Pneumococcal Conjugate Vaccine to prevent mortality and morbidity of pneumococcal disease in Indian Adults.

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&
Health Technology Assessment in India (HTAIn)

Policy Brief of HTA

Executive Summary

A Health Technology Assessment was conducted to establish the cost-effectiveness of Pneumococcal Vaccines administration in reducing mortality and morbidity due to Pneumococcal disease in Indian adults, compared to a no- vaccination scenario. The analysis considered the proportion of high-risk groups for pneumococcal disease in various age bands. A budget impact analysis was also conducted to evaluate the overall costs of administering pneumococcal vaccine to eligible age/risk subgroups.

Vaccination with Pneumococcal Conjugate Vaccine(PCV13) alone was cost-effective in the 65-74 and 75+ age groups from a health system perspective. Serial vaccination with PCV13 and Pneumococcal Polysaccharide Vaccine (PPSV23) was cost-effective in the 75+ age group alone. The incremental cost effectiveness ratio was highly influenced by cost of vaccination and an increase in vaccine price by 20% will make vaccination cost-ineffective in the 65-74 age group.

The budget impact of rolling out PCV13 to the current cohort of 65+ years in India will be 27,000 crore INR, even with conservative estimates of vaccine prices. Vaccinating all 75+ year olds will add a burden of 8000 crore INR to the exchequer and vaccinating only the high-risk groups in this age band add a burden of 560 crores.

Why this economic evaluation study?

- Streptococcus pneumonia infections can be non-invasive and limited to mucosal surfaces(sinusitis, otitis media, community-acquired pneumonia) or invasive, affecting normally sterile body fluids(meningitis, bacteremia).
- Invasive Pneumococcal Diseases(IPD) result in the deaths of 6-8 lakh adults every year. Pneumococcal diseases can result in several serious complications. Incidence of IPD is highest in people >65 years of age and those with conditions like Chronic heart, lung, kidney or liver diseases, diabetes, HIV infection, immunosuppressant medication etc.
- Pneumococcal Conjugate Vaccine(PCV13) and Pneumococcal Polysaccharide Vaccine(PPSV23) are two important vaccine candidates for vaccinating the elderly.
- As India is in a stage of demographic transition, the number of individuals requiring protection from invasive pneumococcal diseases is bound to rise. In this regard, it is necessary to analyze the cost-effectiveness of pneumococcal vaccinations in the elderly and their budget impact.

Pneumococcal Vaccines.

- ***Pneumococcal Conjugate Vaccines(PCV)***
  - Pneumococcal capsular polysaccharide conjugated to diphtheria toxin
  - T-cell-dependent antibody response, producing a longer immunity duration than PPSV and having a boosting effect at revaccination
  - Reduce carriage rate and have a protective herd effect
- ***Pneumococcal Polysaccharide Vaccine(PPSV23)***
  - Conjugated capsular polysaccharide antigens and is active against 23 serotypes of Streptococcus pneumonia
  - T-cell independent immune response and has proven efficacy of 50-70% against invasive pneumococcal diseases in immunocompetent elderly individuals
  - Vaccine is administered as a 0.5ml dose, IM/SC

Objectives of the study

- Determine the cost-effectiveness of PCV vaccine alone and serial administration of PCV/PPSV in reducing pneumococcal disease morbidity and mortality in the adult population in India and identify age/risk subgroups best served by vaccination.
- Estimate the budget impact of PCV administration in eligible subgroups among the beneficiaries of hospitals, empaneled in the AB-PMJAY scheme.

PICO	Description of the components of PICO
Population	• Indian adults, classified into four age bands: i)18-49 years ii) 50-64 years iii) 65-74 years and iv) 75 years. • Each age bands classified into low-risk, moderate risk and high risk based on existing health conditions
Intervention scenarios	• Single dose of PCV13 administered i/m at adult immunization clinics • Serial administration of PCV13 and PPSV23 8 weeks apart.
Comparator	• Usual care for Pneumococcal disease in the no-vaccination scenario, including in-patient care for Pneumonia and invasive pneumococcal diseases
Outcome	• Mortality from pneumococcal diseases – pneumonia, meningitis, sepsis, and complications • Morbidity from pneumococcal disease in terms of the number and duration of hospital admissions, and the incidence of complications • Cost of management of pneumonia and invasive pneumococcal diseases.

