

The Economics of Vaccines: Ensuring Value amidst Resource Constraints

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Content of Presentation

- Overview of health economic evaluation of vaccines
- Traditional approach - its shortcomings
- Recent approach – the improvements
- Summary of messages



**“An ounce of prevention is
worth a pound of cure”**

Benjamin Franklin



Overview of health economic evaluation of vaccines

- Vaccination has been recognized as one of the most successful health interventions (WHO 2021)
- Vaccination not only affects morbidity and mortality of a target disease but also the complications, long-term sequelae and the related effects on quality of life (QoL) of the vaccinated individuals and the wider population
- Value of vaccines can be assessed in many ways: including prevention, impact on public health (esp long-term), various positive externalities e.g. herd immunity, and internalities e.g. QoL
- In view of the nature of vaccine, its value is traditionally assessed only through direct cost savings, productivity loss of those affected due to absenteeism and adverse effects on QoL



VALUE IN HEALTH REGIONAL ISSUES 2 (2013) 64-74
Available online at www.sciencedirect.com
SciVerse ScienceDirect



The Health Economic Impact of Universal Infant Vaccination with the 10-Valent Pneumococcal Nontypeable Haemophilus influenzae Protein D Conjugate Vaccine as Compared with 13-Valent Pneumococcal Conjugate Vaccine in Hong Kong

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ABSTRACT

Background: Pneumococcal universal vaccination in Hong Kong was introduced in 2009. **Objectives:** We assessed the health and economic impact of the 10-valent pneumococcal nontypeable Haemophilus influenzae protein D conjugate vaccine (PCV-10) compared with the current 13-valent pneumococcal conjugate vaccine (PCV-13) recommended for Hong Kong in 2011, providing new elements to be considered by public health authorities in the future decision-making process for pneumococcal vaccines in this country. **Methods:** on the prevention of deaths caused by IPD and pneumonia, PCV-13 projected to prevent 6 additional cases of IPD, whereas PCV-10 projected to prevent 13,229 additional AOM cases and 101 additional QALYs. For the base case, PCV-10 vaccination is estimated to save millions Hong Kong dollars (34.1 million Hong Kong dollars counted). Sensitivity analysis indicated that PCV-10 would earn more QALYs and save costs as compared with PCV-13. **Conclusion:** Universal infant vaccination with new available pneumococcal vaccines in Hong Kong is associated with economic benefits.



Human Vaccines & Immunotherapeutics

Cost-effectiveness analysis of infant universal routine pneumococcal vaccination in Malaysia and Hong Kong

David Bin-Chia Wu, Craig Roberts, Vivian Wing Yan Lee, Li-Wen Hong, Kah Kee Tan, Vivienne Mak & Kenneth Kwong Chin Lee

To cite this article: David Bin-Chia Wu, Craig Roberts, Vivian Wing Yan Lee, Li-Wen Hong, Kah Kee Tan, Vivienne Mak & Kenneth Kwong Chin Lee (2016) Cost-effectiveness analysis of infant universal routine pneumococcal vaccination in Malaysia and Hong Kong. Human Vaccines & Immunotherapeutics, 12:2, 403-416. DOI: [10.1080/21645515.2015.1067351](https://doi.org/10.1080/21645515.2015.1067351)
To link to this article: <https://doi.org/10.1080/21645515.2015.1067351>

Economic Evaluation of Universal Infant Vaccination with 7vPCV in Hong Kong

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ABSTRACT

Objectives: The purpose of this study was to evaluate the clinical and economic benefits of routine infant vaccination with seven-valent pneumococcal conjugate vaccine (7vPCV) in Hong Kong. **Methods:** A decision-analytic model was populated with local age-specific incidence data to simulate the expected health outcomes resulting from 7vPCV vaccination of a birth cohort of 57,100 children compared with an unvaccinated cohort over a 10-year horizon. Primary analyses were conducted from a payer perspective, using local inpatient and outpatient costs associated with the treatment of pneumococcal disease. Vaccine efficacy a 10-year period, leading to a reduction of HK\$20.7 million (US\$1.7 million) in direct medical costs. Additional cost savings from the indirect prevention of 919 adult cases of IPD during this time period also resulted. Overall, 7vPCV vaccination was estimated to have an incremental cost per life-year gained of HK\$50,416 (US\$6,460) from a payer perspective or HK\$46,308 (US\$5,929) when both direct and indirect costs were included. **Conclusion:** With reference to the World Health Organization's threshold for cost-effectiveness, results from this study indicate that routine infant



Volume 27, Issue 52, 9 December 2009, Pages 7282-7291
Vaccine

Overview of the disease burden of invasive pneumococcal disease in Asia

L.C. Bravo et al., the members of the Asian Strategic Alliance for Pneumococcal Disease Prevention (ASAP) Working Group¹



