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# Acute bronchiolitis and respiratory syncytial virus seasonal transmission during the COVID-19 pandemic in Spain: A national perspective from the pediatric Spanish Society (AEP).

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ABSTRACT

*Introduction and Objectives:* The COVID-19 pandemic and the widespread associated use of non-pharmaceutical interventions have impacted viral circulation and the incidence of respiratory tract infections. We compared Pediatric Emergency Department visits, bronchiolitis admissions, and respiratory syncytial virus (RSV) cases in 2020 with those documented for the preceding four years.

*Methods:* This was a retrospective multicentric national survey study, driven by the Pediatric Spanish Society, and gathering monthly data from Spanish hospitals between 1st January 2016 and 31st December 2020. An Interrupted Time Series Analysis and Poisson regression models were performed for each index.

*Results:* Thirty-eight hospitals representing most of the different regions of Spain participated. Compared to the preceding four years, in 2020, Pediatric emergency department visits significantly decreased immediately after initiation of the national lockdown. The median number of visits averted per month was 39,754 (IQR 26,539–50,065). RSV diagnoses during the 2020 winter season nearly disappeared with only 21 cases being documented among participating hospitals. The expected seasonal peak of bronchiolitis hospitalizations never occurred. The median number of admissions in 2020 averted per month was 100 (IQR 37–185) compared to 2016–2019. Only 3 hospitalized cases were RSV-confirmed. Reopening of schools and kindergarten was not associated with a remarkable increase in RSV cases or bronchiolitis hospitalizations.

*Conclusion:* A dramatic reduction of bronchiolitis admissions and near disappearance of RSV cases was observed in Spanish hospitals coinciding with the peak of the COVID-19 pandemic.

## 1. Introduction

Acute bronchiolitis is the leading cause of admission in children under 1 year of age. More than 70% of cases are produced by respiratory syncytial virus (RSV), usually with a seasonal epidemic pattern between October and March in the Northern Hemisphere [1]. The COVID-19 pandemic has changed the epidemiological situation of acute respiratory infections globally and has triggered a generalized implementation of non-pharmaceutical interventions (NPIs) to reduce transmission. These facts have impacted viral circulation and respiratory tract infections incidence worldwide [2–5].

The objectives of this study were (1) to describe monthly visits to Pediatric Emergency Department (PED), RSV-confirmed infections, and acute bronchiolitis admissions in Spanish hospitals from January 2016 to December 2020 and, (2) to analyze and compare bronchiolitis and

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**Abbreviations**

| | |
|---|---|
| AEP | Pediatric Spanish Society. |
| PED | Pediatric Emergency Department. |
| PICU | Pediatric Intensive Care Unit. |
| ITSA | Interrupted time series analysis. |
| IQR | Interquartile range. |
| NPIs | Non-pharmaceutical interventions. |
| RSV | Respiratory syncytial virus. |

RSV epidemics during COVID-19 pandemic with the corresponding previous seasons for a better understating of their causes and future implications on healthcare management.

## 2. Patients and methods

This was a retrospective multicentric national study using data obtained from Spanish hospitals. We included patients under two years of age diagnosed with acute bronchiolitis between 1st January 2016 and 31st December 2020. Data were collected following a pre-established research protocol and through a survey sent to collaborating hospitals in Pediatric Spanish Society (AEP) within the National Project RSV/COVID-AEP. Cases were monthly identified from hospitalization and PED diagnostic codes, and microbiology charts.

An interrupted time series analysis (ITSA) was carried out and Poisson regression models were estimated. Variance was considered to be proportional to the mean to account for over dispersion [6]. Due to the nature of these data, seasonality was controlled using Fourier terms (pairs of sine and cosine functions) [6,7]. The significance level was set at 0.05. The analysis was carried out using Stata® [8]. The study received the approval of the local ethics committee (HULP: PI-4573).

## 3. Results

A total of 38 hospitals from different regions in Spain participated in this study (Fig. 1), gathering monthly data from January 2016 to December 2020. Monthly median of cases observed for each index are outlined in Table 1.

### 3.1. Pediatric emergency department visits

In 2020, there were 579,393 visits to the PED, a 40% reduction of the annual visits compared to those occurring in the period 2016–2019. These were significantly lower than those expected according to our model (Fig. 2A). This trend was observed for every month since March 2020, when general lockdown was established in Spain. The minimum number of visits was in April 2020 (18,366).

