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Italian COVID-19 epidemic: Effects on Paediatric Emergency attendance

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Italian COVID-19 epidemic: Effects on Paediatric Emergency attendance

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Keywords: SARS-CoV-2; Paediatric Emergency Unit; COVID-19; Short-stay Observation and Assessment

Word count: 1157

Abstract
Objective: To evaluate the effect of COVID-19 epidemic on Paediatric Emergency Unit (PEU) attendance in a region of Northern Italy.

Methods: A survey was proposed to six out of nine PEUs in Emilia Romagna region, to evaluate attendance data, distribution by age and gender, triage code score, outcome of clinical course, number of hospitalisations and the distribution of patients by disease. Data were collected during March 2020 and compared to March 2019.

Results: A drop in PEU attendances of more than 83.8% was observed, with higher percentage of infants, and of severe triage scores. The proportion of patients hospitalised was significantly higher in 2020 than in 2019 (p-value: <0.001). Looking at the distribution of accesses by type of disease, a significantly different distribution was highlighted (p-value: <0.00001); in relative terms, we observed a statistically significant increase (p-value: <0.05) of PEU accesses due to poisonings, psychiatric pathologies, head injuries and fever.

Conclusions: Our survey suggests that in the 1st month of COVID-19 epidemic in Italy there has been an increase in delayed access and provision of care of potentially severe diseases in PEUs. Hospital and Community paediatricians should be aware of this phenomenon and adopt appropriate strategies to prevent this danger, as it may affect children more seriously than COVID-19 itself.

Keywords: SARS-CoV-2; Paediatric Emergency Unit; COVID-19; Short-stay Observation and Assessment

Introduction
Since December 2019, a novel Coronavirus (SARS-CoV-2) infection has rapidly spread worldwide. At the end of February 2020, the first cases of Coronavirus Disease 2019 (COVID-19) were also identified in Italy in the province of Lodi, in the south of the Lombardy region. On March 11, the WHO declared the global pandemic of COVID-19.

Simultaneously with the onset of the outbreak in Lombardy region, in the neighbouring Emilia Romagna region the first cases of suspected patients were assisted in the Paediatric Emergency Unit (PEU) of Piacenza City Hospital. Subsequently, the entire Italy was progressively struck by the spread of the virus.[1]

Although little is known about COVID-19 course in children, it appears that they are mainly asymptomatic or present with mild symptoms, resulting in low rates of hospitalisation.[2,3]

Since the beginning of March, after school closure and the adoption of social distancing measures by the Italian Government, there has been a dramatic decrease in Italian PEU attendances [4] as also reported by Isba and colleagues, in United Kingdom.[5]

Our study aimed at evaluating the effect of COVID-19 epidemic on PEU attendances in Emilia Romagna region, in order to assess characteristics of PEU attendances during March 2020 and possible implications with regards to the use of PEU.

**Methods**

A survey was proposed to the PEU of the nine provinces of Emilia Romagna, with the aim to collect and compare activity data during March 2020 with March 2019. PEU attendance data, the distribution by age and gender, and the severity of triage code (red, yellow, green and white) were evaluated and compared with the same month in 2019. The outcome of the clinical course in PEU was evaluated, as well as the number of admittances to Short-stay Observation and Assessment Unit (SOAU; duration of stay: below 36 hours) and outcome, the number of hospitalisations into Paediatrics wards, and the distribution of patients by disease group. Finally, information was collected on the cases that came to PEU with suspected SARS-CoV-2 infection.
Statistical analysis included: Chi-squared test for differences in types of disease and triage codes between the 2 study periods; Mann-Whitney-Wilcoxon and Anderson-Darling test for age distribution and Z-test for admittance proportions by subclass of disease (e.g.: SOAU vs total admittances). Statistical significance was assumed at p-value <0.05.

Results
Six Units participated (Piacenza, Reggio Emilia, Modena, Ravenna, Forlì, and Rimini Hospitals) representative of most of the regional territory.

Our survey included infants and children under the age of 14 years, living in the mentioned provinces, encompassing a global figure of 332,212 which covers 61% of the same age population of the entire region.

Data from our study are summarised in the table. In March 2020 compared to March 2019, a drop of more than 80% in PEU overall attendances was observed.

| PEU Attendances # | March 2019 | % | March 2020 | % | % Delta | p-value° |
|-------------------|------------|---|------------|---|---------|---------|
| Piacenza          | 1400       |   | 179        |   | - 87.2  |         |
| Reggio Emilia     | 1255       |   | 261        |   | - 79.2  |         |
| City       | PEU overall attendances | Male | Female | Mean Age (years) | Median Age (years) | Under the age of 1year | SOAU overall admissions | Overall hospitalisations from PEU | Overall hospitalisations from SOAU | Overall attendances by Triage Codes* |
|------------|------------------------|------|--------|------------------|-------------------|------------------------|------------------------|-----------------------------------|-----------------------------------|--------------------------------------|
| Modena     | 2087 437 - 79.6        | 4366 | 3534   | 4.74 4.71        | 4.71              | 951 12.9 247 19.1 5.2 | 563 7.1 132 9.5 2.4 | 553 7.0 271 19.5 12.5 | 88 15.6 41 31.0 14.6 | Red 23 0.3 9 0.65 0.35 0.065 |
| Ravenna    | 960 179 - 81.3         | 476  | 625    | 4.67 4.71        | 4.71              | 247 11.9 247 19.1 5.2 | 514 6.1 132 9.5 2.4 | 509 6.7 271 19.5 12.5 | 86 14.6 41 31.0 14.6 | Yellow 785 9.9 209 15.0 5.1 0.001 |
| Forlì      | 504 97 - 80.7          | 486  | 508    | 4.74 4.71        | 4.71              | 247 11.9 247 19.1 5.2 | 482 6.1 132 9.5 2.4 | 473 6.7 271 19.5 12.5 | 85 14.6 41 31.0 14.6 | Green 5599 70.9 1021 73.4 2.5 0.059 |
| Rimini     | 1694 238 - 85.9        | 1021 | 929    | 4.74 4.71        | 4.71              | 247 11.9 247 19.1 5.2 | 540 6.1 132 9.5 2.4 | 531 6.7 271 19.5 12.5 | 86 14.6 41 31.0 14.6 | White 1493 18.9 152 10.9 - 8 0.001 |

*Legend: Four-Level Triage Score System: Red Code: Emergency; Yellow Code: Urgency; Green Code: Deferable Urgency; White Code: Not Urgency.

* Statistical significance (p-value: <0.05) is related to percentages.

Table: Emergency attendances and their characteristics from six PEUs in Emilia Romagna region.

A significant higher percentage of accesses of infants under the age of 1 year (p-value: <0.00001) was documented in March 2020 compared to the same month in 2019, both as overall data and as singular PEU.
In the distribution of accesses by triage code, the yellow codes and, although not statistically significantly the red codes, increased significantly. The green codes, the most frequent access category, have remained substantially unchanged, while the white codes have decreased significantly.

Of the total number of PEU attendances, the proportion of patients admitted to SOAU was significantly higher in 2020 than in 2019 (p-value: <0.01). This result is confirmed both by the aggregate data and by each PEU. Additionally, there was an increase in subsequent hospitalisations. By comparing the two months, there was also a significantly greater number of hospitalised children (p-value: <0.001).

Looking at the distribution of accesses by type of disease, a significantly different distribution was highlighted (p-value: <0.00001) (see Figure). In relative terms, we observed a statistically significant increase of accesses due to fever, head injuries, poisonings and psychiatric pathologies, whereas those due to acute respiratory and gastrointestinal diseases, and abdominal pain dropped significantly. Additionally, no significant variation in accesses for headache, seizure, and accidental trauma was found.

