1. **Economic benefits of keeping vaccines at ambient temperature during mass vaccination: the case of meningitis A vaccine in Chad**


   Patrick Lydon, Simona Zipursky, Carole Tevi-Benissan, Mamoudou Harouna Djingarey, Placide Gbedonou, Brahim Oumar Youssouf & Michel Zaffran

   **Abstract**

   **Objective** To evaluate the potential economic benefits of keeping a meningitis A vaccine at or near ambient temperature for up to 4 days during a mass vaccination campaign.

   **Methods** During a 10-day mass vaccination campaign against meningitis A in three regions of Chad in 2011, the costs associated with storage and transport of the vaccine in a traditional cold chain system were evaluated. A mathematical model was used to estimate the savings that could have been achieved if the vaccine had been stored at or near ambient temperature – in a “controlled temperature” chain – at the peripheral levels of the supply chain system.

   **Findings** The cost of the cold chain and associated logistics used in the campaign in Chad was 0.24 United States dollars (US$) per person vaccinated. In the modelled scenario for a controlled temperature chain, however, these costs dropped by 50% and were estimated to be only US$ 0.12 per person vaccinated.

   **Conclusion** The implementation of a “controlled temperature” chain at the most peripheral levels of the supply chain system – assuming no associated loss of vaccine potency, efficacy or safety – could result in major economic benefits and allow vaccine coverage to be extended in low-resource settings.

2. **Influenza vaccines in low and middle income countries: a systematic review of economic evaluations**

   *Hum Vaccin Immunother.* 2013 Jul;9(7):1500-11.

   Ott JJ, Klein Breteler J, Tam JS, Hutubessy RC, Jit M, de Boer MR.

   **Abstract**

   **Objectives** Economic evaluations on influenza vaccination from low resource settings are scarce and have not been evaluated using a systematic approach. Our objective was to conduct a systematic review on the value for money of influenza vaccination in low- and middle-income countries.

   **Methods** PubMed and EMBASE were searched for economic evaluations published in any language between 1960 and 2011. Main outcome measures were costs per influenza outcome averted, costs per quality-adjusted life years gained or disability-adjusted life years averted, costs per benefit in monetary units or cost-benefit ratios.

   **Results** Nine economic evaluations on seasonal influenza vaccine met the inclusion criteria. These were model- or randomized-controlled-trial (RCT)-based economic evaluations from middle-income countries. Influenza vaccination provided value for money for elderly, infants, adults and children with high-risk conditions. Vaccination was cost-effective and cost-saving for chronic obstructive pulmonary disease patients and in elderly above 65 y from model-based evaluations, but conclusions from RCTs on elderly varied.

   **Conclusion** Economic evaluations from middle income regions differed in population studied, outcomes and definitions used. Most findings are in line with evidence from high-income countries highlighting that influenza vaccine is likely to provide value for money. However, serious methodological limitations do not allow drawing conclusions on cost-effectiveness of influenza vaccination in middle income countries. Evidence on cost-effectiveness from low-income countries is lacking altogether, and more information is needed from full economic evaluations that are conducted in a standardized manner.
3. **Economic analysis for evidence-based policy-making on a national immunization program: A case of rotavirus vaccine in Thailand**

Vaccine, Volume 30, Issue 18, 16 April 2012, Pages 2839-2847
Charung Muangchana, Arthon Riewpaiboon, Suchada Jiamsiri, Piyanit Thamapornpilas, Porpit Warinsatian

**Keywords**
Economic analysis; Cost-effectiveness analysis; Rotavirus; Vaccine; National immunization program; Thailand

**Abstract**
Severe diarrhea caused by rotavirus is a health problem worldwide, including Thailand. The World Health Organization has recommended incorporating rotavirus vaccination into national immunization programs. This policy has been implemented in several countries, but not in Thailand where the mortality rate is not high. This leads to the question of whether it would be cost-effective to implement such a policy. The Thai National Vaccine Committee, through the Immunization Practice Subcommittee, has conducted an economic analysis. Their study aimed to estimate the costs of rotavirus diarrhea and of a rotavirus vaccination program, and the cost-effectiveness of such a program including budget impact analysis. The study was designed as an economic evaluation, employing modeling technique with both provider and societal perspectives. A birth cohort of Thai children in 2009 was used in the analysis, with a 5-year time horizon. Costs were composed of cost of the illness and the vaccination program. Outcomes were measured in the form of lives saved and DALYs averted. Both costs and outcomes were discounted at 3%. The study found the discounted number of deaths to be 7.02 and 20.52 for vaccinated and unvaccinated cohorts, respectively (13.5 deaths averted). Discounted DALYs were 263.33 and 826.57 for vaccinated and unvaccinated cohorts, respectively (563.24 DALYs averted). Costs of rotavirus diarrhea in a societal perspective were US$6.6 million and US$21.0 million for vaccinated and unvaccinated cohorts, respectively. In the base case, the costs per additional death averted were US$5.1 million and US$5.7 for 2-dose and 3-dose vaccines, respectively, in a societal perspective. Costs per additional DALYs averted were US$128,063 and US$142,144, respectively. In a societal perspective, with a cost-effectiveness threshold at 1 GDP per capita per DALYs averted, vaccine prices per dose were US$4.98 and US$3.32 for 2-dose and 3-dose vaccines, respectively; in a provider perspective, they were US$2.90 and US$1.93. One-way and probabilistic sensitivity analyses were included. The budget required for vaccine purchase was calculated for all scenarios.

4. **Economic Impact of Pneumococcal Protein-D Conjugate Vaccine (PHiD-CV) on the Malaysian National Immunisation Programme**

Value in Health Regional Issues, Volume 3, May 2014, Pages 146-155
Syed Aljunid, Namaitijiang Maimaiti, Zafar Ahmed, Amrizar Muhammad Nur, Zaleha Md Isa, Soraya Azmi, Saperi Sulong

**Keywords**
cost-effectiveness; Malaysia; nontypeable Haemophilus influenzae; PHiD-CV; pneumococcal conjugate vaccine; pneumococcal protein-D conjugate vaccine; Streptococcus pneumoniae; 13-valent pneumococcal conjugate vaccine

**Abstract**
**Objective** To assess the cost-effectiveness of introducing pneumococcal polysaccharide and nontypeable Haemophilus influenzae protein D conjugate vaccine (PHiD-CV) in the National Immunization Programme of Malaysia. This study compared introducing PHiD-CV (10 valent vaccine) with current no vaccination, as well as against the alternative 13-valent pneumococcal conjugate vaccine (PCV13).

