from 13 March to 27 March (date that the Prime Minister instituted 'stay-at-home' orders). The final group, 'Stay Home (SH)', includes all attendances from 28 March to 11 April, the date in which the study analysis was completed. Attendances in 2020 were compared with the average number of attendances for each day over the same period in 2017–2019 to estimate the expected volume of attendances.

### Presentations

Patient presentations were grouped into 14 categories, with 5 predetermined presentation categories of interest further analysed. Any category with attendances less than 2% of the total, that was not prespecified as of interest, was combined into a group labelled 'Other'. The five categories chosen for analysis included 'abdominal pain', 'shortness of breath', 'chest pain', 'headache' and 'trauma'. 'Trauma' was defined as ambulance trauma calls. These categories were chosen as they were deemed most likely to represent serious medical emergencies. The average number of daily attendances in each category from 2020 were then compared with the average number of attendances over the same dates in 2017–2019. Further analysis determined the method of referral (general practitioner (GP) referral, emergency medical service (EMS) call or self-referral) and the disposition (home or ward) for each aforementioned presentation. The use of disposition destination alludes to the number of patients being admitted to hospital and thus was used as a surrogate measurement of presentation acuity. Similar to the raw number of attendances, differences between modes of



**Figure 2** ED attendances over the study period in relation to expected trends. (A) Mean attendances (SEM) on each day of the study period in 2017–2019 (grey) were compared with the same period in 2020 (red). (B) The percentage difference from expected attendances per day was then calculated. CUH ED, Cork University Hospital emergency department.

referral and discharge destinations were compared with the average percentages from the corresponding time periods in 2017–2019. Triage categories were assigned to patients at presentation and may not have always fully aligned with discharge impression.

### Statistical analysis

Data processing was conducted in Microsoft Excel (Microsoft), and statistical analysis was performed with SPSS V.25 (IBM). Figures were created using Prism V.6 (GraphPad Software, San Diego, California, USA). Independent-samples t-test was used to determine whether differences existed between the mean number of presentations per day in 2020 when compared with previous years for each group, respectively. Mode of referral and discharge destination, within presentation group from 2020, were then compared with data from the same time period in previous years using proportional data and a  $\chi^2$  analysis. Data are represented as mean  $\pm$  SD unless otherwise stated, and significance was determined by an  $\alpha=0.05$ .

## RESULTS

### Attendances

There were a total of 8261 attendances to the ED between 15 February 2020 and 11 April 2020 inclusive compared with an average of 10 389 attendances during the same period in 2017–2019, representing a 32% reduction in attendances

(figure 2). The average number of daily attendances was the same in the BC group in 2020 when compared with the same time period in 2017–2019 (183 vs 180,  $p=0.3$ ; table 1). There was a significantly lower average number of daily attendances in 2020 compared with the same time periods in 2017–2019 in the AC (142 vs 188,  $p=0.02$ ), EC (122 vs 184,  $p<0.001$ ) and SH (121 vs 181,  $p<0.001$ ) groups (table 1).

### Presentations

When comparing absolute attendance numbers for the presenting complaints (figure 3), there were differences in the proportions of patients presenting in 2020 when compared with 2017–2019. After the first confirmed case of COVID-19 in the hospital, there was a gross decrease in the number of attendances for most presentations in 2020 when compared with attendances in 2017–2019 (figure 3).