### 3.2. RSV diagnoses

In 2020, there were 3912 RSV diagnoses, a 65.9% reduction compared to 2016–2019. However, nearly all RSV cases in 2020 were detected from January to March, at the tail end of the 2019–2020 winter RSV season. From May 2020, RSV cases disappeared and only a few cases were reported even during the expected seasonal epidemic: six cases in September, three in October, seven in November, and five in December (Fig. 2B).

### 3.3. Bronchiolitis admissions

In 2020, there were 1962 hospitalizations, a 62.1% reduction compared to 2016–2019. However, most of these admissions occurred in the first months of 2020. If we focus on the 2020 winter season, only 279 patients (14.1% of the total 1962) were admitted with bronchiolitis. Of these, only 3 cases were due to RSV-confirmed infection. The expected seasonal peak of bronchiolitis and RSV hospitalizations in our model did not appear during the 2020 winter season compared to the preceding 5 years (Figs. 2C and D). Similarly, bronchiolitis admissions to Pediatric Intensive Care Unit (PICU) decreased dramatically. During the 2020 winter season, 27 patients required PICU admission (compared to 492–674 cases from 2016 to 2019), and only one of them was due to RSV-confirmed disease.

## 4. Discussion

This study revealed a dramatic reduction of bronchiolitis admissions and near disappearance of RSV cases in 2020 winter season compared to the same period in the preceding four years in Spanish hospitals. This reduction of cases represents a significant decrease in the burden of disease by any cause, and particularly by bronchiolitis and RSV-

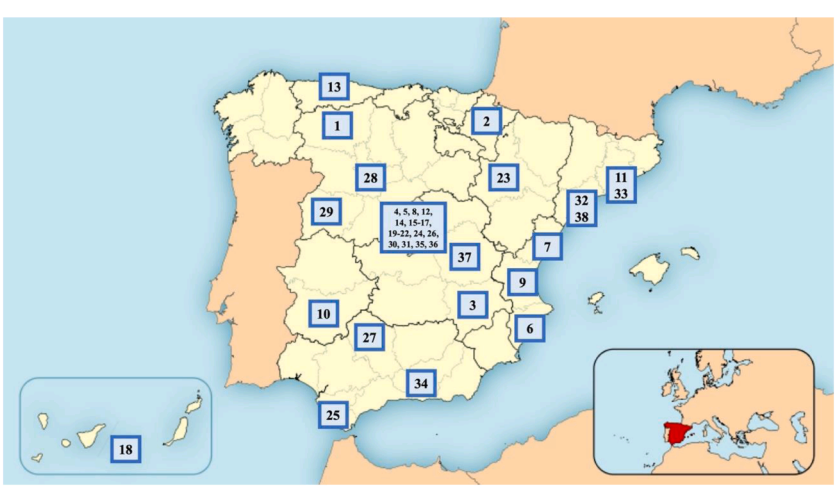


**Fig. 1.** Participant hospitals for which data were analyzed (in alphabetical order): 1) Complejo Asistencial Universitario de León. 2) Complejo Hospitalario de Navarra. 3) Complejo Hospitalario Universitario de Albacete. 4) Hospital Clínico San Carlos. 5) Hospital Infantil Universitario Niño Jesús. 6) Hospital General Universitario de Alicante. 7) Hospital General Universitario de Castellón. 8) Hospital General Universitario Gregorio Marañón. 9) Hospital Lluís Alcanyís de Xátiva. 10) Hospital de Mérida. 11) Hospital Sant Joan de Déu Barcelona. 12) Hospital Universitario 12 de Octubre. 13) Hospital Universitario Central de Asturias. 14) Hospital Universitario de Fuenlabrada. 15) Hospital Universitario Fundación Jiménez Díaz. 16) Hospital Universitario General de Villalba. 17) Hospital Universitario de Getafe. 18) Hospital Universitario Insular-Materno Infantil, Las Palmas de Gran Canaria. 19) Hospital Universitario Infanta Elena. 20) Hospital Universitario Infanta Leonor. 21) Hospital Universitario Infanta Sofía. 22) Hospital Universitario La Paz. 23) Hospital Universitario Miguel Servet. 24) Hospital Universitario de Móstoles. 25) Hospital Universitario Puerta del Mar de Cádiz. 26) Hospital Universitario Ramón y Cajal. 27) Hospital Universitario Reina Sofía de Córdoba. 28) Hospital Universitario Río Hortega de Valladolid. 29) Hospital Universitario de Salamanca. 30) Hospital Universitario Sanitas La Zarzuela. 31) Hospital Universitario del Sureste. 32) Hospital Universitari Sant Joan de Reus. 33) Hospital Universitario Vall d'Hebron. 34) Hospital Universitario Virgen de las Nieves. 35) Hospital Universitario Quirón Salud Madrid. 36) Hospital Vithas Pardo de Aravaca. 37) Hospital Virgen de la Luz de Cuenca. 38) Pius Hospital de Valls.

