

Advancing Public Health Through Vaccination: A Narrative Review of Respiratory Syncytial Virus (RSV) Immunization Strategies

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Abstract

RSV is a significant factor in causing lower respiratory tract infections in children, especially among infants and toddlers. Different age groups are affected by RSV in distinct ways, specifically affecting young children and elderly. People who are immunocompromised are more susceptible to RSV. Centres for Disease Control and Prevention has recommended vaccination doses with the age group to prevent mortality associated with RSV. Signs and symptoms often resemble common cold in coughing, decreased appetite, runny nose, etc. Additionally, RSV not only provides protection to the pregnant mother, but also to the growing fetus. If the mother had taken immunization within the past 14 days of childbirth, the child until his/her 8 months is not necessary to take additional RSV vaccine, as the vaccine taken by mother provides protection for the child. Hospitalizations are mostly required in severe elderly RSV-associated pneumonia. Coordination of immunization strategies, awareness and suitable protocol of administration may help reach out to people at risk of getting RSV infection. Monoclonal antibodies plays an important role in preventing RSV infections. Several ongoing and future studies may help reveal clues towards more advanced immunization practices. Continued research and investment in RSV immunization efforts are crucial for achieving long-term public health goals and reducing the global impact of this infectious disease. Beyond several challenges that hurdle the vaccine development and administration, vaccines are administered and they help in reducing the global burden by preventing RSV-associated hospitalization and mortality in all age groups.

Keywords: Respiratory syncytial virus (RSV), immunization, monoclonal antibody, vaccines, signs and symptoms, public health, fetal protection.

INTRODUCTION

Respiratory Syncytial Virus (RSV) is a paramyxovirus primarily affecting the respiratory tract [1]. It is a leading global cause of acute respiratory infections, especially in elderly persons, young children, and babies. RSV infections can cause many symptoms, it may range from minor cold-like symptoms to serious lower respiratory tract infections (LRTI) like pneumonia and bronchiolitis. Different age groups are affected by RSV in different ways, including infants, young children, adults, and elderly individuals. Severe RSV disease can particularly affect infants and young children. RSV-related hospitalizations and mortality makes it a major public health concern. RSV causes between 58,000 and 80,000 hospital admissions and between 100 and 300 catastrophic fatalities among children under the age of five each year. In this age range, RSV can result in more serious respiratory diseases including pneumonia or bronchiolitis. Early signs and symptoms in kids and babies include coughing,

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runny noses, and decreased appetite. Coughing fits might become more severe and cause wheezing and breathing difficulties. Risk factors include prematurity, long-term lung illness, compromised immune systems, neuromuscular conditions, and trouble swallowing or removing mucus [2]. Teenagers are less likely to experience severe RSV illness, although certain medical conditions or compromised immune systems can increase their risk. Teens may experience runny nose, decreased appetite, coughing, sneezing, fever, or wheezing in addition to other symptoms. The majority of adults also experience moderate RSV respiratory symptoms. On the other hand, people being immunocompromised or with particular medical disorders can be more vulnerable. Severe RSV problems are more likely to occur in older persons, particularly in those over 65. In this age range, RSV-related pneumonia can be more hazardous, increasing the risk of hospitalization or even death. To shield older persons from the morbidity and mortality associated with RSV, vaccination and preventive interventions are essential [3].

The prevention of RSV infections is greatly aided by vaccinations. Although there isn't a certified RSV vaccine on the market just yet, encouraging advancements are being made in this field. By transferring maternal antibodies, for example, immunization of the mother with an RSV vaccine candidate during pregnancy has demonstrated possible protection for the fetus. Furthermore, in high-risk neonates, monoclonal antibody medicines like palivizumab are utilized to prevent severe RSV disease. In particular for vulnerable individuals, these preventative strategies are crucial for lowering hospitalizations and morbidity associated with RSV [4].

EPIDEMIOLOGY AND BURDEN OF RSV

RSV is a significant global health concern, particularly due to its impact on vulnerable populations. For children under five, it is the main cause of acute lower respiratory tract infections. Infections with RSV in this age group are thought to occur globally at a rate of 17.0 cases per 1000 persons [5]. Severe illnesses such as pneumonia and bronchiolitis can result from these infections [6]. RSV affects older persons as well, particularly those who are 70 years of age or older. For this age group, the global incidence of RSV infections is roughly 6.3 cases per 1000 persons. For older persons, RSV-related pneumonia can be more deadly, increasing the risk of hospitalization and possibly death. Adults who have underlying medical issues are more vulnerable to serious RSV disease. RSV infections have been increasingly reported in adults, and the number of cases in older adults in high-income countries can be substantial [7]. According to some estimates, there were 10.9 million RSV cases among older persons, which led to a considerable number of hospitalizations and fatalities [5]. Every year, RSV exhibits a dependable seasonal pattern; however, the alternating subtypes A and B can have an effect on the virus' epidemiology. The number of hospitalizations and clinical severity are influenced by genetic variants seen in RSV strains [8]. RSV dynamics were also impacted by the COVID-19 pandemic, which resulted in a brief drop in infections before a comeback [5].

