Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

American Journal of Emergency Medicine 38 (2020) 2101–2109

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

The influence of coronavirus disease 2019 on emergency department visits in Nanjing, China: A multicentre cross-sectional study

Hao Sun, MD [a,1], Keqin Liu, MD [b,1], Meng Li, MSc [a,1], Shaowen Tang, MD, PhD [c], Andrew A. Monte, MD, PhD [d,ae,**], Jun Wang, MD [e], Shinan Nie, MD [f], Qinglin Rui, MD [g], Wenge Liu, MD [h], Haidong Qin, MD [i], Xiao Tan, MD [j], Haibin Ni, MD [k], Wenxin Yang, MD [l], Congjian Zhu, MD [m], Runhua Yang, MD [n], Tianhao Yu, MD [o], Shengwei Wang, MD [p], Hao Jiang, MD [q], Xiaofeng Chen, MD [r], Wei Zhang, MD [s], Yi Zhu, MD [t], Huatou Zhao, MD [u], Shiyu Yang, MD [v], Kejin Yin, MD [w], Danbing Shao, MD [x], Liang Xiao, MD [y], Zhengwei Chen, MD [z], Weizhong Yuan, MD [aa], Dongdong Hu, MD [ab], Xiaoyong Wan, MD [ac], Lanfu Wu, MD [ad], Jinsong Zhang, MD [a,*]

[a] Department of Emergency, Jiangsu Province Hospital, The First Affiliated Hospital of Nanjing Medical University, 300 Guang Zhou Road, Nanjing, Jiangsu, 210029, People's Republic of China
[b] Department of Emergency, Jiangsu Provincial Second Chinese Medicine Hospital, The Second Affiliated Hospital of Nanjing University of Chinese Medicine, 23 Nanhu Road, Nanjing, Jiangsu 210002, People's Republic of China
[c] Department of Epidemiology and Biostatistics, School of Public Health, Nanjing Medical University, 818 Tianyuandong Road, Nanjing, Jiangsu, 211166, People's Republic of China
[d] Department of Emergency Medicine, University of Colorado School of Medicine Leprino Building, 7th Floor Campus Box B-215, 12401 E. 17th Avenue, Aurora, CO 80045, United States
[e] Department of Emergency, Affiliated Drum Tower Hospital of Nanjing University Medical School, 321 Zhongshan Road, Nanjing, Jiangsu 210008, People's Republic of China
[f] Department of Emergency, Jinling Hospital, Medical School of Nanjing University, 305 Zhongshan East Road, Nanjing, Jiangsu 211002, People's Republic of China
[g] Department of Emergency, Jiangsu Province Hospital of Chinese Medicine, Affiliated Hospital of Nanjing University of Chinese Medicine, 155 Hanzhong Road, Nanjing, Jiangsu, 210029, People's Republic of China
[h] Department of Emergency, Zhongda Hospital Southeast University, 87 Dingjiaqiao, Nanjing, Jiangsu 210009, People's Republic of China
[i] Department of Emergency, Nanjing First Hospital, Nanjing Medical University, 68 Changle Road, Nanjing, Jiangsu 210006, People's Republic of China
[j] Department of Emergency, The Second Affiliated Hospital of Nanjing Medical University, 121 Jiangjiayuan Road, Nanjing, Jiangsu 210011, People's Republic of China
[k] Department of Emergency, Jiangsu Province Hospital on Integration of Chinese and Western Medicine, 100, Shizi Street, Nanjing, Jiangsu 210028, People's Republic of China
[l] Department of Emergency, Eastern Theater General Hospital, Qinhuai District Medical Area 34, 34 Biao, Yanggongjing Street, Nanjing, Jiangsu 210002, People's Republic of China
[m] Department of Emergency, Nanjing Tongren Hospital, School of Medicine, Southeast University Nanjing, 2007, Jiyin Road, Nanjing, Jiangsu 211102, People's Republic of China
[n] Department of Emergency, Nanjing Integrated Traditional Chinese and Western Medicine Hospital, 179, Xiao Lin-Wei, Nanjing, Jiangsu 210014, People's Republic of China
[o] Department of Emergency, Nanjing Brain Hospital Affiliated to Nanjing Medical University, 264 Guangzhou Road, Nanjing, Jiangsu 210029, People's Republic of China
[p] Department of Emergency, Nanjing Chest Hospital, 215, Guangzhou Road, Nanjing, Jiangsu 210029, People's Republic of China
[q] Department of Emergency, The Second Hospital of Nanjing, Nanjing University of Chinese Medicine, 1 Zhongfu Road, Nanjing, Jiangsu 210003, People's Republic of China
[r] Department of Emergency, The 454th Hospital of PLA, 1, Malu Street, Nanjing, Jiangsu 210002, People's Republic of China
[s] Department of Emergency, Nanjing Hospital of Chinese Medicine Affiliated to Nanjing University of Chinese Medicine, 157 Daming Road, Nanjing, Jiangsu 210022, People's Republic of China
[t] Department of Emergency, Jiangsu Province Official Hospital, 30, Luojia Road, Nanjing, Jiangsu, People's Republic of China, 210024
[u] Department of Emergency, People's Hospital of Gaochun, 9, Chunzhong Road, Gaochun, Nanjing, Jiangsu 211300, People's Republic of China
[v] Department of Emergency, Nanjing BENQ Medical Center, 71, Hexi Road, Nanjing, Jiangsu, People's Republic of China, 210019
[w] Department of Emergency, Nanjing Jiangbei People's Hospital, 552, Ge-guan Road, Nanjing, Jiangsu 220000, People's Republic of China
[x] Department of Emergency, Sir Run Run Hospital, Nanjing Medical University, 109 Longmian Road, Nanjing, Jiangsu 211166, People's Republic of China
[y] Department of Emergency, Nanjing Luhe People's Hospital, 28, Yan'an Road, Nanjing, Jiangsu 211500, People's Republic of China
[z] Department of Emergency, Nanjing Pukou Central Hospital, 166, Shanghe Street, Nanjing, Jiangsu 211800, People's Republic of China
[aa] Department of Emergency, Nanjing Meishan Hospital, 505, Xiongfeng Road, Nanjing, Jiangsu 210039, People's Republic of China
[ab] Department of Emergency, The Pukou Hospital of Nanjing, The Fourth Affiliated Hospital of Nanjing Medical University, 18 Puyuan Road, Nanjing, Jiangsu 210031, People's Republic of China
[ac] Department of Emergency, Nanjing Central Hospital, 116, Chengxian Street, Nanjing, Jiangsu 210018, People's Republic of China
[ad] Department of Emergency, Nanjing Yangzi Hospital, 21, Pingdingshan Road, Nanjing, Jiangsu 210048, People's Republic of China
[ae] Nanjing Medical University, 818 Tianyuandong Road, Nanjing, Jiangsu, 211166, People's Republic of China

* Corresponding Author. Department of Emergency, Jiangsu Province Hospital, the First Affiliated Hospital of Nanjing Medical University.
** Corresponding author at: Department of Emergency Medicine, University of Colorado School of Medicine Leprino Building, 7th Floor Campus Box B-215, 12401E.17th Avenue, Aurora, CO 80045, United States.
E-mail address: zhangjso@njmu.edu.cn (J. Zhang).
[1] These authors are contributed equally for the study.

https://doi.org/10.1016/j.ajem.2020.07.086

ARTICLE INFO

Article history:
Received 7 May 2020
Received in revised form 24 July 2020
Accepted 29 July 2020

Keywords:
Coronavirus
Covid-19
Emergency medicine
Pandemic
ED visit volume

ABSTRACT

Introduction: Influenza has been linked to the crowding in emergency departments (ED) across the world. The impact of the Coronavirus Disease 2019 (COVID-19) pandemic on China EDs has been quite different from those during past influenza outbreaks. Our objective was to determine if COVID-19 changed ED visit disease severity during the pandemic.

