Cost-Utility Analysis of Palivizumab to prevent respiratory syncytial virus infections in the Dominican Republic

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Introduction

Respiratory syncytial virus (RSV) is a common cause of lower respiratory tract infections in infants and young children worldwide. RSV causes a seasonal respiratory disease responsible for a high rate of pediatric hospitalizations for bronchiolitis and pneumonia [1]. Palivizumab, a humanized monoclonal murine antibody, has been available since 1998 as passive prophylaxis to prevent RSV infection [2], but there is considerable debate about its cost-effectiveness.

Several systematic reviews have evaluated the cost-effectiveness of palivizumab, with inconsistent results ranging from cost-effective to not cost-effective depending on the scenario [3]. A recent study concluded that palivizumab is a cost-effective strategy as prophylaxis for RSV in premature infants, those with lung complications, and those living in remote communities. However, the authors note that heterogeneity in the designs of the different models and their parameters and the different contexts in which these economic evaluations were made make it difficult to reach definitive conclusions about the value of palivizumab [4]. Therefore, it is necessary to identify palivizumab's clinical and economic outcomes as passive immunization for RSV prevention in different contexts, including the Dominican Republic, to reduce uncertainty about its cost-effectiveness.

Methods

The economic evaluation focuses on premature neonates with 35 weeks gestational age (wGA) or less and infants with clinical diagnoses of bronchopulmonary dysplasia or hemodynamically significant congenital heart disease who require ongoing medical treatment. The perspective of the analysis is from the third-party payer, and the model's time horizon is six years. The primary clinical outcomes are the rates of RSV-related hospitalizations avoided and the rates of relapses avoided for recurrent wheezing (Fig. 1).

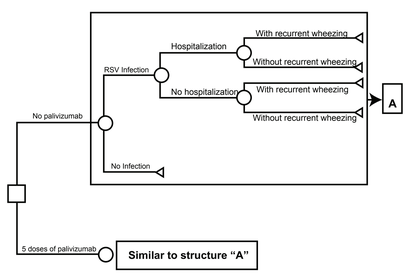

Figure 1. Decision tree model structure with two health states for prophylaxis with palivizumab to prevent the respiratory syncytial virus in children.

The study takes the efficacy of palivizumab in preventing RSV-related hospitalizations from the IMpact-RSV clinical trial and the Cardiac Synagis clinical trial [2,5]. The probability of RSV-related hospitalization in preterm neonates without immune-prophylaxis is taken from the SENTINEL1 study [6]. The cost of each RSV-related hospitalization is adjusted based on studies conducted in the Dominican Republic. We took the costs of each wheezing exacerbation from an advisory board with pediatrics from the Dominican Republic. We estimated the Quality-Adjusted Life Years (QALYs) from a study about the quality of life lost due to RSV [7].

The model assumes that there are no deaths from RSV infection in neonates with RSV-related hospitalizations. We carried out 1 000 Monte Carlo simulations to characterize uncertainty, and the maximum net benefit is estimated through willingness-to-pay curves. Neonatologists and pediatricians from the Dominican Republic validated the inputs.

Results

Tables 1, 2, and 3 show the discounted total direct costs and QALYs of palivizumab versus no palivizumab in preterm neonates ≤ 35 wGA, in infants with BPD, and infants with CHD in the Dominican Republic, respectively.

Preterm neonates and infants with CHD that received palivizumab have lower total costs than those that do not receive it because they have fewer RSV-related hospitalizations due to the drug's clinical efficacy prevents them. In infants with BPD, the incremental cost-effectiveness ratio (ICER) is $ 853, less than one gross domestic product (GDP) per capita, meaning that palivizumab is highly cost-effective in infants with BPD.

Figures 1, 2, and 3 show the results of the willingness to pay curves of palivizumab versus no palivizumab in preterm neonates < 35 wGA, in infants with BPD, and infants with CHD in the Dominican Republic, respectively. The probability that palivizumab is the best therapeutic option to prevent RSV infection compared to no palivizumab with a willingness to pay 3 GDP per capita in the Dominican Republic is 91.8 % in preterm neonates ≤ 35 wGA, 51.6 % in infants with BPD, and 81.0 % in infants with CHD.

Table 1. Total discounted direct costs, RSV-related hospitalizations, and QALYs of palivizumab vs. placebo in preterm neonates < 35 wGA in the Dominican Republic, 2022.