**Methods** A lifetime Markov cohort model was adapted using national estimates of disease burden, outcomes of pneumococcal disease, and treatment costs of disease manifestations including pneumonia, acute otitis media, septicemia, and meningitis for a hypothetical birth cohort of 550,000 infants. Clinical information was obtained by review of medical records from four public hospitals in Malaysia from the year 2008 to 2009. Inpatient cost from the four study hospitals was obtained from a diagnostic-related group–based costing system. Outpatient cost was estimated using clinical pathways developed by an expert panel. The perspective assessed was that of the Ministry of Health, Malaysia.
Results The estimated disease incidence was 1.2, 3.7, 70, and 6.9 per 100,000 population for meningitis, bacteremia, pneumonia, and acute otitis media, respectively. The Markov model predicted medical costs of Malaysian ringgit (RM) 4.86 billion (US $1.51 billion) in the absence of vaccination. Vaccination with PHiD-CV would be highly cost-effective against no vaccination at RM30,290 (US $7,407) per quality-adjusted life-year gained. On comparing PHiD-CV with PCV13, it was found that PHiD-CV dominates PCV13, with 179 quality-adjusted life-years gained while saving RM35 million (US $10.87 million).

Conclusions It is cost-effective to incorporate pneumococcal vaccination in the National Immunization Programme of Malaysia. Our model suggests that PHiD-CV would be more cost saving than PCV13 from the perspective of the Ministry of Health of Malaysia.

5. Using standardized tools to improve immunization costing data for program planning: The cost of the Colombian Expanded Program on Immunization

Vaccine, Volume 31, Supplement 3, 2 July 2013, Pages C72-C79
Carlos Castañeda-Orjuela, Martin Romero, Patricia Arce, Stephen Resch, Cara B. Janusz, Cristiana M. Toscano, Fernando De la Hoz-Restrepo

Keywords Costs and cost analysis; Vaccines; Immunization programs; Colombia

Abstract

Introduction The cost of Expanded Programs on Immunization (EPI) is an important aspect of the economic and financial analysis needed for planning purposes. Costs also are needed for cost-effectiveness analysis of introducing new vaccines. We describe a costing tool that improves the speed, accuracy, and availability of EPI costs that was piloted in Colombia.

Methods The ProVac CostVac Tool is a spreadsheet-based tool that estimates overall EPI costs considering program inputs (personnel, cold chain, vaccines, supplies, etc.) at three administrative levels (central, departmental, and municipal) and one service delivery level (health facilities). It uses various costing methods. The tool was evaluated through a pilot exercise in Colombia. In addition to the costs obtained from the central and intermediate administrative levels, a survey of 112 local health facilities was conducted to collect vaccination costs. Total cost of the EPI, cost per dose of vaccine delivered, and cost per fully vaccinated child with the recommended immunization schedule in Colombia in 2009 were estimated.

Results The ProVac CostVac Tool is a novel, user-friendly tool, which allows users to conduct an EPI costing study following guidelines for cost studies. The total costs of the Colombian EPI were estimated at US$ 107.8 million in 2009. The cost for a fully immunized child with the recommended schedule was estimated at US$ 153.62. Vaccines and vaccination supplies accounted for 58% of total costs, personnel for 21%, cold chain for 18%, and transportation for 2%. Most EPI costs are incurred at the central level (62%). The major cost driver at the department and municipal levels is personnel costs.

Conclusion The ProVac CostVac Tool proved to be a comprehensive and useful tool that will allow researchers and health officials to estimate the actual cost for national immunization programs. The present analysis shows that personnel, cold chain, and transportation are important components of EPI and should be carefully estimated in the cost analysis, particularly when evaluating new vaccine introduction.

6. Cost-effectiveness and economic benefits of vaccines in low- and middle-income countries: A systematic review

Vaccine, Volume 31, Issue 1, 17 December 2012, Pages 96-108
Sachiko Ozawa, Andrew Mirelman, Meghan L. Stack, Damian G. Walker, Orin S. Levine

Keywords Vaccine; Cost-effectiveness; Economic evaluation; DALY; Benefits; Systematic review

Abstract

Background Public health interventions that prevent mortality and morbidity have greatly increased over the past decade. Immunization is one of these preventive interventions, with a potential to bring economic benefits beyond just health benefits. While vaccines are considered to be a cost-effective public health intervention, implementation has become increasingly challenging. As vaccine costs rise
and competing priorities increase, economic evidence is likely to play an increasingly important role in vaccination decisions.

**Methods** To assist policy decisions today and potential investments in the future, we provide a systematic review of the literature on the cost-effectiveness and economic benefits of vaccines in low-and middle-income countries from 2000 to 2010. The review identified 108 relevant articles from 51 countries spanning 23 vaccines from three major electronic databases (Pubmed, Embase and Econlit).

**Results** Among the 44 articles that reported costs per disability-adjusted life year (DALY) averted, vaccines cost less than or equal to $100 per DALY averted in 23 articles (52%). Vaccines cost less than $500 per DALY averted in 34 articles (77%), and less than $1000 per DALY averted in 38 articles (86%) in one of the scenarios. 24 articles (22%) examined broad level economic benefits of vaccines such as greater future wage-earning capacity and cost savings from averting disease outbreaks. 60 articles (56%) gathered data from a primary source. There were little data on long-term and societal economic benefits such as morbidity-related productivity gains, averting catastrophic health expenditures, growth in gross domestic product (GDP), and economic implications of demographic changes resulting from vaccination.

**Conclusions** This review documents the available evidence and shows that vaccination in low- and middle-income countries brings important economic benefits. The cost-effectiveness studies reviewed suggest to policy makers that vaccines are an efficient investment. This review further highlights key gaps in the available literature that would benefit from additional research, especially in the area of evaluating the broader economic benefits of vaccination in the developing world.

