Infectious disease

Trend of accesses to the Emergency Department of a Teaching Hospital of Tuscany due to bronchiolitis in 2018-2023: new challenges

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Keywords

RSV • Bronchiolitis • Emergency Department • Infectious Disease

Summary

Introduction. *Acute bronchiolitis is one of leading causes of lower respiratory tract infection and hospitalisation in children less than one year old worldwide. The aim of our study is investigating the impact of bronchiolitis in children paediatric to the Emergency Department (ED) of Teaching Hospital (AOUS), Santa Maria alle Scotte of Siena, Tuscany (Italy).*
Methods. *A retrospective observational study was conducted on the accesses performed at the ED of the AOUS of Siena by children under 18 years of age suffering from bronchiolitis from September 2018 to April 2023.*
Results. *There were 36,031 patients between 0 and 18 years old in the Emergency Department, 383 of which presented bronchiolitis (age 4.8 months C.I.:3.5-6 months.; 54% male). Those who accessed the ED with a higher priority code were more likely to be subsequently admitted (O.R.:2.6; C.I.:1.3-5.1; $p < 0.01$). Those who accessed the ED with symptoms of bronchiolitis during the weekend were less likely to have been sent from community medicine services or professionals (O.R:0.1; C.I:0.0-0.5; $p < 0.001$). Children below 1 year old were more likely to access the ED with respiratory distress symptoms (O.R.:2.6; C.I.:1.5-4.3; $p < 0.001$). Finally, those who accessed the ED with bronchiolitis were more likely to be admitted than those who accessed for other conditions (O.R:24.5; C.I.:19.4-31; $p < 0.001$).*
Conclusions. *It is necessary to invest protocols integrating hospital services and community medicine in order to achieve a timely diagnosis and to reduce the accesses to the ED of children presenting mild, non-severe form of bronchiolitis in order to avoid the overload of hospital services.*

Background

In the last 2 years in Italy and worldwide, several epidemics of bronchiolitis that significantly stressed health care facilities and services, due to bed saturation in wards and intensive care units were observed. Most of these kinds of hospitalisations concern infants in their first year of life [1].
Bronchiolitis is a viral lower respiratory tract infection characterized by obstruction of small airways and terminal bronchioles caused by acute inflammation, oedema, increased mucus production and necrosis of the epithelium composing the small airways [2].
The main cause of Bronchiolitis is Respiratory Syncytial Virus (RSV); it has been estimated that this pathogen infects more than 60% of all children during their first year of life, reaching almost 100% of them by the time they turn 2 [3]. Human Rhinovirus (HRV), human Parainfluenza virus (HPIV), human Metapneumovirus (HMPV), Influenza virus (IAV, IBV), and human Adenovirus (HAdV), alone or in the form of co-infection, have also been reported [4].
The estimated global impact of RSV-caused infections in infants younger than 5 years of age was reported being approximately 33 million children (range: 21.6-50.3 million), with 3.2 million hospitalizations (range: 2.7-3.8 million), and 120,000 deaths (range: 94,000-149,000) per year [5].
During the pre-pandemic years, analysing the medical databases of national RSV surveillance of 27 countries worldwide reports, the RSV wave started cyclically every year roughly between March and June in the Southern Hemisphere. In the Northen Hemisphere, waves began sometime between September and December. Decrease in RSV activity was observed from August to October in Southern Hemisphere and from February to May in Northen Hemisphere each year, estimating an average of5-6 months for every RSV wave [6].
In March 2020, global SARS-CoV-2 pandemic was declared [7]. In Italy, following this declaration, a lockdown was carried out: all non-essential facilities and activities were shut down [8]. During most 2020 and 2021, in Italy, social interactions were limited, and schools were occasionally closed, replaced by distance learning activities [9].
During the 2020/2021 cold season a significant reduction in the incidence of bronchiolitis patient accessing the Emergency Ward was observed, alongside a general