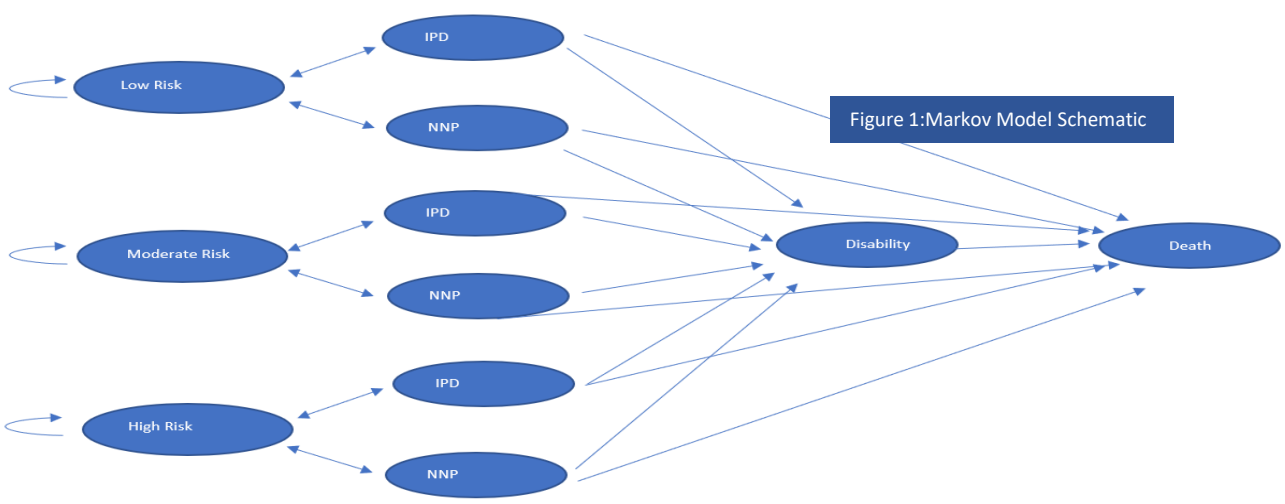

Figure 1:Markov Model Schematic

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Methods and Approach

Type of economic evaluation	Cost-utility analysis
Key Health States	• Initial: Low risk, intermediate risk, high risk. • Intermediate: Pneumonia, IPD • Disability • Death(Absorbing)
Type of Model	• Decision-analytic model (Markov model)
Perspective	• Health system
Time Horizon	• 15 years • 10 years for 75+ age group
Discounting	• Three percent for costs and consequences
Sensitivity Analysis	• One way sensitivity analysis (OWSA) • Probabilistic sensitivity analysis (PSA)
Software Used	• TreeAge Pro Healthcare 2022 • Microsoft Excel

Model Overview

- Cohort enters the Markov model into three risk groups- low risk, moderate risk, and high risk. It moves into nonbacteremic pneumococcal pneumonia(NPP) or invasive pneumococcal diseases(IPD) as per respective incidence risks. Henceforth, cohort can move into Disability stage/Death based on incidence risk of multiple complications and the disease-related mortality, respectively. Age-related mortality risks are also applied to all stages of the cycle.
- The stages in the Markov model and the initial probabilities of the stages are identical for both vaccination and no-vaccination arms
- In the vaccination arm, the incidence risk for IPD and NPP are multiplied by the proportion of the population susceptible after vaccination to incorporate change in transition probability due to vaccination
- The initial prevalence, utility values, treatment and vaccination costs, and transition probabilities were obtained from previously published studies. Where appropriate, values were modified based on expert opinions to better suit local settings.
- Cycle length was taken as one year