Methods: This was a retrospective cross sectional study conducted in Nanjing, China. We captured ED visit data from 28 hospitals. We then compared visit numbers from October 2019 to February 2020 for a month-to-month analysis and every February from 2017 to 2020 for a year-to-year analysis. Inter-group chi-square test and time series trend tests were performed to compare visit numbers. The primary outcome was the proportion of severe disease visits in the EDs.

Results: Through February 29 th 2020, there were 93 laboratory-confirmed COVID-19 patients in Nanjing, of which 40 cases (43.01%) were first seen in the ED. The total number of ED visits in Nanjing in February 2020, were dramatically decreased ($n = 99{,}949$) in compared to January 2020 ($n = 313{,}125$) and February 2019 ($n = 262{,}503$). Except for poisoning, the severe diseases in EDs all decreased in absolute number, but increased in proportion both in year-to-year and month-to-month analyses. This increase in proportional ED disease severity was greater in higher-level referral hospitals when compared year by year.

Conclusion: The COVID-19 outbreak has been associated with decreases in ED visits in Nanjing, China, but increases in the proportion of severe ED visits.

1. Introduction

Beginning in December 2019, a novel, highly contagious infectious disease named Coronavirus Disease 2019 (COVID-19) caused by a new pathogen "SARS-CoV-2", became rampant in China and quickly spread globally [1,2]. Similar to influenza, the novel coronavirus is transmitted via respiratory droplets during close unprotected contact between people [3]. Unfortunately, the pathological mechanisms, the treatments, and prognosis remain unclear.

The first affected area was in Wuhan and the adjoining city in Hubei province, China. Infected individuals quickly spread the disease throughout the country with the rate of secondary COVID-19 infections ranging from 1 to 5% among the tens of thousands of close contacts of confirmed cases in China [4]. Nanjing, the capital city of Jiangsu Province in East China, was not spared in this pandemic. There are approximately 80 million people in Jiangsu Province and 8.335 million that live in Nanjing. Nanjing Hospitals serve as the regional referral center for the Province. In response to the importation of COVID-19, we set up fever clinics in each general hospital for screening and local isolation of confirmed cases. However, emergency departments (ED) remained a priority choice for patients with symptom onset in China, facing enormous pressure, especially in the early stages of the epidemic.

From January 23, 2020, Chinese authorities suspended travel from multiple cities; from January 25, 2020, Jiangsu province initiated the highest level response to the public health emergency of COVID-19, including travel bans, mandatory masks, and adoption of stringent 'social distancing' practices [4]. These unprecedented efforts to control this infectious disease had a profound impact on ED visits. In contrast to previous epidemic experiences, such as influenza [5], COVID-19 has in a noticeable drop in ED visits in China and other countries worldwide, rather than overcrowding which may have been expected.

We conducted a multicentre descriptive study with the support from the Society of Emergency Medicine of the Nanjing Medical Association to examine the relationship between ED visits and COVID-19 outbreaks in Nanjing, China. This study is expected to provide a reference for relevant policy development and for the rational allocation of emergency medical resources when facing a pandemic.

2. Materials and methods

2.1. Study design and setting

This was a retrospective, cross-sectional, descriptive study carried out in Nanjing, China from October 2019 through February 2020. We performed month-to-month analyses on disease severity for ED visits in Nanjing. Furthermore, since February 2020 was the peak month of the COVID-19 epidemic in Nanjing, the same month each year from 2017 to 2020 was compared for the year-to-year analysis. Nanjing is the nation's tenth largest city with a population of 8.335 million people and has 31 comprehensive public hospitals with EDs open during the course of the study (including 18 Grade-A tertiary hospital, 5 Grade-B tertiary hospital and 8 Grade-A secondary hospital). There are over two thousand ED medical staff (including doctors and nurses) in Nanjing. The study was approved by the Research Ethics Board of project sponsor, Jiangsu Province Hospital (No. 2020-SR-133).

2.2. Data collection and processing

The COVID-19 epidemic associated information was confirmed by regional and national official health agencies. Patients were divided into four categories: patients under investigation, suspected cases, confirmed cases, and non-infected cases. Confirmation of COVID-19 diagnoses in ED patients was performed as follows:

2.3. COVID-19 infection risk stratification in China

Step 1: Determination of patients under investigation (PUI) for COVID-19 (clinical features +1 out of 3 epidemiologic risks):

Clinical features: fever (defined as temperature 37.5 °C) or signs / symptoms of lower respiratory illness (eg. Cough or shortness of breath).

Epidemiologic risk:

1. A history of travel from Wuhan city and surrounding areas, China, or other community with case reports within 14 days;
2. Any person, who has had close contact with a laboratory-confirmed COVID-19 patient within 14 days;
3. Any person, who has had close contact with a person from Wuhan city and surrounding areas, China, or other community with case reports within 14 days.

Step 2: Criteria to Guide PUI as Suspected Cases for COVID-19 (all clinical features + no epidemiologic risk OR 2 out of 3 clinical features +1 out of 4 epidemiologic risks):

Clinical features:

1. fever or signs / symptoms of lower respiratory illness (eg. Cough or shortness of breath);
2. With relevant chest CT imaging characteristics of pneumonia;

3. The total number of white blood cells is normal or decreased in early onset, or the lymphocyte count is reduced.

Epidemiologic risk:

1. A history of travel from Wuhan city and surrounding areas, China, or other community with case reports within 14 days of symptom onset;
2. Any person, who has had close contact with a laboratory-confirmed COVID-19 patient within 14 days of symptom onset;
3. Any person, who has had close contact with a person from Wuhan city and surrounding areas, China, or other community with case reports within 14 days of symptom onset;
4. Cluster onset.

Step 3: Criteria to Guide Suspected Patient as Confirmed Cases for COVID-19 (with one of the following pathogenic evidence):

1. Confirmed by real-time reverse-transcriptase-polymerase-chain-reaction (RT-PCR) assay;
2. Confirmed by high throughput sequencing.