During the monitored period, 103 nasopharyngeal swabs for suspected SARS-CoV-2 infection were collected in the included PEUs, of which 26 tested positive; 6 of these required hospitalisation into Paediatrics Units.
Discussion and Conclusions

The data from our study shows a consistent drop in PEU attendances during the COVID-19 epidemic onset, in accordance to other experiences recently reported in the literature.[4,5] This phenomenon may depend on a number of possible reasons. The recommendations issued by the Italian Government regarding social distancing and the indications to minimize hospital accesses, especially in the epidemic hotspot area, may have had an immediate effect. School closures have certainly had an impact on the transmission rate of acute infectious diseases, in particular those affecting the respiratory and gastrointestinal tracts, as shown from our data. Social distancing itself has been likely responsible for the lower incidence of accidental traumas; in contrast, head injuries rate increased.

Another possible reason that may have contributed to the dramatic decrease in PEU attendances is the fear of contracting SARS-CoV-2 infection by entering hospitals, as considered a place at high risk of contagion. This led to a sharp reduction of the so-called inappropriate use of PEU, mostly due to parental anxiety or convenience, as reflected by the decreased rate of white codes in March 2020.

However, the reduced use of PEU, associated with a different mode of assistance provided by Family Paediatricians (increase in telephone triage with a reduction in outpatient and home visits), may have implied an increased risk of delayed access to PEU. The significant increase in the most severe triage codes and the highest percentage of SOAU admittances and hospitalisations seem to confirm this hypothesis, as well as the higher percentage of attendance of younger patients (under 1 year), probably considered more vulnerable by parents. Additionally, hospitalisation for intoxication, head injuries and psychiatric problems increased, perhaps as a consequence of experiences of neglect or maltreatment and/or domestic conflicts.

In case of clinical suspicion of SARS-CoV-2 infection, nasopharyngeal swab was collected in PEU; only a few selected cases needed admission into Paediatrics Unit, thus confirming the mild clinical course of COVID-19 in children.
The results of our survey clearly show the potential risks linked to the reduced use of PEU due to the COVID-19 outbreak, which include the risk of delayed provision of care of potentially severe diseases and/or serious conditions.[4] We believe it is worth of interest to evaluate whether the documented delay in the use of health services could also concern children with chronic pathologies and/or with serious disabilities requiring intensive and continuous care, as well as the most vulnerable children of families of the lower socio-economic classes.

As the pandemic phase may not be short-lived, we believe that PEU, Hospital and Community health professionals should adopt appropriate strategies to prevent the potential danger resulting from delayed diagnoses and therapies. In the absence of these, children might be more seriously affected by this pandemic “side effect” rather than by COVID-19 itself.

**Acknowledgments:** The authors thank Prof. Enrico Fabrizi, DISES and DSS, Università Cattolica del Sacro Cuore, Piacenza, Italy, for statistical analysis and Dr. Jenny Bua, Neonatal Intensive Care Unit, Institute for Maternal and Child Health, IRCCS Burlo Garofolo, Trieste, Italy, for her linguistic advice and revision.

**What is already known on this topic?**

- Up to now only a few studies showed that, during COVID-19 pandemic, Paediatric Emergency Unit (PEU) attendances decreased compared with same period of the previous year.
- COVID-19 children appear to be mainly asymptomatic or experience mild symptoms, resulting in a small number of COVID-19 related PEU attendances.
- During COVID-19 pandemic, there is risk of delayed access to hospital care for non-COVID-19 severe conditions.
What this study adds?

- At the start of the Italian COVID-19 epidemic a drop of more than 80% in PEU overall attendances was observed with a higher percentage of children resulting in hospitalisations due to more severe conditions.
- A significant increase of PEU accesses due to poisonings, psychiatric pathologies, head injuries and fever was recorded.
- The impact of delayed provision of care for non-COVID-19 severe conditions may be even worse than COVID-19 itself.

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No Patient and Public Involvement:

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.
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Figure: Relative frequency distribution of accesses by type of disease (March 2020 vs 2019).
Legend: * Statistical significance (p-value: <0.05)
Italian COVID-19 epidemic: Effects on Paediatric Emergency attendance; a survey in the Emilia Romagna region

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Italian COVID-19 epidemic: Effects on Paediatric Emergency attendance; a survey in the Emilia Romagna region

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Keywords: SARS-CoV-2; Paediatric Emergency Unit; COVID-19; Short-stay Observation and Assessment

Word count: 1682
Abstract

Objective: To evaluate the effect of COVID-19 epidemic on Paediatric Emergency Unit (PEU) attendance in a region of Northern Italy.

Methods: A survey was proposed to six out of nine PEUs in Emilia Romagna region, to evaluate attendance data, distribution by age and gender, triage code score, outcome of clinical course, number of hospitalisations and the distribution of patients by disease. Data were collected during March 2020 and compared to March 2019.

Results: A drop in PEU attendances of more than 83.8% was observed, with higher percentage of infants, and of severe triage scores. The proportion of patients hospitalised was significantly higher in 2020 than in 2019 (p-value: <0.001). The effect size for the comparison of proportions of hospitalised patients was 0.379. Looking at the distribution of accesses by type of disease, a significantly different distribution was highlighted (p-value: <0.00001); in relative terms, we observed a statistically significant increase (p-value: <0.05) of PEU accesses due to poisonings, psychiatric pathologies, head injuries and fever.

Conclusions: Our survey suggests that in the 1st month of COVID-19 epidemic in Italy there has been an increase in delayed access and provision of care of potentially severe diseases in PEUs. Hospital and Community paediatricians should be aware of this phenomenon and adopt appropriate strategies to prevent this danger, as it may affect children more seriously than COVID-19 itself.

Keywords: SARS-CoV-2; Paediatric Emergency Unit; COVID-19; Short-stay Observation and Assessment
Introduction

Since December 2019, a novel Coronavirus (SARS-CoV-2) infection has rapidly spread worldwide. At the end of February 2020, the first cases of Coronavirus Disease 2019 (COVID-19) were also identified in Italy in the province of Lodi, in the south of the Lombardy region. On March 11, the WHO declared the global pandemic of COVID-19.

Simultaneously with the onset of the outbreak in Lombardy region, in the neighbouring Emilia Romagna region the first cases of suspected patients were assisted in the Paediatric Emergency Unit (PEU) of Piacenza City Hospital. Subsequently, the entire Italy was progressively struck by the spread of the virus.[1]

Although little is known about COVID-19 course in children, it appears that they are mainly asymptomatic or present with mild symptoms, resulting in low rates of hospitalisation.[2,3]

Since the beginning of March, after school closure and the adoption of social distancing measures by the Italian Government, there has been a dramatic decrease in Italian PEU attendances [4] as also reported by Isba and colleagues, in United Kingdom.[5]

Our study aimed at evaluating the effect of COVID-19 epidemic on PEU attendances in Emilia Romagna region, in order to assess characteristics of PEU attendances during March 2020 and possible implications with regards to the use of PEU.

Methods

The paediatric healthcare system in Italy is part of the National Health System. It is made up of 3 main levels of intervention: primary care, which is provided by the so-called “family paediatricians network”; secondary care, which includes PEUs and general Paediatrics Units, and tertiary care, which includes specialty Paediatrics Units. Up to 14 years of age, each child may have a referral family paediatrician (FP), which is mandatory for children up to 6 years. Despite this provision of
care and assistance, the decision to go to PEU is made more often by parents alone than under FP’s advice.