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decrease in the incidence of acute respiratory tract infection among the population, leading to a decrease in hospitalized patients in Italy [10]. It is also worth noting that no cases of Influenza were recorded during winter 2020-2021, not even during the "flu season", identified as the timeframe between the 42nd week and the 17th week of the following year [11].
An increase in cases of bronchiolitis has been detected in Italy from September 2021, anticipating the seasonal peak compared to previous years [12,10]. For that reason, a surveillance has been introduced for RSV through the InfluNet & RespiVirNet operating protocol [13].
In Italy, currently, in the age group 0-4 years the incidence of influenza syndromes is 13.17 cases per thousand patients. In 2022/2023 season, in subjects under two years of age, 54.9% of the samples positive for a respiratory virus detected RSV, 30.4% influenza and 2.6% SARS-CoV-2 [11].
Bronchiolitis' diagnosis is based on directed history and physical examination. Neither laboratory tests nor radiological exams are usually indicated for the routine work-up of infants with bronchiolitis [1, 14, 15].
Laboratory and instrumental investigations are not routinely recommended [14]. Bronchiolitis may present with a wide range of symptoms and severity, from a mild upper respiratory tract infection (URTI) to impending respiratory failure [5].
Diagnostic criteria for the disease include, but are not limited to, the following [1, 5]: onset with rhinorrhoea and/or upper respiratory tract infections; first episode of respiratory distress associated with: crackles and/or wheezing, use of accessory muscles or lower chest wall retractions, low O2 saturation levels, high respiratory rate, skin colour alterations, nasal flaring, fever.
Risk factors for severe bronchiolitis are [14] also known premature birth (< 35 weeks' gestation); being less than 3 months old; decreased hydration and feeding (< 50% of usual fluid intake in preceding 24 h); hemodynamically significant cardiac disease; chronic lung disease; neurological disorders; immunodeficiency and environmental factors, such as exposure to tobacco smoke and or air pollution.
Moderate-to-severe cases and risk factors associated with severe bronchiolitis must be considered for hospital admission [14].
Severity classification is based on: respiratory rate, respiratory effort, oxygen saturation, feeding, apnoea, wheezing, crackles, effort, inspiration to expiration ratio [14].
Most children with acute bronchiolitis may be adequately managed in the outpatient setting by primary care paediatricians, parents or caregivers able to provide assistance and monitoring [14-16].
Bronchiolitis lasts 12 days (average) in children under 24 months; after 21 days about 18% still have the disease and after 28 days 9% [16]. Most infants who contract bronchiolitis recover without sequelae; however, up to 40% may have subsequent wheezing episodes up to their fifth year of age and approximately ten percent will have wheezing episodes after that timeframe [16-19].
In addition to its impact on children, bronchiolitis also has a major impact in terms of hospitalisation costs even for mild and moderate forms [20]. Moreover, the need for intensive care almost doubles the necessary costs [20].
The aim of our study is to assess the impact of this condition in the emergency services and the severity of the cases that lead to hospitalisation.

