



High burden of RSV hospitalizations in Germany 2021–2022

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Abstract

Background Public health measures implemented to mitigate the effects of the COVID-19 pandemic disrupted the worldwide transmission of endemic respiratory viruses such as RSV, as well as other typical, seasonal, and viral respiratory pathogens.

Methods From October 18, 2021 to March 31, 2022, RSV cases admitted to German pediatric hospitals were monitored via a newly established, national, Clinician-Led Reporting System (CLRS) that recorded patient age and type of respiratory support. A subanalysis of the first 4 months of the monitoring period was additionally performed.

Results In October 2021, a total of 471 hospitalized pediatric RSV cases per day were documented by 67 reporting hospitals. By January 2022, this number dropped to three cases at 11 hospitals (median of reporting hospitals: 37 (11%)). During these months, the median of hospitalized children on general wards and intensive care units was 133 and 15, respectively. In the subanalysis conducted to examine the period October to January, an average of 3.6 ± 2.2 patients per hospital per day were hospitalized on general wards (median 4 cases; range 0.3–8 cases), whereas 0.4 ± 2.2 patients were on intensive care units (median 0.3 cases; range 0–0.9 cases), with 11.5% receiving respiratory support. The majority of patients were under 2 years old.

Conclusion The overall burden of out-of-season RSV cases was extraordinarily high in Germany in 2021–2022. The newly established CLRS may help evaluate and, therefore, better allocate local and national pediatric care resources.

Keywords Respiratory syncytial virus · Pandemic · Seasonality · COVID-19 · Nonpharmaceutical intervention

Abbreviations

CLRS Clinician-led reporting system
DGPI German society for pediatric infectious diseases
RSV Respiratory syncytial virus

viruses such as RSV, as well as other typical, seasonal, and viral respiratory pathogens [2, 3].

Methods

In October 2021, the German Society for Pediatric Infectious Diseases (DGPI) established a Clinician-Led Reporting System (CLRS) to capture the rate of RSV infections in German pediatric hospitals. This CLRS is an openly accessible, public resource. Accordingly, all data presented in the report on pediatric RSV, related respiratory support, and hospitalization rates also were made publicly available via the DGPI website [4]. The CLRS was promoted via the websites of the DGPI and the German Society of Pediatrics (DGKJ) and additionally was announced in a newsletter sent to all German pediatric hospitals. From October 18, 2021, to March 31, 2022, participating hospitals (Fig. 1) submitted data on RSV-positive children admitted to German pediatric hospitals. The number of RSV cases on general pediatric and intensive care wards was documented daily. Patient age and type of respiratory

Introduction

Respiratory syncytial virus (RSV) infection is a leading cause of hospitalizations in infants and young children worldwide [1]. During 2021–2022, public health measures implemented to mitigate the effects of the COVID-19 pandemic disrupted the transmission of endemic respiratory