CLINICAL MANIFESTATIONS AND RISK GROUPS

The clinical presentation of RSV infections focuses both on upper and lower respiratory tract involvement (Table 1).

Table 1. Clinical presentation of RSV infections.

Clinical feature	Upper respiratory tract	Lower respiratory tract
Initial symptoms	Rhinitis (runny nose), mild cough, low-grade fever	Progression from mild symptoms to more severe manifestations
Coryza	Nasal congestion and discharge	-
Cough	Persistent, mild cough	Worsening cough
Tachypnea	-	Rapid breathing, especially in infants and young children
Labored breathing	-	Dyspnea (shortness of breath), retractions of chest wall
Severe cases	-	Can lead to bronchiolitis and pneumonia
Age groups affected	All age groups	Infants, young children, older adults
Risk factors	-	Prematurity, chronic lung disease, weakened immune systems
Severity in older adults	-	RSV-related pneumonia can be dangerous

Initially, patients experience mild upper respiratory symptoms like runny nose and cough. As the infection progresses, it affects the lower respiratory tract, leading to tachypnea, labored breathing, and potentially severe conditions such as bronchiolitis and pneumonia. The severity varies by age group, with infants, young children, and older adults being particularly vulnerable. Preventive measures and vigilance are crucial to manage RSV-related morbidity and hospitalizations [9].

RSV is a highly contagious virus that affects people of all ages. RSV can cause serious lower respiratory tract infections in newborns and early children, such as pneumonia and bronchiolitis. Particularly at risk are premature babies, people with congenital cardiac conditions, and people with long-term lung diseases. Serious RSV disease is also a risk for older persons, especially those over 70. RSV-related pneumonia is a serious concern. Adults who suffer from long-term illnesses (such as lung or heart disease) are also more vulnerable. The symptoms manifest clinically in a variety of ways, ranging from minor runny nose to wheezing and difficulty breathing. Monoclonal antibody products and maternal immunization are important preventive interventions that can lower hospitalizations and morbidity associated with RSV [10].

RSV VACCINE AND AGE GUIDELINES

The CDC has recommended RSV immunization schedules for some range of age groups. The U.S. Food and Drug Administration has granted permission for the injection of two RSV vaccinations to older persons over 60: GSK Arexvy and Pfizer Abrysvo [11]. The first RSV vaccination for older persons is called Arexvy and is produced by GSK. A portion of the RSV virus is included in each of these vaccinations. In the event of a subsequent RSV infection, they function by inducing an immune response that may offer defense against lower respiratory tract disease (LRTD) [12]. The vaccination has an acceptable safety profile and is usually well accepted. Myalgia, headache, arthralgia, injection site pain, and exhaustion were the most commonly reported requested adverse effects. These were generally mild to moderate and transient [13].

Nirsevimab (Beyfortus) is a vaccine that is advised for all newborns under 8 months old who are either starting or have completed their first season of RSV infection and are younger than 20 months of age. Nirsevimab is not usually necessary for infants under 8 months old who were born at least 14 days after their mother received the RSV vaccine [11].

Furthermore, for certain children between the ages of 8 and 19 months who are starting their second RSV season and are at a higher risk of developing severe RSV disease, nirsevimab is recommended. Hospitalization rates are highest in the first few months of life and fall as newborns and early childhood age [14].

The CDC advises expectant mothers to follow two precautions to protect their unborn child from serious RSV infections. There are two ways to do this: either give RSV immunization directly to infants and some older babies or use Pfizer's bivalent RSVpreF vaccine (Abrysvo) to pregnant women between 32 and 36 weeks gestation, especially during RSV season. When moms take the RSV vaccine at least two weeks before giving birth, their babies usually become protected and may not require a follow-up RSV vaccination [15].

IMMUNIZATION STRATEGIES FOR RSV PREVENTION

Importance of Immunization

RSV is a significant cause of morbidity and mortality, particularly in infants, young children, and older adults. Immunization plays a crucial role in preventing RSV-related complications. Despite the lack of a licensed RSV vaccine at this time, research on mother immunization during pregnancy is still being conducted. Passive immunity can be provided by maternal antibodies given to the fetus, shielding the infant throughout the delicate first few months of life. Moreover, the goal of vaccination campaigns is to lower the total number of hospitalizations and serious illnesses linked to RSV.

