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Valuing the impact of incorporating an acellular hexavalent vaccine in the national vaccination scheme of Peru in the context of COVID-19

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INTRODUCTION

COVID-19 affected regular vaccination schedules reducing Vaccine Coverage Rates (VCRs). Therefore, a strategy to achieve optimal immunization levels is required. An available option corresponds to the use of the fully-liquid acellular hexavalent vaccine, given the improvement in reducing adverse events (AEs)[1], logistic costs[2] and greater acceptance from parents[2,3].

OBJECTIVE

Evaluate the impact of incorporating a fully-liquid acellular hexavalent vaccine into the National Vaccination Scheme (NVS) of Peru in terms of several factors, including expected positive impact on VCRs and resulting economic benefits from a more efficient burden control.

METHODS

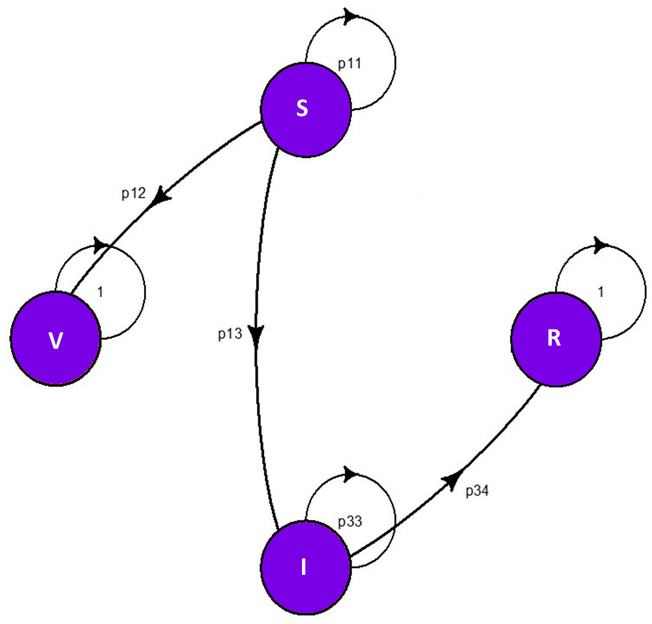
- Four scenarios were evaluated. The current scheme of a whole-cell pentavalent (DTwP-Hib-HepB)+IPV/OPV and an alternative scheme of a fully-liquid acellular hexavalent vaccine (DTaP-IPV-Hib-HepB) were compared under 2 vaccination strategies: conventional (mostly institution based) and alternative (institution and additional vaccination modalities) **(Table 1).**
- VCRs, adverse events (AEs), healthcare management and logistic costs were evaluated over a 2-year horizon and disease cases over a 5-year horizon, for a population of 494,595 children[4].
- Current VCRs were modeled using Monte Carlo simulations based on current vaccination patterns[5]. VCRs under alternative scheme and alternative vaccination strategies were derived based on published literature[6,7]. AE rates were estimated using reported incidences in previous studies.
- Markov modelling was used to estimate disease cases using local epidemiological data **(Figure 1).**
- Healthcare management costs were obtained through micro-costing and logistical costs by replicating the logistical chain of five representative regions. All costs are expressed in $USD using an equivalence of $1 to S/3.621 Peruvian Soles[8].
- One-way sensitivity analysis (OWSA) was performed for VCR, AE incidence, infection rate, vaccines prices, input costs and percentage of institution vaccinated population.

POSTER HIGHLIGHT: The introduction of the fully-liquid hexavalent vaccine into Peru's NVS represents an opportunity to increase vaccine coverage rates closer to optimal immunization levels, with better health outcomes and lower costs per fully protected child.

Table 1: Scenarios by Vaccination Scheme and Strategy

		Conventional Strategy	Alternative Strategy
Vaccination Scheme	Current Vaccination Scheme	Scenario 1 (S1 - base) wP liquid pentavalent vaccine + anti-polio Modalities: . Healthcare Institution (92.1%) . Home by home visit (5.1%) . Itinerant brigades (2.9%)	Scenario 3 (S3) wP liquid pentavalent vaccine + anti-polio Modalities: . Healthcare Institution (60.0%) . Vaccination Center (15.4%) . Targeted home visit (15.2%) . Strategic satellites (4.5%) . Home by home visit (2.0%) . Itinerant brigades (2.9%)
	Alternative Vaccination Scheme	Scenario 2 (S2) Fully-liquid acellular hexavalent vaccine Modalities: . Healthcare Institution (92.1%) . Home by home visit (5.1%) . Itinerant brigades (2.9%)	Scenario 4 (S4) Fully-liquid acellular hexavalent vaccine Modalities: . Healthcare Institution (60.0%) . Vaccination Center (15.4%) . Targeted home visit (15.2%) . Strategic satellites (4.5%) . Home by home visit (2.0%) . Itinerant brigades (2.9%)