PUI were sent to the fever clinic from ED, if patients were too sick for the fever clinic, they received a single room in an ED isolation ward or isolation bed in the ICU, under the management of the fever clinic. PUI were not treated in ED system after referral to the fever clinic, until they were confirmed as a non-COVID case.

Data on ED visits were obtained from 28 hospitals with ED electronic record systems (ERS). We collected the following data: total numbers of ED visits; critically ill patients (defined as triage grade I and II according to Chinese Emergency Triage Scale (ETS) [6]. The ETS has five grades (I, II, III, IVa and IVb) and is equivalent to the American Emergency Severity Index (ESI) [7] levels of 1–5. Grade I (acute and dangerous) includes patients who are critically ill and require immediate life-saving interventions; grade II (acute and severe) describes patients in severe or rapidly deteriorating conditions); patient deaths (defined as patients who died during emergency treatment in EDs); and disease diagnoses, coded by using the International Classification of Diseases, Tenth Revision (ICD-10); occurrence of cardiopulmonary resuscitation (CPR) (ICD-10 codes I46); acute coronary syndrome (ACS) (ICD-10 codes I20-I24); stroke (ICD-10 codes I60-I63); trauma (ICD-10 codes S00-S99) and poisoning (ICD-10 codes T36-T65).

2.4. Outcome measures

We captured the number of ED visits with clinical features of COVID (fever or signs / symptoms of lower respiratory illness), the proportion of PUI sent to the fever clinic from the ED visit with clinical features of COVID-19 infection, the number of suspected cases, confirmed cases, and excluded cases from those PUI. We also captured the proportion of confirmed cases in Nanjing sent from their ED visit. We recorded the number of ED medical staff who were sent to Hubei province makeshift hospitals to support front line.

We performed month-to-month analysis and year-to-year analysis on the most severe visits seen in Nanjing EDs. We examined whether the total number and the proportion of all ED visits with one of these conditions (critically ill; death) / diagnoses (CPR; ACS; stroke; trauma; poisoning) changed during the study period. Furthermore, we evaluated the extent to which the different grades of hospitals were affected.

2.5. Data definitions

Critically ill visits were defined as ETS grade I (acute and dangerous), which includes patients who are critically ill and require immediate life-saving interventions (those undergoing CPR, mechanical ventilation, etc), and grade II (acute and severe) describes patients in severe or rapidly deteriorating conditions, e.g. myocardial infarction or trauma with hemodynamic instability. Then, disease classifications were defined according to ICD code for patients not triaged into ETS grade II or above, e.g. trauma with one extremity fracture. We considered the most severe and the most common ED visits to involve deaths, critically ill, cardiopulmonary resuscitation (CPR), ACS, stroke, trauma, or poisoning. These visits require emergency management and can't be effectively managed outside of an ED in China, or most countries worldwide.

2.6. Primary data analysis

Categorical variables were described as frequencies and proportions. The year-to-year analyses (4 time points) and month-to-month analyses (5 time points) were compared with chi-square and *t*-tests on the whole dataset (4 time points or 5 time points). We then performed a time series trend chi-square test on the dataset (4 time points or 5 time points). If the P_{trend} value is statistically significant, it means that the whole dataset exhibits an upward or downward trend. We then determined the trend for the first 3 or 4 data points by disregarding the data from February 2020, to determine if there was a trend in ED visits prior to the pandemic. When the February 2020 trend was consistent with the preceding data trend, we determined the magnitude of the data variation, according to the increasing monthly proportion. To compare the proportion of disease severity visits, we calculated ICD code proportion changes. We performed inter-group chi-square test for the first 3 or 4 data points by disregarding the data for February 2020, then performed the analyses on the entire dataset, including the February 2020 data. We then performed the time course analysis including the February 2020 data as described above. We then performed these analyses stratified by hospital grade to determine if the trend was driven by larger referral center hospitals. All analyses were performed using SPSS for Windows (version 20.0, IBM Inc., Chicago, IL, USA). A two-tailed *t*-test using a p value $<.05$ was considered statistically significant.

3. Results

3.1. Visits to Nanjing EDs

Twenty-eight (90.32%) of 31 EDs provided data for this cross-sectional study. By the end of February 2020, 22 (70.97%) ED units from Nanjing sent a total of 77 (4.13%) ED medical staff to Hubei province makeshift hospitals to support front line (supplemental Table S1). There were 631 laboratory-confirmed COVID-19 cases in Jiangsu Province (including 429 cases confirmed in February 2020); of which 93 cases were in Nanjing (65 cases in February). There were 40 cases (43.01%) screened from ED visits (Grade-A tertiary hospital: 35 cases, Grade-B tertiary hospital: 4 cases, Grade-A secondary hospital: 1 case). Between January and February 2020, the number of ED visits with clinical features of COVID-19 infection was 39,636 (Grade-A tertiary hospital: 29,337, Grade-B tertiary hospital: 6916, Grade-A secondary hospital: 3383); 6977 (17.60%) of these visits were sent to fever clinic as PUI. Seven hundred and eighteen (10.29% of PUI) people sent to the fever clinic were determined to be suspected cases and 40 were confirmed cases (0.57% of PUI) (see Fig. 1).

During the peak of the pandemic, i.e., February 2020, the number of patients admitted to EDs acutely declined. Compared to February 2019, the ED visits in 28 Nanjing hospitals dropped from 262,503 to 99,949, i.e., a decrease of 61.92% (95% CI 61.74%–62.11%), in which 24 hospitals (85.71%) experienced a decrease of more than 50% in ED volume. Sixteen Grade-A tertiary hospitals, four Grade-B tertiary hospitals, and five Grade-A secondary hospitals faced a decrease in patient visits. Compared to January 2020 ($n = 313,125$ ED visits), the decrease reached 68.08% (95% CI 67.92%–68.24%). There were 26 hospitals (92.86%) that had a decrease of more than 50% in ED visits (17 Grade-A tertiary hospitals, 4 Grade-B tertiary hospitals, and 5 Grade-A secondary hospitals).