In 2020, there was a significantly smaller mean daily number of patients presenting with abdominal pain (AC: 9 vs 22, EC: 10 vs 19, SH: 11 vs 18,  $p<0.001$ ), chest pain (AC: 9 vs 15, EC: 8 vs 15, SH: 9 vs 15,  $p<0.01$ ), headache (AC: 5 vs 11, EC: 4 vs 9, SH: 4 vs 9,  $p<0.01$ ) and trauma (AC: 3 vs 5, EC: 2 vs 6, SH: 3 vs 5,  $p<0.01$ ) (figure 4) when compared with the same dates in 2017–2019. Shortness of breath presentations were significantly higher in the EC group (14 vs 10,  $p<0.001$ ) in 2020 when compared with

**Table 1** Patient demographics

	Mean 2017–2019 (mean=10 389)	2020 (n=8261)	Difference
Age	43±26	43±26	–
Male (%)	52	50	–
Attendances n/day±SD			
Before COVID	180±18	183±28	3±10
After COVID	188±19	142±33*	–46±14*
Educational closure	184±21	122±19*	–62±2*
Stay home	181±14	121±34*	–60±20*
Triage category (n)			
	(mean=10 124)	(n=7476)	
1	80	66	–14
2	2625	2018	–607*
3	5064	3672	–1392*
4	2130	1605	–525*
5	225	115	–100*
Age category (n)			
	(mean=10 389)	(n=8261)	
0–16	2158	1515	–643*
17–64	5520	4505	–1015*
65+	2711	2241	–470*

\*A significant difference ( $p<0.05$ ) in the number of presentations in 2020 when compared with previous years. The 2017–2019 column data include the mean number of attendances between the 3 years.

2017–2019 and significantly lower in the SH group (6 vs 10,  $p<0.001$ ).

### Mode of referral

When assessed by mode of referral, patients experiencing chest pain were more likely to arrive to the ED via EMS in the AC (42% vs 21%,  $\chi^2=7.75$ ,  $p=0.005$ ) and EC groups (39% vs 24%,  $\chi^2=8.20$ ,  $p<0.01$ ) and less likely to arrive by GP referral in the EC (27% vs 46%,  $\chi^2=11.8$ ,  $p<0.001$ ) and SH groups (35% vs 50%,  $\chi^2=6.00$ ,  $p<0.001$ ) in 2020 when compared with 2017–2019 (online supplemental table 3).

### Discharge destination

When assessed by discharge destination, there were no differences for patients with abdominal pain or headache (table 2). For patients with shortness of breath, they were more likely to be sent home in 2020 for the groups AC (57% vs 40%,  $\chi^2=4.72$ ,  $p=0.03$ ) and EC (56% vs 44%,  $\chi^2=5.11$ ,  $p=0.02$ ), but more likely to be admitted for the SH group (70% vs 57%,  $\chi^2=4.08$ ,  $p=0.04$ ) when compared with patients in previous years. Patients with chest pain were more likely to be discharged home in the EC group in 2020 when compared with previous years (69% vs 57%,  $\chi^2=4.8$ ,  $p=0.03$ ). In all groups, after the first documented case of COVID-19 in Cork, there was no increase in the admission rate of patients with chest pain (table 2). However, there was a greater proportion of patients presenting with trauma being admitted to the ward in 2020 for the EC (47% vs 24%,  $\chi^2=7.0$ ,  $p<0.01$ ) and SH (49% vs 24%,  $\chi^2=7.65$ ,  $p<0.01$ ) groups when compared with previous years (table 2).

### DISCUSSION

This study has demonstrated a significant reduction in daily ED attendances after the first COVID-19 case was diagnosed in the hospital, even prior to the imposition of any government restrictions. For each corresponding time period, there were significant reductions in patients presenting