Outcome	No palivizumab	Palivizumab
Palivizumab cost	-	$ 5,800
Health outcomes costs	$ 9,595	$ 615
Total discounted direct costs	$ 9,595	$ 6,415
Δ Costs (palivizumab – no palivizumab)	- $ 3,180	
Δ QALYs (palivizumab – no palivizumab)	0,125	

Table 2. Total discounted direct costs, RSV-related hospitalizations, and QALYs of palivizumab vs. placebo in infants with BPD, the Dominican Republic, 2022.

Outcome	No palivizumab	Palivizumab
Palivizumab cost	-	$ 5,800
Health outcomes costs	$ 8,019	$ 1,439
Total discounted direct costs	$ 8,019	$ 7,239
Δ Costs (palivizumab – no palivizumab)	$ 38	
Δ QALYs (palivizumab – no palivizumab)	0,125	
ICER	$ 853	

Table 3. Total discounted direct costs, RSV-related hospitalizations, and QALYs of palivizumab vs. placebo in infants with CHD, the Dominican Republic, 2022.

Outcome	No palivizumab	Palivizumab
Palivizumab cost	-	$ 5,800
Health outcomes costs	$ 9,195	$ 1,274
Total discounted direct costs	$ 9,195	$ 7,074
Δ Costs (palivizumab – no palivizumab)	-$ 2,120	
Δ QALYs (palivizumab – no palivizumab)	0,040	

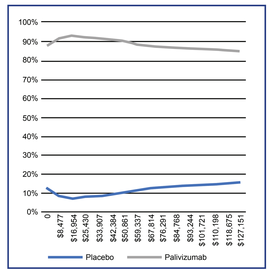

Figure1. Willingness to pay curves to obtain the Maximum Net Benefit of palivizumab vs. placebo in preterm neonates ≤ 35 wGA in the Dominican Republic, 2022.

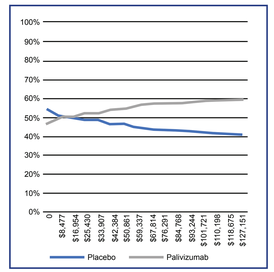

Figure2. Willingness to pay curves to obtain the Maximum Net Benefit of palivizumab vs. placebo in infants with BPD in the Dominican Republic, 2022.

Results

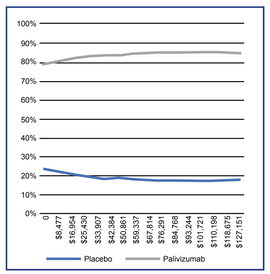

Figure7. Willingness to pay curves to obtain the Maximum Net Benefit of palivizumab vs. placebo in infants with CHD in the Dominican Republic, 2022.

Discussion

Palivizumab, a monoclonal antibody, is a cost-saving strategy for preventing RSV infections in the Dominican Republic's preterm neonates and infants with CHD. In addition, it is highly cost-effective in infants with BPD. The prevention of RSV-related hospitalizations and wheezing exacerbations not only improves patients' quality of life but also saves healthcare costs. Each hospitalization costs between $4,812 and $8,740, and the average price of each relapse is $488. Patients have an average of 4.63 relapses per year for at least the first six years of life, resulting in substantial savings, especially in low- and middle-income countries.

Palivizumab's efficacy in preventing RSV infections in preterm neonates is higher than in infants with BPD, making it more effective in the former group. Infants with CHD have a slightly lower risk of RSV-related hospitalization than infants with BPD. Still, each hospitalization costs are higher due to their extended stay and the need for more expensive diagnostic tests. Several systematic reviews on the cost-effectiveness of palivizumab versus not using it have similar conclusions to this economic evaluation [8-10]. Palivizumab's proven clinical efficacy and safety contribute to its dominance in the Dominican Republic.

The preterm neonates defined for this study are those with <35 wGA, the population included in the pivotal clinical trial of palivizumab. The largest cohort of preterm infants with RSV infection without immunoprophylaxis is from the SENTINEL1 study, which included 1,360 infants between 29 and 35 wGA [6]. Palivizumab's cost-effectiveness is mainly due to its proven clinical efficacy, and it has been on the market for a quarter of a century, demonstrating its safety [1].

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