Figure 1: Markov Model for Disease Incidence Estimation



S: Susceptible
V: Vaccinated
I: Infected
R: Recovered

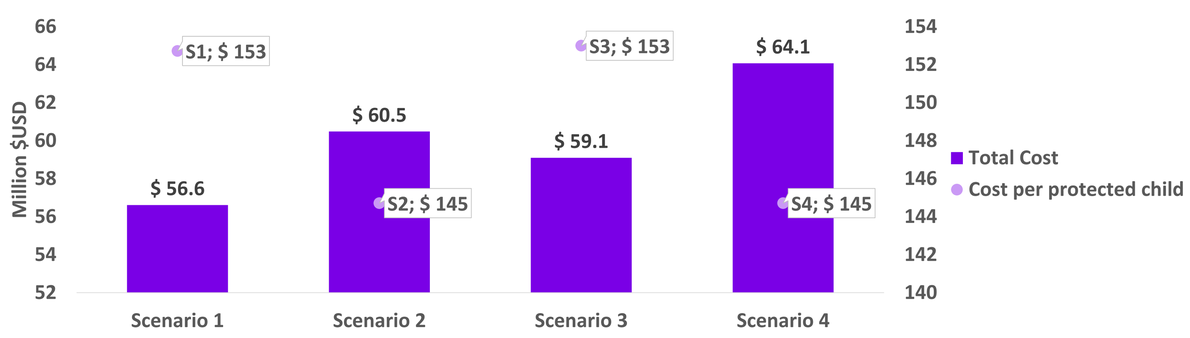
$$\begin{array}{c} \\ S \\ V \\ I \\ R \end{array} \begin{array}{c} \begin{array}{cccc} S & V & I & R \end{array} \\ \begin{bmatrix} p_{11} & p_{12} & p_{13} & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & p_{33} & p_{34} \\ 0 & 0 & 0 & 1 \end{bmatrix} \end{array}$$

Initial Values
c(S: # of children born in month I, V:0, I:1, R:0

Table 2: Vaccine Coverage Rates Results by Vaccination Scenario

	Vaccination Scenarios VCR (CI for OWSA)			
Vaccination Indicator	S1	S2	S3	S4
Child proportion with 3° pentavalent and anti-polio doses de polio (S1 & S3) or 3° hexavalent doses (S2 & S4).	75.1% [72.8% - 77.3%]	84.5% [82.0% - 87.1%]	78.2% [75.8% - 80.5%]	89.4% [86.7% - 92.1%]
Child proportion with 3° pentavalent and anti-polio doses de polio (S1 & S3) or 3° hexavalent doses (S2 & S4) at 6 months.	65.6% [63.6% - 67.6%]	74.0% [71.8% - 76.3%]	68.3% [66.3% - 70.3%]	78.3% [75.9% - 80.6%]
Child proportion with 3° pentavalent doses	75.6% [73.4% - 77.9%]	N/A	78.7% [76.4% - 81.1%]	N/A
Child proportion with 3° anti-polio doses	76.0% [73.7% - 78.2%]	N/A	79.2% [76.8% - 81.5%]	N/A
Child proportion with at least 1 pentavalent or anti-polio dose (S1 & S3) or at least 1 hexavalent dose (S2 & S4)	89.4% [86.7% - 92.1%]	89.4% [86.7% - 92.1%]	95.4% [92.5% - 98.3%]	95.4% [92.5% - 98.3%]

Figure 2: Cost per Protected Child by Scenario



	S1	S2	S3	S4
Total Cost (m$USD)	56.6	60.5	59.1	64.1
VCR	75.10%	84.50%	78.20%	89.40%
Cost per VCR p.p (m$USD/p.p)	75.37	71.60	75.58	71.70

RESULTS

VCRs would increase 9.4p.p.–14.3p.p. under S2 and 3.1p.p. under S4 **(Table 2)**.

A reduction of around 25 p.p. in AE and 5.7%–8.7% in disease cases would occur under S2 and S4.

Although, there would be a reduction of 33–38%, 4%–8% and 81% in AE, disease, and logistic costs categories respectively, overall costs would increase by 6.7%–12.8% with hexavalent vaccination **(Figure 2)**.

Additionally, cost per protected child and VCR p.p. would be reduced by around 5% **(Figure 2)**.

CONCLUSIONS

- Introducing a fully-liquid hexavalent vaccine into Peru's NVS represents an opportunity to close VCR gaps generated by COVID-19, mitigating the risk of disease outbreaks that could bring further costs.
- Reduced costs per protected child and per VCR p.p. achieved with a hexavalent vaccine, implies an efficient use of resources and better value for money.

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