Cost-Effectiveness Analysis Of Joint Vaccination With 13-Valent Pneumococcal Conjugate Vaccine (Pcv13) And Influenza Vaccine In Taiwan During Seasonal Influenza

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Open Archive * DOI: <https://doi.org/10.1016/j.jval.2014.03.1562>



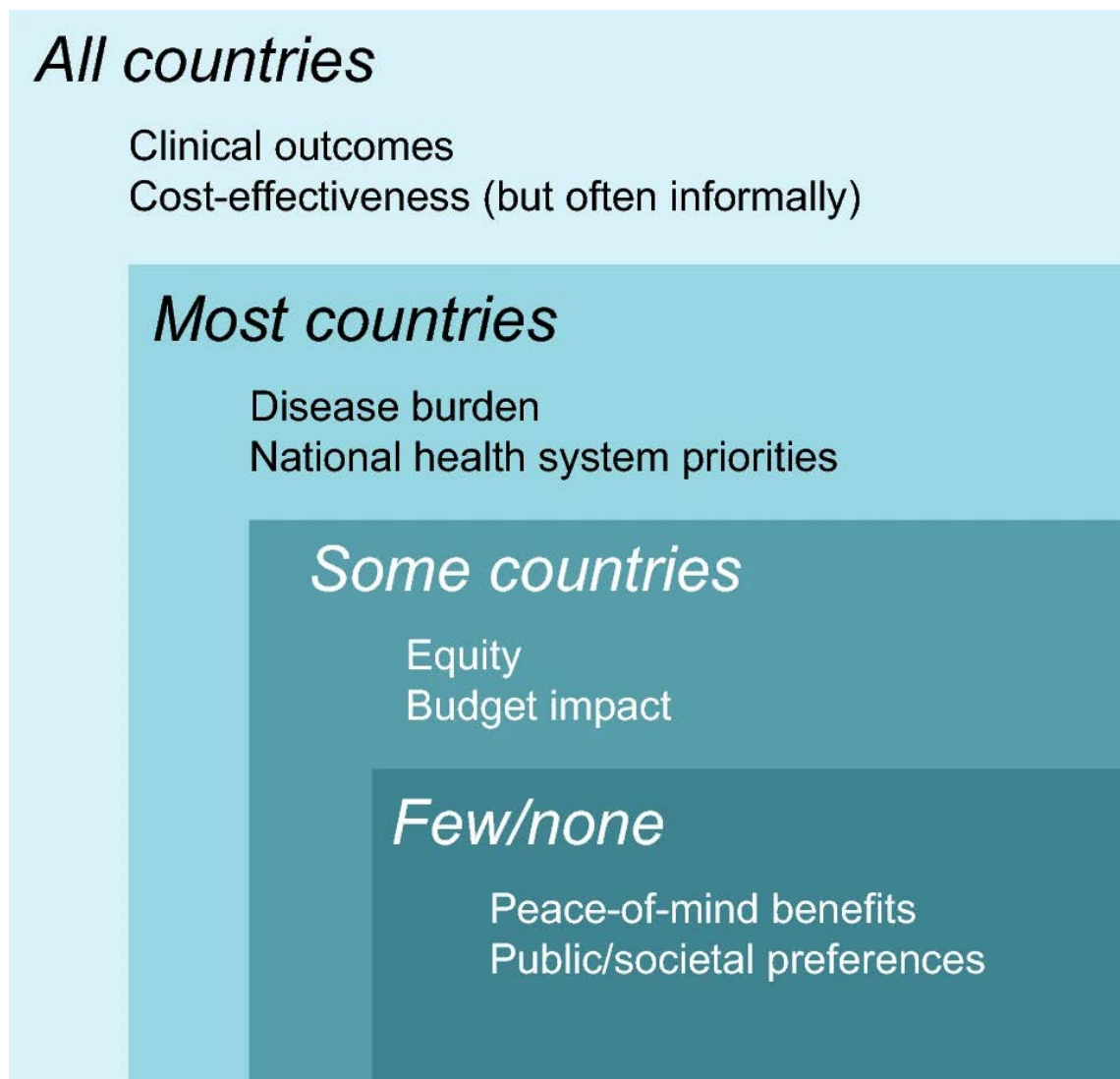
Traditional approach of evaluation and its shortcomings

- **Narrow perspective:** usually from payer's perspective, hence NOT capturing the value/benefits on the wider society such as:
 - non health-related costs e.g. transport, communication, energy, human capital, peace of mind (Bloom et al 2018)
- **Short time horizon for assessment,** not able to capture benefits at older age from avoiding childhood diseases, so whether there is indeed cost savings/avoidance is unclear (Annemans et al 2021)
- **Same discounting rate across** (Christensen et al 2020) e.g. Covid-19 vaccines vs Pneumococcal vaccines