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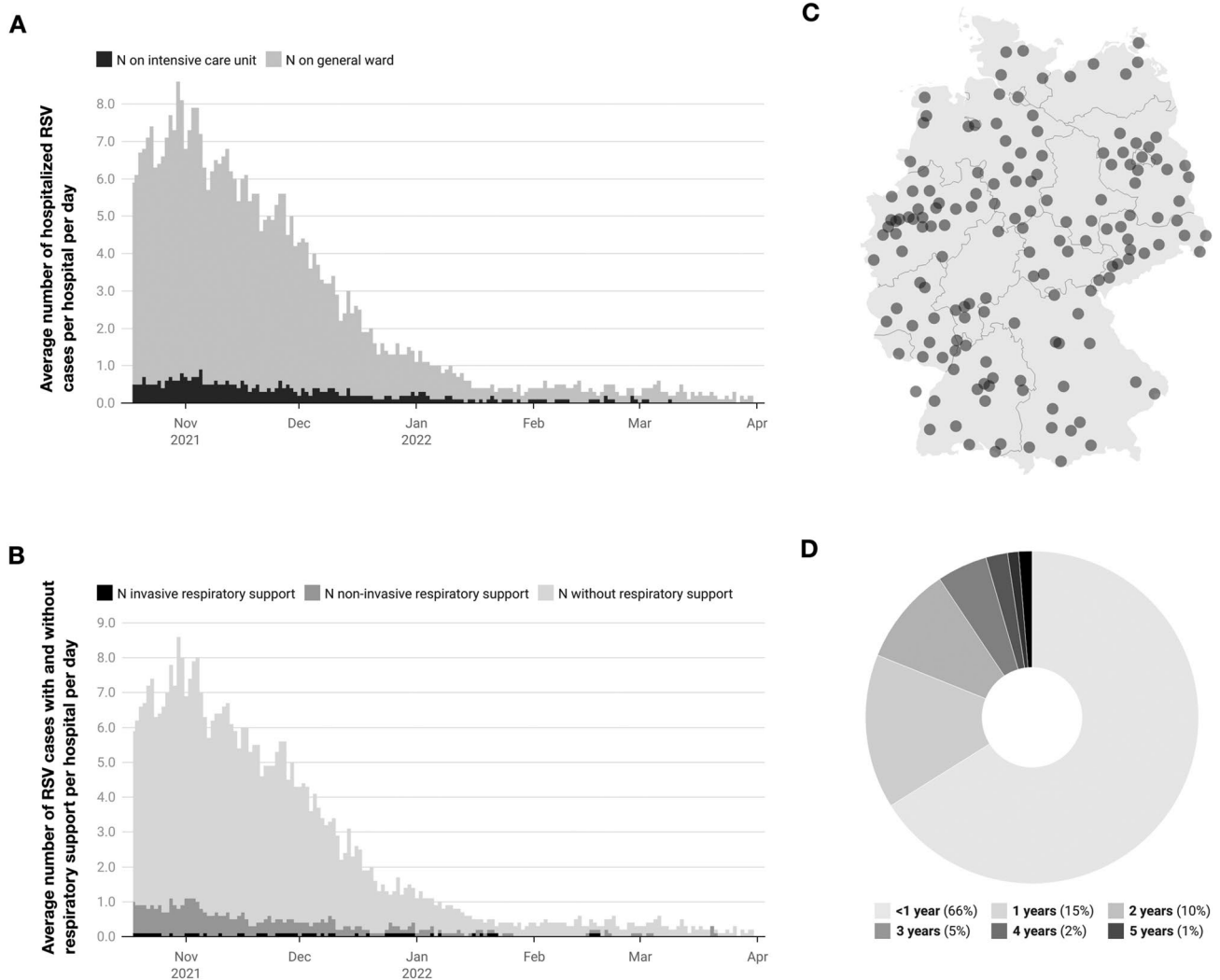


Fig. 1 Burden of RSV hospitalizations in Germany, October 2021–March 2022. **A** Average number of reported RSV cases per hospital per day. General wards and intensive care units are displayed sepa-

ately. **B** Average number of RSV cases with and without respiratory support per hospital per day. **C** German hospitals participating in the RSV CLRS. **D** Age distribution of RSV cases admitted to hospital

support (invasive vs. non-invasive) were recorded. A further subanalysis was performed of the first 4 months of the monitoring period.

Subsequently, data were compared to those from the open-source network ClinicalVirology.net [5]. Clinical-virology.net–Respiratory Viruses Network (RespVir)–is a network of laboratories across Europe whose primary focus is to report on hospitalized patients with respiratory viruses, including RSV. The majority of participating laboratories are from German university hospitals listed on the Network website. The Respiratory Viruses Network provides weekly updates based on evidence of respiratory viruses that have been recorded in a database portal. Since only aggregated and anonymized data are processed, our institutional review board did not require ethical approval for our study.

Results

During the survey period, an average of $11.3 \pm 6.7\%$ of all German pediatric hospitals participated in the CLRS. At the high point, the number of hospitals reporting cases was 100 (27.8%; November 9, 2021), whereas the low point was 4 (1.1%; March 27, 2022) [median of reporting hospitals: 37 (11%)]. Most RSV cases were entered into the CLRS in October, November, December, and January, during which 67, 75, 46, and 28 hospitals reported patients, respectively. After January, the average case rate and number of reporting hospitals dropped significantly, with 18 reporting in February and 11 in March (Supplemental Table 1). In total, 471 hospitalized children with RSV per day were reported in October, with the number

dropping to three cases in March. On general wards and intensive care units, the median of hospitalized children was 133 and 15, respectively (Supplemental Table 1).

Hospitalizations peaked in late October/early November 2021 (Fig. 1). At their height, the total number of new hospitalizations was 240; by mid-January, the number decreased to two. In the subanalysis covering the October–January period, an average of 3.6 ± 2.2 cases per hospital per day was recorded on general wards (median 4 cases; range 0.3–8 cases), whereas 0.4 ± 2.2 cases were seen on intensive care units (median 0.3 cases; range 0–0.9 cases) (Fig. 1). The vast majority of patients did not require invasive ventilation (88.5%). Of those receiving respiratory support (11.5%), 10.2% were provided non-invasive support, such as CPAP, NIV, or high-flow therapy; only 1.3% required ventilation (Fig. 1). A preponderance of cases was under 2 years old (81%), with 66% being < 1 year (Fig. 1).