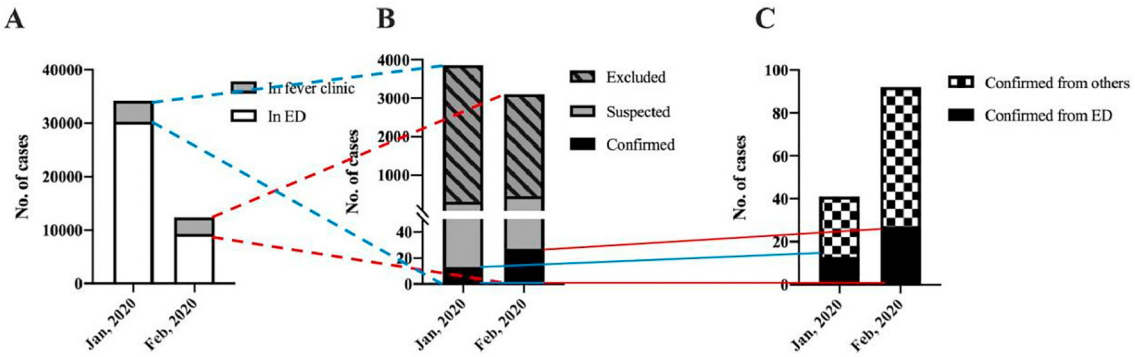

Fig. 1. The distribution of COVID-19 confirmed cases from ED visits in Nanjing 28 hospitals. A: In January and February 2020, total number of ED visits with key clinical features, fever or symptoms of lower respiratory which were sent to fever clinics as patients under investigation (PUI) for COVID-19. B: PUI sent from EDs identified as suspected patients (10.29% of PUI), confirmed cases (0.57% of PUI), or excluded between January and February 2020. C: The total confirmed cases between January and February 2020 in Nanjing, 43.01% (40 cases) were screened from ED visits.

3.2. Visit severity: Year-year analysis

To observe the influence on ED visit severity, we first analyzed data from February from 2017 to 2020 (see Table 1). When all hospital visits were analyzed, six out of seven severe ED visit types were affected by the pandemic. There were no significant differences in fatality, the proportion of CPR, or ACS between 2017 and 2019. However, when the 2020 data were included, the change in fatality (0.26%, 95% CI 0.22%–0.29%), CPR (0.19%, 95% CI 0.16%–0.21%), and ACS (0.39%, 95% CI 0.35%–0.42%) became significantly increased ($P < .001$, respectively). In addition, the number of critically ill and trauma visits showed a downward trend from 2017 to 2019, but while the overall number decreased, the proportion increased in 2020 due to the pandemic. Furthermore, the proportions of stroke showed an upward trend in the first 3 years, with a marked increase in Feb 2020 (0.81%, 95%CI 0.76–0.87) (increasing from 2017 to 2018: 9.76%; from 2018 to 2019: 2.22%; from 2019 to 2020: 76.09%). Although the absolute number in each severe visit type decreased during Feb 2020, the proportion of each variable was significantly increased, possibly due to change in proportion of other ED visits during the pandemic. Lastly, the proportion of poisoning showed a downward trend in the first 3 years, and for the whole period including February 2020, though the decrease in numbers for February 2020 alone was not statistically significant (increasing rate from 2017 to 2018: 6.90%; from 2018 to 2019: −32.26%; from 2019 to 2020: −19.05%). There was no direct evidence that the poisoning visits were affected by the pandemic. While the proportion of severe visits increased, the gross number of severe visits decreased along with all other visit types. Overall decreases in visits were likely due to fear of coming to the healthcare facility during the peak of the pandemic.

Higher level hospitals had more pronounced effects due to the pandemic. For Grade-A tertiary hospitals (level A), 6 out of 7 severe visit categories significantly increased during the pandemic (the fatality rate, the proportion of CPR, stroke, critically ill, ACS and trauma visits). For Grade-B tertiary hospitals (level B), 4 out of 7 severe visit categories were affected by the pandemic and increased significantly, (the percentages of critically ill, ACS, stroke and trauma). For the Grade-A secondary hospitals (level C), only 3 out of 7 severe visit categories were affected and increased during the pandemic, i.e., the fatality rate, proportions of critically ill and CPR visits. However, all three hospitals levels had a decrease in poisoning visits with no direct evidence that those visit types were affected by the pandemic. Other severe visit types did not change significantly.

3.3. Visit severity: Month-month analysis

We observed month-to-month data from the last quarter of 2019 through February 2020 (see Table 2). Overall, 6 out of 7 severe visit categories were affected by the pandemic: the percentages of CPR ($P = .333$) for October 2019 through January 2020 showed no difference, while the fatality rate just reached statistical significance ($P = .049$) during these first 4 months of the epidemic. While the overall number of severe visits decreased in February 2020, as did overall ED visit volume, the inclusion of the February 2020 data led to an increase in proportion of visits with both CPR and death ($P < .001$, respectively). The number of severe visits declined, but not as much as other visit types, leading to an increased proportion. Critically ill, ACS, stroke and trauma visit types decreased between October–January but increased in February 2020 due to the pandemic. The proportion of poisoning visits decreased but there was insufficient evidence (decreasing rate from Oct 2019 to Nov 2019: −16.00%; from Nov 2019 to Dec 2019: 17.24%; from Dec 2019 to Jan 2020: 16.67%; from Jan 2020 to Feb 2020: 15.00%) to suggest that its decrease is due to the pandemic or by natural trend. When stratified by different categories of hospital, the differences in severe visit categories affected by the pandemic in the entire dataset did not change. For instance, Grade-A tertiary hospitals had 6 variables affected by the pandemic, which was consistent with the overall data. Grade-B tertiary hospitals and Grade-A secondary hospitals had increases in the proportion of fatality, CPR, critically ill, ACS, stroke and trauma during February 2020 while the proportion of poisoning decreased significantly.

4. Limitations

Similar to other cross sectional data, our findings may be limited by response bias, but the data are obtained from the electronic record system (ERS) that are available for all the ED units. Also, the response rate (90.32%) of Nanjing hospitals was high. The analyses only included adults and cannot be applied to children. Other ecologic variables were not accounted for (eg, season, temperature, air quality) and may have confounded our results. Similarly, we did not control for other variables known to contribute to ED visits, such as hospital or ED unit expansion or new housing construction, during the study period.

The conditions and diagnosis involved in this study were designed to include a sample representative of one of China's largest capital province cities, Nanjing. And these changes may not reflect changes in visit types observed in other hospital types in China or the US cities. Categorization of ED visits were defined according to the initial diagnosis when entering the EDs but not to the discharge diagnoses. Therefore, not all diagnoses were definitive and confirmed through gold standard methods (eg, the diagnosis of coronary heart disease by percutaneous coronary angiography). However, all the data were collected in a consistent way and comparable across the observation period between hospitals.

Table 1
The year-to-year analysis between February of each year from 2017 to 2020.

