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The impact of COVID-19 lockdown on infectious diseases epidemiology: The experience of a tertiary Italian Pediatric Emergency Department

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ABSTRACT

Introduction: The aim of this study was to describe the rate and types of community-acquired respiratory infections observed in a pediatric ED during the SARS-CoV-2 related lockdown in Italy and to compare data with the same period of previous year.

Methods: A retrospective analysis of medical charts of patients arrived at the ED of Gaslini Children's Hospital from 10th March 2020 to 30th April 2019 and the same frame of 2020 were performed. We compared two groups by demographics, duration of fever before ED admission, triage code, number of patients hospitalized after ED evaluation. We calculated proportion and incidence rate for airborne infections, fever, and urinary tract infections (UTI), appendicitis, and gastroenteritis for control.

Results: 1362 children arrived at the ED during the lockdown compared to 5628 in the same period of 2019 (−75.8%). No difference was noticed (27.7% vs 28.4%) in the total amount of infectious episodes. A significant reduction in rate of incidence and proportion were observed for upper respiratory tract infections (21.4% vs 28%), otitis (2.6% vs 16.2%), streptococcal infections (0.5% vs 5.2%) and bronchiolitis (2.1% vs 5.7%). Conversely, FUO (27.8 vs 11.1%), infectious mononucleosis (2.6% vs 0.4%), UTI (7.4% vs 2.9%) and appendicitis (6.8% vs 1.1%) significantly increased. Median time from the onset of fever and arrival in ED was significantly lower in 2020 group.

Conclusion: Our results demonstrated a reduction in community-acquired respiratory infections during the lockdown for COVID-19. The increase in rate of FUO and febrile conditions, together with the short time from fever onset and ED visit could be related to the fear for a SARS-CoV-2 infection.

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1. Introduction

The COVID-19 pandemic is a challenge for the health care world representing an enormous threat for emergency departments (ED). Italy was hardly affected by COVID-19 pandemic with exponential growth in cases since the end of February 2020, when the first case of SARS-CoV-2 infection was diagnosed. Starting from the evening of March 9th, the Italian government declared a national lockdown. Subsequently, a reduction in the use of the Emergency Department in pediatric and adult populations has been widely documented [1,2]. Possible reasons for this decrease were the reduction of other seasonal infections due to self-isolation, the recommendation not to use the ED in the absence of serious conditions, and, above all, the fear of patients and parents of being infected with SARS-CoV-2. Most of the non-emergent diseases usually seen at our pediatric ED have been avoided but, one

of the most negative consequences was delayed access to pediatric emergency facilities, even for the most severe non-SARS-CoV-2 related conditions [1-5].

The present work aims to describe the rate and types of community-acquired respiratory infections observed in a pediatric ED during the SARS-CoV-2 related lockdown in Italy and to compare these data with that observed in the same period in 2019.

2. Methods

The IRCCS Giannina Gaslini is a tertiary care children's hospital in North-West of Italy (Liguria), a part heavily involved in SARS-Cov-2 infection, serving as local pediatric hospital and as referral center nationwide.

The hospital is equipped with a tertiary ED, with an average admission rate of 35,000 patients per year.

Based on symptoms, history, and vital signs, ED visits are triaged by nurses in emergency care (red code), high priority care (yellow code), low priority care (green code), non-urgent care (white code). A

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diagnosis code is assigned by ED pediatrician according to the ICD9 classification.

We reviewed the electronic medical charts of children assessed in ED from 10th March 2020 to 30th April (during the national lockdown) comparing them with the same time frame of the previous year.

First, we analyzed the overall ED visits comparing 2019 and 2020 cohorts in sex, age, triage code and outcome.

Then, from the total number of accesses to ED, we collected diagnosis of the following airborne infectious diseases: upper airways infections, streptococcal infections, acute otitis media, infectious mononucleosis, bronchitis, pneumonia, bronchiolitis.

The diagnosis of fever of unknown origin (FUO) has been included in the analysis as a suspected infectious episode.

To estimate whether the variations in the number of visits were general or related to the epidemiology of respiratory infections, we selected urinary tract infections (UTI), appendicitis and gastroenteritis as a control group. Variables analyzed were sex, age, duration of fever before ED admission, triage code, hospitalization.

