EE138

Cost-Effectiveness of 20-Valent Pneumococcal Conjugate Vaccine in Singaporean Adults Aged ≥18 Years

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INTRODUCTION

- The Singapore Ministry of Health recommends pneumococcal vaccination—with 13-valent pneumococcal conjugate vaccine (PCV13) and/or 23-valent pneumococcal polysaccharide vaccine (PPV23)—in adults[1]:
  - A single dose of PPV23 for adults aged 18-64 years with chronic medical conditions
  - A single dose of PCV13 followed by a single dose of PPV23 with PPV23 revaccination for adults aged 18-64 with immunocompromising conditions
  - A single dose of PCV13 followed by a single dose of PPV23 for all adults aged ≥65 years
- A higher valent conjugate vaccine—20-valent PCV (PCV20)–was recently licensed in Singapore for use in adults

OBJECTIVE

- We conducted a cost-effectiveness analysis (CEA) to evaluate the impact of replacing current pneumococcal vaccine recommendations in Singapore with PCV20

METHODS

Model Overview

- Lifetime risks and costs of invasive pneumococcal disease (IPD), including bacteremia and meningitis, and all-cause non-bacteremic pneumonia (AC-NBP) were projected using a probabilistic cohort model with a Markov-type process
- Model population included adults aged 18-64 years with underlying chronic medical or immunocompromising conditions and all adults aged 65-99 years in Singapore (N=1.6M)[5,6]:
  - Population was characterized by age (1-yr increments) and risk profile (healthy [immunocompetent without chronic medical conditions], at-risk [immunocompetent with ≥1 chronic medical condition], high-risk [immunocompromised])[7]
- Vaccination strategies included:
  - Hypothetical: PCV20 at model entry
  - Current:
    - Aged 18-64 years, at-risk: PPV23 alone at model entry
    - Aged 18-64 years, high-risk: PCV13 at model entry, PPV23 1 year later, and revaccination with PPV23 5 years later (i.e., model year 7)
    - Aged 65-99 years, all risk: PCV13 at model entry and PPV23 1 year later
- Clinical and economic outcomes for each strategy were projected annually based on age, risk profile, disease/fatality rates, vaccination status/type, time since vaccination, and unit costs and include: cases of IPD and AC-NBP, deaths due to IPD and inpatient AC-NBP, life-years (LYs) and quality-adjusted LYs (QALYs), and costs of vaccination and medical treatment for IPD and AC-NBP

Model Parameters

- Model population comprised at-risk/high-risk adults aged 18-64 years and all adults aged ≥65 years
- Proportion of disease that is vaccine-type (VT)[8,9] was assumed to remain the same over the modelling horizon as herd effects have not been observed following PCV13 introduction among children in Singapore
- Effectiveness of PCV20 (VE-PCV20) was assumed to be the same as that for PCV13 (VE-PCV13)[10]
- VE-PCV13 was assumed to be durable for 5 years and to wane to 0% by year 16[2,3,11]
- VE-PPV23 vs. VT-IPD was assumed to wane to 0% by year 10[12]; VE-PPV23 vs. VT-NBP assumed to be 0%[13,14]
- Utility reductions for persons with IPD, inpatient AC-NBP, and outpatient AC-NBP were 0.13, 0.13, and 0.004, respectively, in the year in which the illness occurred[15,16]
- Costs included medical care (IPD, S$5,654; inpatient AC-NBP, S$3,459; outpatient AC-NBP, S$2,360)[17-19] and vaccine (confidential) and administration (S$0)
- Vaccine uptake was 14.4% in both Current and Hypothetical strategies[20]:
  - For persons in Current Strategy who receive multiple vaccinations, all those who received a dose of vaccine at model entry were assumed to receive subsequent dose(s) (if alive)
- Other model inputs are summarized in Table 1

Analyses

- Cost-effectiveness was calculated in terms of cost per QALY gained and evaluated using a 3x GDP per capita willingness-to-pay (WTP) threshold
- Benefits and costs were discounted at 3% annually
- Analyses were conducted from healthcare system perspective
- Probabilistic sensitivity analyses (PSA; 1,000 replications) were also conducted to account for uncertainty surrounding estimates of key model parameters