Traditional approach of evaluation and its shortcomings

- Distribution of costs and outcomes/effects **only on affected parties**, but unequal distribution among different populations in reality e.g. age, socioeconomic, ethnicity, leading to an equity issue (EUnetHTA.HTA Core Model 2020, Standaert et al 2020)
- Quality-adjusted life years (QALY) assumed to be equivalent among all populations leading to uncertainty on true value of vaccines
- Over reliance of decision making on incremental cost-effectiveness ratio (ICER) and cost-effectiveness threshold

Evaluation approach adopted by different jurisdictions



Source: Christensen et al (2020)

Recently advocated approach of value evaluation

- 1. Value of avoiding complications** should be included (Annemans et al 2021)
 - complications can lead to extended hospitalizations
 - health gains for caregivers and caregivers' family
 - ↑ QoL
- 2. Herd immunity** due to vaccination can be significant
 - indirect effect found in unvaccinated individuals

Recently advocated approach of value evaluation

3. Effects at the **community level** need to be considered
 - serotype redistribution (Shiri et al 2019) due to appearance of serotypes not covered by a specific vaccine
 - ↓ infections → ↓ **use of antibiotic** → ↓ speed of antibiotic resistance (Esposito 2018)
4. **Improved productivity** of populations (Verlinden 2018) is important from a societal perspective
 - ↓ absenteeism and effect of peace-of-mind at work → positive effect on national GDP
 - improvement in human capital

Recently advocated approach of value evaluation

5. The issue of **EQUITY** should be included
 - by developing adjusting factors (using tools like discrete choice experiments) to adjust perceived value of outcomes depending on populations e.g. age, socioeconomic status, whose value may not necessarily be the same (Phelps et al 2018)
 - a **distributional cost-effectiveness analysis** may be a more reliable tool (Dawkins et al 2018)

Recently advocated approach of value evaluation

6. **Differential discounting rate** for vaccines (Christensen et al 2020)
7. **Flexibility of cost-effectiveness threshold** for vaccines instead of using a national threshold across the board
8. Improved consistency and **transparency** in developing economic evaluation models (Walker 2010)

Principles of equity in vaccine application

Table 2. Equity principles and their application to vaccines.

Equity principle	Explanation of principle	Translation to vaccines	Value
Principles related to the healthcare recipient			
Tackling social determinants of health	More effort should be made to create health in socially disadvantaged groups.	Large vaccination programs are tools to reduce burden of disease in deprived social groups, directly through providing vaccines or indirectly through herd immunity.	Positive
Protecting the most vulnerable	It is ethically imperative to protect those who are vulnerable and cannot protect themselves.	Vaccines can protect the most vulnerable groups that cannot become vaccinated (eg, immunocompromised individuals, the very young or old) via herd immunity.	Positive
Fair innings	Although controversial, there is a body of research that indicates that people prefer health benefits for younger vs older people.	Vaccines typically target children.	Positive
Professional deontology	For some professions, there is an additional ethical imperative to avoid falling sick to avoid spreading infections (eg, healthcare workers), or to protect the country (eg, the military).	Healthcare workers, police, and the military are target groups for vaccination.	Positive
Social inclusion of minorities	Effort should be made to integrate ethnic minorities into society.	Outbreaks can be stigmatizing. Vaccines targeted at ethnic groups at risk of infectious diseases help prevent disease transmission among those groups.	Positive
Principles related to the health benefit			
The aggregation problem	Size matters: many small health gains do not add up to a few big ones.	Some vaccines typically protect against very serious but rare outcomes (eg, meningitis) and deserve a higher valuation. Other vaccines protect against common but mild outcomes and deserve lower priority.	Mixed
Luck egalitarianism	There are ethical reasons to distinguish between option luck and brute luck and to prioritize health problems that were self-inflicted over those that were unavoidable.	Vaccines are preventive and are examples of responsible health behavior.	Positive
Equity beyond health	Are the ignored broader consequences disproportionately affecting sensitive ethnic groups?	Comorbidities occur more often in disadvantaged groups, and health- and career-related productivity losses are worse among these groups.	Positive
Principles related to the intervention			
Man-made vs natural effects	Individuals respond differently to side effects than to natural infections.	Vaccines occasionally cause side effects, negatively affecting public trust.	Negative
Respect for individual autonomy	Though not considered in economic evaluations, there is a cost to individual autonomy when people are forced to use healthcare.	Vaccines are often embedded in programs that stimulate uptake (from soft nudges to stronger legal compulsion).	Negative

Protecting the most vulnerable

Social inclusion of minorities

Equity beyond health

Source: Annemans et al 2021

Summary of take home messages

- Traditional evaluation framework is grossly insufficient in identifying the true value of vaccine across the entire population
- New approach should encompass a societal perspective instead of limiting to the payer's perspective
- New outcomes should extend beyond just cost and benefit to include equity of the population

THANK YOU

