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Management of Respiratory Viral Infections in Children

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Abstract. **Background:**Respiratory viral infections are a major cause of morbidity and mortality in children, posing a significant burden on healthcare systems. A proper understanding of the epidemiology, diagnostic methods, and management strategies is essential to improve paediatric care and avoid the unjustified use of antibiotics, thereby contributing to the fight against antimicrobial resistance. **Aim:** This study aims to provide a comprehensive synthesis of the literature on respiratory viral infections in children, focusing on the role of antibiotics and the importance of preventive measures. **Methodology:** For this literature review, an initial 87,000 articles were identified from seven databases, following the PRISMA protocol. After removing duplicates and applying exclusion criteria, 200 articles were reviewed, of which 43 were selected for the final synthesis**. Results:** The study highlights the diversity of viral agents involved, including RSV, influenza viruses, and rhinoviruses. It emphasizes that antibiotics are effective only in cases of bacterial superinfections. Vaccination and hygiene measures are crucial for prevention, while health education plays a central role in reducing infection incidence. **Conclusions:** Optimal management of respiratory viral infections in children requires a multidisciplinary approach centred on prevention and accurate diagnosis. The study underscores the need for evidence-based protocols, as well as the importance of education and hygiene measures in paediatric communities. These findings provide a solid foundation for developing tailored health policies and contribute to improving clinical practices in paediatrics.

Keywords. respiratory viral infections in children, antibiotics in viral infections, pediatric infection prevention, management of respiratory infections in children, management of respiratory infections.

1. Introduction

Respiratory viral infections are among the leading causes of morbidity and mortality in children worldwide [1, 2]. These infections have been found to pose a significant burden on healthcare systems, particularly in resource-limited countries where access to adequate medical care may be insufficient [3]. For instance, the World Health Organisation estimates that millions of children under the age of five are affected annually by infections such as influenza, respiratory syncytial virus (RSV), or rhinoviruses, leading to a substantial number of hospitalisations and associated deaths [4]. Beyond

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their impact on individual health, these conditions also impose significant social and economic costs [5].

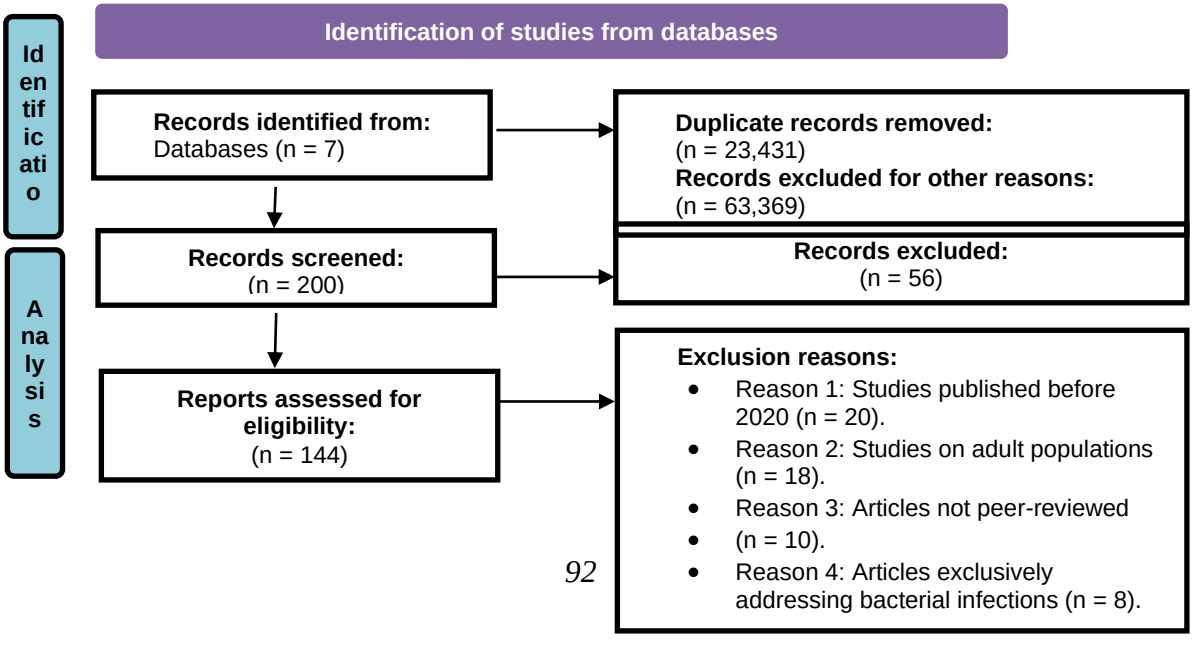
Given the high prevalence and impact of these illnesses, an effective approach to managing respiratory viral infections is essential. Despite advances in diagnostic tools and treatment options, respiratory infections remain a significant challenge. Preventive interventions such as vaccination and hygiene measures continue to be key strategies, yet they are often underutilised, particularly in less developed regions [6]. Furthermore, the development of specific antivirals for paediatric use remains limited, and viral resistance is becoming an emerging concern [7].Children possess distinct immunological characteristics that make them particularly vulnerable to respiratory viral infections. Their immune systems, particularly in infants and young children, are underdeveloped, reducing their ability to respond effectively to pathogens [8]. This immunological immaturity is associated with an increased risk of severe complications such as bronchiolitis and pneumonia [9]. Another critical challenge is the difficulty of early and accurate diagnosis of these infections. Non-specific symptoms such as fever, cough, and nasal congestion are common across various infections, which can delay the initiation of appropriate treatment [10]. Additionally, administering medications to children often requires specific adjustments to dosage and pharmaceutical formulations to minimise risks and side effects.Considering these factors, this study aims to provide a detailed and integrated analysis of the epidemiological factors, diagnostic methods, and management strategies for respiratory viral infections in children.