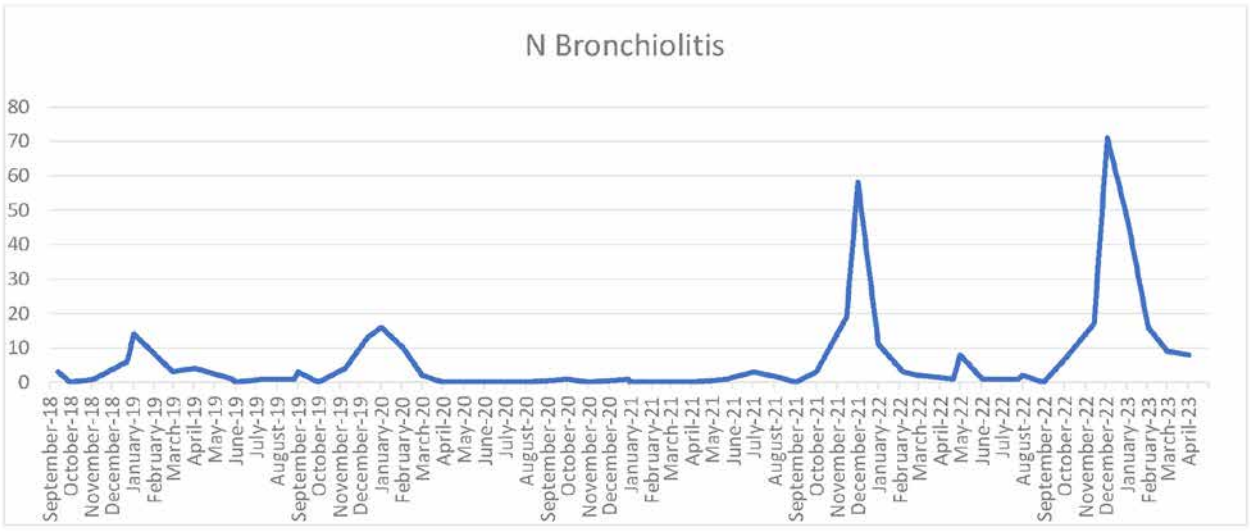
Materials and methods

An observational retrospective pilot study was conducted in the Emergency Department (ED) of Teaching Hospital of Siena, Tuscany, inall children under 18 years of age who had a diagnosis of bronchiolitis at the time of discharge from the ED of the Teaching Hospital of Siena by from September 2018 to April 2023 were included in the study.
All children under 18 years of age who had a diagnosis of bronchiolitis at the time of discharge from the ED were included in the study.
Clinical examination and anamnesis were performed to confirm the diagnosis of bronchiolitis.
Data were taken from the ED software management 'Aurora'.
The "Aurora" management software is the management software that is used in the ED to register entering patients Master data, triage, medical and nursing diary and discharge diagnosis are entered in the management software.
Of all patients, gathered variables included gender, residence, age, during which day of the week they accessed the ED, how were patients sent to ED or how they reached it, whether they had previously been seen by community medicine services, admission code, access symptoms, admission and ward in which they were admitted.
Statistical analysis was performed with STATA 17. The tests performed were X2 test to see if there was a statistically significant correlation between two variables and the Odds Ratio to see how likely one variable influenced the other.
No ethics committee approval was required as for epidemiological studies using health care administrative databases and anonymized data for researcher purpose.

Results

A total of 382 patients visited the emergency department for bronchiolitis.
54.7% were male and the average age was 4.8 months (C.I: 3.5-6.0 months).
The highest number of accesses, 175, occurred in the 2022/2023 season as shown in Figure 1. Only 1 case was recorded in the 2020/2021 season.
The annual distribution of accesses for bronchiolitis shows a progressive increase in cases, in particular 10 cases was recorded in 2018, 80 in 2023, with a peak of

Fig. 1. Number of accesses for bronchiolitis in Emergency Department (ED), (September 2018- April 2023).



124 cases in 2022, only in 2020, where the accesses wee only 31.

Most of our samples (89.8%) came from the province of Siena and 26.7% of them were admitted to the ED during the weekend.

Only 14.1% accessed the emergency room referred by the paediatrician or the doctor on duty.

The most commonly reported symptoms were fever (33.5%), cough (41.1%), but mainly respiratory difficulties in 74.3%.

Most of our sample accessed the ED with code 3, while 21.8% accessed with a higher severity code (1 and 2).

72.8% of our sample were subsequently hospitalised, 17.6% of them in an intensive care unit.

A statistically significant correlation was found between the presence of bronchiolitis and the season being either autumn or winter ($p < 0.001$).

A statistically significant correlation was found between the year of admission and hospitalisation ($p < 0.05$), with an increase in admissions in the post-COVID-19 lockdown. Those who accessed the ED with symptoms of bronchiolitis during the weekend were less likely to have been referred from community medicine services or professionals (O.R: 0.1; C.I: 0.0-0.5; $p < 0.001$).

Children below 1 year of age were more likely to access the ED with respiratory distress (O.R.: 2.6; C.I.: 1.5-4.3; $p < 0.001$).

Those who accessed the ED with bronchiolitis were more likely to be hospitalizedthan those who accessed for other conditions (O.R: 24.5; C.I.: 19.4-31; $p < 0.001$).

Discussion

In our sample, the average age of children which were most affected by bronchiolitis and accessed the Emergency Department was less than 1 year, in line with national and international data in literature [1, 16].

Like most parainfluenza viruses, the trend of bronchiolitis waves is seasonal [5, 15]. The results of our study highlight seasonal incidence peaks from November to February. Our results are in fact in line with previous Italian studies, which peaked between November and February [21, 22].

It's worth highlighting that from November 2020 to February 2021 there was only 1 case of bronchiolitis in Siena Hospital and 3 cases occurred in July 2021. In addition to that, it's important to point out that from March 2020 the SARS-CoV-2 pandemic began [23], which brought Health Authorities to recommend social distancing measures and regulated the mandatory use of masks [24], providing protection not only from SARS-CoV-2, but also from several airborne diseases such as influenza and parainfluenza, causing a decrease in their diffusion [25-27]. An increase in cases during the summer season was also reported in a British study, possibly due to the relaxation of restrictive measures [28]. Many countries have reported a lack of RSV cases during the expected peak season, followed by an out-of-season surge upon relaxation of NPI use. These dynamics have disrupted traditional RSV disease patterns and assumptions, while also provide a unique opportunity to learn more about the transmission of RSV and other respiratory viruses in order to tackle future RSV preventive strategies [29].