Grade of hospitals	Variables	Feb, 2017	Feb, 2018	Feb, 2019	Feb, 2020	χ^2	P	χ^2_{trend}	P $_{trend}$	χ^{2*}	P*	χ^2_{trend}**	P $_{trend}$**
		N (%, 95%CI)	N (%, 95%CI))	N (%, 95%CI))	N (%, 95%CI))								
Grade-A Tertiary	ED visits	127,101	147,521	168,222	65,382								
	Critically ill visits	11,727 (9.23, 9.07–9.39)	12,077 (8.19, 8.05–8.33)	13,394 (7.96, 7.83–8.09)	7209 (11.03, 10.79–11.27)	650.495	<0.001	28.590	<0.001	163.501	<0.001	142.389	<0.001
	Deaths	198 (0.16, 0.13–0.18)	247 (0.17, 0.15–0.19)	260 (0.15, 0.14–0.17)	216 (0.33, 0.29–0.37)	93.110	<0.001	36.924	<0.001	0.951	0.622	0.026	0.872
	CPR	155 (0.12, 0.10–0.14)	188 (0.13, 0.11–0.15)	227 (0.13, 0.12–0.15)	141 (0.22, 0.18–0.25)	31.726	<0.001	18.501	<0.001	0.978	0.613	0.971	0.325
	ACS	468 (0.37, 0.33–0.40)	477 (0.32, 0.29–0.35)	501 (0.30, 0.27–0.32)	284 (0.43, 0.38–0.48)	30.172	<0.001	0.150	0.699	11.091	0.004	10.810	0.001
	Stroke	517 (0.41, 0.37–0.44)	630 (0.43, 0.39–0.46)	728 (0.43, 0.40–0.46)	490 (0.75, 0.68–0.81)	131.873	<0.001	66.232	<0.001	1.231	0.540	1.108	0.293
	Trauma	1060 (0.83, 0.78–0.88)	1077 (0.73, 0.69–0.77)	1069 (0.64, 0.60–0.67)	592 (0.91, 0.83–0.98)	63.877	<0.001	2.264	0.132	39.811	<0.001	39.782	<0.001
	Poisoning	344 (0.27, 0.24–0.30)	418 (0.28, 0.26–0.31)	314 (0.19, 0.17–0.21)	118 (0.18, 0.15–0.21)	46.671	<0.001	33.477	<0.001	35.949	<0.001	22.887	<0.001
Grade-B Tertiary	ED visits	30,015	37,059	44,342	14,793								
	Critically ill visits	987 (3.29, 3.09–3.49)	1266 (3.42, 3.23–3.60)	1687 (3.80,3.63–3.98)	1105 (7.47, 7.05–7.89)	541.025	<0.001	293.793	<0.001	16.328	<0.001	15.114	P < .001
	Deaths	24 (0.08, 0.05–0.11)	26 (0.07, 0.04–0.10)	28 (0.06, 0.04–0.09)	16 (0.11, 0.06–0.16)	3.234	0.357	0.123	0.726	0.724	0.696	NA	NA
	CPR	26 (0.09, 0.05–0.12)	27 (0.07, 0.05–0.10)	35 (0.08, 0.05–0.11)	20 (0.14, 0.08–0.19)	5.195	0.158	1.291	0.256	0.398	0.819	NA	NA
	ACS	18 (0.06, 0.03–0.09)	26 (0.07, 0.04–0.10)	15 (0.03, 0.02–0.05)	16 (0.11, 0.06–0.16)	11.528	0.009	0.120	0.729	5.416	0.067	NA	NA
	Stroke	131 (0.44, 0.36–0.51)	161 (0.43, 0.37–0.50)	162 (0.37, 0.31–0.42)	118 (0.80, 0.65–0.94)	46.970	<0.001	8.663	0.003	3.225	0.199	NA	NA
	Trauma	148 (0.49, 0.41–0.57)	181 (0.49, 0.42–0.56)	159 (0.36, 0.30–0.41)	82 (0.55, 0.43–0.67)	14.272	0.003	1.023	0.312	10.662	0.005	8.470	0.004
	Poisoning	74 (0.25, 0.19–0.30)	55 (0.15, 0.11–0.19)	82 (0.18, 0.14–0.22)	21 (0.14, 0.08–0.20)	10.384	0.016	4.350	0.037	8.526	0.014	2.671	0.102
Grade-A Secondary	ED visits	37,191	39,311	49,939	19,774								
	Critically ill visits	319 (0.86, 0.76–0.95)	379 (0.96, 0.87–1.06)	403 (0.81, 0.73–0.88)	309 (1.56, 1.39–1.73)	91.494	<0.001	27.740	<0.001	6.395	0.041	0.984	0.321
	Deaths	25 (0.07, 0.04–0.09)	38 (0.10, 0.07–0.12)	25 (0.05, 0.03–0.07)	24 (0.12, 0.07–0.17)	12.269	0.007	0.559	0.455	6.912	0.032	1.318	0.251
	CPR	28 (0.08, 0.05–0.10)	40 (0.10, 0.07–0.13)	30 (0.06, 0.04–0.08)	24 (0.12, 0.07–0.17)	8.561	0.036	0.329	0.566	4.967	0.083	NA	NA
	ACS	15 (0.04, 0.02–0.06)	33 (0.08, 0.06–0.11)	115 (0.23, 0.19–0.27)	85 (0.43, 0.34–0.52)	143.695	<0.001	131.586	<0.001	68.687	<0.001	63.183	P < .001
	Stroke	148 (0.40, 0.33–0.46)	225 (0.57, 0.50–0.65)	325 (0.65, 0.58–0.72)	203 (1.03, 0.89–1.17)	85.520	<0.001	75.253	<0.001	25.253	<0.001	24.124	P < .001
	Trauma	801 (2.15, 2.01–2.30)	925 (2.35, 2.20–2.50)	1268 (2.54, 2.40–2.68)	552 (2.79, 2.56–3.02)	26.399	<0.001	26.251	<0.001	13.747	0.001	13.741	P < .001
	Poisoning	150 (0.40, 0.34–0.47)	211 (0.54, 0.46–0.61)	168 (0.34, 0.29–0.39)	31 (0.16, 0.10–0.21)	54.124	<0.001	25.709	<0.001	21.476	<0.001	3.491	0.062
All hospitals	ED visits	194,307	223,891	262,503	99,949								
	Critically ill visits	13,033 (6.71, 6.60–6.82)	13,722 (6.13, 6.03–6.23)	15,484 (5.90, 5.81–5.99)	8623 (8.63, 8.45–8.80)	962.607	<0.001	106.768	<0.001	128.847	<0.001	121.077	<0.001
	Deaths	247 (0.13, 0.11–0.14)	311 (0.14, 0.12–0.15)	313 (0.12, 0.11–0.13)	256 (0.26, 0.22–0.29)	102.577	<0.001	33.087	<0.001	3.673	0.159	NA	NA
	CPR	209 (0.11, 0.09–0.12)	255 (0.11, 0.10–0.13)	292 (0.11, 0.10–0.12)	185 (0.19, 0.16–0.21)	40.022	<0.001	18.315	<0.001	0.377	0.828	NA	NA

(continued on next page)

Table 1 (*continued*)