2. Materials and Methods

The research methodology for this study was developed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This framework was employed to ensure transparency and rigour in the selection, analysis, and synthesis of the literature.

The primary research question was: What are the most effective practices in the epidemiology, diagnosis, management, and prevention of respiratory viral infections in children, with a focus on antibiotic use and preventive strategies?To address this question, a systematic search was conducted across seven major databases: Mdpi, Taylor & Francis, Frontiers, Springer, Nature, The Lancet Global Health, and Elsevier. The keywords used included: "respiratory viral infections in children" (21,000 results), "antibiotics in viral infections" (16,800 results), "pediatric infection prevention" (21,800 results), "management of respiratory infections in children" (27,400 results). Boolean operators (AND, OR) were applied to combine search terms. The search was restricted to articles published between 2020 and 2024 and available in English.

Inclusion criteria: articles published between 2020 and 2024, original studies, systematic reviews, clinical guidelines, and international reports addressing respiratory viral infections in children, the role of antibiotics, and prevention.Exclusion criteria: studies published before 2020, studies focusing on adult populations, articles not peer-reviewed, studies exclusively addressing bacterial infections.



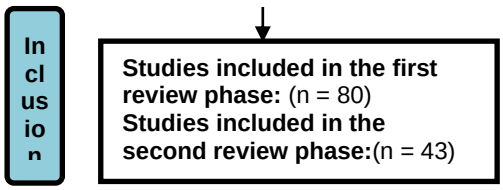


Figure 1.PRISMA Flow Diagram of articles related to Respiratory Viral Infections in Children

The PRISMA flow diagram presented in Figure 1 illustrates the selection process for articles related to respiratory viral infections in children. 7 databases were identified, which generated a total of 87,000 results. After the removal of duplicate records (23,431) and those excluded for other reasons (63,369), 200 records remained for screening. During the analysis phase, 56 records were excluded based on the established criteria, and 144 reports were assessed for eligibility. In the end, 80 studies were included in the first review phase, and 43 were included in the second phase, being considered relevant for analysis.

3. Results

Respiratory viral infections in children represent a significant public health challenge, with considerable impacts on quality of life and the healthcare costs associated with their management. To better understand the complexity of these conditions, a structured analysis is helpful, encompassing the main viruses involved, risk factors, seasonality, geographical distribution, clinical manifestations, and common complications. Table 1 summarises these aspects, incorporating relevant data from the literature to provide a clear overview of the main epidemiological and clinical characteristics.