Among the 2020 cohort, we included patients with a diagnosis of COVID-19, confirmed by a polymerase chain reaction detection of SARS-CoV2 on a nasopharyngeal swab.

2.1. Statistical analysis

Continuous variables were presented as the median and interquartile range (IQR) and evaluated using the Mann-Whitney *U* test. Categorical variables were presented as count and percentage.

Fisher exact test or chi-square test were used to evaluate differences in categorical variables between groups. An incidence rate was calculated by dividing the numbers of suspected infectious events by the number of ED visits assessed during the lockdown period and normalized to 1000.

A *p*-value less than 0.05 was considered as statistically significant. All data analyses were done with Stata® version 13 software (StataCorp LLP, Texas, USA).

3. Results

From March 10 to April 30, 2020, 1362 children came to the ED of our hospital compared to 5628 in the same period of 2019 (−75.8%). Table 1 summarizes demographic data and results of comparison between the two periods.

Suspected infectious episodes admitted to ED were 378 (27.7%) and 1602 (28.4%) in 2020 and 2019, respectively.

We observed a reduction in the number of patients presenting with an airborne infectious disease (158 vs 1099) corresponding to the 41.8% vs 68.6% ($p < 0.01$) of the total amount of consultations for infectious episodes in 2020 and 2019, respectively.

Upper respiratory tract infections (21.4% vs 28%, $p < 0.01$), otitis (2.6% vs 16.2%, $p < 0.01$), streptococcal infections (0.5% vs 5.2%, $p < 0.01$) and bronchiolitis (2.1% vs 5.7%, $p < 0.01$) significantly decreased.

Bronchitis (6% vs 4.5%, $p = 0.2$) and pneumonia (6.6 vs 4.9%, $p = 0.18$) slightly increased in March–April 2020, but not statistically significant.

A significant increase both in proportions and in rates was observed for patients diagnosed with FUO (27.8% vs 11.1%, $p < 0.01$), infectious mononucleosis (2.6% vs 0.4%, $p < 0.01$), UTI (7.4% vs 2.9%, $p < 0.01$) and appendicitis (6.8% vs 1.1%, $p < 0.01$).

The rate of hospitalization significantly increased for patients presenting with FUO (51.4% vs 32.4%, vs $p < 0.01$), bronchitis (26% vs 8.2%, $p < 0.01$), pneumonia (72% vs 41.2%, $p < 0.01$), UTI (67.8% vs 42.5%, $p < 0.01$).

During the lockdown period, 16 children were diagnosed with COVID-19, 12 presenting with symptoms (7 fever, 3 upper airways infections, 1 bronchitis, 1 cough), and 4 asymptomatic. These asymptomatic children were evaluated in ED in the early stage of pandemic following concerns linked to COVID-19 family cases.

Table 2 summarizes characteristics, absolute numbers and rates of suspected infectious episodes observed.

4. Discussion

We observed an overall drop of the total number of ED consultations, consistent with recent literature reports [6–9]. A clear reduction in community acquired respiratory infections, including streptococcal infections, was noticed during the lockdown. These results could be the effect of school closures that led to an early disappearance of seasonal epidemics as well as effective containment for the SARS-CoV2 pandemic. Our observations are consistent with those reported in Singapore and in France after the implementation of public health measures for COVID-19 [8–10]. Similar results on pediatric respiratory infections were observable in few pre-COVID-19 era reports, referring to unusual situations: in an urban transport strike in France that led to the exceptional closure of schools in 1995, associated with a significant reduction in cases of acute bronchiolitis and in a recent Dutch study during a large measles epidemic showing a reduction in measles cases during school closures [11].

Conversely, we observed an increase in cases of infectious mononucleosis and FUO. To estimate if the variations of ED admission for

Table 1
Demographics, triage urgency and outcome of children admitted to Gaslini Emergency Department during the study period

