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Patterns of Emergency Department visits for acute and chronic diseases during the two pandemic waves in Italy

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A R T I C L E   I N F O

Article history:
Received 2 April 2021
Received in revised form 28 June 2021
Accepted 1 July 2021

Keywords:
ED visits
COVID-19
Pandemic
Acute diseases
Chronic diseases
Emergency departments

A B S T R A C T

Background: Evidence is lacking about the impact of subsequent COVID-19 pandemic waves on Emergency Departments (ED). We analyzed the differences in patterns of ED visits in Italy during the two pandemic waves, focusing on changes in accesses for acute and chronic diseases.

Methods: We conducted a retrospective study using data from a metropolitan area in northern Italy that includes twelve ED. We analyzed weekly trends in non-COVID-19 ED visits during the first (FW) and second wave (SW) of the pandemic. Incidence rate ratios (IRRs) of triage codes, patient destination, and cause-specific ED visits in the FW and SW of the year 2020 vs. 2019 were estimated using Poisson regression models.

Main findings: We found a significant decrease of ED visits by triage code, which was more marked for low priority codes and during the FW. We found an increased share of hospitalizations compared to home discharges both in the FW and in the SW. ED visits for acute and chronic conditions decreased during the FW, ranging, from −70% for injuries (IRR = 0.2862, p < 0.001) to −50% and −60% for ischemic heart disease and heart failure.

Conclusions: The two pandemic waves led to a selection of patients with higher and more urgent needs of acute hospital care. These findings should lead to investigate how to improve systems’ capacity to manage changes in population needs.

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1. Introduction

Few weeks after the first case of COVID-19 was identified in Italy on February 21st, 2020, the Italian government enforced a national lockdown from March to May 2020 [1,2]. After the easing of several important restrictions on May 4, 2020, a total lockdown was never put back in place in Italy. By late October 2020, when Italy experienced a second wave of COVID-19, the Italian authorities adopted a different approach: the Government enforced differentiated response measures organized in progressively restrictive tiers (imposed on a regional basis) that were strictly related to epidemiological criteria. Between spring and autumn 2020 national and regional governments had plenty of time to get prepared for a possible resurgence of COVID-19 contagions, and citizens and patients had time to get used to the new habits enforced by the pandemic. In response to the extended state of emergency and the novel restrictive measures, healthcare utilization patterns changed among the general population [3,4].

Evidence is lacking about the impact of subsequent COVID-19 pandemic waves on Emergency Departments (ED). We analyzed the differences in patterns of ED visits in Italy during the two pandemic waves, focusing on changes in accesses for acute and chronic diseases.

Methods: We conducted a retrospective study using data from a metropolitan area in northern Italy that includes twelve ED. We analyzed weekly trends in non-COVID-19 ED visits during the first (FW) and second wave (SW) of the pandemic. Incidence rate ratios (IRRs) of triage codes, patient destination, and cause-specific ED visits in the FW and SW of the year 2020 vs. 2019 were estimated using Poisson regression models.

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Conclusions: The two pandemic waves led to a selection of patients with higher and more urgent needs of acute hospital care. These findings should lead to investigate how to improve systems’ capacity to manage changes in population needs.

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and 7825 COVID-19 deaths (135.0 mortality rate per 100,000 population) from February 01 to December 31, 2020 [11].

This study aims to analyze the differences in patterns of ED visits in BMA (Italy) during the two pandemic waves of 2020, focusing on changes in ED accesses for acute time-dependent diseases and exacerbation of chronic diseases.

2. Methods

We conducted a retrospective cross-sectional observational study, using anonymized data from the healthcare services’ information systems of BMA, a wide metropolitan area in Emilia-Romagna (northern Italy) that encompasses the city of Bologna and the neighboring municipalities (1,019,875 citizens) and includes twelve ED. The study population consisted of patients of all ages that visited the ED (i.e., with an ED diagnosis code) in 2019 and 2020. The diagnosis code is given by the physician to each patient undergoing clinical evaluation at the ED.

We then classified ED visits as COVID-19 and non-COVID-19, based on the primary International Classification of Diseases Manual 9th Edition – Clinical Modification (ICD-9-CM) diagnostic code [9], and excluded the COVID-19 ED visits from the analysis. The classification algorithm for COVID-19 cases is reported in the section a) of the Supplementary material.