Table 1. Epidemiological Analysis, Risk Factors, and Clinical Manifestations of Respiratory Viral Infections

Criteria	Description	Relevant examples	Authors and year
Main viruses involved	Analysis of major respiratory pathogens responsible for viral infections.	RSV [bronchiolitis, higher risk in infants], Influenza [seasonal flu], Rhinovirus [common cold].	van Doorn and Yu, 2020 [1]; Geppe et al., 2023 [11]; Al-Harrasi and Bharia, 2022 [12].
Risk factors	Identification of elements that increase susceptibility to respiratory viral infections.	Young age, group settings [daycare, schools], asthma, exposure to crowded environments or tobacco smoke.	Balasubramani et al., 2022 [13]; Cortes-Ramirez et al., 2021 [14]; Islam et al., 2024 [15]; Han et al., 2020 [16].
Seasonality and geographical distribution	Influence of seasons and regional distribution on infection incidence.	RSV: cold season; Rhinoviruses: autumn/spring; Coronaviruses: global distribution.	Suryadevara and Domachowske, 2021 [17]; Chadha et al., 2020 [18]; Thongpan et al., 2020 [19]; Zimmermann and Curtis, 2020 [20]; Wang et al., 2020 [21].
Common symptoms and clinical progression	General clinical manifestations observed in patients with respiratory viral infections.	Cough, fever, rhinorrhoea, laboured breathing; more severe symptoms in infants.	Basa and Sovtić, 2022 [22]; Zhao et al., 2022 [23].
Age-Based symptom	Differences in symptomatic	Infants: noisy breathing, bronchiolitis;	Douros and Everard, 2020 [24]; Biary and Desai, 2024 [25];

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variability	presentation of infections depending on the age group.	Preschoolers: cough, fever; School-aged children: flu-like symptoms.	Haddadin et al., 2021 [26]; Jung et al., 2020 [27]; Streng et al., 2022 [28]; Macias Reyes et al., 2023 [29]; Tempte et al., 2022 [30].
Common complications	Assessment of complications associated with respiratory viral infections in paediatrics.	Pneumonia, bronchiolitis, asthma exacerbations, otitis media, bacterial superinfections.	Paul, 2024 [31]; Das, 2020 [32]; George and Govindaraj, 2023 [33].

As observed, Table 1 provides an integrated perspective on the main epidemiological and clinical characteristics, as well as risk factors associated with respiratory viral infections in children. This information highlights the complexity of managing these conditions, underscoring the need for preventive strategies, early diagnosis, and tailored treatment, with a focus on paediatric-specific considerations. Strengthening knowledge from the literature can support the development of more effective interventions and reduce the global burden of these infections.

Accurate diagnosis of respiratory viral infections in children is essential for the proper management of these conditions and to avoid unnecessary antibiotic use. The diagnostic process involves a detailed initial clinical evaluation, supplemented by specific diagnostic tests to identify the pathogen. Differentiating between viral and bacterial infections is also critical to prevent complications and guide treatment. Table 2 summarises the main criteria and methods used for diagnosing these infections.

Table2. Criteria for Diagnosing Respiratory Viral Infections in Children

Criteria	Description	Relevant examples	Authors and year
Initial clinical evaluation	The process of collecting clinical data to identify characteristic signs and symptoms of respiratory viral infections.	History: acute onset of symptoms, fever, cough; Examination: lung auscultation, signs of respiratory distress.	Castagnoli et al., 2020 [34]; Tsoi et al., 2021 [35]; Buonsenso et al., 2022 [36]; Chen et al., 2019 [37].
Available diagnostic tests	Methods used to confirm the viral aetiology of respiratory infections.	Rapid tests: antigen detection for RSV, influenza; PCR: high-sensitivity viral detection; Imaging: chest X-rays in severe cases.	Cohen et al., 2024 [38]; Lin et al., 2020 [39]; Stefanidis et al., 2021 [40].
Differential diagnosis	Identifying other conditions or complications that may present with similar symptoms.	Bacterial infections: bacterial pneumonia, otitis media; Coinfections: bacterial superinfections following viral infections.	Pichichero et al., 2021 [41]; Meskill and O'Bryant, 2020 [42]; Rossi et al., 2020 [43]; Musuuza et al., 2021 [44].

Table 2 highlights the key approaches to diagnosing respiratory viral infections in children, emphasising the importance of a thorough medical history and clinical examination, as well as the use of modern tests such as PCR and antigen-based diagnostics. Accurate differential diagnosis is essential to distinguish between viral and bacterial infections, thereby reducing the risk of overdiagnosis and inappropriate treatment. These elements contribute to more effective management and improved clinical outcomes in paediatrics. The management of respiratory viral infections in children requires a multidimensional approach, encompassing supportive interventions, selective use of antiviral therapy,

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and management of severe complications. For children with recurrent infections, long-term monitoring and preventive measures are crucial.