Grade of hospitals	Variables	Feb, 2017 N (%, 95%CI)	Feb, 2018 N (%, 95%CI))	Feb, 2019 N (%, 95%CI))	Feb, 2020 N (%, 95%CI))	χ^2	P	χ^2_{trend}	P_{trend}	χ^{2*}	P*	χ^{2}_{trend}**	P_{trend}**
	ACS	501 (0.26, 0.24–0.28)	536 (0.24, 0.22–0.26)	631 (0.24, 0.22–0.26)	385 (0.39, 0.35–0.42)	66.971	<0.001	18.952	<0.001	1.827	0.401	NA	NA
	Stroke	796 (0.41, 0.38–0.44)	1016 (0.45, 0.43–0.48)	1215 (0.46, 0.44–0.49)	811 (0.81, 0.76–0.87)	246.603	<0.001	139.732	<0.001	7.760	0.021	6.724	0.010
	Trauma	2009 (1.03, 0.99–1.08)	2183 (0.98, 0.93–1.02)	2496 (0.95, 0.91–0.99)	1226 (1.23, 1.16–1.29)	59.620	<0.001	6.374	0.012	8.115	0.017	7.653	0.006
	Poisoning	568 (0.29, 0.27–0.32)	684 (0.31, 0.28–0.33)	564 (0.21, 0.20–0.23)	170 (0.17, 0.14–0.20)	78.232	<0.001	61.722	<0.001	43.984	<0.001	28.876	<0.001

P: inter-group chi-square test on the whole dataset (4 time points). P_{trend}: time series trend test on the entire dataset (4 time points). P*: inter-group chi-square test for the first 3 data points by disregarding the data for Feb 2020. P_{trend}**: time series trend test on the first 3 data points.

Due to the scarcity of resources, we did not capture specific symptoms of COVID-19 confirmed cases in detail, such as the proportion of fever. However, from the early stages of the epidemic through the peak of the outbreak, confirmed cases were identified through ED visits, suggesting the importance of COVID-19 screening in EDs.

Last, although all the suspected patients in fever clinic received at least two pathogenic test before they get confirmed or excluded, according the Chinese authorities' criteria, not all the patients discharged from the ED were tested due to the limitation on testing availability at the peak time. With increasing awareness of disease and technical improvements, there is evidence that patients who were positive for SARS-CoV-2 were asymptomatic [8]. However, this part of the population may not be the major ED utilizers.

5. Discussion

Here we demonstrate that COVID-19 was associated with decreased ED volume but increased ED visit severity in a major Chinese city. On March 11, 2020, the World Health Organization designated “coronavirus disease 2019” (COVID-19) a global pandemic. As of 10:00 CET 20 April 2020, a total of 84,237 COVID-19 cases have been confirmed in China, as reported by the Chinese national authorities [9]. Globally, 2,314,621 cases have been reported in 212 countries, areas or territories. As the epidemic is evolves it is critical to determine the impact on EDs to guide resource utilization.

Since China experienced the rise in in this epidemic earlier than the world, it is critical to report some of the lessons learned to complement our understanding of this pandemic. Our data demonstrate that in a first-tier, non-outbreak major Chinese city, 28 EDs with totally 716 beds, played an important role in screening out 43.01% of the confirmed cases citywide. Second, local ED collaboration with fever clinics provided an effective prevention and control approach for this epidemic, especially limiting the propensity for nosocomial spread.

Previous studies on COVID-19 have mainly focused on epidemiological, clinical, and therapy of patients with confirmed infection. While significant attention has been paid to providing adequate medical supplies to front line providers, little attention has been paid to the impact on other emergency medical conditions. Emergency department (ED) utilization has risen in recent years, with a cumulative growth 6.7% in the number of visits between 2010 and 2014 in the United States, compared to the U.S. population growth of 2.97% [10]. This same phenomenon has been observed in China, only worse. A study [11] of 17 Grade A tertiary hospital from 12 provinces of China showed that the average volume of ED visits per hospital in 2012 was 147,400 $\pm$ 67,000 and the average waiting time exceeded 30 min for 59% of ED visits. In 2013, a survey [12] from 36 EDs in Beijing showed that participating EDs saw a median of 80,000 patients (interquartile range 40,000-118,508), more than three times that of the United States, with over half the patients having greater than a 6 h length of stay. The current hospital systems and emergency departments are already at or over capacity in daily operations. Lessons from history tell us a system that is stressed cannot respond adequately to crisis. This has played out in places such as Milan, Italy and New York City as EDs have been overwhelmed with lack of emergency personnel and ventilators [13]. In order to respond to the epidemic, most hospitals closed routine clinics and canceled elective surgeries. But EDs have no such option. EDs remain open; not only to care for the traumatic injuries, heart attacks, or strokes that continue whether a pandemic is circulating or not, but because people who are ill with acute clinical symptoms are most likely to seek care in EDs. Public health messaging to maintain patient comfort with seeking emergency care is critical to minimize late presentation of severe illness.

Although the absolute number in each variable was decreased during Feb 2020, with the exception of poisoning visits, the proportion of

Table 2
The month-to-month analysis from October 2019 to February 2020.