A survey was proposed to the PEU of the nine provinces of Emilia Romagna, with the aim to collect and compare activity data during March 2020 with March 2019. The data were extracted in each hospital from a regional PEU access database by a delegated paediatrician. PEU attendance data, the distribution by age and gender, and the severity of triage code (red, yellow, green and white) were evaluated and compared with the same month in 2019. The outcome of the clinical course in PEU was evaluated, as well as the number of admittances to Short-stay Observation and Assessment Unit (SOAU; duration of stay: below 36 hours) and outcome, the number of hospitalisations into Paediatrics wards, and the distribution of patients by disease group. Finally, information was collected on the cases that came to PEU with suspected SARS-CoV-2 infection.

Statistical analysis included: Chi-squared test for differences in types of disease between the 2 study periods; t-test for comparing age means and Z-test for admittance proportions by subclass of disease (e.g.: SOAU vs total admittances). A Jonckheere-Terpstra test was used to assess whether the severity of the accesses by triage code increased in from 2019 to 2020. Statistical significance was assumed at p-value <0.05. For the Z-test comparing proportions, the effect sizes were computed according to Cohen's methodology [6].

**Results**

Six Units participated (Piacenza, Reggio Emilia, Modena, Ravenna, Forli, and Rimini Hospitals) representative of most of the regional territory.

Our survey included infants and children under the age of 14 years, living in the mentioned provinces, encompassing a global figure of 332,212 which covers 61% of the same age population of the entire region.

Data from our study are summarised in Table 1. In March 2020 compared to March 2019, a drop of more than 80% in PEU overall attendances was observed.
| PEU Attendances # | March 2019 | % | March 2020 | % | % Delta | p-value° |
|------------------|------------|---|------------|---|---------|---------|
| Piacenza         | 1400       | 179 | - 87.2     |   |         |         |
| Reggio Emilia    | 1255       | 261 | - 79.2     |   |         |         |
| Modena           | 2087       | 437 | - 79.6     |   |         |         |
| Ravenna          | 960        | 179 | - 81.3     |   |         |         |
| Forlì            | 504        | 97  | - 80.7     |   |         |         |
| Rimini           | 1694       | 238 | - 85.9     |   |         |         |
| PEU overall attendances | 7900       | 1391 | - 83.8     |   |         |         |
| Male             | 4366       | 55.3 | 766 | 55.1 | -0.2 |         |
| Female           | 3534       | 44.7 | 625 | 44.9 | +0.2 |         |
| Mean Age (years) | 4.74       | 4.71 |         |   | 0.807  |         |
| Median Age (years) | 4         | 4  |         |   |         |         |
| Under the age of 1 year | 951 | 12.9 | 247 | 19.1 | + 5.2 | <0.00001 |

* Statistical significance (p-value: <0.05) is related to percentages.

**Table 1:** Emergency attendances and their characteristics from six PEUs in Emilia Romagna region.

A significant higher percentage of accesses of infants under the age of 1 year (p-value: <0.00001) was documented in March 2020 compared to the same month in 2019, both as overall data and as singular PEU.

In the distribution of accesses by triage code, the yellow codes and, although not statistically significantly the red codes, increased significantly; nevertheless, the total number of severely ill children decreased along with the drop of overall attendances. The green codes, the most frequent access category, have remained substantially unchanged, while the white codes have decreased significantly (see Table 2).
Of the total number of PEU attendances, the proportion of patients admitted to SOAU was significantly higher in 2020 than in 2019 (p-value: <0.01). This result is confirmed both by the aggregate data and by each PEU. Additionally, there was an increase in subsequent hospitalisations. By comparing the two months, there was also a significantly greater percentage of hospitalised children (p-value: <0.001) (see Table 2). The effect size for the comparison of proportions of hospitalised patients was 0.379.

| PEU Attendances #            | March 2019 | %   | March 2020 | %   | % Delta | p-value<sup>°</sup> |
|------------------------------|------------|-----|------------|-----|---------|---------------------|
| SOAU overall admissions      | 563        | 7.1 | 132        | 9.5 | + 2.4   | < 0.01              |
| Overall hospitalisations from PEU | 553       | 7.0 | 271        | 19.5| + 12.5  | < 0.001             |
| Overall hospitalisations from SOAU | 88        | 15.6| 41         | 31.0| + 14.6  | < 0.001             |
| Overall attendances by Triage Codes*: |          |     |            |     |         |                     |
| Red                          | 23         | 0.3 | 9          | 0.65| + 0.35  | 0.065               |
| Yellow                       | 785        | 9.9 | 209        | 15.0| + 5.1   | < 0.001             |
| Green                        | 5599       | 70.9| 1021       | 73.4| + 2.5   | 0.059               |
| White                        | 1493       | 18.9| 152        | 10.9| - 8     | < 0.001             |

* Statistical significance (p-value: <0.05) is related to percentages.

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**Table 2:** SOAU overall admissions, and overall hospitalisations from PEU and SOAU; Triage codes distribution.

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respectively, and 126 and 113 minutes in the same period of the previous year. Although we could not carry out a test procedure (as we did not have access to individual level data), the marked observed differences and the large sample sizes are very likely associated to strong statistical significance.

Looking at the distribution of accesses by type of disease, a significantly different distribution was highlighted (p-value: <0.00001). In relative terms, we observed a statistically significant increase of accesses due to fever, head injuries, poisonings and psychiatric pathologies, whereas those due to acute respiratory and gastrointestinal diseases, and abdominal pain dropped significantly. Additionally, no significant variation in accesses for headache, seizure, and unintentional trauma was found (see Table 3). As the Jonckheere-Terpstra test was used to compare the severity of the accesses in the two periods, we have that the null hypothesis (no severity difference) is rejected, so we can conclude that the severity of the accesses as classified by triage codes was higher in 2020 than in 2019 (p-value <0.00001).

| Disease                                               | March 2019 | March 2020 | p-value | Effect Size |
|-------------------------------------------------------|------------|------------|---------|-------------|
| Headache                                              | 0.014      | 0.013      | > 0.1   | 0.009       |
| Febrile seizures                                      | 0.012      | 0.014      | > 0.1   | 0.018       |
| Epilepsy and other neurological disease*              | 0.020      | 0.031      | <0.05   | 0.070       |
| Fever**                                               | 0.150      | 0.233      | <0.00001| 0.212       |
| Acute respiratory disease**                           | 0.262      | 0.159      | <0.00001| 0.254       |
| Acute gastrointestinal disease**                      | 0.151      | 0.067      | <0.00001| 0.275       |
| Abdominal pain**                                      | 0.100      | 0.070      | <0.001  | 0.108       |
| Head injury**                                         | 0.030      | 0.065      | <0.00001| 0.167       |
| Accidental trauma                                     | 0.059      | 0.068      | >0.1    | 0.037       |
| Poisoning*                                            | 0.007      | 0.014      | <0.05   | 0.070       |
| Psychiatric disease**                                 | 0.003      | 0.012      | <0.0001 | 0.110       |
| Others                                                | 0.191      | 0.254      | <0.00001| 0.152       |

Table 3: Proportion of attendance in 2019 and 2020 for each disease, with p-values associated to the test for the equality between two proportions and the effect size (those associated to non-significant differences are reported in grey). Significance levels: **p<0.01; *p<0.05.
During the monitored period, 103 nasopharyngeal swabs for suspected SARS-CoV-2 infection were collected in the included PEUs, of which 26 tested positive; 6 of these required hospitalisation into Paediatrics Units, but none were intubated or required non-invasive ventilation.