We analyzed weekly trends in non-COVID-19 cause-specific ED visits during the two time periods of COVID-19 case peak (i.e., daily incidence higher than 100 cases in BMA): from March 9 to May 3 (first wave, FW), when a strict nation-wide lockdown was enforced, and from October 18 to December 31 (second wave, SW), when a set of more lenient and region-based social distancing measures was enforced.

We analyzed the distribution of ED visits overall, by gender and by age group in the FW and SW, compared with the same periods of the previous year.

We classified ED visits according to the patients’ triage code (red-yellow vs. green-white). ED visits in BMA have been categorized by severity codes according to the triage protocols in four levels of urgency [12,13]: white code (not-urgent condition), green code (postponable conditions); yellow code (medical condition requiring urgent care with no vital signs impairment but at-risk for deterioration); red code (medical condition with acute impairment of vital signs requiring emergency care).

We also classified ED visits according to patients’ discharge destination (admitted to hospital vs. discharged at home).

We then identified 5 acute time-dependent conditions (ischemic heart disease, conduction disorders of the heart, and dysrhythmias, ischemic cerebral disorders, gastrointestinal hemorrhages, injury) that need timely intervention and are usually diagnosed and treated in the emergency department, as identified by the Italian Government Decree DM 70/2015 [14], and 5 conditions that reflect exacerbation of chronic diseases (neoplasm, diabetes, heart failure, COPD, anemia), whose care is normally shared between the ED and out-patient services. These conditions have been chosen among those with higher impact on BMA’s ED in terms of yearly number of cause-specific ED visits during the study period [9,15]. The categorization into acute and chronic diseases was made according to the main diagnosis of ED visits, which we identified through the ICD-9-CM manual codes reported in section b) (see Supplementary material).

The weekly number of visits and the incidence rate per 10,000 inhabitants were compared with the same period of the previous year. Incidence rate ratios (IRRs) of triage codes, patient destination, and cause-specific ED visits in the FW and SW of the year 2020 vs. 2019 were estimated using Poisson regression models.

This study has been approved by the Emilia Romagna AVEC research ethics committee board with identifier n° 726/2020/Oss/AOUB on 08.03.2020 and carried out in conformity with the regulations on data management with the Italian law on privacy (Legislation Decree 196/2003 amended by Legislation Decree 101/2018).

3. Results

The study population consisted of 219,151 patients accessing BMA’s ED, of which 29,917 during the FW of year 2020 and 43,232 during the SW of 2020 (Table 1).

The number of ED visits was stable until week 82,020, then it dropped abruptly (Fig. 1). The reduction was −58.8% in the FW (Table 1). Afterward, the number of ED visits started to slowly rise again during the FW until it reached levels closer to those of 2019. From week 43 to week 50, 2020 we registered a second decline of ED visits. The reduction was −38.7% in the SW (Table 1).

The distribution by gender and age group showed no differences between each wave and the corresponding period of the previous year (Table 1). However, we found a more marked reduction of ED visits for patients aged 0–14 years during the FW (IRR = 0.1955, p < 0.0001, 95% CI: 0.1923–0.1986) than during the SW (IRR = 0.4528, p < 0.0001, 95% CI: 0.4474–0.4582).

We found a clear and statistically significant decrease of ED visits by triage code (Table 2). The decrease was more marked for low priority (white-green) codes than for high priority (red-yellow) ones and in the FW than in the SW (IRR = 0.3817, 0.4582, 0.4582 vs IRR = 0.4528, 0.6231, 0.6133).

We identified 5 acute time-dependent conditions (ischemic heart disease, conduction disorders of the heart, and dysrhythmias, ischemic cerebral disorders, gastrointestinal hemorrhages, injury) that need timely intervention and are usually diagnosed and treated in the emergency department, as identified by the Italian Government Decree DM 70/2015 [14], and 5 conditions that reflect exacerbation of chronic diseases (neoplasm, diabetes, heart failure, COPD, anemia), whose care is normally shared between the ED and out-patient services. These conditions have been chosen among those with higher impact on BMA’s ED in terms of yearly number of cause-specific ED visits during the study period [9,15]. The categorization into acute and chronic diseases was made according to the main diagnosis of ED visits, which we identified through the ICD-9-CM manual codes reported in section b) (see Supplementary material).

The weekly number of visits and the incidence rate per 10,000 inhabitants were compared with the same period of the previous year. Incidence rate ratios (IRRs) of triage codes, patient destination, and cause-specific ED visits in the FW and SW of the year 2020 vs. 2019 were estimated using Poisson regression models.