7. **Introducing new vaccines in developing countries**

   **Expert Review of Vaccines.** December 2013, Vol. 12, No. 12, Pages 1465-1478
   Sonali Kochhar, Barbara Rath, Lea D Seeber, Gabriella Rundblad, Ali Khamesipour, Mohammad Ali and The Vienna Vaccine Safety Initiative

   **Keywords**
   AEFI, developing countries, immunization, vaccines, vaccine introduction, vaccine safety

   **Abstract**
   Vaccines offer the most cost-effective approach to controlling infectious diseases. Access to vaccines remains unequal and suboptimal, particularly in poorer developing countries. Introduction of new vaccines and long-term sustainability of immunization programs will require proactive planning from conception to implementation. International and national coordination efforts as well as local and cultural factors need to be known and accounted for. Adequate infrastructure should be in place for the monitoring of disease burden, vaccine effectiveness and vaccine safety, based on the common terminology and international consensus. This overview paper aims to raise awareness of the importance of introduction efforts for vaccines of special relevance to resource-poor countries. The target audiences are those involved in immunization programs, from planning or oversight roles to frontline providers, as well as health care professionals.

8. **Economic evaluations of hepatitis A vaccination in middle-income countries**

   **Expert Review of Vaccines.** December 2013, Vol. 12, No. 12, Pages 1479-1494
   Auliya A Suwantika, Selen Yegenoglu, Arthorn Riewpaiboon, Hong-Anh T Tu and Maarten J Postma

   **Keywords**
   economic evaluation, hepatitis A, middle-income countries, vaccination

   **Abstract**
   Economic evaluations of hepatitis A vaccination are important to assist national and international policy makers in different jurisdictions on making effective decisions. Up to now, a comprehensive review of the potential health and economic benefits on hepatitis A vaccination in middle-income countries (MICs) has not been performed yet. In this study, we reviewed the literature on the cost–effectiveness of hepatitis A vaccination in MICs. Most of the studies confirmed that hepatitis A vaccination was cost effective or even cost saving under certain conditions. We found that vaccine price, medical costs, incidence and discount rate were the most influential parameters on the sensitivity analyses. Vaccine price has been shown as a barrier for MICs in implementing universal vaccination of hepatitis A. Given their relatively limited financial resources, implementation of single-dose vaccination could be considered. Despite our findings, we argue that further economic
evaluations in MICs are still required in the near future.

9. **Influenza vaccines in low and middle income countries: a systematic review of economic evaluations**


Jördis J. Ott, Janna Klein Breteler, John S. Tam, Raymond C.W. Hutubessy, Mark Jit, and Michiel R. de Boer,

**Keywords**
cost analysis; developing countries; economic evaluation; influenza; systematic review; vaccines

**Abstract**

**Objectives:** Economic evaluations on influenza vaccination from low resource settings are scarce and have not been evaluated using a systematic approach. Our objective was to conduct a systematic review on the value for money of influenza vaccination in low- and middle-income countries.

**Methods:**

PubMed and EMBASE were searched for economic evaluations published in any language between 1960 and 2011. Main outcome measures were costs per influenza outcome averted, costs per quality-adjusted life years gained or disability-adjusted life years averted, costs per benefit in monetary units or cost-benefit ratios.

**Results:**

Nine economic evaluations on seasonal influenza vaccine met the inclusion criteria. These were model- or randomized-controlled-trial (RCT)-based economic evaluations from middle-income countries. Influenza vaccination provided value for money for elderly, infants, adults and children with high-risk conditions. Vaccination was cost-effective and cost-saving for chronic obstructive pulmonary disease patients and in elderly above 65 from model-based evaluations, but conclusions from RCTs on elderly varied.

**Conclusion:** Economic evaluations from middle income regions differed in population studied, outcomes and definitions used. Most findings are in line with evidence from high-income countries highlighting that influenza vaccine is likely to provide value for money. However, serious methodological limitations do not allow drawing conclusions on cost-effectiveness of influenza vaccination in middle income countries. Evidence on cost-effectiveness from low-income countries is lacking altogether, and more information is needed from full economic evaluations that are conducted in a standardized manner.

10. **Health economics of rubella: a systematic review to assess the value of rubella vaccination**


Joseph B Babigumira, Ian Morgan, and Ann Levin

**Abstract**

**Background** Most cases of rubella and congenital rubella syndrome (CRS) occur in low- and middle-income countries. The World Health Organization (WHO) has recently recommended that countries accelerate the uptake of rubella vaccination and the GAVI Alliance is now supporting large scale measles-rubella vaccination campaigns. We performed a review of health economic evaluations of rubella and CRS to identify gaps in the evidence base and suggest possible areas of future research to support the planned global expansion of rubella vaccination and efforts towards potential rubella elimination and eradication.

**Methods** We performed a systematic search of on-line databases and identified articles published between 1970 and 2012 on costs of rubella and CRS treatment and the costs, cost-effectiveness or cost-benefit of rubella vaccination. We reviewed the studies and categorized them by the income level of the countries in which they were performed, study design, and research question answered. We analyzed their methodology, data sources, and other details. We used these data to identify gaps in the evidence and to suggest possible future areas of scientific study.

**Results** We identified 27 studies: 11 cost analyses, 11 cost-benefit analyses, 4 cost-effectiveness analyses, and 1 cost-utility analysis. Of these, 20 studies were conducted in high-income countries, 5 in upper-middle income countries and two in lower-middle income countries. We
did not find any studies conducted in low-income countries. CRS was estimated to cost (in 2012 US$) between $4,200 and $57,000 per case annually in middle-income countries and up to $140,000 over a lifetime in high-income countries. Rubella vaccination programs, including the vaccination of health workers, children, and women had favorable cost-effectiveness, cost-utility, or cost-benefit ratios in high- and middle-income countries.

Conclusions Treatment of CRS is costly and rubella vaccination programs are highly cost-effective. However, in order for research to support the global expansion of rubella vaccination and the drive towards rubella elimination and eradication, additional studies are required in low-income countries, to tackle methodological limitations, and to determine the most cost-effective programmatic strategies for increased rubella vaccine coverage.

11. Economic analyses to support decisions about HPV vaccination in low- and middle-income countries: a consensus report and guide for analysts

Mark Jit, Carol Levin, Marc Brisson, Ann Levin, Stephen Resch, Johannes Berkhof, Jane Kim and Raymond Hutflessy

Keywords
Human papillomavirus; vaccination; low- and middle-income countries; economic evaluation.