**Discussion and Conclusions**

The data from our study shows a consistent drop in PEU attendances during the COVID-19 epidemic onset, in accordance to other experiences recently reported in the literature.[4,5] This phenomenon may depend on a number of possible reasons. The recommendations issued by the Italian Government regarding social distancing and the indications to minimize hospital accesses, especially in the epidemic hotspot area, may have had an immediate effect. School closures have certainly had an impact on the transmission rate of acute infectious diseases, in particular those affecting the respiratory and gastrointestinal tracts, as shown from our data. Social distancing itself has been likely responsible for the lower incidence of accidental traumas; in contrast, head injuries rate increased.

Another possible reason that may have contributed to the dramatic decrease in PEU attendances is the fear of contracting SARS-CoV-2 infection by entering hospitals, as considered a place at high risk of contagion. This led to a sharp reduction of the so-called inappropriate use of PEU, mostly due to parental anxiety or convenience, as reflected by the decreased rate of white codes in March 2020. This fact could be a positive externality of the pandemic, as the use of PEUs was indirectly limited for diseases that do not require access to emergency services and that are at risk of over medicalization.

However, the reduced use of PEU, associated with a different mode of assistance provided by FPs (increase in telephone triage with a reduction in outpatient and home visits), may have implied an increased risk of delayed access to PEU for diseases that require timely evaluation.

The significant increase in the most severe triage codes and the highest percentage of SOAU admittances and hospitalisations seem to confirm this hypothesis, as well as the higher percentage of attendance of younger patients (under 1 year), probably considered more vulnerable by parents.
Additionally, hospitalisation for intoxication, head injuries and psychiatric problems increased, perhaps as a consequence of experiences of neglect or maltreatment and/or domestic conflicts. The exacerbations of chronic mental health conditions or the emotional consequences related to the lockdown may also explain the higher percentage of admittances due to psychiatric symptoms.

In case of clinical suspicion of SARS-CoV-2 infection, nasopharyngeal swab was collected in PEU; only a few selected cases needed admission into Paediatrics Unit, thus confirming the mild clinical course of COVID-19 in children.

The results of our survey clearly show the potential risks linked to the reduced use of PEU due to the COVID-19 outbreak, which include the risk of delayed provision of care of potentially severe diseases and/or serious conditions.[4] We believe it is worth of interest to evaluate whether the documented delay in the use of health services could also concern children with chronic pathologies and/or with serious disabilities requiring intensive and continuous care, as well as the most vulnerable children of families of the lower socio-economic classes.

Finally, with regard to the implications on resource utilization, the epidemic required a structural re-organisation of PEUs in order to control the risk of contagion, including the redesigning of tracks and spaces, and the provision of adequate protective equipment for the health personnel. As a consequence of this re-arrangement, each PEU had to face higher costs than those incurred in March 2019.

As the pandemic phase may not be short-lived, we believe that PEU, Hospital and Community health professionals should adopt appropriate strategies to prevent the potential danger resulting from delayed diagnoses and therapies. In the absence of these, children might be more seriously affected by this pandemic “side effect” rather than by COVID-19 itself.

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What is already known on this topic?

- Up to now only a few studies showed that, during COVID-19 pandemic, Paediatric Emergency Unit (PEU) attendances decreased compared with same period of the previous year.
- COVID-19 children appear to be mainly asymptomatic or experience mild symptoms, resulting in a small number of COVID-19 related PEU attendances.
- During COVID-19 pandemic, there is risk of delayed access to hospital care for non-COVID-19 severe conditions.

What this study adds?

- At the start of the Italian COVID-19 epidemic a drop of more than 80% in PEU overall attendances was observed with a higher percentage of children resulting in hospitalisations due to more severe conditions.
- A significant increase of PEU accesses due to poisonings, psychiatric pathologies, head injuries and fever was recorded.
- The impact of delayed provision of care for non-COVID-19 severe conditions may be even worse than COVID-19 itself.

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No Patient and Public Involvement:

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

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Italian COVID-19 epidemic: Effects on Paediatric Emergency attendance; a survey in the Emilia Romagna region

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Abstract

Objective: To evaluate the effect of COVID-19 epidemic on Paediatric Emergency Unit (PEU) attendance in a region of Northern Italy.

Methods: A survey was proposed to six out of nine PEUs in Emilia Romagna region, to evaluate attendance data, distribution by age and gender, triage code score, outcome of clinical course, number of hospitalisations and the distribution of patients by disease. Data were collected during March 2020 and compared to March 2019.

Results: A drop in PEU attendances of more than 83.8% was observed, with higher percentage of infants, and of severe triage scores. The proportion of patients hospitalised was significantly higher in 2020 than in 2019 (p-value: <0.001). The effect size for the comparison of proportions of hospitalised patients was 0.379. Looking at the distribution of attendances by type of disease, a significantly different distribution was highlighted (p-value: <0.00001, Cramer’s V); in relative terms, we observed a statistically significant increase (p-value: <0.05) of PEU attendances due to poisonings (effect size equal to 0.07), psychiatric pathologies (effect size 0.110), head injuries (effect size 0.167) and fever (effect size 0.212).

Conclusions: Our survey suggests that in the 1st month of COVID-19 epidemic in Italy there has been an increase in delayed attendance and provision of care of potentially severe diseases in PEUs. Hospital and Community paediatricians should be aware of this phenomenon and adopt appropriate strategies to prevent this danger, as it may affect children more seriously than COVID-19 itself.

Keywords: SARS-CoV-2; Paediatric Emergency Unit; COVID-19; Short-stay Observation and Assessment
Introduction

Since December 2019, a novel Coronavirus (SARS-CoV-2) infection has rapidly spread worldwide. At the end of February 2020, the first cases of Coronavirus Disease 2019 (COVID-19) were also identified in Italy in the province of Lodi, in the south of the Lombardy region. On March 11, the WHO declared the global pandemic of COVID-19.

Simultaneously with the onset of the outbreak in Lombardy region, in the neighbouring Emilia Romagna region the first cases of suspected patients were assisted in the Paediatric Emergency Unit (PEU) of Piacenza City Hospital. Subsequently, the entire Italy was progressively struck by the spread of the virus.[1]

Although little is known about COVID-19 course in children, it appears that they are mainly asymptomatic or present with mild symptoms, resulting in low rates of hospitalisation.[2,3] Since the beginning of March, after school closure and the adoption of social distancing measures by the Italian Government, there has been a dramatic decrease in Italian PEU attendances [4] as also reported by Isba and colleagues, in United Kingdom.[5]

Our study aimed at evaluating the effect of COVID-19 epidemic on PEU attendances in Emilia Romagna region, in order to assess characteristics of PEU attendances during March 2020 and possible implications with regards to the use of PEU.

Methods

The paediatric healthcare system in Italy is part of the National Health System. It is made up of 3 main levels of intervention: primary care, which is provided by the so-called “family paediatricians network”; secondary care, which includes PEUs and general Paediatrics Units, and tertiary care, which includes specialty Paediatrics Units. Up to 14 years of age, each child may have a referral family paediatrician (FP), which is mandatory for children up to 6 years. Despite this provision of care and assistance, the decision to go to PEU is made more often by parents alone than under FP’s advice.
A survey was proposed to the PEU of the nine provinces of Emilia Romagna, with the aim to collect and compare activity data during March 2020 with March 2019. The data were extracted in each hospital from a regional PEU attendance database by a delegated paediatrician. PEU attendance data, the distribution by age and gender, and the severity of triage code (red, yellow, green and white) were evaluated and compared with the same month in 2019. The outcome of the clinical course in PEU was evaluated, as well as the number of admittances to Short-stay Observation and Assessment Unit (SOAU; duration of stay: below 36 hours) and outcome, the number of hospitalisations into Paediatrics wards, and the distribution of patients by disease group. Finally, information was collected on the cases that came to PEU with suspected SARS-CoV-2 infection.

