Cost-effectiveness of prophylaxis with palivizumab among high-risk children in Hong Kong: abridged secondary publication

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KEY MESSAGES

1. Prophylaxis with palivizumab administered after start of respiratory syncytial virus seasons identified by moving epidemic method (ie, one-peak seasons typically starting in April and ending in October or later) was the most cost-effective strategy when used for infants with congenital heart disease and Down syndrome or extreme preterm delivery with bronchopulmonary dysplasia.
2. Our findings can provide insights into further investigations concerning long-lasting monoclonal antibodies and vaccines.

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Introduction

Respiratory syncytial virus (RSV) causes acute respiratory tract infections in humans every year, including bronchiolitis and pneumonia in children aged <5 years and insidious respiratory illness in older adults. Prophylactic therapy with the monoclonal antibody, palivizumab, has been recommended by the American Academy of Pediatrics (AAP) to reduce occurrences of severe RSV infection in high-risk infants. However, there has been a lack of consensus concerning the target population and treatment schedule, given the high treatment cost and regional variations in RSV seasonality.[1] We conducted this study to systematically evaluate the cost-effectiveness of palivizumab in reducing the burden of RSV-associated disease in Hong Kong, considering the seasonal patterns and health impact of RSV in the local population.

Methods

Data for age-specific weekly hospitalisation between 1998 and 2015 in Hong Kong were obtained from the Hospital Authority. Data for weekly rates of respiratory virus detection in sentinel surveillance samples were provided by the Centre for Health Protection, as were data for weekly rates of influenza-like illness consultations at sentinel outpatient clinics. Data for hospitalised infants with laboratory-confirmed RSV infection between 2004 and 2011 were collected from two public hospitals (Queen Mary Hospital and Pamela Youde Nethersole Eastern Hospital), including dates of birth, admission and discharge, gestational age at birth, high-risk conditions, and test results of RSV infection, as well as infants with potentially high RSV infection risk but no laboratory-confirmed RSV infection during hospitalisation. Seven high-risk groups were investigated based on recommendations from the AAP[2]: (1) extreme preterm delivery (born at ≤28 weeks gestational age) with or without (2) bronchopulmonary dysplasia and with (3) chronic lung disease or bronchopulmonary dysplasia, (4) haemodynamically significant congenital heart disease, (5) Down syndrome, (6) neuromuscular impairment, and (7) congenital heart disease and Down syndrome.

Results

We first examined the population-level impact of RSV infection on respiratory hospitalisation in Hong Kong among infants aged <1 year, children aged 1-5 years, and older adults aged ≥65 years. Then, we characterised RSV seasonality by three approaches: (1) time series analysis of the standardised weekly ratio of RSV-associated hospitalisation estimated as the weekly RSV-associated excess respiratory hospitalisation rate among infants divided by the maximum weekly excess respiratory hospitalisation rate in the same year according to regression models, (2) a moving epidemic method, and (3) a threshold method that analysed RSV virus activity based on sentinel surveillance. The results showed that Hong Kong, a subtropical city, had a prolonged RSV season in most years, without regular epidemic peaks. RSV activity generally started between February and March every year and remained relatively high for 6 months during which >80% of RSV-associated respiratory hospitalisations occurred.

Based on the RSV seasonality in Hong Kong, the cost-effectiveness of palivizumab use in the high-risk groups was estimated by decision tree analysis. The incremental cost-effectiveness ratio (ICER) was measured as the change in cost per hospital admission prevented (HAP) under the following four strategies: (1) prophylaxis administered in the weeks with the highest RSV-attributable burden of hospitalisation (weeks 12 to 18, and 27 to 38); (2) prophylaxis administered after start of RSV seasons identified by moving epidemic method (ie, one-peak seasons typically starting in April and ending in October or later); (3) prophylaxis administered after start of RSV seasons determined by the threshold method (ie, one-peak annual seasons between weeks 5-10 and 40-45, based on a threshold of the 30th percentile of weekly RSV activity in that year); (4) prophylaxis administered throughout the year (weeks 1 to 52), whereby each high-risk infant received an injection of palivizumab once per month.

Strategy 2 was superior because it showed the lowest estimated ICERs to prevent one RSV-associated hospital admission. Strategy 1 showed slightly higher estimated ICERs for different risk groups. Strategy 2 was generally more cost-effective when used for infants with congenital heart disease and Down syndrome (US$42 000 per HAP) or extreme preterm delivery with bronchopulmonary dysplasia (US$50 900 per HAP). It was less cost-effective when recommended for widespread use among infants with haemodynamically significant congenital heart disease, chronic lung disease or bronchopulmonary dysplasia, and extreme preterm delivery with bronchopulmonary dysplasia, because efficacy of palivizumab was lower in these patients. Strategy 2 was moderately cost-effective (US$91 400 per HAP) among infants with neuromuscular impairment, which is rare in Hong Kong. Extreme preterm infants without bronchopulmonary dysplasia had the highest ICER estimate.

Discussion

The considerable respiratory hospitalisation burden was potentially attributable to RSV infection, particularly in children aged <5 years, considering the prolonged RSV season in Hong Kong. Widespread use of palivizumab among infants with high-risk conditions as recommended by the AAP may not be appropriate in Hong Kong, given the variable RSV seasonality and the characteristics of high-risk infants in Hong Kong. At the end of this study, palivizumab was the only available medication for RSV prophylaxis. Since 2022, Beyfortus (nirsevimab)[3] for neonates and infants, and Arexvy (RSV vaccine) from GSK[4] and Abrysvo (RSV vaccine) from Pfizer[5] for older adults, have been approved for use to prevent severe RSV infection. Our findings can provide insights into further investigations concerning long-lasting monoclonal antibodies and vaccines.

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References

1. Lee SH, Hon KL, Chiu WK, Ting YW, Lam SY. Epidemiology of respiratory syncytial virus infection and its effect on children with heart disease in Hong Kong: a multicentre review. Hong Kong Med J 2019;25:363-71.
2. Roberts KB, Revised AAP guideline on UTI in febrile infants and young children. Am Fam Physician 2012;86:940-6.
3. Hammitt LL, Dagan R, Yuan Y, et al. Nirsevimab for prevention of RSV in healthy late-preterm and term infants. N Engl J Med 2022;386:837-46.
4. Papi A, Ison MG, Langley JM, et al. Respiratory syncytial virus prefusion F protein vaccine in older adults. N Engl J Med 2023;388:595-608.
5. Walsh EE, Pérez Marc G, Zareba AM, et al. Efficacy and safety of a bivalent RSV prefusion F vaccine in older adults. N Engl J Med 2023;388:1465-77.