Abstract
Low- and middle-income countries need to consider economic issues such as cost-effectiveness, affordability and sustainability before introducing a program for human papillomavirus (HPV) vaccination. However, many such countries lack the technical capacity and data to conduct their own analyses. Analysts informing policy decisions should address the following questions: 1) Is an economic analysis needed? 2) Should analyses address costs, epidemiological outcomes, or both? 3) If costs are considered, what sort of analysis is needed? 4) If outcomes are considered, what sort of model should be used? 5) How complex should the analysis be? 6) How should uncertainty be captured? 7) How should model results be communicated? Selecting the appropriate analysis is essential to ensure that all the important features of the decision problem are correctly represented, but that the analyses are not more complex than necessary. This report describes the consensus of an expert group convened by the World Health Organization, prioritizing key issues to be addressed when considering economic analyses to support HPV vaccine introduction in these countries.

12. Model-Based Impact and Cost-Effectiveness of Cervical Cancer Prevention in the Extended Middle East and North Africa (EMENA)

Vaccine 31S (2013) G65–G77
Jane J. Kima, Monisha Sharmaa, Meredith O'Sheaa, Steven Sweeta, Mireia Diazb, Hélène Sancho-Garnierc, Muhieddine Seoudda

Keywords
HPV; Mathematical model; Cost-effectiveness; Extended Middle East; North Africa

Abstract
To date, no studies have evaluated the cost-effectiveness of human papillomavirus (HPV) vaccination in countries in the Extended Middle East and North Africa (EMENA) region. We synthesized population and epidemiologic data for 20 EMENA countries using a model-based approach to estimate averted cervical cancer cases and deaths, disability-adjusted life years (DALYs) and cost-effectiveness ratios (US$ [international dollars] per DALY averted) associated with HPV vaccination of pre-adolescent girls. We utilized additional epidemiologic data from Algeria, Lebanon, and Turkey to evaluate select cervical cancer screening strategies either alone or in combination with vaccination. Results showed that pre-adolescent vaccination of five consecutive birth cohorts at 70% coverage has the potential to prevent over 180,000 cervical cancer cases. Cases averted varied by country, largely due to differences in cancer burden and population size; 69% of cases averted occurred in the three GAVI-eligible countries in EMENA. Despite the low cervical cancer incidence in EMENA, we found that HPV vaccination was cost-effective using a threshold of each country's gross domestic product per capita (a common metric for evaluating cost-effectiveness) in all but five countries at a cost per vaccinated girl of IS$25 ($5 per dose). However, cost-effectiveness diminished with increasing vaccine cost; at a cost of IS$200 per vaccinated girl, HPV vaccination was cost-effective in only five countries. When the cost per vaccinated girl exceeded IS$50 in Lebanon and Turkey and IS$150 in
Algeria, screening alone was most attractive. We identified opportunities to improve upon current national screening guidelines, involving less frequent screening every 3–5 years. While pre-adolescent HPV vaccination promises to be a cost-effective strategy in most EMENA countries at low costs, decision makers will need to consider many other factors, such as affordability, acceptability, feasibility, and competing health priorities, when making decisions about cervical cancer prevention. This article forms part of a regional report entitled “Comprehensive Control of HPV Infections and Related Diseases in the Extended Middle East and North Africa Region” Vaccine Volume 31, Supplement 6, 2013. Updates of the progress in the field are presented in a separate monograph entitled “Comprehensive Control of HPV Infections and Related Diseases” Vaccine Volume 30, Supplement 5, 2012.

13. Health and economic outcomes of HPV 16,18 vaccination in 72 GAVI-eligible countries

Sue J. Goldie, Meredith O'Shea, Nicole Gastineau Campos, Mireia Diaz, Steven Sweet, Sun-Young Kim

Keywords
HPV; Cost-effectiveness; GAVI

Abstract
The risk of dying from cervical cancer is disproportionately borne by women in developing countries. Two new vaccines are highly effective in preventing HPV 16,18 infection, responsible for approximately 70% of cervical cancer, in girls not previously infected. The GAVI Alliance (GAVI) provides technical assistance and financial support for immunization in the world's poorest countries. Using population-based and epidemiologic data for 72 GAVI-eligible countries we estimate averted cervical cancer cases and deaths, disability-adjusted years of life (DALYs) averted and incremental cost-effectiveness ratios ($/DALY averted) associated with HPV 16,18 vaccination of young adolescent girls. In addition to vaccine coverage and efficacy, relative and absolute cancer reduction depended on underlying incidence, proportion attributable to HPV types 16 and 18, population age-structure and competing mortality. With 70% coverage, mean reduction in the lifetime risk of cancer is below 40% in some countries (e.g., Nigeria, Ghana) and above 50% in others (e.g., India, Uganda, Kenya). At $10 per vaccinated girl (approximately $2.00 per dose assuming three doses, plus wastage, administration, program support) vaccination was cost-effective in all countries using a per capita GDP threshold; for 49 of 72 countries, the cost per DALY averted was less than $100 and for 59 countries, it was less than $200. Taking into account country-specific assumptions (per capita GNI, DPT3 coverage, percentage of girls who are enrolled in fifth grade) for the year of introduction, percent coverage achieved in the first year, and years to maximum coverage, a 10-year modeled scenario prevented the future deaths of approximately 2 million women vaccinated as adolescents. Despite favorable cost-effectiveness, assessment of financial costs raised concerns about affordability; as the cost per vaccinated girl was increased from $10 to $25 (approximately $2 to $5 per dose), the financial costs for the 10-year scenario increased from >US$ 900 million to US$ 2.25 billion. Provided high coverage of young adolescent girls is feasible, and vaccine costs are lowered, HPV 16,18 vaccination could be very cost-effective even in the poorest countries, and provide comparable value for resources to other new vaccines such as rotavirus.

14. Systematic review of incremental non-vaccine cost estimates used in cost-effectiveness analysis on the introduction of rotavirus and pneumococcal vaccines

Vaccine. 2013 Jul 2;31 Suppl 3:C80-7; doi: 10.1016/j.vaccine.2013.05.064.
Fernando De la Hoz-Restrepo, Carlos Castañeda- Orjuela, Angel Paternina, Nelson Alvis-Guzman

Keywords
Costs and cost analysis; Cost-effectiveness analysis; Vaccines; Immunization programs; Rotavirus vaccines; Pneumococcal vaccines

Abstract
Objective To review the approaches used in the cost-effectiveness analysis (CEAs) literature to estimate the cost of expanded program on immunization (EPI) activities, other than vaccine purchase, for rotavirus and pneumococcal vaccines.

Methods A systematic review in PubMed and NHS EED databases of rotavirus and pneumococcal
vaccines CEAs was done. Selected articles were read and information on how EPI costs were calculated was extracted. EPI costing approaches were classified according to the method or assumption used for estimation.

