ORIGINAL RESEARCH

Effect of the COVID-19 Pandemic on Emergency Department Visits of Patients with an Emergent or Urgent Diagnosis

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Purpose: During the coronavirus disease 2019 (COVID-19) pandemic, visits to emergency department (ED) have significantly declined worldwide. The purpose of this study was to identify the trend of visits to ED for different diseases at the peak and slack stages of the epidemic.

Patients and Methods: This was a retrospective observational study conducted in a tertiary referral medical center in northern Taiwan. We recorded weekly ED visits for myocardial infarction with or without ST-elevation (STEMI or NSTEMI), out-of-hospital cardiac arrest (OHCA), acute stroke, and congestive heart failure from 2016 to 2021. We compared the local epidemic peak periods (calendar weeks 4–18, 2020 and calendar weeks 21–31, 2021) and its corresponding slack periods (calendar weeks 4–18, 2021 and calendar weeks 21–31, 2020) with the baseline period (2016–2019) using Mann–Whitney test to identify the difference.

Results: We observed a significant decline in ED visits (median [Q1, Q3]) during the epidemic for OHCA (6 [5, 7] and 5 [4, 6], $p = 0.046$, for baseline and peak period, respectively, in week 4–18), acute stroke (41.5 [38, 47] and 35 [28, 39], $p < 0.001$, in week 4–18, 40 [35, 45] and 35 [28, 40], $p = 0.039$, in week 21–31) and CHF (28 [24.25, 33] and 19 [12, 23], $p < 0.001$, in week 4–18, 18 [16, 23] and 13 [11, 16], $p = 0.001$, in week 21–31). Significant difference was not observed in patients with NSTEMI and STEMI in both week 4–18 and 21–31, and cardiac arrest in week 21–31. There was a rebound in ED visits in the slack period.

Conclusion: This study revealed that ED visits significantly declined during the COVID-19 epidemic and rebounded in the slack period. The trend was significant for acute stroke and heart failure but was relatively less prominent effect for emergent events such as cardiac arrest or myocardial infarction.

Keywords: cardiac arrest, congestive heart failure, emergency department, health seeking behavior, myocardial infarction, stroke

Introduction

Since 2020, the coronavirus disease 2019 (COVID-19) pandemic has changed our life drastically. In Taiwan, the first case of COVID-19 was detected on January 20, 2020, and led to few months of struggle at the beginning of 2020.[1] However, Taiwan successfully contained the infection due to its containment strategy.[2] On June 7, 2020, local restrictions were eased due to the absence of new local cases cluster for a long period until May, 2021.

The first local community infection in Taiwan was reported on April 20, 2021, and it soon progressed to a national level 3 epidemic alert on May 19, 2021.[1] The alert persisted from May 19, 2021, to July 26, 2021, with regulations such as school closure, compulsory wearing of facial mask, and social gathering restriction.[1] The pandemic and lockdown policy affected people's health seeking behavior. According to a previous cross-sectional survey, a high prevalence of anxiety existed among 44.9–50.9% of the general population in different countries.[3–5] Under such anxiety, people may fear to visit a hospital to seek help. A statistic report in the United States revealed a significant decline in emergency

department (ED) visits during the pandemic.[6] Moreover, this trend was observed in Korea,[7] the Netherlands,[8] and Canada.[9] Furthermore, ED visits for some acute life-threatening events declined during the pandemic, such as myocardial infarction (23% decline) and stroke (20% decline).[10] It may have been due to many factors, such as the fear of the pandemic, public policy of minimizing nonurgent health care, lockdown order, or collapse of the emergency medical system.[10] Although still unclear, this phenomenon indicated that there may be an unmet gap between health-care utility and patient need.

Various studies have reported a decline in ED visits during the pandemic, but limited knowledge exists regarding how different stages of the pandemic affect this trend. Our hypothesis is that the number of ED visits would change depending on the pandemic stage. The aim of this study was to demonstrate changes in ED visits for life-threatening disease before the pandemic, during the local epidemic peak period, and after the pandemic subsided.

