Acta Biomed 2020; Vol. 91, N. 2: 45-49 DOI: 10.23750/abm.v91i2.9565

Impact of the COVID-19 epidemic on census, organization and activity of a large urban Emergency Department

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Summary. *Background.* The spread of coronavirus disease 2019 (COVID-19) is overwhelming the response of many regional health services across Italy. This article aims to report and discuss the data of the first 8 weeks of COVID-19 epidemic in the emergency department (ED) of the University Hospital of Parma. *Methods.* The ED visits were analyzed as follows: total ED visits, divided in COVID-19/ non-COVID-19 cases, and in trauma-related/non-trauma-related cases; outcome (i.e., discharged, admitted, dead in the ED) of patients, altogether or stratified according to triage class; age classes of the entire ED population. *Results.* Total ED visits decreased starting from the first days of the outbreak, then exhibiting progressive growth afterwards. COVID suspected cases rapidly increased, whereas non-COVID suspected dropped and remained well below the standard. Trauma-related cases declined, both as ED visits and as hospital admissions. The percentage and absolute number of patients admitted to hospital wards progressively increased, rapidly overwhelming the number of cases that could be discharged. The admission rate in the lowest priority classes also displayed a marked increase. The youngest age classes dramatically declined, whilst the oldest progressively increased, remaining considerably over the standard rate of the local ED. *Conclusions.* The COVID-19 pandemic has obliged the health care systems to undergo a paradigm shift. Even triage criteria have partially lost their meaning, as shown by the dramatic increase of hospital admissions, even in the lowest priority classes. A deep re-organizational process of the ED was undertaken. Hospitals must be constantly resilient and prepared to these new emergencies in terms of equipment, medical and nurses staff, larger bed capacity in short time, availability of intensive and sub-intensive beds, and flexibility. (www.actabiomedica.it)

Key words: COVID-19, SARS-CoV-2, Emergency Department, epidemic, pandemic

Introduction

A deadly revolution has begun. We are living in it: we are living despite it.

The continuous spread of Coronavirus Disease 2019 (COVID-19), the new severe and highly infectious disorder caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), has been so devastating in Northern Italy that the response of most regional health services has been overwhelmed (1). Similar evidence is increasingly seen all around the world (2).

Shortly after the first four cases were diagnosed in Lombardy, around half of February 2020, many other COVID-19 cases could be identified in the surrounding area, including a substantial number of critically ill patients (3,4). Few days later, a second outbreak originated in the neighboring Veneto region. Very quickly, the virus spread all over Italy, especially in northern regions. The province of Parma, located in Emilia-Romagna (adjacent to Lombardy, only separated by the River Po), was dramatically invested after the neighboring province of Piacenza, which strictly confines with Lombardy.

As it has been recently underscored, emergency departments (EDs), intensive care units (ICUs) along with the entire hospital and healthcare system are overwhelmed and their organization is deeply disrupted by this type of catastrophic epidemiological crisis (5). Therefore, the aim of this article is reporting and discussing data of the first 8 weeks of COVID-19 epidemic in the province of Parma.

Methods

This retrospective observational study was performed at the ED of the University Hospital of Parma. Parma is a province with approximately 440.000 inhabitants and three hospitals. The data of this article are mainly focused on the activity of the ED of the hub hospital, i.e. the University Hospital of Parma. The two smaller spoke EDs of the province have been partially closed from March 18th.

All digital data of ED visits from February 17th to April 12th were anonymously retrieved from the hospital information system (HIS). The data concern all the sections of the ED, including orthopedics, pediatrics, and obstetrics and gynecology. During the epidemic period only very few patients suspected for COVID-19 were visited in those specialties. Since the pathway of suspected COVID-19 cases (defined as patients presenting with fever, cough, dyspnea or flu-like symptoms) and that of the non-suspected COVID-19 cases have been physically separated starting from February 27th, patients were classified accordingly, with a reasonable degree of precision. In the last 5 years the annual volume of ED visits per year was comprised between a minimum of 110.474 in 2015 and a maximum of 116.745 in 2017. During this same period the percentage of discharged, admitted and deceased patients was 78,1%, 17,5%, and 0,2%, respectively, with a residual 4.3% represented by patients leaving the ED without being visited or without waiting the conclusion of the diagnostic and therapeutic process.