Statistical analysis included: Chi-squared test for differences in types of disease between the 2 study periods; two samples Wilcoxon-Mann-Whitney test for comparing age medians and two-samples Z-tests to compare the admittance proportions (e.g.; SOAU vs total admittances). A Jonckheere-Terpstra test was used to assess whether the severity of the attendances by triage code increased in from 2019 to 2020. Statistical significance was assumed at p-value <0.05. For the Z-test comparing proportions, the effect sizes were computed according to Cohen’s methodology [6].

**Results**

Six Units participated (Piacenza, Reggio Emilia, Modena, Ravenna, Forlì, and Rimini Hospitals) representative of most of the regional territory.

Our survey included infants and children under the age of 14 years, living in the mentioned provinces, encompassing a global figure of 332,212 which covers 61% of the same age population of the entire region.

Data from our study are summarised in Table 1 and Table 2. In March 2020 compared to March 2019, a drop of more than 80% in PEU overall attendances was observed.
| PEU Attendances # | March 2019 | %  | March 2020 | %  | % Delta | p-value° |
|-------------------|------------|----|------------|----|---------|---------|
| Piacenza          | 1400       |    | 179        |    | - 87.2  |         |
| Reggio Emilia     | 1255       |    | 261        |    | - 79.2  |         |
| Modena            | 2087       |    | 437        |    | - 79.6  |         |
| Ravenna           | 960        |    | 179        |    | - 81.3  |         |
| Forlì             | 504        |    | 97         |    | - 80.7  |         |
| Rimini            | 1694       |    | 238        |    | - 85.9  |         |
| PEU overall attendances | 7900   |    | 1391       |    | - 83.8  |         |

| Gender | March 2019 | %  | March 2020 | %  | % Delta | p-value° |
|--------|------------|----|------------|----|---------|---------|
| Male   | 4366       | 55.3| 766        | 55.1| -0.2    |         |
| Female | 3534       | 44.7| 625        | 44.9| +0.2    |         |

| Mean Age (years) | March 2019 | 4.74 | March 2020 | 4.71 | 0.807 |
| Median Age (years) | 4.27       | 4.06 |           |

| Under the age of 1 year | March 2019 | 12.9 | March 2020 | 19.1 | +5.2 | <0.00001 |

* Statistical significance (p-value: <0.05) is related to percentages.

**Table 1:** Emergency attendances and their characteristics from six PEUs in Emilia Romagna region.

| Age (yrs) | March 2019 | March 2020 |
|-----------|------------|------------|
| <1        | 0.129      | 0.191      |
| 1         | 0.131      | 0.121      |
| 2         | 0.113      | 0.107      |
| 3         | 0.104      | 0.076      |
| 4         | 0.088      | 0.096      |
| 5         | 0.070      | 0.044      |
| 6         | 0.060      | 0.058      |
| 7         | 0.051      | 0.036      |
| 8         | 0.048      | 0.043      |
| 9         | 0.050      | 0.039      |
| 10        | 0.044      | 0.047      |
| 11        | 0.036      | 0.032      |
| 12        | 0.032      | 0.043      |
| 13        | 0.028      | 0.037      |
| >13       | 0.017      | 0.030      |

**Table 2:** Relative frequency of age distribution in the two study periods
A significant higher percentage of attendances of infants under the age of 1 year (p-value: <0.00001) was documented in March 2020 compared to the same month in 2019, both as overall data and as singular PEU.

In the distribution of attendances by triage code, the yellow codes and, although not statistically significantly the red codes, increased significantly; nevertheless, the total number of severely ill children decreased along with the drop of overall attendances. The green codes, the most frequent attendance category, have remained substantially unchanged, while the white codes have decreased significantly (see Table 3).

Of the total number of PEU attendances, the proportion of patients admitted to SOAU was significantly higher in 2020 than in 2019 (p-value: <0.01). This result is confirmed both by the aggregate data and by each PEU. Additionally, there was an increase in subsequent hospitalisations. By comparing the two months, there was also a significantly greater percentage of hospitalised children (p-value: <0.001) (see Table 3). The effect size for the comparison of proportions of hospitalised patients was 0.379.

| PEU Attendances #                        | March 2019 | %   | March 2020 | %   | % Delta | p-value° |
|------------------------------------------|------------|-----|------------|-----|---------|----------|
| SOAU overall admissions                  | 563        | 7.1 | 132        | 9.5 | + 2.4   | < 0.01   |
| Overall hospitalisations from PEU        | 553        | 7.0 | 271        | 19.5| + 12.5  | < 0.001  |
| Overall hospitalisations from SOAU       | 88         | 15.6| 41         | 31.0| + 14.6  | < 0.001  |
| Overall attendances by Triage Codes*     |            |     |            |     |         |          |
| Red                                      | 23         | 0.3 | 9          | 0.65| + 0.35  | 0.065    |
| Yellow                                   | 785        | 9.9 | 209        | 15.0| + 5.1   | < 0.001  |
| Green                                    | 5599       | 70.9| 1021       | 73.4| + 2.5   | 0.059    |
| White                                    | 1493       | 18.9| 152        | 10.9| - 8     | < 0.001  |
| Jonckheere-Terpstra test comparing the severity of the attendances | | | | | | <0.00001 |
* Statistical significance (p-value: <0.05) is related to percentages.

*Legend: Four-Level Triage Score System: Red Code: Emergency; Yellow Code: Urgency; Green Code: Deferable Urgency; White Code: Not Urgency.

**Table 3:** SOAU overall admissions, and overall hospitalisations from PEU and SOAU; Triage codes distribution.

As we did not primarily focus on waiting time from triage to the first medical examination and/or length of stay until discharge or hospitalization in our survey, we did not extract these data from all PEUs database. Nevertheless, we were able to collect data from our PEU database in Piacenza Hospital; mean and median waiting time were 15 and 8 minutes in 2020 respectively, compared to 56 and 41 minutes in 2019. Mean and median length of stay were 70 and 48 minutes in 2020 respectively, and 126 and 113 minutes in the same period of the previous year. Although we could not carry out a test procedure (as we did not have access to individual level data), the marked observed differences and the large sample sizes are noteworthy.

Looking at the proportional distribution of attendances by type of disease, a significantly different distribution was highlighted (p-value: <0.00001). In relative terms, we observed a statistically significant increase of attendances due to fever, head injuries, poisonings and psychiatric pathologies, whereas those due to acute respiratory and gastrointestinal diseases, and abdominal pain dropped significantly. Additionally, no significant variation in attendances for headache, seizure, and unintentional trauma was found (see Table 4). As the Jonckheere-Terpstra test was used to compare the severity of the attendances in the two periods, we have that the null hypothesis (no severity difference) is rejected, so we can conclude that the severity of the attendances as classified by triage codes was higher in 2020 than in 2019 (p-value <0.00001).
Table 4: Actual numbers and proportion of attendance (in brackets) in 2019 and 2020 for each disease, with p-values associated to the test for the equality between two proportions and the effect size (those associated to non-significant differences are reported in grey). Significance levels: **p<0.01; *p<0.05.