Patients and Methods

Study Design

This retrospective observational study was conducted in the largest referral medical center in northern Taiwan. Our study setting was a tertiary medical center with about 3500-bed and was the only referral hospital in the three nearby counties. The ED with a team of 46 attending physicians was open for all patients during the pandemic, irrespective of whether they had tested positive for COVID-19. All ED visits were recorded during the study period. This study was reviewed and approved by the Institutional Review Board of Chang Gung Memorial Hospital (No. 202101591B0). The study protocol was not involved in personal data collection and was conducted in compliance with the Declaration of Helsinki. Consent to participate was waived by the Institutional Review Board because no personal data was collected in our study.

Data Collection

We collected the diagnosis at ED visits in each week retrospectively from January 1, 2016 to August 31, 2021 based on International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) codes. We recorded the number of patients who were ≥18 years old and visited the ED during the study period with the main diagnosis of (1) myocardial infarction without ST-elevation (NSTEMI, I214, diagnosed on the basis of clinical manifestation and laboratory test), (2) myocardial infarction with ST-elevation (STEMI, I213, diagnosed on the basis of clinical manifestation and electrocardiogram), (3) OHCA (I469, admitting diagnosis, defined as out-of-hospital cardiac arrest due to any cause), (4) acute stroke (I6789, diagnosed on the basis of clinical manifestation and computer tomography), and (5) congestive heart failure (CHF, I509, diagnosed on the basis of clinical manifestation and laboratory test). All diagnoses were made and recorded by ED specialists, and they served as the basis for clinical practice in ED and for applying for the National Health Insurance payment. We collected the total and triage 1–2 ED visit during the study period as reference.

Definition of Different Pandemic Stages

We defined six periods to represent the different stages of the pandemic: (1) calendar weeks 4–18, 2016–2019: baseline period; (2) calendar weeks 21–31, 2016–2019: baseline period; (3) calendar weeks 4–18, 2020: first peak of the COVID-19 epidemic; (4) calendar weeks 21–31, 2020: slack period; (5) calendar weeks 4–18, 2021: slack period; and (6) calendar weeks 21–31, 2021: second peak of the epidemic with a national level 3 epidemic alert (Figure 1). The first peak of the epidemic (calendar weeks 4–18, 2020) was defined as the period from the detection date of the first COVID-19 case in Taiwan until 6 weeks before the easing of local restriction to avoid overlapping with other study periods. The second peak of the epidemic (calendar week 21–31, 2021) was defined as the period of national level 3 epidemic alert. The slack period was defined as the period after the COVID-19 pandemic but with no change in community infection in Taiwan (calendar weeks 21–31 in 2020 and calendar weeks 4–18 in 2021)".
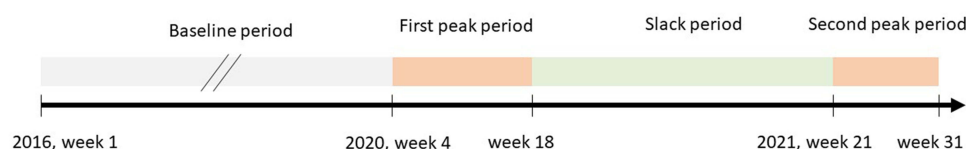
Figure 1 The definition of different pandemic stages.

Statistical Analysis

The median, 25th (Q1) and 75th percentiles (Q3) of weekly ED visits, and change from baseline were calculated for each period. All the data of ED visits in 2020 and 2021 were compared with data of the corresponding period in 2016–2019 (baseline period). All variables were tested for normality by using the Shapiro–Wilk test. The ED visit numbers were compared with those of their corresponding periods by using the Mann–Whitney test. Statistical significance was defined as two-tailed p < 0.05. Statistical analysis was performed using PASW statistics, version 18 (SPSS Inc., Chicago, IL, USA).