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Table 1
Change in total ED visits, ED visits by gender and age group. Change in ED visits by gender and age group for the two study periods compared to the same period of the previous year.a

|                      | First wave |                   | Second wave |                   |
|----------------------|------------|-------------------|-------------|-------------------|
|                      |            | 2019 | 2020 | IRR  | 95% CI  | 2019 | 2020 | IRR  | 95% CI  |
| ED visits            |            |      |      |      |         |      |      |      |         |
| Total                |            | 74,443 | 4919 | 29,917 | 197.9 | 0.4122b | 0.4056–0.4190 | 71,559 | 474.8 | 43,232 | 286.0 | 0.6132b | 0.6045–0.6221 |
| Gender               |            |        |      |      |         |      |      |      |         |
| Male                 |            | 36,278 | 240.7 | 14,401 | 95.2 | 0.4127b | 0.4072–0.4182 | 34,808 | 230.9 | 21,204 | 140.2 | 0.6231b | 0.6159–0.6304 |
| Female               |            | 38,165 | 253.2 | 15,516 | 102.6 | 0.4113b | 0.4037–0.4190 | 36,751 | 243.8 | 22,028 | 145.7 | 0.6032b | 0.5933–0.6133 |
| Age group            |            |        |      |      |         |      |      |      |         |
| 0–14                 |            | 12,244 | 81.2 | 2,199 | 14.5 | 0.1953b | 0.1923–0.1986 | 11,235 | 74.6 | 4,801 | 31.8 | 0.4528b | 0.4474–0.4582 |
| 15–49                |            | 28,878 | 191.6 | 11,856 | 78.4 | 0.4278b | 0.4220–0.4336 | 28,951 | 186.1 | 16,712 | 110.5 | 0.6127b | 0.6053–0.6201 |
| 50–64                |            | 11,807 | 78.3 | 5,852 | 38.7 | 0.4989b | 0.4917–0.5062 | 11,448 | 76.0 | 7,720 | 51.1 | 0.6723b | 0.6634–0.6813 |
| 65–74                |            | 7,263 | 48.2 | 3,219 | 21.3 | 0.4548b | 0.4486–0.4611 | 6,978 | 46.3 | 4,517 | 29.9 | 0.6554b | 0.6474–0.6635 |
| >75                  |            | 14,229 | 94.4 | 6,772 | 44.8 | 0.5003b | 0.4952–0.5055 | 13,794 | 91.5 | 9,390 | 62.1 | 0.7006b | 0.6941–0.7071 |
| n/a                  |            | 22     |      | 19    |      |         |         | 53     |      | 92     |      |         |         |

a) ED visits are reported as absolute numbers (n), incidence rate per 10,000 population (IR), incidence rate ratio (IRR) and 95% confidence interval (95% CI).
b) p < 0.0001.
As to ED visits for specific conditions (Table 2), we found a statistically significant decrease of ED visits for all acute time-dependent conditions and exacerbations of chronic diseases during the FW as compared to 2019, ranging, from approximately −70% for injuries (IRR = 0.2862, p < 0.001, 95% CI: 0.2772–0.2954) to −50% and −60% for ischemic heart disease and heart failure (IRR = 0.5202, p < 0.0001, 95% CI: 0.4284–0.6317, and IRR = 0.4024, p < 0.01, 95% CI: 0.3494–0.4635). We found a similar, albeit lower, decrease of ED visits during the SW (e.g., −40% for injury, IRR = 0.6101, p < 0.0001, 95% CI: 0.5949–0.6256), except for ischemic heart disease and heart failure, which failed to reach statistical significance.

4. Discussion

In this study, we registered a significant reduction of ED visits during the two pandemic waves in Italy compared to the same periods of the previous year. The decrease of ED visits for medical conditions requiring urgent care with no vital signs’ impairment but at-risk for deterioration (yellow codes) and medical condition with acute impairment of vital signs requiring emergency care (red codes) is more marked during the first pandemic wave. The same applies to not-urgent (white codes) and postponable conditions (green codes). However, the decrease is steeper for white-green codes than for red-yellow codes.