The following data were analyzed: i) total ED daily visits; ii) daily COVID-19 and non COVID-19 cases; iii) total weekly number of ED visits and total hospital admissions, divided in trauma-related and non-trauma-related cases; iv) weekly outcome (i.e., discharged, admitted, dead in the ED) of all patients; v) age classes of the entire ED population throughout the study period (i.e., 8 weeks), compared with the usual ED census.

We also compared the rate of discharged, admitted and deceased patients, classified according to triage priority, with analogous data over the past 5 years. A four-level triage system is used in the local ED, based on color codes, i.e., i) red, highest priority, no waiting time; ii) yellow, high priority, target waiting time 15 min; iii) green, medium priority, target waiting time 60 min; v) white, no priority, no target waiting time (6-8).

Due to the retrospective design of this study, which also entailed complete anonymization of patient data, ethical committee approval was unnecessary, in accordance with local policy. The study was performed in accordance with the Declaration of Helsinki under the terms of relevant local legislation.

Results

The overall number of ED visits consistently decreased from the first days of the COVID-19 alarm, reaching the nadir on April 5th, and then displaying a progressive increase afterwards, still not approximating standard ED activity (Figure 1).

During this same period, the number of admissions for non-COVID-19 suspected cases dramatically declined, whilst that of COVID-19 suspected cases progressively increased, thus exceeding the non-COVID-19 suspected ones for several days, and reaching

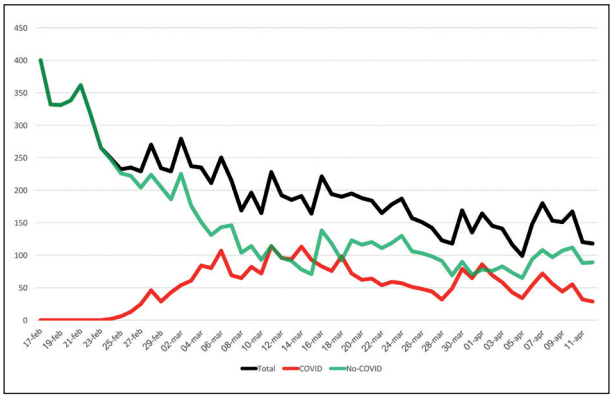

Figure 1. Daily visits at the Parma ED during the 8 week period of the study (total, COVID, no-COVID).

an impressive percentage of 62,5% of total census, on March 16th.

Trauma-related cases dramatically declined, both in terms of ED visits and as hospital admissions, in particular concerning victims of car crashes and sports injuries, and this is mainly due to the almost total stop of traffic and sport activities. The ED census was represented almost exclusively, for weeks, by non-traumatic cases, which peaked at 89,5% during the 5th week (Figures 2, 3). In comparison, during the years 2015-2019 trauma-related cases accounted for an average 30.8% of total ED census.

The percentage and absolute number of hospital admissions progressively increased, rapidly exceeding the number of patients discharged (i.e., 59%), remaining for weeks over the standard of the local ED (i.e., around 17.5% of all ED visits during the past 5 years), and then displaying a progressive decline from the fifth week (Fig. 4). Interestingly, the percentages of admissions according to triage priority class exhibited a sharp increase. Surprisingly, the admission rates were higher than the local standard even for the lowest priority classes (Table 1).

The youngest age classes, in particular between 0-12 and 13-18 years, dramatically declined, whilst the oldest age classes, in particular between 71-80 and 81-90 years, were progressively more represented, remaining over the standard of the local ED (Fig. 5). A trend toward normalization of admissions could only be noted starting from the fifth week. Table 2 shows the age classes of the entire ED population throughout the 8-week study period compared with data of the previous 5 years.