Results

Compared to the baseline (the same period 9 in 2016–2019), we observed a prominent decrease in total ED visits and triage 1–2 ED visits during the peaks of the epidemic (Table 1). The analysis of the mode of arrival and the referral of the patients is listed as Supplementary Table 1. However, the decline trend was significant for CVA and CHF, but not significant for myocardial infarction (STEMI and NSTEMI). In the case of OHCA, it declined significantly in the peak of 2020, but not significant in peak of 2021. The ED visits of all the diagnosis rebounded during the slack period.

Total ED Visits and Triage 1–2 ED Visits

We did not use the total ED visits as a denominator for several reasons (government policy of using ED as a COVID-19 quick survey site for the local population during the pandemic); however, it can be useful reference. During the baseline periods of weeks 4–18 from 2016 to 2019, a median [first and third quartiles] of 3330.5 [3165.25, 3518.75] and 847.5 [672.75, 938.5] visits per week were observed for the total ED visits and triage 1–2 ED visits, respectively. This decreased to 2007 [1794, 2455] and 376 [345, 467], and 2573 [2484, 2700] and 486 [458, 490] in 2020 (peak period) and 2021 (slack period), respectively.

During the baseline periods (2016–2019) of weeks 21–31, this was 3475 [3307, 3567.75] and 937.5 [765, 1060.5], respectively, decreased to 2582 [2448, 2658] and 461 [426, 499] and then further decreased to 2543 [2211, 2780] and 376 [325, 397] in 2020 (peak period) and 2021 (slack period), respectively.

NSTEMI and STEMI (ICD-10 Codes I214 and I213)

During calendar weeks 4–18, a median of 9 [7, 12.75] and 8 [5, 12], 10 [7, 11] and 7 [6, 8], and 6 [4, 8] and 6 [4, 9] visits per week were observed for NSTEMI and STEMI in 2016–2019 (baseline period), 2020 (first peak period), and 2021 (slack period), respectively (Figure 2A and B). During calendar weeks 21–31, 8 [6, 9] and 8 [7, 13], 7 [5, 8] and 7 [5, 9], and 7 [4, 8] and 7 [5, 7] visits per week were observed for NSTEMI and STEMI in 2019 (baseline period), 2020 (slack period), and 2021 (second peak period), respectively. All above lack statistical significance.

OHCA (ICD-10 Code I469)

During calendar weeks 4–18, a median of 6 [5, 7] visits per week due to OHCA were observed in 2019 (baseline period), then it dropped to 5 [4, 6], and 5 [4, 7] in 2020 (first peak period, p = 0.046) and 2021 (slack period, p = 0.061), respectively (Figure 2C). During calendar weeks 21–31, 5 [4, 7], 4 [3, 8], and 4 [2, 7] visits per week for OHCA were observed in 2019 (baseline period), 2020 (slack period), and 2021 (second peak period), respectively, without statistical significance.

Table 1 Number of ED Visits at Different Stages of the Pandemic Presented by Median [Q1, Q3]