**Table 1**
Monthly median number of cases observed for each index. Data shown as medians and interquartile ranges.

| Year | Emergency department visits | Total RSV diagnoses | Bronchiolitis admissions | RSV-confirmed admissions | PICU bronchiolitis admissions | PICU RSV-confirmed admissions |
|---|---|---|---|---|---|---|
| 2016 | 83,785.5 [72,064.5 – 91,259.5] | 547.5 [50.0 – 1362.0] | 169.0 [92.5 – 559.0] | 43.5 [10.0 – 383.0] | 9.0 [6.0 – 52.5] | 4.0 [0.0 – 43.0] |
| 2017 | 83,380.0 [74,310.5 – 88,431.5] | 932.5 [132.0 – 1659.0] | 192.0 [88.0 – 677.0] | 57.5 [15.0 – 475.0] | 15.0 [6.5 – 67.5] | 5.0 [2.0 – 51.0] |
| 2018 | 79,936.0 [71,632.5 – 85,201.5] | 626.0 [237.0 – 1527.5] | 223.0 [91.5 – 518.5] | 59.0 [16.0 – 371.5] | 23.0 [7.5 – 75.0] | 6.0 [1.0 – 48.0] |
| 2019 | 82,577.0 [71,249.5 – 89,908.0] | 645.5 [114.0 – 1507.5] | 192.5 [67.5 – 512.5] | 45.5 [5.5 – 371.5] | 17.0 [5.0 – 68.0] | 4.5 [1.0 – 41.5] |
| 2020 | 42,923.5 [35,118.0 – 50,274.0] | 5.5 [1.0 – 76.5] | 51.5 [17.5 – 144.5] | 0.5 [0.0 – 32.5] | 5.0 [1.0 – 19.5] | 0.0 [0.0 – 6.0] |