| Disease                                         | March 2019 | March 2020 | p-value | Effect Size |
|------------------------------------------------|------------|------------|---------|-------------|
| Headache                                       | 18 (0.014) | 111 (0.013) | > 0.1   | 0.009       |
| Febrile seizures                               | 20 (0.012) | 97 (0.014)  | > 0.1   | 0.018       |
| Epilepsy and other neurological disease*       | 43 (0.020) | 158 (0.031) | < 0.05  | 0.070       |
| Fever**                                        | 324 (0.150)| 1185 (0.233)| <0.00001| 0.212       |
| Acute respiratory disease**                    | 222 (0.262)| 2069 (0.159)| <0.00001| 0.254       |
| Acute gastrointestinal disease**               | 93 (0.151) | 1196 (0.067)| <0.00001| 0.275       |
| Abdominal pain**                               | 97 (0.100) | 789 (0.070) | <0.001  | 0.108       |
| Head injury**                                  | 90 (0.030) | 238 (0.065) | <0.00001| 0.167       |
| Accidental trauma                              | 95 (0.059) | 467 (0.068) | >0.1    | 0.037       |
| Poisoning*                                     | 20 (0.007) | 57 (0.014)  | <0.05   | 0.070       |
| Psychiatric disease**                          | 16 (0.003) | 23 (0.012)  | <0.00001| 0.110       |
| Others                                         | 353 (0.191)| 1510 (0.254)| <0.00001| 0.152       |

During the monitored period, 103 nasopharyngeal swabs for suspected SARS-CoV-2 infection were collected in the included PEUs, of which 26 tested positive; 6 of these required hospitalisation into Paediatrics Units, but none were intubated or required non-invasive ventilation.

**Discussion and Conclusions**

The data from our study show a consistent drop in PEU attendances during the COVID-19 epidemic onset, in accordance to other experiences recently reported in the literature.[4,5] This phenomenon may depend on a number of possible reasons. The recommendations issued by the Italian Government regarding social distancing and the indications to minimize hospital attendances, especially in the epidemic hotspot area, may have had an immediate effect. School closures have certainly had an impact on the transmission rate of acute infectious diseases, in particular those affecting the respiratory and gastrointestinal tracts, as shown from our data. Social distancing itself has been likely responsible for the lower incidence of accidental traumas; in contrast, head injuries rate increased.

Another possible reason that may have contributed to the dramatic decrease in PEU attendances is the fear of contracting SARS-CoV-2 infection by entering hospitals, as considered a place at high
risk of contagion. This led to a sharp reduction of the so-called inappropriate use of PEU, mostly
due to parental anxiety or convenience, as reflected by the decreased rate of white codes in March
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However, the reduced use of PEU, associated with a different mode of assistance provided by FPs
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implied an increased risk of delayed attendance to PEU for diseases that require timely evaluation.
The significant percentage in the most severe triage codes and the highest percentage of SOAU
admittances and hospitalisations seem to confirm this hypothesis, as well as the higher percentage
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Additionally, hospitalisation for intoxication, head injuries and psychiatric problems proportionally
increased, perhaps as a consequence of experiences of neglect or maltreatment and/or domestic
conflicts.

In case of clinical suspicion of SARS-CoV-2 infection, nasopharyngeal swab was collected in PEU;
only a few selected cases needed admission into Paediatrics Unit, thus confirming the mild clinical
course of COVID-19 in children.

The results of our survey, in particular the proportional changes in the causes of attendances,
suggest the potential risks linked to the reduced use of PEU due to the COVID-19 outbreak, which
include the risk of delayed provision of care of potentially severe diseases and/or serious
conditions.[4] We believe it is worth of interest to evaluate whether the documented delay in the use
of health services could also concern children with chronic pathologies and/or with serious
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Finally, with regard to the implications on resource utilization, the epidemic required a structural re-
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As the pandemic phase may not be short-lived, we believe that PEU, Hospital and Community health professionals should adopt appropriate strategies to prevent the potential danger resulting from delayed diagnoses and therapies. In the absence of these, children might be more seriously affected by this pandemic “side effect” rather than by COVID-19 itself.

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**What is already known on this topic?**

- Up to now only a few studies showed that, during COVID-19 pandemic, Paediatric Emergency Unit (PEU) attendances decreased compared with same period of the previous year.
- COVID-19 children appear to be mainly asymptomatic or experience mild symptoms, resulting in a small number of COVID-19 related PEU attendances.
- During COVID-19 pandemic, there is risk of delayed attendance to hospital care for non-COVID-19 severe conditions.

**What this study adds?**

- At the start of the Italian COVID-19 epidemic a drop of more than 80% in PEU overall attendances was observed with a higher percentage of children resulting in hospitalisations due to more severe conditions.
- A significant proportional increase of PEU attendances due to poisonings, psychiatric pathologies, head injuries and fever was recorded.
The impact of delayed provision of care for non-COVID-19 severe conditions may be even worse than COVID-19 itself.

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**Competing interests:** None declared.

**Patient consent for publication:** Not required

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## Italian COVID-19 epidemic: Effects on Paediatric Emergency attendance; a survey in the Emilia Romagna region

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Italian COVID-19 epidemic: Effects on Paediatric Emergency attendance; a survey in the Emilia Romagna region

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Keywords: SARS-CoV-2; Paediatric Emergency Department; COVID-19; Short-stay Observation and Assessment

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Abstract

Objective: To evaluate the effect of COVID-19 epidemic on paediatric Emergency Department (ED) attendance in a region of Northern Italy.

Methods: A survey was proposed to six out of nine paediatric EDs in Emilia Romagna region, to evaluate attendance data, distribution by age and gender, triage code score, outcome of clinical course, number of hospitalisations and the distribution of patients by disease. Data were collected during March 2020 and compared to March 2019.

Results: A drop in paediatric ED attendances of more than 83.8% was observed, with higher percentage of infants, and of severe triage scores. The proportion of patients hospitalised was significantly higher in 2020 than in 2019 (p-value: <0.001). The effect size for the comparison of proportions of hospitalised patients was 0.379. Looking at the distribution of attendances by type of disease, a significantly different distribution was highlighted (p-value: <0.0001, Cramer’s V); there was a greater proportion of patients presenting to paediatric EDs with poisonings (effect size equal to 0.07), psychiatric pathologies (effect size 0.110), head injuries (effect size 0.167) and fever (effect size 0.212).

Conclusions: Our survey suggests that in the 1st month of COVID-19 epidemic in Italy there has been an increase in delayed attendance and provision of care of potentially severe diseases in paediatric EDs. Hospital and Community paediatricians should be aware of this phenomenon and adopt appropriate strategies to prevent this danger, as it may affect children more seriously than COVID-19 itself.

Keywords: SARS-CoV-2; Paediatric Emergency Department; COVID-19; Short-stay Observation and Assessment
Introduction

Since December 2019, a novel Coronavirus (SARS-CoV-2) infection has rapidly spread worldwide.
At the end of February 2020, the first cases of Coronavirus Disease 2019 (COVID-19) were also identified in Italy in the province of Lodi, in the south of the Lombardy region. On March 11, the WHO declared the global pandemic of COVID-19.
Simultaneously with the onset of the outbreak in Lombardy region, in the neighbouring Emilia Romagna region the first cases of suspected patients were assisted in the paediatric Emergency Department (ED) of Piacenza City Hospital. Subsequently, the entire Italy was progressively struck by the spread of the virus.[1]

Although little is known about COVID-19 course in children, it appears that they are mainly asymptomatic or present with mild symptoms, resulting in low rates of hospitalisation.[2,3]
Since the beginning of March, after school closure and the adoption of social distancing measures by the Italian Government, there has been a dramatic decrease in Italian paediatric ED attendances[4] as also reported by Isba and colleagues, in United Kingdom.[5]

Our study aimed at evaluating the effect of COVID-19 epidemic on paediatric ED attendances in Emilia Romagna region, in order to assess characteristics of paediatric ED attendances during March 2020 and possible implications with regards to the use of paediatric ED.