		Total ED Visit	Triage 1–2	NSTEMI		STEMI		OHCA		Acute Stroke		CHF	
Week 4–18	2016	3663 [3449, 3767]	801 [675, 962]	7 [3, 10]		7 [6, 8]		6 [5, 7]		41 [38, 43]		31 [26, 39]	
	2017	3165 [3137, 3407]	925 [912, 1035]	10 [8, 11]		6 [5, 8]		5 [5, 9]		40 [37, 43]		29 [27, 33]	
	2018	3307 [3095, 3511]	929 [835, 958]	12 [7, 14]		8 [5, 9]		6 [5, 7]		47 [38, 49]		28 [21, 32]	
	2019	3319 [3207, 3422]	651 [632, 688]	10 [7, 13]		7 [6, 8]		6 [4, 7]		43 [39, 48]		26 [22, 28]	
	Baseline (2016–2019)	3330.5 [3167.25, 3518.75]	874.5 [672.75, 938.5]	9 [7, 12.75]		7 [6, 8]		6 [5, 7]		41.5 [38, 47]		28 [24.25, 33]	
	2020 (peak)	2007 [1794, 2455]	376 [345, 467]	8 [5, 12]	p = 0.259	6 [4, 8]	p = 0.139	5 [4, 6]	**p = 0.046**	35 [28, 39]	**p < 0.001**	19 [12, 23]	**P < 0.001**
	2021 (slack)	2573 [2484, 2700]	486 [458, 490]	10 [7, 11]	p = 0.878	6 [4, 9]	p = 0.438	5 [4, 7]	p = 0.061	37 [36, 45]	p = 0.170	21 [17, 30]	**P = 0.002**
Week 21–31	2016	3499 [3441, 3582]	1030 [1001, 1076]	6 [4, 7]		6 [3, 9]		5 [4, 7]		36 [34, 45]		20 [18, 25]	
	2017	3568 [3437, 3401]	1086 [1021, 1102]	9 [7, 12]		7 [4, 10]		5 [3, 6]		40 [35, 45]		21 [19, 25]	
	2018	3322 [3215, 3395]	911 [834, 919]	6 [6, 10]		7 [5, 9]		6 [3, 7]		44 [36, 48]		13 [12, 18]	
	2019	3465 [3292, 3567]	689 [654, 717]	9 [7, 11]		8 [5, 12]		6 [4, 7]		40 [32, 46]		18 [16, 26]	
	Baseline (2016–2019)	3475 [3307, 3567.75]	937.5 [765, 1060.5]	8 [6, 9]		7 [5, 9]		5 [4, 7]		40 [35, 45]		18 [16, 23]	
	2020 (slack)	2582 [2448, 2658]	461 [426, 499]	8 [7, 13]	p = 0.223	7 [4, 8]	p = 0.526	4 [3, 8]	p = 0.545	42 [35, 46]	p = 0.866	17 [14, 20]	p = 0.250
	2021 (peak)	2543 [2211, 2780]	376 [325, 397]	7 [5, 8]	p = 0.229	7 [5, 7]	p = 0.325	4 [2, 7]	p = 0.551	35 [28, 40]	**p = 0.039**	13 [11, 16]	**p = 0.001**