A comparison of our CLRS data with those from ClinicalVirology.net demonstrated higher RSV case numbers during the late fall/early winter 2021–2022 season than at any other point since 2009 (Supplemental Fig. 1).

Discussion

Due to COVID-19 mitigation measures, the classical seasonality of RSV was dramatically impacted. During both the first and second lockdown periods in Germany, an overall decrease in viral infections was observed [2, 3].

These trends in Germany followed spatiotemporal patterns for respiratory viral pathogen epidemics worldwide. A recent Australian study showed that in 2020–2021, the RSV season started in early summer instead of the preceding fall/winter, with disease severity similar to that of previous years. As in our survey, these authors reported a higher RSV hospitalization rate as compared to previous years, with an increase in RSV infection rates among children 2 to 4 years old. In our cohort, by contrast, the majority was under 2 years old [1]. A study from the United Kingdom also showed a higher median age in the pandemic cohort as compared to the pre-pandemic cohort (1.8 yr vs. 0.3 yr) [2]. These UK data additionally indicate that RSV cases remained suppressed during the first 15 months of the pandemic—significantly longer than for rhinovirus and adenovirus [2]. In the northern hemisphere (e.g., in Catalonia, Spain), the 2020–2021 RSV season was delayed by 5 months and had a higher magnitude [6], whereas in the Southern hemisphere (e.g., Argentina), the RSV season had a similar or slightly smaller magnitude than in previous seasons, although the start was just 10 weeks later than usual [7].

A recent simulation modelling study projected that the 2021–2022 RSV season will be more intense and will affect patients in a broader age range than have previous,

typical RSV seasons [8]. As was predicted in June–October 2021, an extraordinary increase in the number of viral respiratory infections, predominantly caused by human rhinovirus, enterovirus and RSV, was observed after mitigation measures in Germany were scaled back [3]. Our data confirm that the disease burden of 2021–2022 RSV infections was unusually high. A recent publication has suggested that increasing population susceptibility and the full (re)opening of schools may have been a significant potential driver for the 2019 out-of-season RSV epidemic [9]. Because, however, our CLRS only recently had been established, we were unable to evaluate whether the impact on pediatric hospital care was due exclusively to an increase in RSV cases or whether individual cases also were more likely to need respiratory and/or ICU support as compared to previous years. In addition, in individual cases, coinfections with Severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) and/or other respiratory viruses may have contributed to disease severity [10]; these data were not specifically captured by the CLRS.

In the recently published INSPIRE Study, for the period 2015–2018, RSV was shown to increase the burden of hospitalized children (≤ 5 years) in Germany, particularly among preterm infants and those < 6 months old [11]. In contrast to our CLRS, however, the authors analyzed not only intensive care unit (ICU) admissions, but also hospital length of stay on general wards and ICUs, supplemental oxygen demand and medication usage. Further limitations of our study include the CLRS's slightly delayed start at the beginning of the RSV epidemic, the uneven participation of German pediatric hospitals, and potential missing negative reports.

In January 2021, the multicenter database EpiCH began collecting data on RSV infections among hospitalized children in Switzerland [12]. Our CLRS expanded upon EpiCH's approach by additionally collecting data on the necessity for respiratory support, an aspect which enabled reporting on national and potentially regional impacts for general wards and intensive care units. In April 2022, the CLRS had paused its monitoring of RSV infections since the number of cases and reporting hospitals had significantly decreased, dropping from 471 cases per day in October to 3 per day in March 2022, and from 67 to 11 hospitals, respectively [4]. For this reason, our subanalysis focused on the months in which the highest number of RSV infections was reported and a representative proportion of clinics were submitting data in the system.

In sum, our CLRS provides a vital tool for healthcare professionals and national policy-makers when assessing, evaluating, and allocating pediatric hospital care resources. High participation rates among hospitals, as well as the quality of data submitted, are essential to the value the CLRS is able to deliver.

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Author contributions TT, RB, and JA conceived the study and its design, had full access to the data, and take responsibility for the integrity of the data and accuracy of the analysis. MD, ND, and JA organized and entered data. TT, MD, ND, RB, and JA contributed to data analyses. TT, MD, ND, RB, and JA had access to the underlying data for verification. TT, MD, ND, RB, and JA contributed to data interpretation. TT, MD, ND, RB, and JA wrote the main draft of the manuscript. All authors contributed to the final drafting of the manuscript.

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Availability of data and materials Not applicable.

Code availability Not applicable.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Ethics approval Since only aggregated and anonymized data were processed, our institutional review board did not require ethics approval for the study.

Consent to participate Not applicable.

Consent to publish Not applicable.

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