The InfluNet report also shows an incidence of 0.8 cases per thousand of influenza syndromes (ILI) by sentinel physicians and out of a total of 6818 samples analysed, none were found positive for influenza in the 2020/2021 season [30].

The 2022/2023 season has registered the most severe increase in incidence of the timeframe of our study, reporting 175 bronchiolitis incidents. This increase has not only occurred in our study, but has been reported throughout Europe, so much so that the ECDC issued a note highlighting this scenario, leading to increased pressure on hospitals and thus recommending enhanced surveillance measures [31].

As previously stated, bronchiolitis is the first cause of hospitalisation in children aged 1 year or lower: most of the children in our study were hospitalised and children aged < 1 year presented respiratory distress symptoms on admission to the emergency department.
Those who accessed the emergency department during the weekend were less likely to have been visited by the family paediatrician or out-of-hours service doctors. We hypothesized this might occur due to the lack of available paediatricians in community services on Saturdays and Sundays, which can manage and treat mild cases before they get worse, thus gatekeeping the emergency department when possible [32].
This public health scenario is important to address because, as already mentioned, bronchiolitis has a big impact on the cost of emergency room services and admissions [20].
Italy is currently developing a reform of territorial and community medicine with the goal to allow patients to be treated mainly at home, with the vision of "home as the first and main healthcare location" [33]. Among the various actions identified to achieve this goal, a huge part of it is the implementation of telemedicine and telemonitoring services. During the COVID-19 emergency, positive patients with mild to moderate symptoms were monitored at home by devices capable of detecting vital parameters in real time and transmitting them to the territorial emergency services [34]. This type of telemonitoring could also be impractical in paediatric patients with parental/caregiver support. However, one possible prevention strategy currently available is a monoclonal antibody (mAb) indicated in a subset of preterm infants or those with comorbidities, hence leaving the majority of the infant population unprotected against this virus. Therefore, development of prevention strategies against RSV for all infants entering their first RSV season constitutes a large unmet medical need [35].
In the next future, it is likely that new possibilities of prevention will add, including use of more potent and longer-acting monoclonal antibodies, implementation of maternal vaccination in pregnancy, and active immunization in children [36, 37].
In 2023, the European Union approved the first RSV vaccine suitable for protecting infants up to six months of age as well as two vaccines for older adults. When given to a mother during pregnancy, the antibodies generated in response to the vaccine can cross the placenta to the foetus, protecting the child for up to six months following birth [38].
Despite all the efforts, prevention remains, to date, the most effective strategy to reduce RSV-related morbidity. Among the current prevention strategies, strict hygiene, breastfeeding and passive immunization with the monoclonal antibody and maternal vaccination are the cornerstone.
The limitations of our study are that the children enrolled were taken from the ED computerised system, so they were not followed up during their admission and the diagnosis is based on the clinic and the objective examination. Yet, we were still able to observe the trends of admission in the ER departments and future studies tackling samples of children followed after the ER discharge can be a relevant research issue to tackle. Moreover, the limitations of this study are given above all by the very small sample. In the Region of Tuscany, the paediatric hub hospital is the Meyer Hospital in Florence. About the University Hospital of Siena, the specific catchment area is structured, for basic activities, on 17 Municipalities of the Sienese Area with approximately 120,000 inhabitants, and for specialist services on 36 Municipalities of the Province of Siena with approximately 254,000 inhabitants. The study is a preliminary study to evaluate the trend of paediatric patients' accesses for RSV, subsequently the study will be extended.

Conclusions

In conclusion, our study also supports evidence confirming the increasing trend of bronchiolitis cases in the 2022/2023 season. Our study also highlights the importance of taking preventive action to avoid the spread of viruses that cause bronchiolitis, such as RSV, through surveillance and vaccine development. Furthermore, it is necessary to invest in hospital-territory integration pathways for timely diagnosis and to reduce the number of children with bronchiolitis with minor codes entering the ED, thus overburdening hospital services. RSV has been identified as a major global priority but a solution to tackle this unmet need for all children has yet to be implemented.

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Conflicts of interest statement

The authors declare that they have no conflict of interest.

Ethics approval

No ethics commitee approval is required in Italy for epidemiological studies using health care administrative databases for research purposes and with individuals identified by an anonymous patient code. All methods were carried out in accordance with the Declaration of Helsinki.

Authors' contribution

All Authors made substantial contributions to the concept and design, analysis and interpretation of data, and drafting and revisions.

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