Methods

The paediatric healthcare system in Italy is part of the National Health System. It is made up of 3 main levels of intervention: primary care, which is provided by the so-called “family paediatricians network”; secondary care, which includes paediatric EDs and general Paediatrics Units, and tertiary care, which includes specialty Paediatrics Units. Up to 14 years of age, each child may have a referral family paediatrician (FP), which is mandatory for children up to 6 years. Despite this provision of care and assistance, the decision to go to paediatric ED is made more often by parents alone than under FP's advice.
A survey was proposed to the paediatric ED of the nine provinces of Emilia Romagna, with the aim to collect and compare activity data during March 2020 with March 2019. The data were extracted in each hospital from a regional paediatric ED attendance database by a delegated paediatrician. Paediatric ED attendance data, the distribution by age and gender, and the severity of triage code (red, yellow, green and white) were evaluated and compared with the same month in 2019. The outcome of the clinical course in paediatric ED was evaluated, as well as the number of admittances to Short-stay Observation and Assessment Unit (SOAU; duration of stay: below 36 hours) and outcome, the number of hospitalisations into Paediatrics wards, and the distribution of patients by disease group. Finally, information was collected on the cases that came to paediatric ED with suspected SARS-CoV-2 infection.

Statistical analysis included: Chi-squared test for differences in types of disease between the 2 study periods; two samples Wilcoxon-Mann-Whitney test for comparing age medians and two-samples Z-tests to compare the admittance proportions (e.g.: SOAU vs total admittances). A Jonckheere-Terpstra test was used to assess whether the severity of the attendances by triage code increased in from 2019 to 2020. Statistical significance was assumed at p-value <0.05. For the Z-test comparing proportions, the effect sizes were computed according to Cohen's methodology [6].

Results

Six paediatric EDs participated (Piacenza, Reggio Emilia, Modena, Ravenna, Forli, and Rimini Hospitals), representative of most of the regional territory.

Our survey included infants and children under the age of 14 years, living in the mentioned provinces, encompassing a global figure of 332,212 which covers 61% of the same age population of the entire region.

Data from our study are summarised in Table 1 and Table 2. In March 2020 compared to March 2019, a drop of more than 80% in paediatric ED overall attendances was observed.
| Paediatric ED Attendances # | March 2019 | %  | March 2020 | %  | % Delta | p-value° |
|-----------------------------|------------|----|------------|----|---------|---------|
| Piacenza                    | 1400       |    | 179        |    | -87.2   |         |
| Reggio Emilia               | 1255       |    | 261        |    | -79.2   |         |
| Modena                      | 2087       |    | 437        |    | -79.6   |         |
| Ravenna                     | 960        |    | 179        |    | -81.3   |         |
| Forlì                        | 504        |    | 97         |    | -80.7   |         |
| Rimini                      | 1694       |    | 238        |    | -85.9   |         |
| Overall attendances         | 7900       |    | 1391       |    | -83.8   |         |

| Sex              | March 2019 | %  | March 2020 | %  | % Delta | p-value° |
|------------------|------------|----|------------|----|---------|---------|
| Male             | 4366       | 55.3 | 766        | 55.1 | -0.2    |         |
| Female           | 3534       | 44.7 | 625        | 44.9 | +0.2    |         |

| Age (yrs)       | March 2019 | %  | March 2020 | %  | % Delta | p-value° |
|-----------------|------------|----|------------|----|---------|---------|
| <1              | 12.9       |    | 19.1       |    |         |         |
| 1               | 13.1       |    | 12.1       |    |         |         |
| 2               | 11.3       |    | 10.7       |    |         |         |
| 3               | 10.4       |    | 7.6        |    |         |         |
| 4               | 8.8        |    | 9.6        |    |         |         |
| 5               | 7.0        |    | 4.4        |    |         |         |
| 6               | 6.0        |    | 5.8        |    |         |         |
| 7               | 5.1        |    | 3.6        |    |         |         |
| 8               | 4.8        |    | 4.3        |    |         |         |
| 9               | 5.0        |    | 3.9        |    |         |         |
| 10              | 4.4        |    | 4.7        |    |         |         |
| 11              | 3.6        |    | 3.2        |    |         |         |
| 12              | 3.2        |    | 4.3        |    |         |         |
| 13              | 2.8        |    | 3.7        |    |         |         |
| >13             | 1.7        |    | 3.0        |    |         |         |

* Statistical significance (p-value: <0.05) is related to percentages.

**Table 1:** Emergency attendances and their characteristics from six paediatric EDs in Emilia Romagna region.

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**Table 2:** Relative frequency (percentage) of age distribution in the two study periods

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A significant higher percentage of attendances of infants under the age of 1 year (p-value: <0.00001) was documented in March 2020 compared to the same month in 2019, both as overall data and as singular paediatric ED.

In the distribution of attendances by triage code, the proportion of yellow codes increased significantly; nevertheless, the total number of severely ill children decreased along with the drop of overall attendances. The green codes, the most frequent attendance category, have remained substantially unchanged, while the white codes have decreased significantly (see Table 3).

Of the total number of paediatric ED attendances, the proportion of patients admitted to SOAU was significantly higher in 2020 than in 2019 (p-value: <0.01). This result is confirmed both by the aggregate data and by each paediatric ED. Additionally, there was an increase in subsequent hospitalisations. By comparing the two months, there was also a significantly greater percentage of hospitalised children (p-value: <0.001) (see Table 3). The effect size for the comparison of proportions of hospitalised patients was 0.379.

| Paediatric ED Attendances | March 2019 | % | March 2020 | % | % Delta | p-value° |
|---------------------------|------------|---|------------|---|---------|---------|
| SOAU overall admissions   | 563        | 7.1| 132        | 9.5| + 2.4   | < 0.01  |
| Overall hospitalisations from paediatric ED | 553 | 7.0 | 271 | 19.5 | + 12.5 | < 0.001 |
| Overall hospitalisations from SOAU | 88 | 15.6 | 41 | 31.0 | + 14.6 | < 0.001 |
| Overall attendances by Triage Codes*: | | | | | | |
| Red                       | 23         | 0.3| 9          | 0.65| + 0.35  | 0.065   |
| Yellow                    | 785        | 9.9| 209        | 15.0| + 5.1   | < 0.001 |
| Green                     | 5599       | 70.9| 1021       | 73.4| + 2.5   | 0.059   |
| White                     | 1493       | 18.9| 152        | 10.9| - 8     | < 0.001 |
| Jonckheere-Terpstra test comparing the severity of the attendances | | | | | | <0.00001 |

° Statistical significance (p-value: <0.05) is related to percentages.
*Legend: Four-Level Triage Score System: Red Code: Emergency; Yellow Code: Urgency; Green Code: Deferable Urgency; White Code: Not Urgency.

Table 3: SOAU overall admissions, and overall hospitalisations from paediatric ED and SOAU; Triage codes distribution.

As we did not primarily focus on waiting time from triage to the first medical examination and/or length of stay until discharge or hospitalisation in our survey, we did not extract these data from all paediatric EDs database. Nevertheless, we were able to collect data from our paediatric ED database in Piacenza Hospital; mean and median waiting time were 15 and 8 minutes in 2020 respectively, compared to 56 and 41 minutes in 2019. Mean and median length of stay were 70 and 48 minutes in 2020 respectively, and 126 and 113 minutes in the same period of the previous year. Although we could not carry out a test procedure (as we did not have access to individual level data), the marked observed differences and the large sample sizes are noteworthy.