Note: *The p value will be presented in bold if p < 0.05.
Abbreviations: CHF, congestive heart failure; OHCA, out-of-hospital cardiac arrest; NSTEMI, non ST-elevation myocardial infarction; STEMI, ST-elevation myocardial infarction.
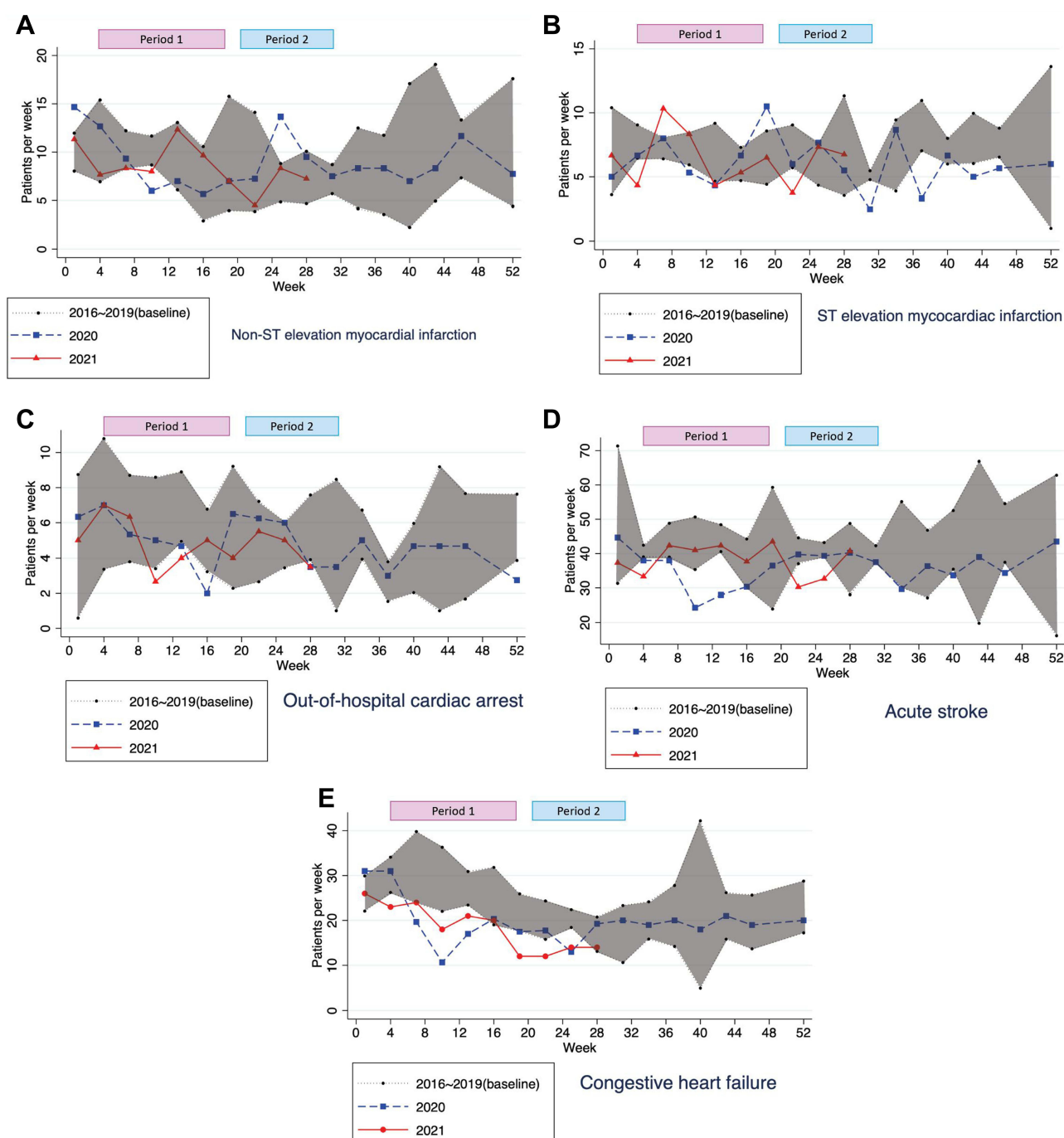
Figure 2 Trends of ED visits for different diagnoses: (**A**) NSTEMI, (**B**) STEMI, (**C**) OHCA, (**D**) acute stroke, (**E**) CHF.

Acute Stroke (ICD-10 Code I6789)

During calendar weeks 4–18, a median of 41.5 [38, 47] visits per week due to acute stroke was observed in 2019 (baseline period), then it significantly dropped to 35 [28, 39] visits per week in 2020 (first peak period, p < 0.001), then rebounded to 37 [36, 45] visits per week 2021 (slack period, p = 0.170, Figure 2D). During calendar weeks 21–31, 40 [35, 45] and 42 [35, 46] and visits per week was observed in 2019 (baseline period) and 2020 (slack period, p = 0.866), and it significantly dropped to 35 [28, 40] visits per week in 2021 (second peak period, p = 0.039).

Congestive Heart Failure (ICD-10 Code I509)

During calendar weeks 4–18, an average of 28 [24.25, 33] visits per week due to CHF was observed in 2019 (baseline period), then it significantly declined to 19 [12, 23] in 2020 (first peak epidemic period, p < 0.001), and backed to 21 [17, 30] in 2021 (slack period, p = 0.002, Figure 2E). During calendar weeks 21–31, 18 [16, 23] visits per week was observed in 2019 (baseline period), 17 [14, 20] in 2020 (slack period, p = 0.250), and significant decline to 13 [11, 16] in 2021 (second peak epidemic period, p = 0.001).

Discussion

In our study, we found a significant decline in ED visits for acute stroke and CHF during the two epidemic peaks and for OHCA during the first peak periods, but no significant decline was found for myocardial infarction (STEMI and NSTEMI). The gap was minimized during the slack period.