Grade of hospitals	Variables	Oct, 2019	Nov, 2019	Dec, 2019	Jan, 2020	Feb, 2020	χ^2	P	χ^2_{trend}	P $_{trend}$	χ^{2*}	P*	$\chi^2_{trend}{}^{**}$	P $_{trend}{}^{**}$
		N (%, 95%CI)	N (%, 95%CI)	N (%, 95%CI)	N (%, 95%CI)	N (%, 95%CI)								
Grade-A Tertiary	ED visits	165,300	159,715	180,083	207,378	65,382								
	Critically ill visits	14,992 (9.07,8.93–9.21)	14,129 (8.85, 8.71–8.99)	15,270 (8.48, 8.35–8.61)	14,891 (7.18, 7.07–7.29)	7209 (11.03, 10.79–11.27)	1086.374	<0.001	32.758	<0.001	538.691	<0.001	461.759	<0.001
	Deaths	197 (0.12, 0.10–0.14)	236 (0.15, 0.13–0.17)	246 (0.14, 0.12–0.15)	260 (0.13, 0.11–0.14)	216 (0.33, 0.29–0.37)	164.647	<0.001	44.383	<0.001	6.059	0.109	NA	NA
	CPR	180 (0.11, 0.09–0.12)	200 (0.13, 0.11–0.14)	202 (0.11, 0.10–0.13)	227 (0.11, 0.10–0.12)	141 (0.22, 0.18–0.25)	53.577	<0.001	11.831	0.001	2.571	0.463	NA	NA
	ACS	530 (0.32, 0.29–0.35)	493 (0.31, 0.28–0.34)	571 (0.32, 0.29–0.34)	447 (0.22, 0.20–0.24)	284 (0.43, 0.38–0.48)	93.739	<0.001	1.842	0.175	51.932	<0.001	33.371	<0.001
	Stroke	761 (0.46, 0.43–0.49)	787 (0.49, 0.46–0.53)	784 (0.44, 0.40–0.47)	691 (0.33, 0.31–0.36)	490 (0.75, 0.68–0.82)	201.019	<0.001	0.428	0.513	64.055	<0.001	45.046	<0.001
	Trauma	1875 (1.13, 1.08–1.19)	1659 (1.04, 0.99–1.09)	1562 (0.87, 0.82–0.91)	1106 (0.53, 0.50–0.56)	592 (0.91, 0.83–0.98)	458.242	<0.001	293.661	<0.001	458.927	<0.001	428.392	<0.001
	Poisoning	395 (0.24, 0.22–0.26)	468 (0.29, 0.27–0.32)	404 (0.22, 0.20–0.25)	360 (0.17, 0.16–0.19)	118 (0.18, 0.15–0.21)	64.715	<0.001	36.449	<0.001	57.551	<0.001	30.404	<0.001
Grade-B Tertiary	ED visits	43,792	36,944	45,021	52,624	14,793								
	Critically ill visits	1891 (4.32, 4.13–4.51)	2007 (5.43, 5.20–5.66)	1999 (4.44, 4.25–4.63)	2045 (3.89, 3.72–4.05)	1105 (7.47, 7.05–7.89)	397.726	<0.001	14.283	<0.001	124.979	<0.001	29.361	<0.001
	Deaths	16 (0.04, 0.02–0.05)	26 (0.07, 0.04–0.10)	15 (0.03, 0.02–0.05)	24 (0.05, 0.03–0.06)	16 (0.11, 0.06–0.16)	17.035	0.002	2.346	0.126	7.284	0.063	NA	NA
	CPR	19 (0.04, 0.02–0.06)	27 (0.07, 0.05–0.10)	16 (0.04, 0.02–0.05)	28 (0.05, 0.03–0.07)	20 (0.14, 0.08–0.19)	22.777	<0.001	4.101	0.043	6.251	0.100	NA	NA
	ACS	15 (0.03, 0.02–0.05)	23 (0.06, 0.04–0.09)	22 (0.05, 0.03–0.07)	15 (0.03, 0.01–0.04)	16 (0.11, 0.06–0.16)	18.945	0.001	1.311	0.252	7.018	0.071	NA	NA
	Stroke	148 (0.34, 0.28–0.39)	154 (0.42, 0.35–0.48)	163 (0.36, 0.31–0.42)	124 (0.24, 0.19–0.28)	118 (0.80, 0.65–0.94)	103.704	<0.001	3.669	0.055	24.196	<0.001	10.113	0.001
	Trauma	234 (0.53, 0.47–0.60)	357 (0.97, 0.87–1.07)	289 (0.64, 0.57–0.72)	172 (0.33, 0.28–0.38)	82 (0.55, 0.43–0.67)	156.796	<0.001	31.520	<0.001	155.786	<0.001	37.924	<0.001
	Poisoning	103 (0.24, 0.19–0.28)	104 (0.28, 0.23–0.34)	112 (0.25, 0.20–0.29)	101 (0.19, 0.15–0.23)	21 (0.14, 0.08–0.20)	13.410	0.009	6.914	0.009	7.920	0.048	2.846	0.092
Grade-A Secondary	ED visits	50,724	47,797	56,064	53,123	19,774								
	Critically ill visits	621 (1.22, 1.13–1.32)	570 (1.19, 1.10–1.29)	661 (1.18, 1.09–1.27)	575 (1.08, 0.99–1.17)	309 (1.56, 1.39–1.74)	28.537	<0.001	0.861	0.353	5.070	0.167	NA	NA
	Deaths	19 (0.04, 0.02–0.05)	17 (0.04, 0.02–0.05)	29 (0.05, 0.03–0.07)	28 (0.05, 0.03–0.07)	24 (0.12, 0.07–0.17)	23.101	<0.001	13.237	<0.001	2.865	0.413	NA	NA
	CPR	22 (0.04, 0.03–0.06)	17 (0.04, 0.02–0.05)	29 (0.05, 0.03–0.07)	30 (0.06, 0.04–0.08)	24 (0.12, 0.07–0.17)	20.952	<0.001	11.336	0.001	2.741	0.433	NA	NA
	ACS	127 (0.25, 0.21–0.29)	128 (0.27, 0.22–0.31)	145 (0.26, 0.22–0.30)	143 (0.27, 0.23–0.31)	85 (0.43, 0.34–0.52)	19.033	0.001	7.485	0.006	0.452	0.929	NA	NA
	Stroke	758 (1.49, 1.39–1.60)	598 (1.25, 1.15–1.35)	425 (0.76, 0.69–0.83)	257 (0.48, 0.42–0.54)	203 (1.03, 0.89–1.17)	336.390	<0.001	221.982	<0.001	337.347	<0.001	331.463	<0.001
	Trauma	1719 (3.39, 3.23–3.55)	1589 (3.32, 3.16–3.49)	1393 (2.48, 2.36–2.61)	1163 (2.19, 2.06–2.31)	552 (2.79, 2.56–3.02)	204.448	<0.001	134.104	<0.001	204.189	<0.001	185.973	<0.001
	Poisoning	158 (0.31, 0.26–0.36)	135 (0.28, 0.23–0.33)	155 (0.28, 0.23–0.32)	172 (0.32, 0.28–0.37)	31 (0.16, 0.10–0.21)	15.583	0.004	2.884	0.089	2.756	0.431	NA	NA
All hospitals	ED visits	259,816	244,456	281,168	313,125	99,948								
	Critically ill visits	17,504 (6.74, 6.64–6.83)	16,706 (6.83, 6.73–6.93)	17,930 (6.38, 6.29–6.47)	17,511 (5.59, 5.51–5.67)	8623 (8.63, 8.45–8.80)	1237.352	<0.001	2.643	0.104	464.839	<0.001	375.575	<0.001
	Deaths	232 (0.09, 0.08–0.10)	279 (0.11, 0.10–0.13)	290 (0.10, 0.09–0.12)	312 (0.10, 0.09–0.11)	256 (0.26, 0.22–0.29)	199.430	<0.001	60.983	<0.001	7.856	0.049	0.469	0.493
	CPR	221 (0.09, 0.07–0.10)	244 (0.10, 0.09–0.11)	247 (0.09, 0.08–0.10)	285 (0.09, 0.08–0.10)	185 (0.19, 0.16–0.21)	85.894	<0.001	24.496	<0.001	3.406	0.333	NA	NA

(continued on next page)

Table 2 (*continued*)

Grade of hospitals	Variables	Oct, 2019 N (%, 95%CI)	Nov, 2019 N (%, 95%CI)	Dec, 2019 N (%, 95%CI)	Jan, 2020 N (%, 95%CI)	Feb, 2020 N (%, 95%CI)	χ^2	P	χ^2_{trend}	P_{trend}	χ^{2*}	P*	χ^2_{trend}**	P_{trend}**
	ACS	672 (0.26, 0.24–0.28)	644 (0.26, 0.24–0.28)	738 (0.26, 0.24–0.28)	605 (0.19, 0.18–0.21)	385 (0.39, 0.35–0.42)	115.461	<0.001	0.124	0.725	43.384	<0.001	24.924	<0.001
	Stroke	1667 (0.64, 0.61–0.67)	1539 (0.63, 0.60–0.66)	1372 (0.49, 0.46–0.51)	1072 (0.34, 0.32–0.36)	811 (0.81, 0.76–0.87)	466.233	<0.001	65.382	<0.001	330.513	<0.001	303.925	<0.001
	Trauma	3828 (1.47, 1.43–1.52)	3605 (1.47, 1.43–1.52)	3244 (1.15, 1.11–1.19)	2441 (0.78, 0.75–0.81)	1226 (1.23, 1.16–1.29)	793.844	<0.001	492.037	<0.001	794.804	<0.001	708.415	<0.001
	Poisoning	656 (0.25, 0.23–0.27)	707 (0.29, 0.28–0.31)	671 (0.24, 0.22–0.26)	633 (0.20, 0.19–0.22)	170 (0.17, 0.14–0.20)	65.936	<0.001	44.443	<0.001	44.310	<0.001	24.801	<0.001