Looking at the proportional distribution of attendances by type of disease, a significantly different distribution was highlighted (p-value: <0.00001). In relative terms, we observed a statistically greater proportion of attendances due to fever, head injuries, poisonings and psychiatric pathologies, whereas those due to acute respiratory and gastrointestinal diseases, and abdominal pain dropped significantly. Additionally, no significant variation in attendances for headache, seizure, and unintentional trauma was found (see Table 4). As the Jonckheere-Terpstra test was used to compare the severity of the attendances in the two periods, we have that the null hypothesis (no severity difference) is rejected, so we can conclude that the severity of the attendances as classified by triage codes was higher in 2020 than in 2019 (p-value <0.00001).
| Disease                                      | March 2019 (%) | March 2020 (%) | p-value | Effect Size |
|----------------------------------------------|----------------|----------------|---------|-------------|
| Headache                                    | 111 (1.4)      | 18 (1.3)       | > 0.1   | 0.009       |
| Febrile seizures                            | 97 (1.2)       | 20 (1.4)       | > 0.1   | 0.018       |
| Epilepsy and other neurological disease*    | 158 (2.0)      | 43 (3.1)       | <0.05   | 0.070       |
| Fever**                                      | 1185 (15.0)    | 324 (23.3)     | <0.00001| 0.212       |
| Acute respiratory disease**                 | 2069 (26.2)    | 222 (15.9)     | <0.00001| 0.254       |
| Acute gastrointestinal disease**            | 1196 (15.1)    | 93 (6.7)       | <0.00001| 0.275       |
| Abdominal pain**                            | 789 (10.0)     | 97 (7.0)       | <0.001  | 0.108       |
| Head injury**                                | 238 (3.0)      | 90 (6.5)       | <0.00001| 0.167       |
| Accidental trauma                           | 467 (5.9)      | 95 (6.8)       | >0.1    | 0.037       |
| Poisoning*                                  | 57 (0.7)       | 20 (1.4)       | <0.05   | 0.070       |
| Psychiatric disease**                       | 23 (0.3)       | 16 (1.2)       | <0.00001| 0.110       |
| Others                                       | 1510 (19.1)    | 353 (25.4)     | <0.00001| 0.152       |

Table 4: Actual numbers and proportion of attendance (in brackets) in 2019 and 2020 for each disease, with p-values associated to the test for the equality between two proportions and the effect size (those associated to non-significant differences are reported in grey). Significance levels: **p<0.01; *p<0.05.

The diagnoses of the children hospitalised into Paediatrics Unit are shown in Table 5.

| Diagnosis                                      | March 2019 n° (%) | March 2020 n° (%) |
|------------------------------------------------|-------------------|-------------------|
| Headache                                      | 5 (0.91)          | 1 (0.37)          |
| Febrile seizures                              | 39 (6.88)         | 13 (4.80)         |
| Epilepsy and other neurological disease*      | 33 (5.98)         | 13 (4.80)         |
| Fever                                         | 67 (12.14)        | 27 (9.96)         |
| Acute respiratory disease**                   | 142 (25.72)       | 88 (32.47)        |
| Acute gastrointestinal disease**              | 32 (5.80)         | 13 (4.80)         |
| Abdominal pain**                              | 23 (4.17)         | 16 (5.90)         |
| Head injury**                                 | 5 (0.91)          | 7 (2.58)          |
| Accidental trauma                             | 28 (5.07)         | 10 (3.69)         |
| Poisoning*                                    | 7 (1.27)          | 0 (0.00)          |
| Psychiatric disease**                         | 17 (3.08)         | 7 (2.58)          |
| Others                                        | 155 (28.08)       | 76 (28.04)        |

Table 5: Actual numbers and percentage (in brackets) of children hospitalised, by diagnosis

During the monitored period, 103 nasopharyngeal swabs for suspected SARS-CoV-2 infection were collected in the included paediatric EDs, of which 26 tested positive; 6 of these required hospitalisation into Paediatrics Units, but none were intubated or required non-invasive ventilation.

Discussion and Conclusions
The data from our study show a consistent drop in paediatric ED attendances during the COVID-19 epidemic onset, in accordance to other experiences recently reported in the literature.[4,5] This phenomenon may depend on a number of possible reasons. The recommendations issued by the Italian Government regarding social distancing and the indications to minimize hospital attendances, especially in the epidemic hotspot area, may have had an immediate effect. School closures have certainly had an impact on the transmission rate of acute infectious diseases, in particular those affecting the respiratory and gastrointestinal tracts, as shown from our data. Social distancing itself has been likely responsible for the lower incidence of accidental traumas.

Another possible reason that may have contributed to the dramatic decrease in paediatric ED attendances is the fear of contracting SARS-CoV-2 infection by entering hospitals, as considered a place at high risk of contamination. This led to a sharp reduction of the so-called inappropriate use of paediatric ED, mostly due to parental anxiety or convenience, as reflected by the decreased rate of white codes in March 2020. This fact could be a positive externality of the pandemic, as the use of paediatric EDs was indirectly limited for diseases that do not require access to emergency services and that are at risk of over-medicalization.

In case of clinical suspicion of SARS-CoV-2 infection, nasopharyngeal swab was collected in paediatric ED; only a few selected cases needed admission into Paediatrics Unit, thus confirming the mild clinical course of COVID-19 in children.

The results of our survey, in particular the proportional changes in the causes of attendances, suggest the potential risks linked to the reduced use of paediatric ED due to the COVID-19 outbreak, which include the risk of delayed provision of care of potentially severe diseases and/or serious conditions.[4] We believe it is worth of interest to evaluate whether the documented delay in the use of health services could also concern children with chronic pathologies and/or with serious disabilities requiring intensive and continuous care, as well as the most vulnerable children of families of the lower socio-economic classes.
Finally, with regard to the implications on resource utilization, the epidemic required a structural reorganisation of paediatric EDs in order to control the risk of contagion, including the redesigning of tracks and spaces, and the provision of adequate protective equipment for the health personnel. As a consequence of this re-arrangement, each paediatric ED had to face higher costs than those incurred in March 2019.

As the pandemic phase may not be short-lived, we believe that paediatric ED, Hospital and Community health professionals should adopt appropriate strategies to prevent the potential danger resulting from delayed diagnoses and therapies. In the absence of these, children might be more seriously affected by this pandemic “side effect” rather than by COVID-19 itself.

Acknowledgments: The authors thank Prof. Enrico Fabrizi, DISES and DSS, Università Cattolica del Sacro Cuore, Piacenza, Italy, for statistical analysis and Dr. Jenny Bua, Neonatal Intensive Care Unit, Institute for Maternal and Child Health, IRCCS Burlo Garofolo, Trieste, Italy, for her linguistic advice and revision.

What is already known on this topic?

- Up to now only a few studies showed that, during COVID-19 pandemic, paediatric Emergency Department (ED) attendances decreased compared with same period of the previous year.
- COVID-19 children appear to be mainly asymptomatic or experience mild symptoms, resulting in a small number of COVID-19 related paediatric ED attendances.
- During COVID-19 pandemic, there is risk of delayed attendance to hospital care for non-COVID-19 severe conditions.

What this study adds?

- At the start of the Italian COVID-19 epidemic a drop of more than 80% in paediatric ED overall attendances was observed with a higher percentage of children resulting in hospitalisations due to more severe conditions.
There was a greater proportion (p<0.05) of patients presenting with poisonings, psychiatric pathologies, head injuries and fever.

The impact of delayed provision of care for non-COVID-19 severe conditions may be even worse than COVID-19 itself.

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