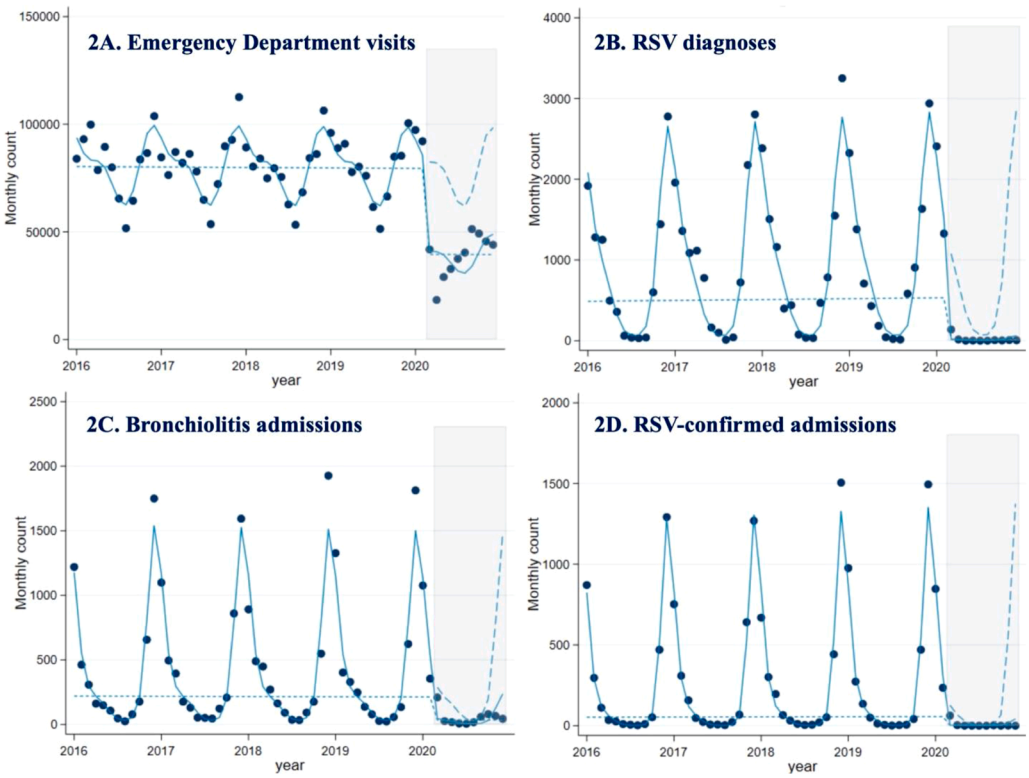


**Fig. 2.** Interrupted time series analysis and Poisson regression models. 2A: Pediatric Emergency Department visits. 2B: RSV diagnoses. 2C: Bronchiolitis admissions. 2D: RSV-confirmed admissions. The solid line shows the results from the estimated model, the dashed line represents what we would have observed without the pandemic and the dotted line summarizes the linear trend of the data. The median number of cases in 2020 averted per month was: Visits to Pediatric Emergency Department 39,754 (Interquartile range [IQR] 26,539 – 50,065), RSV diagnosis 523 (IQR 137 - 939), and bronchiolitis admissions 100 (IQR 37 - 185).

associated infections. However, yearly numbers underestimate the real reduction of cases, as the period January-March 2020 presents the anticipated number of subjects corresponding to the previous season. The general lockdown in Spain was established on 14th March 2020, notably reducing PED visits henceforth. Lockdown measures were progressively relaxed in May and schools reopened in September 2020, when bronchiolitis and RSV cases were expected to re-appear. Despite reopening of schools, PED visits just mildly increased, and bronchiolitis cases remained at a minimum. Even more surprisingly, RSV diagnoses were nearly zero at least until the end of 2020. This suggests that SARS-CoV-2 may have displaced other respiratory viruses with a disproportionate effect on RSV, probably replacing their ecological niche, among other factors.

The first reports came from the Southern Hemisphere, where RSV season typically occurs from April to June. Compared to the preceding years, RSV diagnoses decreased between 68 and 98% [3,9], and PED attendance and bronchiolitis admissions were 70% and 85% lower, respectively [2]. Afterwards, reports from the Northern Hemisphere showed more than 80–95% reduction in RSV detections and bronchiolitis hospitalizations during September-December 2020 [4,10–14]. In a study performed in the East of Spain (ECEALHBA project), a 94% decrease in bronchiolitis admissions was observed [15]. Similarly to RSV, Influenza virus has also experienced a 94–99.4% worldwide case reduction during 2020 [3,4,12,13,16,17].

Measures to prevent transmission in schools were implemented during the reopening of schools in Spain, but outside school there remained opportunities for viral transmission from other children or family. Though at lower levels, other viruses (rhinovirus, adenovirus or bocavirus) seemed less affected and continued circulating all over the year [12]. As a consequence, NPIs cannot fully explain the uneven interruption of RSV transmission we have observed. Other mechanisms, such as virologic features among other factors, may contribute to explain these differences.

After relaxation of NPIs, some countries have experienced a delayed RSV epidemic peak 2–6 months later than expected, with variable severity [18]. In Spain we observed a 7-months delayed transmission wave, starting in early May 2021 and peaking in the first week of July [19]. Schools in Spain have been opened from September 2020 until June 2021, suggesting that reopening schools with adequate security measures may not have a crucial impact in SARS-CoV-2, RSV, and other respiratory virus transmission. However, current surveillance systems appear insufficient. An active effort in epidemiological surveillance

throughout the year, irrespective of the expected peaks, is mandatory to anticipate and adapt healthcare systems to the uncertain viral environment.

This study has some limitations. First, clinical or other laboratory information were not collected, so we could not study other viruses that cause bronchiolitis apart from RSV or individual clinical follow-up. Second, we cannot exclude that changes in health-seeking behavior related to COVID-19 may have impacted viral detections. Nevertheless, a strength of this study is the great number of participating hospitals from different regions in Spain, that gives a national perspective of the epidemiological situation.

## 5. Conclusion

A dramatic reduction of bronchiolitis admissions and near disappearance of RSV cases were observed in Spanish hospitals in the usual winter epidemic period, coinciding with the COVID-19 pandemic. The reappearance of RSV transmission with a delay of seven months, and most importantly, outside of the typical seasonal cycle, warrants the maintenance of strong surveillance mechanisms to further understand, predict, and manage future transmission of RSV and other causes of acute respiratory infections in children.

## Previous presentations

This material has not been previously presented or published.

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## Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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