**Results** Seventy-nine studies that evaluated cost effectiveness of rotavirus (n = 43) or pneumococcal (n = 36) vaccines were identified. In general, there are few details on how EPI costs other than vaccine procurement were estimated. While 30 studies used some measurement of that cost, only one study on pneumococcal vaccine used a primary cost evaluation (bottom-up costing analysis) and one study used a costing tool. Twenty-seven studies (17 on rotavirus and 10 on pneumococcal vaccine) assumed the non-vaccine costs. Five studies made no reference to additional costs. Fourteen studies (9 rotavirus and 5 pneumococcal) did not consider any additional EPI cost beyond vaccine procurement. For rotavirus studies, the median for non-vaccine cost per dose was US$0.74 in developing countries and US$6.39 in developed countries. For pneumococcal vaccines, the median for non-vaccine cost per dose was US$1.27 in developing countries and US$8.71 in developed countries.

**Conclusions** Many pneumococcal (52.8%) and rotavirus (60.4%) cost-effectiveness analyses did not consider additional EPI costs or used poorly supported assumptions. Ignoring EPI costs in addition to those for vaccine procurement in CEA analysis of new vaccines may lead to significant errors in the estimations of ICERs since several factors like personnel, cold chain, or social mobilization can be substantially affected by the introduction of new vaccines.

15. **The decision making process on new vaccines introduction in South Africa**

Volume 30, Supplement 3, 7 September 2012, Pages C9–C13
Ntombenhle Judith Ngcobo, Neil A. Cameron

**Keywords**
New vaccines; Introduction; Decision making; Cost-effectiveness; Immunisation policy

**Abstract**
South Africa has a functional decision making process for the introduction of new vaccines; with an established National Immunisation Technical Advisory Group (NITAG), referred to as National Advisory Group on Immunisation (NAGI). South Africa has played a leadership role in the African continent with introduction of new vaccines, which dates back to 1995 with the introduction of hepatitis B, followed by the Haemophilus influenzae type b in 1999 and recently the national roll out of the pneumococcal conjugate and rotavirus vaccines in 2009.

NAGI has the responsibility to deliberate on key policy issues as part of the process for decision making on the introduction of new vaccines. In developing recommendations NAGI considers: disease burden, cost effectiveness, and the impact on the Expanded Programme on Immunisation (EPI). Although guidance and recommendations from WHO are considered, the decision to introduce a new vaccine in South Africa is based on local data. NAGI recommendations are presented to the National Department of Health (NDOH). The NDOH pursues the matter further through the involvement of provinces. When an agreement has been reached to accept the NAGI recommendations, the NDOH seeks funding from the Ministry of Finance (MOF). Once funds are available, the new vaccines are implemented by the immunisation programme.

Although there is an established functional system for decision making in South Africa, some areas need to be addressed. A system should be developed to allow the NDOH, NAGI and the MOF to engage in the deliberations on financial and economic impact of new vaccines. It is further recommended that a committee be established that will assess the programmatic issues to weigh the potential benefits of a new vaccine. Furthermore, political commitment should support the immunisation programme and strengthen it so that it can make an impact in the achievement of the Millennium Development Goal no. 4 of reducing child mortality.

16. **Randomised controlled trial and health economic evaluation of the impact of diagnostic testing for influenza, respiratory syncytial virus and Streptococcus pneumoniae infection on the management of acute admissions in the elderly and high-risk 18- to 64-year-olds.**

HEALTH TECHNOLOGY ASSESSMENT/VOLUME 18 ISSUE 36 MAY 2014/ISSN 1366-5278

**Background** Western industrialised nations face a large increase in the number of older people.
People over the age of 60 years account for almost half of the 16.8 million hospital admissions in England from 2009 to 2010. During 2009-10, respiratory infections accounted for approximately 1 in 30 hospital admissions and 1 in 20 of the 51.5 million bed-days.

**Objective** To determine the diagnostic accuracy and clinical effectiveness and cost-effectiveness of rapid molecular and near-patient diagnostic tests for influenza, respiratory syncytial virus (RSV) and Streptococcus pneumoniae infections in comparison with traditional laboratory culture.

**Methods** We carried out a randomised controlled trial (RCT) to evaluate impact on prescribing and clinical outcomes of point-of-care tests (POCTs) for influenza A and B and pneumococcal infection, reverse transcriptase-polymerase chain reaction (RT-PCR) tests for influenza A and B and RSV A and B, and conventional culture for these pathogens. We evaluated diagnostic accuracy of POCTs for influenza and pneumococcal infection, RT-PCR for influenza and sputum culture for S. pneumoniae using samples collected during the RCT. We did a systematic review and meta-analysis of POCTs for influenza A and B. We evaluated ease and speed of use of each test, process outcomes and cost-effectiveness.

**Results** There was no evidence of association between diagnostic group and prescribing or clinical outcomes. Using PCR as 'gold standard', Quidel Influenza A + B POCT detected 24.4% [95% confidence interval (CI) 16.0% to 34.6%] of influenza infections (specificity 99.7%, 95% CI 99.2% to 99.9%); viral culture detected 21.6% (95% CI 13.5% to 31.6%; specificity 99.8%, 95% CI 99.4% to 100%). Using blood culture as 'gold standard', BinaxNOW pneumococcal POCT detected 57.1% (95% CI 18.4% to 90.1%) of pneumococcal infections (specificity 92.5%; 95% CI 90.6% to 94.1%); sputum culture detected 100% (95% CI 2.5% to 100%; sensitivity 97.2%, 95% CI 94.3% to 98.9%). Overall, pooled estimates of sensitivity and specificity of POCTs for influenza from the literature were 74% (95% CI 67% to 80%) and 99% (95% CI 98% to 99%), respectively. Median intervals from specimen collection to test result were 15 minutes [interquartile range (IQR) 10-23 minutes] for Quidel Influenza A + B POCT, 20 minutes (IQR 15-30 minutes) for BinaxNOW pneumococcal POCT, 50.8 hours (IQR 44.3-92.6 hours) for semi-nested conventional PCR, 29.2 hours (IQR 26-46.9 hours) for real-time PCR, 629.6 hours (IQR 262.5-846.7 hours) for culture of influenza and 84.4 hours (IQR 70.7-137.8 hours) and 71.4 hours (IQR 69.15-84.0 hours) for culture of S. pneumoniae in blood and sputum, respectively. Both POCTs were rated straightforward and undemanding; blood culture was moderately complex and all other tests were complex. Costs and quality-adjusted life-years (QALYs) of each diagnostic strategy were similar. Incrementally, PCR was most cost-effective (78.3% probability at a willingness to pay of £20,000/QALY). Few patients were admitted within a timescale conducive to treatment with a neuraminidase inhibitor according to National Institute for Health and Care Excellence guidance.