Available Vaccines and Efficacy

Palivizumab

A monoclonal antibody product given to newborns at high risk, palivizumab is not a vaccination. It works by targeting the fusion protein on the surface of the virus to provide passive protection against RSV. When used in conjunction with palivizumab, severe RSV disease has been shown to reduce hospitalizations in preterm newborns and those with particular medical problems [16].

Current RSV Vaccine Research

A number of potential RSV vaccines are undergoing clinical testing. These consist of vector-based vaccinations, live attenuated vaccines, and subunit vaccines. In order to avoid or lessen the severity of an RSV infection, the objective is to boost the immune system. Achieving long-lasting protection, preventing disease increased by vaccines, and regulating immune responses are some of the challenges faced in the creation of vaccines [17].

Monoclonal Antibody Products

Monthly administration of palivizumab during RSV season lowers the risk of severe RSV illness in high-risk newborns. It is advised for premature babies born before 29 weeks of pregnancy, babies with long-term lung conditions, and babies with serious congenital heart defects that affect their hemodynamics.

Nirsevimab is a new monoclonal antibody that has demonstrated promising results in clinical trials. It targets a conserved location on the virus to offer prolonged protection against RSV. If authorized, it might improve RSV preventive measures.

To protect newborns and young children from severe RSV infections, a comprehensive approach to RSV prevention includes maternal immunization, ongoing vaccine research, and the strategic use of monoclonal antibody products [18].

CHALLENGES AND FUTURE DIRECTIONS IN RSV VACCINE DEVELOPMENT

Challenges

- *Antigenic diversity:* RSV has a wide range of antigenic variations, with several strains existing at the same time. It is still difficult to develop a vaccination that offers comprehensive defense against every strain [17].
- Historically, there has been a chance that RSV vaccine candidates will develop a condition that is increased by vaccination. It is essential to regulate immune responses to avoid aggravating disease and preventing severe sickness [18].
- *Maternal immunization:* Although this approach seems promising, further research is needed to determine the best time, dose, and longevity of antibodies that are delivered.
- *Efficacy in elderly people:* It's critical to develop vaccinations that work well in older people, who frequently have weakened immune systems.

Research and Development in Progress

- *Subunit vaccines:* Current studies investigate subunit vaccines that aim to target the RSV fusion (F) protein. These seek to minimize disease increased by vaccination while inducing neutralizing antibodies.
- *Vaccinations:* Research is being done on live-attenuated RSV vaccinations. It is crucial to strike a balance between preserving immunogenicity and attenuation for safety.
- *Vector-based vaccines:* Research is being done on viral vectors that express RSV antigens, such as the measles virus and adenovirus. Strong immunological responses are possible with these platforms [19].
- *Nirsevimab:* Targeting a conserved RSV location, this new monoclonal antibody exhibits prolonged protection. Research is being done on its function in preventative tactics.

- *Adjuvants*: Adjuvants improve vaccination responses (MF59, AS01, etc.). Their addition to RSV vaccinations could increase their effectiveness.
- *Prime-boost strategies*: The goal of sequential vaccination delivery, or “prime-boost,” is to improve immunological memory.
- *Global collaboration*: International collaboration accelerates RSV vaccine development, sharing data and insights. In summary, overcoming challenges requires innovative approaches, rigorous clinical trials, and a commitment to protecting vulnerable populations from RSV [20].

CONCLUSION

This narrative review concludes by highlighting the important role that immunization plays in improving public health and preventing RSV infections. This review also delves into the burden and clinical manifestations of moderate to severe forms of RSV infections in all the age groups. We have emphasized the significance of preventive measures in preventing RSV-related infections through a thorough examination of various immunization regimens, particularly among susceptible populations like infants, pregnant women, and older persons. We may lessen the burden of RSV-associated morbidity and mortality by putting into practice efficient immunization programs and raising public awareness about RSV vaccinations. This will ultimately enhance the well-being of communities and improve the quality of life for individuals across all age groups. Sustained investigation and funding of RSV vaccination campaigns are essential to attaining long-term public health objectives and mitigating the worldwide consequences of this contagious illness. People need to realize the importance of vaccination in prevention of severe infectious diseases like RSV and should come front to get immunized periodically. Future studies should focus on the importance, safety, and efficacy of vaccine-preventable diseases and it's immunization practices.

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Conflict of Interest

All the authors declared no conflict of interest

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