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Review

Cost-effectiveness analysis of vaccinations and decision makings on vaccination programmes in Hong Kong: A systematic review

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ABSTRACT

Objectives: To describe and systematically review the modelling and reporting of cost-effectiveness analysis of vaccination in Hong Kong, and to identify areas for quality enhancement in future cost-effectiveness analyses.

Methods: We conducted a comprehensive and systematic review of cost-effectiveness studies related to vaccination and government immunisation programmes in Hong Kong published from 1990 to 2015, through database search of Pubmed, Web of Science, Embase, and OVID Medline. Methodological quality of selected studies was assessed using Consolidated Health Economic Evaluation Reporting Standards checklist (CHEERS). Decision making of vaccination was obtained from Scientific Committee on Vaccine Preventable Diseases (SCVPD) and Department of Health in Hong Kong.

Results: Nine eligible studies reporting twelve comparative cost-effectiveness comparisons of vaccination programme for influenza (n = 2), pneumococcal disease (n = 3), influenza plus pneumococcal disease (n = 1), chickenpox (n = 2), Haemophilus influenzae b (n = 1), hepatitis A (n = 1), cervical cancer (n = 1) and rotavirus (n = 1) were identified. Ten comparisons (83.3%) calculated the incremental cost-effectiveness ratio (ICER) of a vaccination strategy versus status quo as outcomes in terms of cost in USD per life-years, cost per quality-adjusted life-years, or cost per disability-adjusted life-years. Among those 10 comparisons in base-case scenario, 4 evaluated interventions were cost-saving relative to status quo while the ICER estimates in 3 of the 6 remaining comparisons were far below commonly accepted threshold and WHO willingness-to-pay threshold, suggestive of very cost-effective. Seven studies were of good quality based on the CHEERS checklist; one was of moderate quality; and one was of excellent quality. The common methodological problems were characterisation of heterogeneity and reporting of study parameters.

Conclusions: There was a paucity of cost-effectiveness models evaluating vaccination targeted to the Hong Kong population. All evaluated vaccinations and immunisation interventions in Hong Kong, except for Haemophilus influenzae b, hepatitis A and HPV vaccinations, were considered either cost-saving or very cost-effective when compared to status quo.

Contents

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1. Introduction

In order to reduce the vaccine-preventable morbidity and mortality, annual costs associated with national routine immunisation programmes in low- and middle-income countries are going to increase from US$3.5–4.5 billion in 2011 to US$50–80 billion in 2020 [1]. With scarce resources in public health care system, financial and budgetary impact are the major criteria of decision making processes on which vaccine to introduce and sustain in national immunisation programmes. Theoretically, resources allocated to one emerging vaccine dedicated to one disease population may displace the investment of another health intervention, irrespective of vaccination or not, potentially giving clinical benefits to another disease population.

For equity in access to health services and resources allocation, health economic evaluation including cost-effectiveness analysis and cost-utility analysis is a widely-adopted methodology for assessing the additional value of a new vaccine in current national immunisation programmes. Conclusions from health economic evaluation bring up important information to advisory body for evidence-based recommendation, for example, National Immunisation Technical Advisory Groups (NITAGs) in European countries [2], The Advisory Committee on Immunisation Practices in the US [3], and Australian Technical Advisory Group on Immunisation (ATAGI) [4] in Australia. Apart from health economic evidence, other essential factors such as disease burden, vaccine efficacy and effectiveness, safety, feasibility of programme implementation, ethical and legal considerations also influence the decision making from advisory body and health policy maker [5–8]. In the UK where decision making process is heavily based on absolute incremental cost-effectiveness ratio (ICER) threshold, the value of vaccine for the gain in health of their populations is evaluated by Joint Committee on Vaccination and Immunisation (JCVI) and compared against country-specific threshold value to inform decision making. Efficacious and effective vaccinations are more likely to be incorporated into national immunisation programme in condition when health service is willing to pay for vaccine adoption to routine practice.

In Hong Kong context, the Scientific Committee on Vaccine Preventable diseases, under the Centre for Health Protection [9], has the responsibility of reviewing the up-to-date evidence from both local data and overseas practice, and providing scientific advice and recommendations on strategies for government immunisation programmes in local population [9]. Three universal vaccination programmes (Childhood Immunisation Programme, Government Vaccination Programme, and Residential Care Home Vaccination Programme) have been officially implemented by Department of Health. Under Childhood Immunisation Programme, children have been required to receive at least 12 injections before Primary Six since February 2007 to prevent nine infectious diseases including tuberculosis, poliomyelitis, hepatitis B, diphtheria, pertussis, tetanus, measles, mumps and rubella [10]. Since September 2009, four doses of pneumococcal vaccine have been added to the vaccination schedule for children aged two months, four months, six months and 12 months, respectively. Varicella-containing vaccine for prevention of chickenpox infection was recommended to be scheduled in Childhood Immunisation Programme since 2012, and added to Childhood Immunisation Programme for infant since June 2014 [11]. Completing the routine childhood immunisation programme is a requirement for school entry in Hong Kong whilst the coverage rates of these compulsory vaccines were over 99% among Hong Kong-born children [11]. The decision making of Childhood Immunisation Programme seems to follow the World Health Organization's recommendations [12] but excludes influenza, rotavirus and Haemophilus influenzae b (Hib) vaccines which are available on the private market because of a hybrid public-private healthcare system in Hong Kong [13]. The infant and elderly were recommended to undertake 23-valent pneumococcal polysaccharide vaccine since 2007. The 7-valent pneumococcal conjugate vaccination (PCV-7) was incorporated in Childhood Immunisation Programme for infant since 2007, and subsequently replaced by pneumococcal polysaccharide vaccine with serotype coverage, 10-valent (PCV-10) in 2010 and 13-valent (PCV-13) in 2011. Such changes in decision-making seem to be associated with increasing availability of local epidemiological data, continuously reviewing of vaccine safety and efficacy, and overseas experience [9]. Both the trivalent and quadrivalent influenza vaccines for prevention of seasonal flu were provided by public clinics and hospitals under the Government Vaccination Programme and Residential Care Home Vaccination Programme, and private doctors under Vaccination Subsidy Scheme. However, the public health objectives for the inclusion or exclusion of certain groups for influenza vaccination prioritization are not clearly stated. Overall, group prioritization for influenza vaccination may be based on risk of infection (e.g., young children and poultry workers), risk of severe disease if infected (e.g., pregnant women) and risk of transmission to other vulnerable people (e.g., healthcare workers, young children, and elderly living in residential care homes) [14] with data from surveys of public demands among the potential target groups and may also take into account aspects of cost-benefit and cost-effectiveness.

Although Hong Kong is considered as a region in high-income counties, decision making process was calling for transparency to the general public and health professional for critical appraisal [15]. Recent systematic review [16] linking ICER values of evaluated interventions to government's decisions suggested that the ICER values may be associated with advisory body's decision to inform recommendation. Nevertheless, the impact of cost-effectiveness analysis of vaccination on decision making was uncertain. A single ICER threshold value for decision making on which vaccination to recommend and accept in public health care system is not officially available in Hong Kong, besides the gross domestic product per capita threshold recommended by World Health Organisation [17].

Reporting standard, characteristics and assumption of cost-effectiveness models evaluating vaccination influence the base-case results, contributing to decision making on funding for national immunisation programme. Following the World Health Organisation guideline and consensus [18,19], critically appraisal on whether methodology is properly analysed and adequately presented is a vital step before considering results and consequent recommendations. Heterogeneity in modelling approaches and

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