**Limitations** The accuracy study was limited by inadequate gold standards.

**Conclusions** All tests had limitations. We found no evidence that POCTs for influenza or S. pneumoniae, or PCR for influenza or RSV influenced antimicrobial prescribing or clinical outcomes. The total costs and QALYs of each diagnostic strategy were similar, although, incrementally, PCR was the most cost-effective strategy. The analysis does not support routine use of POCTs for either influenza or pneumococcal antigen for adults presenting with acute cardiopulmonary conditions, but suggests that conventional viral culture for clinical diagnosis should be replaced by PCR.

17. **Economic evaluations of implemented vaccination programmes: key methodological challenges in retrospective analyses**


Newall AT, Reyes JF, Wood JG, McIntyre P, Menzies R, Beutels P.

**Keywords**

Cost-effectiveness; Economic evaluation; Post-implementation; Programme evaluation; Retrospective; Vaccination

**Abstract**

Post-implementation evaluation should play an important role in assessing the success of public health programmes; however, the value for money achieved by vaccine programmes after introduction has received relatively little attention to date. In this article we explore the methodological challenges in these analyses and offer direction for future evaluations in the area. We identify alternative approaches to addressing these challenges, which include the estimation of disease changes attributable to vaccination efforts, the hypothetical no vaccination comparator scenario and the full benefit achieved by implemented vaccination programmes. We also outline other important considerations such as the evolution of prices over time. Further work needs to be done to explore
these issues and to determine how the application of different approaches may impact on the results of evaluations in various circumstances. As retrospective analyses are likely to become more frequent and influential, it is important that both the benefits and the limitations of post-implementation evaluations are recognised and understood. We argue that it would be useful to establish a methodological framework to provide standards and guidance on how to undertake such analyses in the future.

18. The role of health economic analyses in vaccine decision making
Black S.
Keywords
Cost-effectiveness; Vaccine policy
Abstract
Beginning in the 20th century with the consideration of the seven-valent pneumococcal conjugate vaccine in the US, the cost effectiveness became a topic of discussion when this vaccine was being considered for universal use by the US Advisory Committee on Immunization practices (ACIP). In 2008, the ACIP began using formal criteria for the presentation of such data and their inclusion in ACIP discussions. More recently, the US Institute of Medicine has recommended that health economic considerations play a primary role in the prioritization of future vaccine for development. However, such analyses can be biased towards vaccines that provide economic benefit rather than those that reduce severe morbidity and mortality. This is because the economic impact of minor common events that result in medical utilization or time lost from work for parents can outweigh the economic impact of severe morbidity and mortality. Thus diseases with a low mortality and morbidity but with a common clinical manifestation such as the common cold could be prioritized over vaccines against diseases such as meningococcal sepsis where the morbidity and mortality associated with each case is very high, but there is no associated common clinical syndrome. Thus the use of cost effectiveness analyses as a ‘gating criteria’ to decide which vaccines should be developed or routinely used runs the risk of transforming vaccines into primarily a tool for achieving cost savings within the health care system rather than a public health intervention targeting human suffering, death and disability. It is the purpose of this article to review the framework under which health economic evaluations can be undertaken, to review the experience with and reliability of such analyses, and to discuss the potential negative implications of the use of health economic analyses as a primary decision making tool.

19. Systematic review of studies evaluating the broader economic impact of vaccination in low and middle income countries
Deogaonkar R, Hutubessy R, van der Putten I, Evers S, Jit M.
Abstract
Background Most health economic evaluations of childhood vaccination only capture the health and short-term economic benefits. Measuring broader, long-term effects of vaccination on productivity and externalities could provide a more complete picture of the value of vaccines.
Method MEDLINE, EconLit and NHS-EED databases were searched for articles published between January 1990 and July 2011, which captured broader economic benefits of vaccines in low and middle income countries. Studies were included if they captured at least one of the following categories on broader economic impact: outcome-related productivity gains, behaviour-related productivity gains, ecological externalities, equity gains, financial sustainability gains or macroeconomic benefits.
Results Twenty-six relevant studies were found, including observational studies, economic models and contingent valuation studies. Of the identified broader impacts, outcome-related productivity gains and ecological externalities were most commonly accounted for. No studies captured behaviour-related productivity gains or macroeconomic effects. There was some evidence to show that vaccinated children 8-14 years of age benefit from increased cognitive ability. Productivity loss due to morbidity and mortality was generally measured using the human capital approach. When included, herd immunity effects were functions of coverage rates or based on reduction in disease outcomes. External effects of vaccines were observed in terms of equitable health outcomes and
contribution towards synergistic and financially sustainable healthcare programs.

Conclusion Despite substantial variation in the methods of measurement and outcomes used, the inclusion of broader economic impact was found to improve the attractiveness of vaccination. Further research is needed on how different tools and techniques can be used in combination to capture the broader impact of vaccination in a way that is consistent with other health economic evaluations. In addition, more country level evidence is needed from low and middle income countries to justify future investments in vaccines and immunization programs. Finally, the proposed broader economic impact framework may contribute towards better communication of the economic arguments surrounding vaccine uptake, leading to investments in immunization by stakeholders outside of the traditional health care sector such as ministries of finance and national treasuries.

20. Impact des vaccins dans les pays à bas et hauts revenus
Leif Gothefors
Mots-clés Vaccins Vaccination, programme étendu
Résumé
La vaccination est devenue la mesure de santé publique la plus efficace pour le contrôle des maladies infectieuses, après l'accès à de l'eau potable non contaminée. L'histoire de la vaccination est marquée par de grands espoirs et quelques déceptions. La seconde moitié du 20ème siècle a été notamment témoin du développement de remarquables projets de vaccination. Il sera possible d'éradiquer la poliomyélite et la rougeole dans quelques années, mais près de 3 millions de personnes, habituellement des enfants âgés de moins de 5 ans, décèdent chaque année de maladies pouvant être prévenues par des vaccins. Les pays en développement luttent pour obtenir les vaccins dont leurs enfants ont désespérément besoin. Pourtant, en Europe et en Amérique du Nord, des personnes ont fait preuve d'une certaine inconscience à propos des vaccins: «ces maladies ne sont plus une menace, les vaccins sont plus dangereux que ces maladies». Ces conceptions erronées ont été à l'origine d'épidémies de rougeole, de diphtérie et de coqueluche. La communauté internationale doit continuer à consacrer les ressources nécessaires, le financement et le travail humain afin d'exploiter totalement les promesses de soulagement de la misère humaine qu'offrent les vaccins.