Table 1: Base case model input values, by age and risk

	18-49 Years		50-64 Years		65-74 Years			75-84 Years			85-99 Years		
	At-Risk	High-Risk	At-Risk	High-Risk	Healthy	At-Risk	High-Risk	Healthy	At-Risk	High-Risk	Healthy	At-Risk	High-Risk
No. of adults (thousands)[5,6]	396.7	68.4	390.8	107.9	128.3	221.8	86.4	36.3	93.1	51.4	8.6	30.0	22.2
Incidence of IPD (per 100K)[8,21]	1.8	3.7	4.8	7.4	3.2	10.1	13.7	6.3	15.2	16.8	12.6	22.3	17.6
Incidence of inpatient AC-NBP (per 100K)[21-23]	163	305	525	982	563	1,702	2,283	1,709	5,163	6,925	4,112	12,423	16,662
Incidence of outpatient AC-NBP (per 100K)[21-24]	210	393	676	1,266	726	2,193	2,941	1,202	3,633	4,872	1,599	4,831	6,480
General population mortality[25]	0.1	0.1	0.4	0.5	0.8	1.1	1.3	2.2	2.6	3.0	6.6	7.4	8.8
Case-fatality rate for IPD (per 100)[21,26]	17.8	35.7	23.3	36.2	8.1	25.4	34.4	12.1	28.9	31.9	29.0	51.4	40.7
Case-fatality rate for inpatient AC-NBP (per 100)[27,28]	2.7	4.7	8.8	12.0	6.3	12.5	18.4	9.4	18.3	25.0	19.3	29.1	35.3
Yr. 1 VE-PCV20/13 vs. VT-IPD (%)[2,3,29,30]	81.5	65.2	79.2	63.3	75.0	75.0	60.0	75.0	75.0	60.0	75.0	75.0	60.0
Yr. 1 VE-PCV20/13 vs. VT-NBPP (%)[2,3,29,30]	55.6	44.5	51.3	41.1	45.0	45.0	36.0	45.0	45.0	36.0	45.0	45.0	36.0
Yr. 1 VE-PPV23 vs. VT-IPD (%)[12,31]	32.8	17.1	32.3	16.8	55.7	30.9	16.1	50.8	28.1	14.6	37.9	20.5	10.6
General population health utility[32,33]	0.78	0.74	0.73	0.69	0.92	0.72	0.70	0.87	0.67	0.65	0.83	0.61	0.57

RESULTS

- Use of PCV20—in lieu of Current strategy—would reduce cases of AC-NBP and IPD and associated deaths, and would reduce total costs by S$0.7M, making PCV20 the dominant strategy (Table 2)
- In population subgroups, replacing current vaccination strategies with PCV20 was cost-effective under a 3x GDP per capita threshold for at-risk adults aged 18-64 years (cost/QALY = S$3,329; Δcosts: S$3.0M; ΔQALYs: 910) and was cost-saving (i.e., dominant) among high-risk adults aged 18-64 years (Δcosts: -S$1.4M; ΔQALYs: 241) and all adults ≥65 years (Δcosts: -S$2.3M; ΔQALYs: 560)
- In PSA, 92.0% of replications were cost-saving (in the southeast quadrant) (Figures 1 and 2)

Table 2: Base case results

	Hypothetical (PCV20)	Current	Difference
No. cases			
IPD	4,885	4,926	-42
Inpatient AC-NBP	1,900,781	1,902,219	-1,438
Outpatient AC-NBP	1,129,925	1,131,469	-1,544
No. deaths	496,910	497,117	-207
No. LYs/QALYs (discounted)			
LYs	28,203,857	28,201,470	2,387
QALYs	20,018,429	20,016,717	1,712
Costs (millions)			
Medical care	S$4,780.5	S$4,787.9	-S$7.5
Vaccination	S$21.3	S$ 14.5	S$6.8
Total healthcare costs (medical + vaccination)	S$4,801.8	S$4,802.4	-S$0.7
Cost per LY	--	--	**Dominant**
Cost per QALY	--	--	**Dominant**