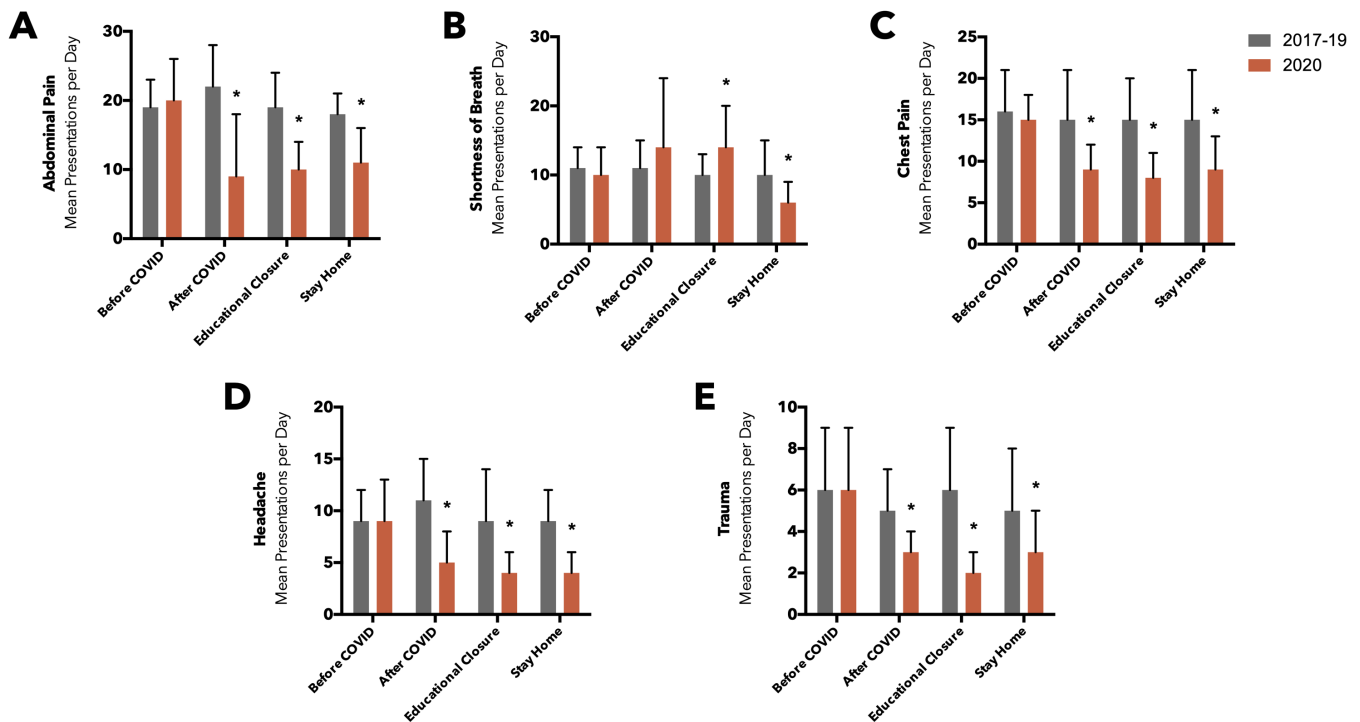


**Figure 3** Relative frequencies of emergency department (ED) presentations in the periods before and during the COVID-19 pandemic in Ireland compared with the same periods in 2017–2019. Presentations of all ED attendees in (A) Before COVID (15 February 2020 to 5 March 2020), (B) After COVID (6 March 2020 to 12 March 2020), (C) Educational Closure (13 March 2020 to 27 March 2020) and (D) Stay Home (28 March 2020 to 11 April 2020) groups. SOB, shortness of breath.

with abdominal pain, chest pain, headache and trauma. We observed an initial increase in shortness of breath presentations at the same time as the closure of the educational institutions, which then decreased during the stay-at-home period.

There was no increase in patient admission rates with the exception of trauma presentations. For analysis, we selected primary complaints that would encompass both common emergency presentations and symptoms of COVID-19. Around the time of government-imposed restrictions, we observed significantly fewer average daily attendances, and composition breakdown revealed a global decrease in all presenting complaints, barring shortness of breath. These decreases in attendances are likely multifactorial, including a combination of public knowledge of the increasing spread of COVID-19 and fear of contracting the virus in hospital: people may be endeavouring to adhere to government-imposed stay-at-home restrictions.