21. The decision to vaccinate a child: an economic perspective from southern Malawi
Holte JH, Maestad O, Jani JV.
Abstract
The dynamics of childhood vaccination uptake in developing countries are unclear. Numerous studies document the relationship between vaccination coverage and access, socio economic and demographic factors. However, there is less knowledge about the relationship between vaccination coverage and carers’ motivation and willingness to seek childhood vaccinations. The aim of this paper is to introduce a framework for studying demand for childhood vaccination and to examine the coherence between theoretical predictions and empirical findings in a rural area in Malawi. We interviewed 635 carers with children aged 18-59 months. About 96 percent of the respondents reported to have fully vaccinated their youngest eligible child for all routine vaccinations scheduled in the Expanded Program on Immunization. This paper concludes that easy access to vaccination services cannot explain why demand is high. Many carers had to travel long distances to reach vaccination delivery points and a considerable share of the respondents scored waiting and travelling time as long. Results from the present study, in combination with theoretical predictions, suggest that a high level of trust in distributors of information and vaccines may be an essential explanatory factor for why carers seek immunization for their children, even in the presence of considerable costs. Trust may be an important explanatory factor as it can be seen to generate positive perceived benefits.
22. **Systematic review of economic evaluations of preparedness strategies and interventions against influenza pandemics**


**Abstract**

**Background** Although public health guidelines have implications for resource allocation, these issues were not explicitly considered in previous WHO pandemic preparedness and response guidance. In order to ensure a thorough and informed revision of this guidance following the H1N1 2009 pandemic, a systematic review of published and unpublished economic evaluations of preparedness strategies and interventions against influenza pandemics was conducted.

**Methods** The search was performed in September 2011 using 10 electronic databases, 2 internet search engines, reference list screening, cited reference searching, and direct communication with relevant authors. Full and partial economic evaluations considering both costs and outcomes were included. Conversely, reviews, editorials, and studies on economic impact or complications were excluded. Studies were selected by 2 independent reviewers.

**Results** 44 studies were included. Although most complied with the cost effectiveness guidelines, the quality of evidence was limited. However, the data sources used were of higher quality in economic evaluations conducted after the 2009 H1N1 pandemic. Vaccination and drug regimens were varied. Pharmaceutical plus non-pharmaceutical interventions are relatively cost effective in comparison to vaccines and/or antivirals alone. Pharmaceutical interventions vary from cost saving to high cost effectiveness ratios. According to ceiling thresholds (Gross National Income per capita), the reduction of non-essential contacts and the use of pharmaceutical prophylaxis plus the closure of schools are amongst the cost effective strategies for all countries. However, quarantine for household contacts is not cost effective even for low and middle income countries.

**Conclusion** The available evidence is generally inconclusive regarding the cost effectiveness of preparedness strategies and interventions against influenza pandemics. Studies on their effectiveness and cost effectiveness should be readily implemented in forthcoming events that also involve the developing world. Guidelines for assessing the impact of disease and interventions should be drawn up to facilitate these studies.

23. **Projected health and economic impact of rotavirus vaccination in GAVI-eligible countries: 2011-2030**


Atherly DE, Lewis KD, Tate J, Parashar UD, Rheingans RD.

**Keywords**

Rotavirus vaccines; Cost-effectiveness; Health impact

**Abstract**

Rotavirus is the leading cause of diarrheal disease in children under 5 years of age. It is responsible for more than 450,000 deaths each year, with more than 90% of these deaths occurring in low-resource countries eligible for support by the GAVI Alliance. Significant efforts made by the Alliance and its partners are providing countries with the opportunity to introduce rotavirus vaccines into their national immunization programs, to help prevent childhood illness and death. We projected the cost-effectiveness and health impact of rotavirus vaccines in GAVI-eligible countries, to assist decision makers in prioritizing resources to achieve the greatest health benefits for their populations. A decision-analytic model was used to project the health outcomes and direct costs of a birth cohort in the target population, with and without a rotavirus vaccine. Current data on disease burden, vaccine efficacy, immunization rates, and costs were used in the model. Vaccination in GAVI-eligible countries would prevent 2.46 million childhood deaths and 83 million disability-adjusted life years (DALYs) from 2011 to 2030, with annual reductions of 180,000 childhood deaths at peak vaccine uptake. The cost per DALY averted is $42 for all GAVI countries combined, over the entire period. Rotavirus vaccination would be considered very cost-effective for the entire cohort of GAVI countries, and in each country individually, as cost-effectiveness ratios are less than the gross domestic product (GDP) per capita. Vaccination is most cost-effective and has the greatest impact in regions with high rotavirus mortality. Rotavirus vaccination in GAVI-eligible countries is very cost-effective and is projected to substantially reduce childhood mortality in this population.
24. **Health economics of rotavirus immunization in Vietnam: potentials for favorable cost-effectiveness in developing countries**

Tu HA, Rozenbaum MH, Coyte PC, Li SC, Woerdenbag HJ, Postma MJ.

**Abstract**

**Introduction** Rotavirus is the most common cause of severe diarrhoea worldwide. Vietnam is situated in the region of high rotavirus infection incidence and eligible for financial support to introduce rotavirus vaccines into the Expanded Program of Immunization (EPI) from the GAVI. This study was designed to assess the cost-effectiveness of rotavirus immunization in Vietnam, explicitly the use of Rotateq® and to assess the affordability of implementing universal rotavirus immunization based on GAVI-subsidized vaccine price in the context of Vietnamese healthcare system for the next 5 years.

**Methodology** An age-structured cohort model was developed for the 2009 birth cohort in Vietnam. Two strategies were compared: one being the current situation without vaccination, and the other being mass universal rotavirus vaccination. The time horizon of the model was 5 years with time cycles of 1 month for children less than 1 year of age and annual analysis thereafter. Outcomes included mild, moderate, severe cases and death. Multiple outcomes per rotavirus infection are possible in the model. Monte Carlo simulations were used to examine the acceptability and affordability of the rotavirus vaccination. All costs were expressed in 2009 US$.