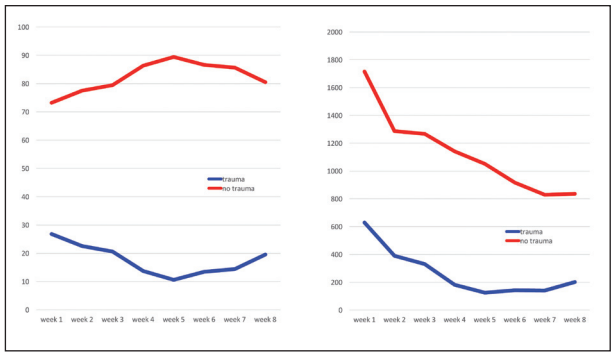

Figure 2. Visits for trauma vs. no-trauma patients, divided in weekly blocks. Data are presented both as absolute numbers (right box) and percentages (left box).

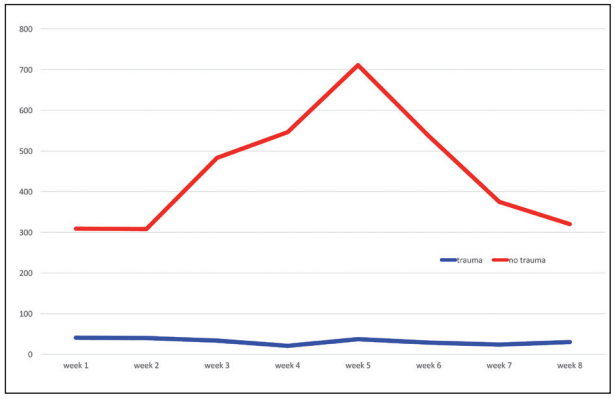

Figure 3. Hospital admissions (absolute numbers) for trauma vs. no-trauma patients, divided in weekly blocks.

Discussion and Conclusions

The COVID-19 pandemic has posed a dramatic, unexpected and unprecedented burden on many

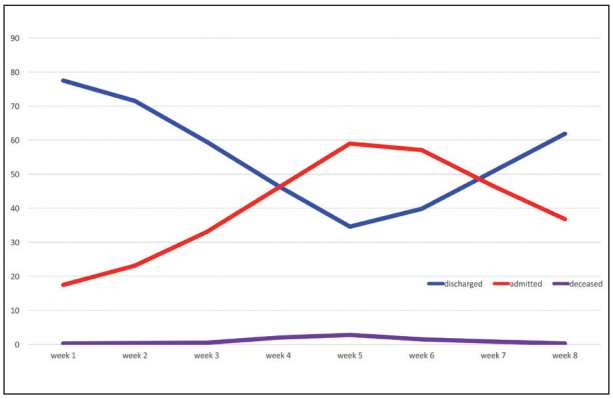

Figure 4. Percentages of discharged, admitted and deceased patients, divided in weekly blocks.

Table 1. Percentages of admissions and dischargements according to triage code. Comparison between the period of the study (February 17th to April 12th, 2020) and the last five years.

	February 17th to April 12th, 2020		Years 2015-2019	
	Discharged (%)	Admitted (%)	Discharged (%)	Admitted (%)
White code	90,8	9,2	98,9	1,1
Green code	72,7	27,3	88,4	11,6
Yellow code	43,7	56,3	62,6	37,4
Red code	15,4	84,6	20,6	79,4

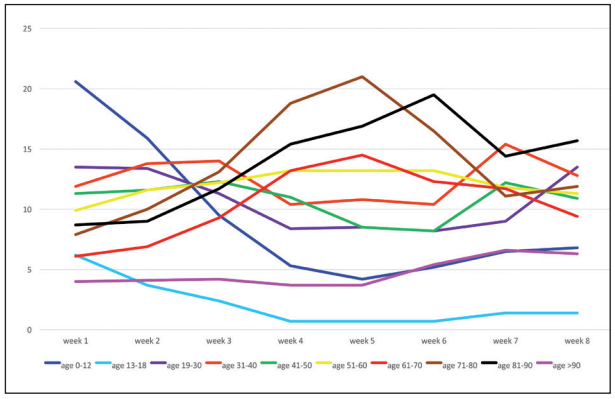

Figure 5 Age classes of the ED census (displayed as percent of total population), divided in weekly blocks.

Table 2. Age segments of the whole ED population in the 8 weeks period of study, compared with the data of the last 5 years, are detailed.