The five categories we analysed represent areas of likely acute medical emergencies.<sup>11</sup> Our analysis establishes a narrative surrounding the potential source of these attendance deviations. The significant decrease in trauma is intuitive. Governmental measures including banning social gatherings, cancellation of



**Figure 4** Mean daily attendances for presentations of interest over the study period in 2020 compared with the preceding 3 years. (A) Abdominal pain, (B) shortness of breath, (C) chest pain, (D) headache and (E) trauma. \*A  $p < 0.05$  when comparing the number of attendances in 2017–2019 (grey) with 2020 (red). Data displayed as mean  $\pm$  SD.

sporting events and closure of non-essential services have vastly reduced population density in areas where most traumas originate (ie, reduced road traffic). However, the greater percentage of admitted presentations around these time periods, used as a surrogate marker of acuity, suggests increased trauma severity at the time of presentation. In addition, there were several reductions in categories that were not included in the main analysis of this article as it was believed that these presentations represented conditions with lesser acuity (figure 3).

The significant decrease in chest pain presentations is more concerning as the prevalence of cardiac emergencies is known

to increase year-to-year.<sup>12</sup> Given the lack of increased GP referrals, a sinister aspect of COVID-19 may be that individuals suffering from chest pain are not only avoiding the hospital but are also not seeking medical attention whatsoever. If there was a significantly higher proportion of chest pain admissions, we might infer that urgent cases are no longer being diluted by less severe issues. However, this was not observed in our study, which suggests that there is a subpopulation of potential cardiac emergencies not attending hospitals. This was recently reported in a study that highlighted a near 40% reduction in ST-elevation myocardial infarction presentations for primary

**Table 2** Attendances to the emergency department with the presentation of abdominal pain, shortness of breath, chest pain, headache or trauma in each group during 2017–2019 and 2020 when stratified by discharge destination (home or ward)

	Abdominal pain		Shortness of breath		Chest pain		Headache		Trauma	
	2017–2019	2020	2017–2019	2020	2017–2019	2020	2017–2019	2020	2017–2019	2020
Before COVID										
Home	188 (51)	204 (52)	98 (45)	106 (53)	182 (57)	192 (68)*	107 (62)	106 (61)	76 (68)	81 (68)
Ward	156 (42)	167 (43)	111 (52)	93 (47)	125 (39)	82 (29)*	55 (32)	65 (37)	28 (25)	34 (28)
After COVID										
Home	68 (45)	36 (55)	30 (40)	55 (57)*	60 (57)	43 (69)	48 (63)	23 (68)	25 (64)	14 (67)
Ward	73 (48)	27 (42)	43 (58)	41 (42)*	40 (38)	19 (31)	25 (33)	11 (32)	11 (29)	7 (33)
Educational Closure										
Home	134 (48)	72 (49)	64 (44)	121 (56)*	126 (57)	84 (69)*	88 (67)	36 (64)	66 (71)	19 (53)
Ward	135 (48)	74 (50)	79 (54)	93 (43)*	84 (38)	37 (30)	40 (31)	19 (34)	22 (24)	17 (47)*
Stay Home										
Home	129 (48)	78 (47)	61 (41)	28 (30)	129 (56)	87 (65)	91 (67)	35 (64)	55 (71)	19 (49)*
Ward	126 (47)	88 (53)	86 (57)	66 (70)*	89 (39)	46 (34)	38 (28)	20 (36)	18 (24)	19 (49)*

\*A  $p < 0.05$  when comparing proportions of attendances between years within the same group and presentation type. Data displayed as n (%). A small percentage of individuals had different discharge destinations, and as such the displayed percentages for the aforementioned groups may not total 100% and this may result in only one of the two categories having a significant difference.

percutaneous coronary intervention across nine cardiac centres in the USA, and a comparable trend was noted by the hospital interventional cardiology service.<sup>13 14</sup> While acute and long-term effects of delayed or missed coronary intervention are not yet clear, this trend may herald a substantial strain on cardiac services in terms of rates of consequential arrhythmias and heart failure.<sup>14</sup> Similar relationships were observed for both abdominal pain and headache in the present data set, the consequences of which may not be fully realised until the pandemic subsides.