A significant decline in ED visits was observed during the pandemic almost worldwide, which may have caused a delay in necessary medical care. In the United States, >40% adults avoided medical care due to the fear of contracting COVID-19, including 12% for urgent/emergent care.[11] The trend of ED visit decline was not only observed in high-prevalence countries but also in medium- or low-prevalence countries. In a relatively low-prevalence region in Australia, a 10.1% delay or avoidance of urgent/emergent care was noted.[12] This phenomenon indicates that the avoidance of medical care may not directly result from a decrease in medical care accessibility during the pandemic but due to public fear of COVID-19.

In addition to the gross decline in the trend of ED visits, we found that the trends of ED visits were different among the diseases. In our study, ED visits due to OHCA significantly declined during the pandemic in 2020, which is different from the findings of most previous studies. A population-based study in France revealed a nearly doubled incidence of OHCA, long delay to intervention, and a reduction in survival rate after the lockdown period of Paris.[13] Moreover, this trend was observed in Italy[14] and other countries.[15,16] In high-prevalence countries, such as Italy, an increase in OHCA was mostly related to COVID-19 infection.[14] However, the trend of OHCA decreased, instead of increasing, in Taiwan even during the 2020 and 2021 local epidemic peak, although statistical significance is only present in the former. This difference may be a result of the good control of the COVID-19 local epidemic and partially because of the decrease in major trauma.[17] Only 16,141 accumulated COVID-19 cases and 840 COVID-19-related deaths (until September 19, 2021) were recorded among approximately 23 million Taiwanese population. Under the relatively low COVID-19 disease burden, the medical system in Taiwan had the capacity to accommodate critically ill patients and thus could prevent their sudden death outside the hospital.

In our study, we found some urgent, but not acute life-threatening, conditions, such as acute stroke or CHF exacerbation, showed a significant decline during both of the epidemic peak periods. This decline was also reported in two Canadian studies, one of which found a 23% drop in the ED visit of strokes of 2020 compared to 2019,[18] and another found a prominent (43.5%) decrease in ED visits related to acute decompensated heart failure during the pandemic.[19] Additionally, an Indian study found a similar decline in CHF-related ED visits, and the reduction in the percentage was higher than for STEMI and NSTEMI.[20] This difference may be related to its subacute nature of stroke and CHF, and the fear of COVID-19 infection in hospital. Like stroke and CHF, similar decline trends were observed during the local epidemic peak period for NSTEMI and STEMI although lack of significance. A possibility to explain this decline trend is that the fear of COVID-19 may have led to a delay in the treatment of such potentially lethal diseases.

Our study has some limitations. First, the study was conducted in a tertiary referral medical center near the epidemic area (northern Taiwan), which may not be representative of other areas with varying COVID-19 prevalence. Similarly, the result cannot be generalized to other regional or local hospitals. The single site observational study design may also result in a great variability of ED visits in each week. Second, we solely examined ED diagnosis data from electronic medical record and not further outcomes after hospitalization or discharge. Although ED diagnosis was made by an emergency medicine specialist and was the basis for clinical management in the ED, it may not be accurate. Patients' mode of arrival (by their own or by the emergency medical service) and referral sheets were not analyzed because some of such data were missing in our ED medical record system. Third, this is a descriptive study, which cannot identify the direct cause of changes in ED visit numbers. We assumed that the incidence of diseases such as MI, CVA, and CHF

during the COVID pandemic was similar to that before the COVID-19 pandemic. ED visits may be affected by changes in patient health-seeking behavior. However, in the current study, the reasons for changes in ED visit number cannot be identified. This phenomenon may be due to a change in disease prevalence, decline in the total number of ED visits, or change in health-seeking behavior. This is a preliminary study, and subsequent studies with a nation-wide population-based dataset are required to examine various diagnoses, regions, and hospital levels and to explore the basic data of patients who seek medical help at different stages of the pandemic.

Conclusion

In our study, we found a significant decline in ED visits for non-critical events such as acute stroke or heart failure, ED visits declined during the COVID-19 outbreak period and then rebounded after it subsided. However, the trend of critical events remained stable during the COVID-19 pandemic, such as NSTEMI and STEMI. Such changes may have resulted from public fear of COVID-19 and may be related to the delay in the provision of necessary medical intervention.

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Disclosure

The authors report no conflicts of interest in this work.

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