Figure 2: Tornado Diagram, PCV13, 75+ age group

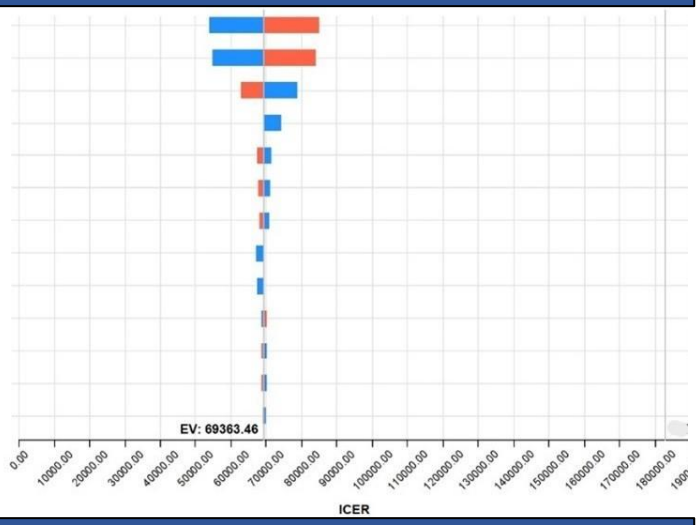
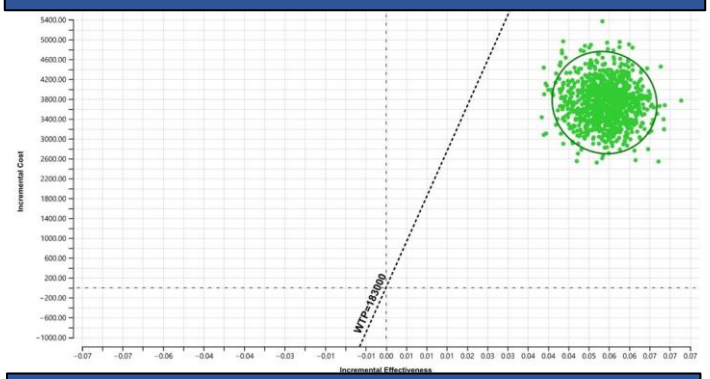


Figure 3: Cost Effectiveness Plane,PCV13. 75+ age group



Budget Impact of Vaccination by Age Group*

Age Group	PCV 13		PCV13+PPS23	
	All	HRG	All	HRG
75+	8,354	560	13,269	889
65-74	18,585	1,338	29,519	2,125
Total	26,939	1897	42,787	3014

Budget Impact of Vaccinating Multidimensionally Poor*

Age Group	PCV 13		PCV13+PPS23	
	All	HRG	All	HRG
75+	1250	84	1985	133
65-74	2780	200	4416	318
Total	4030	284	6401	451

**All values in crores INR*

Results and recommendations

Results

Cost-utility analysis:

- Vaccination with PCV13 alone was cost-effective in the age bands 65-74 and 75+ with ICERs 1,59,418 INR/QALY and 69,363INR/QALY, respectively.
- Serial vaccination with PCV13 and PPSV23 was cost effective in the 75+ age group only with an ICER of 1,04,355INR/QALY.
- ICERs were above the willingness to pay threshold of 1GDP per capita for India in the age bands 18-49 and 50-64 for both intervention scenarios(PCV13 alone, PCV13+PPSV23).
- In OWSA, cost of vaccination had the highest influence on ICER values. ICER for PCV13 vaccine crosses the willingness to pay threshold with 20% higher cost of vaccination in the 65-74 age group and remains within the threshold in the 75+ group.
- In PSA, all simulated ICERs were in the North-East quadrant(higher cost, higher effectiveness) of the ICER plane and below the WTP

Budget impact analysis:

- Budget impact of vaccinating entire cohort of 65+ with PCV13 vaccination is INR 27,000 crore.
- Burden of vaccinating all 75+ population with PCV13 will be around INR 8000 crores and if vaccination is limited to the high-risk groups within this age-band, burden will be around 560 crores.

Recommendations

- Vaccination of high-risk population in 75+ age group with a single dose of PCV13 is most beneficial, considering the ICER value and budget impact.
- We should promote the development and manufacture of indigenous pneumococcal vaccines; the cost of vaccines has the maximum impact on cost-effectiveness. Vaccination in other age bands and low-risk groups may be considered with the availability of cheaper vaccines

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