Age class	February 17th to April 12th, 2020	Years 2015-2019
0-12	10,7	18,8
13-18	2,7	4,7
19-30	10,9	13,2
31-40	12,4	12,3
41-50	10,9	11,2
51-60	11,8	10,2
61-70	9,9	7
71-80	13,2	9,2
81-90	13,1	9,4
>90	4,5	3,2

healthcare systems worldwide, forcing them to undergo a paradigm shift, as clearly described by a group of physicians in Bergamo, which has been identified as the epicenter of the plague in Italy. These physicians observe that «*Western health care systems have been built around the concept of patient-centered care, but an epidemic requires a change of perspective toward a concept of community-centered care*» (1). Although we would all agree that this holds true, physicians must always do their best to take care of single individuals when facing patients rather than communities. A reasonable balance between these two compelling duties is not that easy, and is often painful, but this is exactly what has happened also in our local ED.

The dramatic reduction of non-COVID suspected patients asking for care in the ED during the epidemic shall induce some reflections. This phenomenon is largely but not entirely due to lockdown and sports restrictions. The decline involved a considerable number of patients usually seeking ED care by ambulance for potentially serious problems (i.e., chest pain, abdominal pain…). It is challenging to explain the dramatic reduction of these cases as well. In the future all the emergency services system will perhaps need to rethink and rebuild their structure and organization.

As previously discussed, we recorded a dramatic decline in traumatic cases, in particular those concerning the victims of car crashes and sports injuries. This was mainly due to the stop of traffic and sport activities. The ED admissions were represented almost exclusively by non-traumatic cases. During the entire month of March, there were only 4 deaths due to car crashes in the Emilia Romagna region, whereas in the same month of the year 2019 a total number of 23 car crash-related deaths were recorded.

The ED census markedly changed, since the youngest age classes considerably declined, whilst the oldest ages become more and more represented, becoming those prevailing. This would lead us to conclude that the COVID-19 outbreak, in terms of hospital burden, seems to be a mostly geriatric epidemic.

The triage criteria have partially lost significance, as shown by the dramatic increase of hospital admissions in the lowest priority classes (i.e. white and green codes). Overall, less than 1% of all patients were admitted in ICU directly from the ED. The vast majority of these admissions, occurred within 2 weeks after an ED visit, due to gradual clinical worsening. As such, the number of patients directly admitted to the ICU by the ED does not reflect the actual need of ICU-based care.

During the weeks of maximum inflow of new cases, a profound re-organizational process was needed in the ED. Both the infrastructure and the organization was rapidly modified. For example, all waiting rooms were converted into ED boxes, each equipped with both oxygen and electric supply. Medical and nurses staff was also rapidly reinforced, with several doctors and nurses belonging to other specialties (e.g., general surgery, cardiology, cardiothoracic surgery, and many others) being recruited for initial management of patients based on written protocols, since all the non-

urgent surgical procedures were stopped.

The ED environment was gloomy, and all physicians have probably operated below their usual standard of care. Waiting times for an intensive care beds were very long, as were those for internal medicine (including geriatrics, pulmonology, and infectious diseases' wards). Several elderly patients could not be resuscitated and died alone, while their families could only be notified by a phone call. Nevertheless, the entire staff worked with enthusiasm and self-denial, thus showing an extraordinary resilience. Unfortunately, however, several nurses and physicians were infected by the virus, and some of them even died.

This emergency, which could now be considered a kind of a "perfect storm" (10), is still ongoing, but some important lessons shall be learned. A marked and rapid increase in demand for medical resources can have detrimental effects on the entire healthcare system when resources are not sufficient to meet the magnified demand (9). This is precisely what is happening.

The main lesson we have learned now, is that hospitals must be constantly proactive and prepared in terms of equipment, medical and nurse staff, possibility to rapidly implement new beds, availability of intensive and sub-intensive beds and, first and foremost, extreme flexibility (11,12). This last quality is necessary, and should be formally and constantly trained, to quickly adapt all the hospital system to the emerging needs (13). Many more lessons are, for sure, in sight.

Aknowledgements

We acknowledge all the colleagues, both physicians and nurses, that with their hard work made possible the exceptional ED and hospital activity, capable to take care of hundreds of patients a day. Without the work of all those people this article could not be written.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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Received: 15 April 2020
Accepted: 17 April 2020
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