	March 10th–April 30th 2019	March 10th–April 30th, 2020 (Lockdown for COVID19)	<i>p</i> value
Total number of ED admissions	5628	1362	–
Sex (M)	3138 (55.7%)	733 (53.8%)	0.2
Age (yrs) median (IQR)	6 (2–10)	4 (1–9)	<0.01
Emergency consultations (Red code)	22 (0.4%)	8 (0.6%)	0.3
High priority consultations (Yellow code)	686 (12.2%)	164 (12%)	0.9
Low priority consultations (Green code)	4373 (77.7%)	1121 (82.3%)	<0.01
Non urgent consultations (White code)	547 (9.7%)	69 (5%)	<0.01
Hospitalization	735 (13%)	340 (24.9%)	<0.01
Total number of infectious episodes	1602	378	–
Sex (M)	892 (55.6%)	202 (53.4%)	0.4
Age (yrs) median (IQR)	2 (0–6)	2 (1–8)	0.2
Duration of fever before ED admission (IQR)	2 (1–4)	1 (0–3)	0.048
Emergency consultations (Red code)	3 (0.2%)	0	0.5
High priority consultations (Yellow code)	213 (13.3%)	53 (14%)	0.7
Low priority consultations (Green code)	1378 (86%)	325 (85.9%)	0.9
Non urgent consultations (White code)	8 (0.5%)	0	0.1
Hospitalization	250 (15.6%)	148 (39.1%)	<0.01

Table 2
Incidence rate of infectious episodes admitted to Gaslini Emergency Department during the study period

	March 10th–April 30th 2019	March 10th–April 30th, 2020 (Lockdown for COVID19)	p value
	Rate/1000 patients (95%CI)	Rate/1000 patients (95%CI)	
Fever of unknown origin	111 (96–128)	277 (233–325)	<0.01
Upper respiratory tract infections	315 (293–339)	214 (174–260)	<0.01
Otitis	162 (144–181)	26 (12–48)	<0.01
Streptococcal infection	51 (41–63)	5 (0.6–18)	<0.01
Infectious mononucleosis	3 (1–8)	26 (12–48)	<0.01
Bronchitis	45 (36–57)	58 (37–87)	0.3
Pneumoniae	49 (39–61)	66 (43–96)	0.2
Bronchiolitis	57 (46–70)	21 (9–41)	<0.01
Urinary tract infections	29 (21–39)	74 (50–105)	<0.01
Gastroenteritis	162 (144–181)	119 (88–156)	0.05
Appendicitis	11 (7–18)	69 (45–99)	<0.01

suspected infectious causes was general or mainly related to respiratory infections, we also analyzed the frequencies of UTI, appendicitis and gastroenteritis, used as controls. The proportions and rates of UTI and appendicitis were significantly increased in the lockdown period, compared to the same period of 2019, with a mild, not significant reduction in gastroenteritis. Noteworthy, all these changes were associated with a reduced median time of fever before arrival in ED. It is conceivable that the increase in FUO and the short time from fever onset and ED visit, were at least partially related to parental concern about fever as possible sign of SARS-CoV-2 infection, in a period when the low aggressiveness of the virus in children was still not so clear [12,13].

Another explanation for this findings could be the reticence of Primary Care Pediatricians to visit febrile children due to inadequate personal protective equipment [14].

On the other hand the concomitant fear of acquiring SARS-CoV-2 infection during ED stay, could induce to avoid access to hospital care, even in presence of severe clinical conditions, with the risk of diagnostic delay as reported by others [1–5]. However, according to the triage urgency code only, we did not observe an increase of patients assessed for critical conditions (red and yellow code).

About the outcome, we noticed an increase of the hospitalization rate in 2020, mainly for infectious febrile conditions. This could reflect a more prudent approach to a still little-known disease and the difficulty of discharging children at home considering the restrictive measures in force during lockdown and the closure of outpatient services.

On the other hand, the decline of non-urgent visits observed during the lockdown may suggest a more appropriate use of ED with a rethinking of the territorial organization to allow minor health problems to be solved in a pre-hospital setting.

Our study is limited by the retrospective and single-center nature which inhibits the generalizability of our findings.

However, analyzing the effects of unprecedented public health measures on our clinical setting may provide some evidence which could be useful in the post COVID-19 era, to implement new guidelines and to rearrange health care services also in anticipation of potential future pandemics.

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Authors contributions

GAR, BP, EC developed study design and wrote the paper. MM, AN contributed to data collection. GB, EP, EC performed manuscript revision. GAR analyzed data. EC supervised the work. All authors reviewed and approved the final version.

Credit author statement

All authors have seen and approved the submitted version of the manuscript and take full responsibility for the manuscript, they have contributed significantly to the work and there are not prior publications or submission with any overlapping information.

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

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