Figure 1: PSA scatterplot

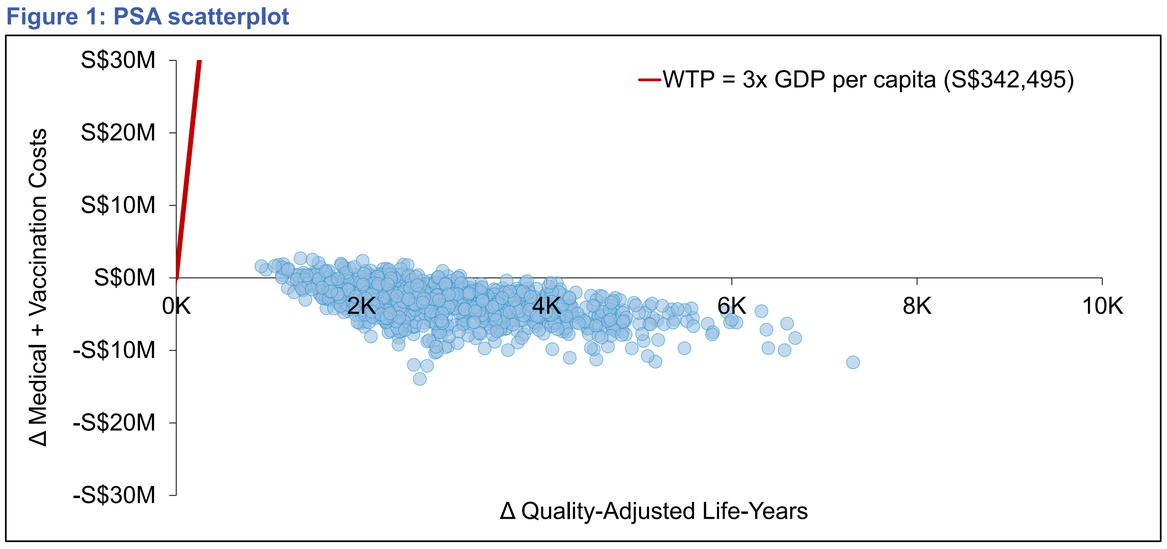
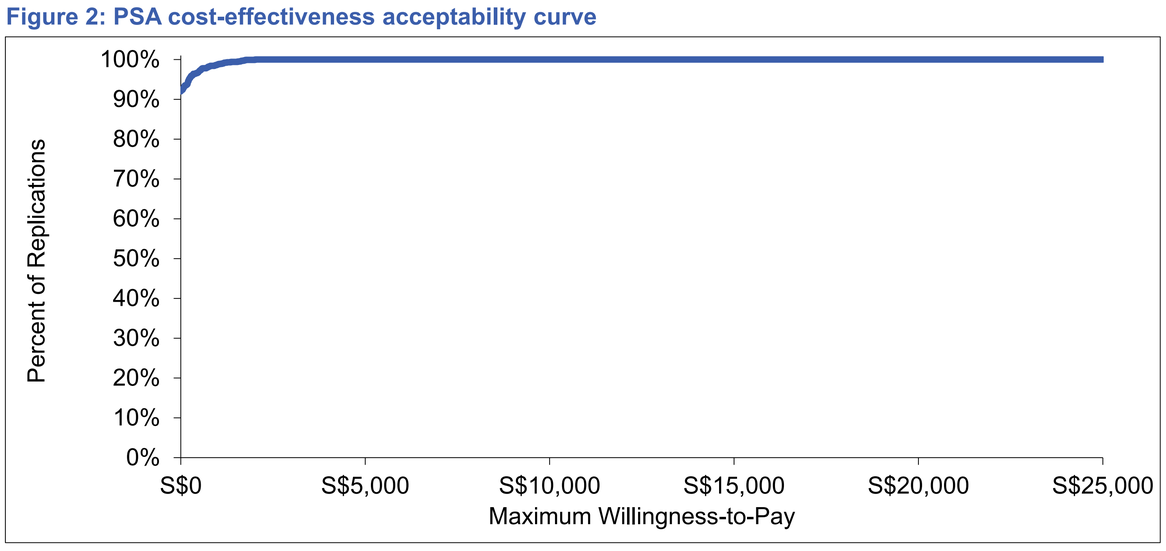


Figure 2: PSA cost-effectiveness acceptability curve



CONCLUSIONS

- **Cost-effectiveness analyses suggest that use of PCV20—in lieu of current recommendations by the Singapore Ministry of Health among at-/high-risk adults aged 18-64 years and all adults aged 65-99 years—would yield overall cost savings and represent a cost-effective use of scarce healthcare resources**
- **Findings support use of PCV20 as standard of care for adult pneumococcal vaccination in lieu of the existing strategies**

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