The initial increase in shortness of breath presentations could be associated with increased suspicion of COVID-19 infections. The subsequent decrease in shortness of breath presentations at the time of stay-at-home order could reflect reduction in all respiratory viruses due to social distancing and improved hygiene measures. As many of our included presentations include symptoms of COVID-19, it is expected that patients infected with SARS-CoV-2 are included in the study. If this is true, our findings support the hypothesis that other sick patients have been displaced into the community. Combined with data on specific population demographics, our findings may serve as an early predictor of the expected post-COVID surges in specific healthcare sectors.

In this study, we observed a 32% reduction in ED attendances, strikingly similar to previous findings suggesting that 30% of ED presentations are non-urgent.<sup>15</sup> An alternative hypothesis is that this reduced load may simply represent a decrease in inappropriate attendances to the ED, giving us the rare ability to potentially observe 'normalcy'. There is also the possibility that these findings are reflective of an increasingly microbe-conscious society, and social distancing has decreased a range of transmissible diseases including other respiratory illnesses—COVID-19 notwithstanding. The significant decrease in attendances across categories suggests this may be a possibility.

The substantial morbidity and mortality caused by COVID-19 among the global community have been well documented; however, the effect of this pandemic on population behaviour in relation to ED attendances has not previously been examined. By characterising ED admission patterns at the time of government-imposed regulations, this study provides valuable insight to guide future government policy and both hospital and community resource management. A postpandemic surge can be expected, as evidenced by previous access-restricting events; however, the extent of this surge is inherently unpredictable. Hospitals have started to experience significant downstream clinical burden as a result of the pandemic; as patients are delaying presentation to hospital, elective procedures are experiencing significant backlog, and appropriate resource utilisation is becoming more important than ever before.<sup>14 16</sup> Since the initiation of our study, there has been a demonstrable increase in out-of-hospital deaths during the pandemic, which supports our findings and related suggestion of COVID-19-related hospital aversion despite acute illness.<sup>17</sup>

### Strengths and Limitations

This study captured data from every patient presenting to the ED over the 8-week study period, representing a complete catalogue of attendances in the period before and during the pandemic. Using attendance data from the previous 3 years allowed us to determine a baseline, providing more accurate comparisons due to the dilution of local attendance perturbations such as the effect of Storm Emma in March 2018. As such, the significant decrease in presentations may be a direct product of national stay-at-home orders, especially noting the 7% attendance inflation typically expected year-on-year.<sup>18</sup>

While we incorporated a full data set, our study is limited by the fact that both the pandemic and the associated public response continue to evolve. The presentation categories are also broad, which prompted inferences regarding the proportion of medical emergencies each category contained (ie, proportion of MIs in the chest pain category). Therefore, by continuing to analyse trends in ED attendance patterns, we can strengthen our hypothesis and further enhance the generalisability of our findings in other countries that are observing similar relationships.<sup>19</sup> In addition, this study is limited by the fact that there may be many other factors contributing towards the decreases in attendances and admissions such as hospital-specific admission thresholds; however, as noted in [table 1](#), there were no significant differences in the triage categories of patient attendances. Given the number of hypotheses tested in this exploratory observational study, there is a potential risk of type I error. Thus, comparisons that generated marginal statistical significance should be viewed and interpreted cautiously. Future research incorporating patient haemodynamic status on presentation should also be conducted to determine whether patients attending the ED are generally further along in their disease course.

### CONCLUSION

Our findings suggest that the combination of government-imposed restrictions and public-perceived risk of attending an ED during a pandemic may contribute to reduced ED attendances. Public confidence in EDs is necessary to reduce long-term collateral damage during a pandemic caused by patients not seeking medical attention. Coupled with adequate ED infrastructure to allow physical distancing and isolation capacity, public health campaigns should be promptly initiated aimed at informing the population that hospitals are an essential service—especially for those who are acutely unwell.

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