P: inter-group chi-square test on the whole dataset (5 time points). P_{trend}: time series trend test on the entire dataset (5 time points). P*: inter-group chi-square test for the first 4 data points by disregarding the data for Feb 2020. P_{trend}**: time series trend test on the first 4 data points.

severe visits were significantly increased, possibly due to change in proportion of other ED visits during the pandemic. During the pandemic, people were mandated to stay at home, which has reduced the chance of trauma. The absolute number of even the most severe diseases decreased, maybe because people tend to avoid medical facilities until their illness became very severe and brought them to the ED during the pandemic. This was also reflected by the higher fatality rate during the peak of the pandemic in Nanjing. It is likely that there were more out of hospital deaths leading to an absolute decrease in the number of fatalities in EDs. Though some behavioral changes may have also decreased these deaths, such as fewer high speed motor vehicle collisions. On the other hand, poisoning visits decreased, both the absolute number and the proportion. Previous epidemiological investigations have confirmed that deliberate suicide was one of the most important reasons for poison exposure in Jiangsu province [14], suggesting that at least, the population was not pushed to overdose during the epidemic.

In the face of COVID-19, China has rolled out perhaps the most ambitious, agile, and aggressive disease containment effort in history. In response to authority policies, travel was suspended from multiple cities, social activities were canceled, and the medical model changed. During the outbreak month in Nanjing the total number of ED visits declined precipitously, rather than the overcrowding that may have been expected. More importantly, the situation may also reflect the actual demand for critical illness treatment in emergency facilities in Nanjing. We have observed that among the seven severe disease categories in this study, representing the key diseases and critical strengths of ED care, the proportion of critical illnesses were significantly increased during the peak of the pandemic. In terms of the year-on-year data, the impact of this epidemic was more pronounced in higher-level hospitals with comprehensive emergency medicine capabilities. However, all levels of hospital were widely affected; no-one was spared.

In a severe pandemic, the usual standards of care are not be maintained. In the context of a pandemic, the value of maximizing benefit is most important [15]. On the other hand, there should be no difference in allocating scarce resources between patients with COVID-19 and those with other medical conditions. We believe health care organizations must prioritize resources immediately to do the most with what we have available. Prioritization guidelines should respond to changing scientific evidence rather than basing decisions on individual institutions' approaches or a clinician's intuition in the heat of the moment. In our experience, non-COVID-related emergency medicine services need to be preserved. Although the proportion of critical illness has increased, the absolute number of critical visits remains stable, suggesting that it is reasonable to consider allocating limited services to higher-level hospitals for comprehensive care of quaternary level patients.

In summary, while overall ED volume decreased during the COVID-19 pandemic, including a decrease in the number of severe visit types, the proportion of severe ED visits increased. The highest level hospitals had the largest magnitude of proportional severe visit increases. This suggests EDs should plan for decreased volume but maintain resources for treatment of the most severe conditions, and medical systems should concentrate resources for long term care of critical patients at the highest level hospitals during an epidemic.

The following are the supplementary data related to this article.

Declarion of Competing Interest

Dr. Sun, Dr. Liu, and Dr. Li were contributed equally for the study. Dr. Sun and Dr. Zhang were supported from Medical Research Team of Jiangsu Province CXTDA2017007 and QNRC2016597 for this project. Dr. Monte received support from NIH 1R35GM124939-01 and NIH CTSI UL1 TR001082 to support this work. There are no conflicts of interests for any author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2020.07.086.

References

[1] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020 Feb 24. https://doi.org/10.1001/jama.2020.2648 [Epub ahead of print].

[2] Wang C, Horby PW, Hayden FG, et al. A novel coronavirus outbreak of global health concern. Lancet. 2020 Feb 15;395(10223):470–3.

[3] Del Rio C, Malani PN. 2019 novel coronavirus-important information for clinicians. JAMA. 2020 Feb 5. https://doi.org/10.1001/jama.2020.1490 [Epub ahead of print].

[4] World Health Organization. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19). Available from: https://www.who.int/publications-detail/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-(COVID-19). Accessed February 28, 2020.

[5] Schull MJ, Mamdani MM, Fang J. Community influenza outbreaks and emergency department ambulance diversion. Ann Emerg Med. 2004 Jul;44(1):61–7.

[6] Zhu A, Zhang J, Zhang H, et al. Comparison of reliability and validity of the Chinese four-level and three-district triage standard and the Australasian triage scale. Emerg Med Int. 2019 Nov 14;2019:8490152.

[7] Emergency Severity Index (ESI) A Triage Tool for Emergency Department Care. Version 4. Implementation Handbook 2012 Edition.

[8] Sutton D, Fuchs K, D'Alton M, et al. Universal screening for SARS-CoV-2 in women admitted for delivery. N Engl J Med. 2020 Apr 13. https://doi.org/10.1056/NEJMc2009316 [Epub ahead of print].

[9] World Health Organization. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports. Accessed April 20, 2020.

[10] Hooker EA, Mallow PJ, Oglesby MM. Characteristics and trends of emergency department visits in the United States (2010-2014). J Emerg Med. 2019 Mar;56(3):344–51.

[11] Li Y, Li C, Xu J, et al. Emergency department enlargement in China: exciting or bothering. J Thorac Dis. 2016 May;8(5):842–7.

[12] Wen LS, Xu J, Steptoe AP, et al. Emergency department characteristics and capabilities in Beijing. China J Emerg Med. 2013 Jun;44(6):1174–9.

[13] Kliff S, Satariano A, Silver-Greenberg J, Kulish N. There aren't enough ventilators to cope with the coronavirus. New York Times Available from: https://www.nytimes.com/2020/03/18/business/coronavirus-ventilator-shortage.html. Accessed March 18, 2020.

[14] Wang N, Wang B, Wen J, et al. Types of exposure pesticide poisoning in Jiangsu Province, China; the epidemiologic trend between 2006 and 2018. Int J Environ Res Public Health. 2019 Jul;19:16(14).

[15] Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of COVID-19. N Engl J Med. 2020 Mar 23. https://doi.org/10.1056/NEJMsb2005114 [Epub ahead of print].