Table 3 provides a structured analysis of the main criteria involved in managing these conditions, highlighting clinical interventions and relevant therapeutic considerations.

For ethical and operational aspects, ensuring data privacy and compliance had moderate support, as did training healthcare professionals, while adaptability across clinical environments showed lower evidence.

Overall, AI applications in areas such as telemedicine, early detection, and differential diagnosis have strong support, while aspects like education and operational adaptability require further research.

Table3. Criteria for Managing Respiratory Viral Infections in Children

Criteria	Description	Relevant examples	Authors and year
Initial clinical evaluation	The process of collecting clinical data to identify characteristic signs and symptoms of respiratory viral infections.	History: acute onset of symptoms, fever, cough; Examination: lung auscultation, signs of respiratory distress.	Castagnoli et al., 2020 [34]; Tsoi et al., 2021 [35]; Buonsenso et al., 2022 [36]; Chen et al., 2019 [37].
Available diagnostic tests	Methods used to confirm the viral aetiology of respiratory infections.	Rapid tests: antigen detection for RSV, influenza; PCR: high-sensitivity viral detection; Imaging: chest X-rays in severe cases.	Cohen et al., 2024 [38]; Lin et al., 2020 [39]; Stefanidis et al., 2021 [40].
Differential diagnosis	Identifying other conditions or complications that may present with similar symptoms.	Bacterial infections: bacterial pneumonia, otitis media; Coinfections: bacterial superinfections following viral infections.	Pichichero et al., 2021 [41]; Meskill and O'Bryant, 2020 [42]; Rossi et al., 2020 [43]; Musuuza et al., 2021 [44].

Table 3 outlines the main strategies for managing respiratory viral infections in children, emphasising the importance of supportive care as the foundation of paediatric treatment. While the use of antiviral therapy is limited to specific cases, it can be beneficial when appropriately indicated. Managing severe complications and recurrent infections remains a challenge, requiring interdisciplinary collaboration and personalised measures to minimise the long-term health impact of these conditions.

4. Discussion

Regarding the epidemiology and primary respiratory viruses, the findings in Table 1 emphasise the diversity of aetiological agents involved in respiratory viral infections in children, with respiratory syncytial virus [RSV], influenza viruses, rhinoviruses, adenoviruses, and coronaviruses, including SARS-CoV-2, playing a predominant role. The literature confirms that RSV is the leading cause of severe bronchiolitis in infants, being associated with higher hospitalisation rates in children under two years of age [55]. Furthermore, rhinoviruses are the most frequent cause of upper respiratory tract infections, with increased recurrence in group settings [56]. The seasonality and geographical distribution detailed in the table reflect well-documented seasonal patterns in the literature, with a higher incidence of RSV and influenza viruses during the cold season, a finding also confirmed by Piradashvili and Tabidze [2023] [57].

In terms of diagnosing respiratory viral infections, Table 2 highlights the complexity of the diagnostic process. Clinical evaluation remains a fundamental component, but rapid antigen tests and

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PCR are recognised as gold standard methodologies for confirming viral aetiology [58]. However, the literature points to certain limitations of rapid tests, such as lower sensitivity compared to PCR, which can lead to false negatives in cases with low viral loads [59]. Differential diagnosis between viral and bacterial infections, as discussed in the table, is critically important because inappropriate empirical treatments, such as the overuse of antibiotics, remain a recurrent issue in clinical practice [60].

With respect to the management of respiratory viral infections, the findings summarised in Table 3 indicate that management focuses on supportive care, selective use of antiviral therapy, and addressing severe complications. The literature supports these conclusions, emphasising that supportive treatments [hydration, antipyretics] are essential in most uncomplicated cases [22]. Antiviral therapies, such as oseltamivir for influenza and remdesivir for SARS-CoV-2, are reserved for cases with clear indications, with limited benefits in advanced stages or mild forms [61]. Regarding severe complications, such as acute respiratory failure, critical interventions, including non-invasive ventilation and intensive care, are supported by recent studies that show reduced mortality through these strategies [62].

In the specialised literature, an integrated approach to respiratory viral infections in children is described as essential. For instance, understanding seasonality and epidemiological risk factors improves diagnostic strategies by enabling more targeted use of tests. Furthermore, accurate differential diagnosis between viral and bacterial infections contributes to preventing severe complications and reducing unnecessary antibiotic use, a point supported by Tsao et al. [2020] [63]. The management of recurrent infections, mentioned in Table 3, is particularly relevant for children with prolonged exposure to group settings, where the literature recommends long-term monitoring and preventive vaccination to reduce the incidence of severe infections [64].