Table 2

| First wave | Second wave |
|------------|-------------|
| 2019 | 2020 | IRR | 95% CI | 2019 | 2020 | IRR | 95% CI |
| Triage code | | | | | | | |
| White-Green | 61,744 | 409.7 | 23,058 | 152.5 | 0.3817b | 0.3760–0.3874 | 58,745 | 398.8 | 33,095 | 218.9 | 0.5709b | 0.5634–0.5786 |
| Yellow-Red | 12,699 | 84.3 | 6859 | 45.4 | 0.5405b | 0.5249–0.5565 | 12,814 | 85.0 | 10,042 | 66.4 | 0.7826b | 0.7626–0.8032 |
| Patient destination | | | | | | | |
| Home discharge | 54,717 | 363.1 | 19,123 | 126.5 | 0.3565b | 0.3507–0.3624 | 52,456 | 348.1 | 30,615 | 202.5 | 0.5900b | 0.5819–0.5981 |
| Hospital admission | 10,828 | 71.8 | 8509 | 56.3 | 0.7845b | 0.7626–0.8070 | 10,855 | 72.0 | 10,102 | 66.8 | 0.9281b | 0.9034–0.9535 |
| Other | 8898 | 59.0 | 2285 | 15.1 | 0.2571b | 0.2456–0.2692 | 8248 | 54.7 | 2515 | 16.6 | 0.3051b | 0.2918–0.3190 |
| Acute time-dependent diseases | | | | | | | |
| Ischemic heart disease | 297 | 2.0 | 155 | 1.0 | 0.5202b | 0.4284–0.6317 | 282 | 1.9 | 250 | 1.7 | 0.8837 | 0.7433–1.0477 |
| Conduction disorders of the heart and dysrhythmias | 867 | 5.8 | 360 | 2.4 | 0.4140b | 0.3661–0.4681 | 806 | 5.3 | 537 | 3.6 | 0.6642b | 0.5955–0.7408 |
| Ischemic cerebral disorders | 411 | 2.7 | 232 | 1.5 | 0.5627b | 0.4791–0.6610 | 411 | 2.7 | 309 | 2.0 | 0.7494b | 0.6466–0.8686 |
| Gastrointestinal hemorrhages | 225 | 1.5 | 145 | 1.0 | 0.6424b | 0.5214–0.7915 | 254 | 1.7 | 169 | 1.1 | 0.6632b | 0.5460–0.8057 |
| Injury | 17,022 | 112.9 | 4848 | 32.1 | 0.2862b | 0.2772–0.2954 | 15,869 | 105.3 | 9673 | 64.0 | 0.6101b | 0.5949–0.6256 |
| Exacerbation of chronic diseases | | | | | | | |
| Neoplasm | 254 | 1.7 | 151 | 1.0 | 0.5930b | 0.4845–0.7248 | 245 | 1.6 | 188 | 1.2 | 0.7649b | 0.6325–0.9250 |
| Diabetes | 207 | 1.4 | 86 | 0.6 | 0.4141b | 0.3221–0.5235 | 167 | 1.1 | 112 | 0.7 | 0.6685b | 0.5262–0.8493 |
| Heart failure | 669 | 4.4 | 270 | 1.8 | 0.4024b | 0.3494–0.4635 | 564 | 3.7 | 520 | 3.4 | 0.9190 | 0.8158–1.0353 |
| COPD and allied conditions | 469 | 3.1 | 121 | 0.8 | 0.2572b | 0.2106–0.3144 | 464 | 3.1 | 227 | 1.5 | 0.4877b | 0.4161–0.5716 |
| Anemia | 253 | 1.7 | 114 | 0.8 | 0.4492b | 0.3601–0.5603 | 274 | 1.8 | 195 | 1.3 | 0.7094b | 0.5904–0.8524 |

Table 2 Change in ED triage codes, patient destination and cause specific ED visits. Change in ED visits by triage code, patient destination, and primary diagnosis for the two study periods compared to the same period of the previous year.a

a Cause-specific ED visits are reported as absolute numbers (n), incidence rate per 10,000 population (IR), incidence rate ratio (IRR) and 95% confidence interval (95% CI).

b p < 0.001.

c p < 0.01.
These findings can be explained by the different containment measures adopted during the two waves of the pandemic. By confining people at home, interrupting work activities, and reducing road traffic, the frequency of travel-, work- and stress-related conditions dropped [7]; this is especially true during the first wave, due to the stricter confinement measures. The fear of contagion and the “stay at home” message delivered by the authorities during the first weeks since the pandemic outbreak seems to have discouraged the general population from seeking medical attention. However, the significantly increased hospitalization rate, observed during both the FW and the SW, shows that the different attitude towards healthcare utilization has led to a - at least partial - selection of more severe patients accessing the ED with unpostponable medical needs.