The Role of Antibiotics in Managing Respiratory Viral Infections

Antibiotics are not effective against respiratory viral infections, and their unjustified use can have significant negative consequences [65]. One of the most common mistakes in medical practice is the automatic association between respiratory infection symptoms and the need for antibiotic therapy. This contributes to the development of antimicrobial resistance, a global public health issue, and exposes patients to unnecessary adverse effects, such as gastrointestinal disturbances or allergic reactions. It is essential that the decision to prescribe antibiotics be based on clear clinical and diagnostic criteria.

In cases of complicated respiratory viral infections, antibiotic therapy may only be indicated when there are clear signs of bacterial superinfection. Secondary bacterial pneumonia, otitis media, or bacterial sinusitis are examples of situations that may require antibiotic intervention [66]. These cases are identified through clinical signs such as persistent fever, worsening respiratory symptoms after a period of improvement, or suggestive radiological findings. The role of the physician is crucial in distinguishing these scenarios to avoid unnecessary empirical treatments.

Preventing Respiratory Viral Infections in Children

Prevention is essential in reducing the incidence and severity of respiratory viral infections in children. Vaccination plays a central role in this regard. Vaccines for seasonal influenza and COVID-19 are available and have proven effective in preventing severe forms of these diseases. The development of a vaccine for respiratory syncytial virus [RSV] represents a promising advancement, with the potential to significantly reduce hospitalisation rates associated with bronchiolitis and pneumonia in infants and young children [67].

Hygiene measures and behavioural prevention are other key components in limiting the spread of viral infections [68]. Proper handwashing, wearing masks during outbreaks, and isolation in case of illness are simple yet effective practices. These measures not only reduce the risk of infection but also support collective health, particularly in large group settings such as schools and nurseries.

Health education plays a fundamental role in raising awareness about preventive measures. Parents and children must be informed about the importance of personal hygiene, vaccination, and isolation

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when ill [69]. Additionally, implementing educational programmes in schools and nurseries can help establish long-term healthy habits, thereby reducing the burden of respiratory viral infections among children.

5. Conclusions

Respiratory viral infections represent a major challenge in paediatrics, with high prevalence and a significant impact on children's health, particularly among those under the age of five. This analysis highlights the importance of an integrated approach that includes prevention, early diagnosis, and effective management of these conditions, while considering their epidemiological and clinical characteristics.

In terms of epidemiology, respiratory syncytial virus (RSV), influenza viruses, rhinoviruses, adenoviruses, and coronaviruses are the primary pathogens involved. Each of these pathogens exhibits distinct characteristics related to seasonality, geographical distribution, and risk factors, such as young age, exposure to crowded settings, and pre-existing comorbidities. The literature confirms that these factors contribute to the high incidence of respiratory viral infections and the variability of clinical manifestations.

Accurate and timely diagnosis is essential for optimal management. Clinical evaluation remains a key step, but the use of modern diagnostic tools, such as PCR and rapid antigen tests, significantly improves diagnostic accuracy. It is also crucial to differentiate between viral and bacterial infections to avoid overdiagnosis and the unnecessary use of antibiotics—a common practice that can lead to bacterial resistance.

The management of respiratory viral infections involves supportive treatments, such as hydration and antipyretics, which are vital for uncomplicated cases. Antiviral therapy, while useful in specific cases—such as oseltamivir for influenza or remdesivir for SARS-CoV-2—is limited by factors such as cost, efficacy, and restricted clinical indications. In severe cases, critical interventions, including non-invasive ventilation or intensive care, play a central role in saving children's lives.

Finally, managing recurrent infections and preventing long-term complications, such as post-viral asthma, highlights the need for continuous monitoring and the implementation of effective preventive measures. Such an integrated approach can significantly reduce the burden of these conditions on paediatric health and global healthcare systems.

The findings from this analysis, combined with the literature, underscore the importance of preventing respiratory viral infections through measures such as influenza vaccination and respiratory hygiene. Additionally, the results support the adoption of an evidence-based clinical protocol, incorporating rapid diagnostic tests and personalised treatments, thereby reducing the disease burden on children and healthcare systems.

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