Notably, the share of patients in need of hospitalization after accessing ED is lower during the SW compared to the FW. A possible explanation might be the enforcement of milder social distancing measures, reduced fear of contagion, and the people adaptation to the pandemic life, during the SW.

The current health crisis represents a natural experiment, and our findings reinforce the concept that many pre-pandemic ED visits were inappropriate, unnecessary or avoidable, as reported by several authors [7-10]. This is supported by the steeper reduction of low priority codes compared to the less marked reduction of high priority ones, together with the variation of the share of patients in need of hospitalization after accessing ED. As pointed out by Mantica and colleagues [10], during the SW the non-COVID-19 admissions to ED showed a progressive slow reduction rather than a collapse. This is confirmed by our findings and may be explained by the health systems’ enhanced capacity and preparedness in maintaining different healthcare pathways for both COVID-19 and non-COVID-19 patients, and by the reduced fear of COVID-19 in the general population [10].

The decline of cause-specific ED visits, both overall and for acute time-dependent and chronic diseases, was lower in the SW than in the FW, and even absent for ischemic heart disease and exacerbation of heart failure. We assume that these findings may be attributable to a delay in seeking hospital care and to the system’s inability to provide the same standards of care, particularly during the unpredictable health crisis of the first pandemic wave in Italy.

The lack of a statistically significant reduction in the number of ED visits for ischemic heart disease and heart failure is noteworthy. For instance, ED visits for ischemic heart disease reduced by 48% during the FW, while they showed no significant reduction during the SW.

This finding might be linked to numerous factors: the slow resumption of normal activities, a greater awareness of the disease, and the rebound effect caused by an exacerbation of the neglected pathological conditions.

Our analysis nevertheless provides an incomplete comparison of the two pandemic waves, since the available data could be affected by misclassification or misreporting of COVID-19 cases. Given that seasonality is an issue that might affect the number and type of ED visits, we were only able to compare the two pandemic waves with the same periods of the previous year. We classified acute and chronic diseases relying on the definitions provided by the ICD-9-CM manual and including those with higher impact on BMA’s ED in terms of yearly number of ED visits [9,15]. This classification may not be completely exhaustive, and this should be considered as a limitation of the study. Furthermore, we had access only to aggregated data for ED visits diagnosis, which prevented us from conducting more detailed analyses (e.g. specific causes of injury). Moreover, the SW of the pandemic lasted more than the FW and our data did not cover the period beyond December 31, 2020. However, this study reinforces the growing body of literature that shows the disruption caused by the pandemic on emergency departments during the year 2020. Furthermore, our findings support the pre-pandemic literature which indicates that one of the most important criticalities of EDs is avoidable or inappropriate access.

5. Conclusions

In this study, we noticed a clear pattern of reduced ED visits in both waves of the COVID-19 pandemic in Italy, with a steeper reduction during the first wave. Our results show that that the two pandemic waves led to a selection of patients with higher and more urgent needs of acute hospital care.

Given the recurrence of the crisis, the scenario described by our study should lead to further investigate how to improve systems’ capacity and capability to manage changes in population healthcare needs.

Source(s) of support

There are no conflicts of interests, financial or otherwise, and no funding from any source.

Author contributions

DG and FC had the idea, contributed to study design and data interpretation, and drafted the manuscript; LS and FS contributed to design, data acquisition and interpretation, and drafted the manuscript; AT contributed to design and data acquisition, and drafted the manuscript; GF contributed to design and data interpretation; SR contributed to data acquisition and analysis; MB contributed to data acquisition and interpretation; BB contributed to study design and data interpretation; MPF contributed to conception and data interpretation, and critically revised the manuscript; FG contributed to design, data interpretation, and critically revised the manuscript. LS and SR have verified the underlying data.

All authors gave their final approval and agreed to be accountable for all aspects of the work.

Data sharing statement

The data used in the study are controlled by a third party, two public health authorities (Local Health Authority of Bologna and Local Health Authority of Imola) and cannot be shared publicly. However, aggregated and anonymized data are available upon specific request to the corresponding authors. Interested researchers can replicate our study findings by contacting the authors or the Local Health Authorities of Bologna Metropolitan Area (AUSL Bologna and AUSL Imola).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2021.07.010.

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