**Results** Rotavirus vaccination would not completely protect young children against rotavirus infection due to partial nature of vaccine immunity, however, would effectively reduce severe cases of rotavirus by roughly 55% during the first 5 years of life. Under GAVI-subsidized vaccine price (US$ 0.3/dose), the vaccine cost would amount to US$ 5.5 million per annum for 3-dose of the Rotateq® vaccine. In the base-case, the incremental cost per quality-adjusted-life-year (QALY) was US$ 665 from the health system perspective, much lower than per-capita GDP of ~US$ 1150 in 2009. Affordability results showed that at the GAVI-subsidized vaccine price, rotavirus vaccination could be affordable for Vietnamese health system.

**Conclusion** Rotavirus vaccination in Vietnam would be a cost-effective health intervention. Vaccination only becomes affordable if the country receives GAVI's financial support due to the current high market vaccine price. Given the high mortality rate of under-five-year children, the results showed that rotavirus immunization is the “best hope” for prevention of rotavirus-related diarrhoeal disease in Vietnam. In the next five years, Vietnam is definitely in debt to financial support from international organizations in implementing rotavirus immunization. It is recommended that new rotavirus vaccine candidates be developed at cheaper price to speed up the introduction of rotavirus immunization in the developing world in general.

25. **Benefits of catch-up in vaccination against human papillomavirus in medium- and low-income countries**

Baussano I, Lazzarato F, Ronco G, Dillner J, Franceschi S.

**Keywords**
HPV vaccination; adolescent girls; catch-up

**Abstract**

Human papillomavirus (HPV) vaccination of a birth cohort of girls in the 9-13 age range is recommended as a priority, but decreases in HPV vaccine cost may make catch-up of a few additional cohorts more attractive not only in high-income countries. We assessed the reduction in HPV16 and 18 infections that could be achieved in a medium- (Poland) and a low-income (Guinea) country by adding one-time catch-up of 12- to 19-year-old girls to the vaccination of 11-year-old girls. According to our ad hoc adapted dynamic model of HPV infection transmission, the addition of catch-up was estimated to bring forward the 50% reduction of HPV16/18 prevalence due to vaccination in women ≤35 by as much as 5 years. Catch-up of 12- to 15-year olds reduced the cumulative probability of HPV16/18 infections by age 35 in the relevant cohorts by about 30% in both countries. Catch-up of 16- to 19-year-old girls added little. Regardless of the chosen catch-up strategy, 16 to 20% of HPV16/18 prevention from vaccination was attributable to herd immunity. Assuming a sufficiently low vaccine cost, the addition of a catch-up round is, therefore, worth considering in
medium/low-income countries to extend vaccine benefits to less young adolescent girls whose future access to cervical screening is uncertain.

26. **Economic costs of rotavirus gastroenteritis and cost-effectiveness of vaccination in developing countries**

Rheingans RD, Antil L, Dreibelbis R, Podewils LJ, Bresee JS, Parashar UD

**Abstract**

**Background** Rotavirus is the leading cause of severe gastroenteritis in children worldwide. We evaluated the economic burden of rotavirus and the cost-effectiveness of vaccination from the healthcare perspective.

**Methods** Estimates were based on existing epidemiological data, cost estimates, vaccine coverage, and efficacy data, as well as hypothetical vaccine prices. Outcome measures included health care and societal costs of rotavirus and benefits and incremental cost-effectiveness ratio of vaccination. Sensitivity analyses evaluated the impact of estimate uncertainty.

**Results** Treatment costs increased with income level, and health burden decreased; however, burden varied across regions. On the basis of current vaccination coverage and timing, rotavirus vaccination would annually prevent 228,000 deaths, 13.7 million hospital visits, and 8.7 million disability-adjusted life-years, saving $188 million in treatment costs and $243 million in societal costs. At $5 per dose, the incremental cost-effectiveness ratio in low-, lower-middle-, and upper-middle-income countries was $88, $291, and $329 per disability-adjusted life-year averted, respectively, and $3,015, $9,951, and $11,296 per life saved, respectively. Vaccination would prevent approximately 45% of deaths and approximately 58% of associated medical visits and costs.

**Conclusions** Vaccination is a cost-effective strategy to reduce the health and economic burden of rotavirus. The cost-effectiveness of vaccination depends mostly on vaccine price and reaching children at highest risk of mortality.

27. **Economic evaluation of hepatitis B vaccination in low-income countries: using cost-effectiveness affordability curves**

Kim SY, Salomon JA, Goldie SJ

**Abstract**

**Objective** We sought to describe a method that explicitly considers both a health-care programme’s cost-effectiveness and its affordability. For illustration, we apply the method to the programme to vaccinate infants against hepatitis B in the Gambia.

**Methods** We synthesized selected data and developed a computer-based model from the societal and payer perspectives to evaluate the cost-effectiveness of routine infant vaccination against hepatitis B in the Gambia compared with no vaccination. The primary outcome measure was cost per averted disability-adjusted life year (DALY), which was expressed in 2002 US dollars. We used Monte Carlo methods for uncertainty analysis to examine the affordability of the programme from the payers perspective, and we derived an affordability curve and cost-effectiveness affordability curves for the programme.

**Findings** In the Gambia, vaccinating infants against hepatitis B is highly cost-effective. Compared with offering no intervention, the vaccination programme would cost US$ 28 per DALY averted from the societal perspective or US$ 47 per DALY averted from the payers perspective. The programme also has the potential to be affordable, starting at a relatively low budget of US$ 160,000 per year. Combining the two dimensions of the outcome measure, the probability that vaccinating infants would be both cost-effective and affordable is 40% at an annual programme budget of US$ 182,000 (the estimated total programme cost from the payers perspective), given a threshold cost-effectiveness value of US$ 47 per DALY averted.

**Conclusion** In the face of uncertainties about both the health and economic consequences of a vaccine programme, as well as the availability and magnitude of resources needed to fund the programme, cost-effectiveness affordability curves can provide information to decision-makers about the probability that a programme will be both cost-effective and affordable: these are distinct but equally relevant considerations in resource-poor settings.
Résumé
Objectif Nous avons recherché une méthode permettant de prendre en compte explicitement à la fois le rapport coût/efficacité d'un programme et son accessibilité économique.

A titre illustratif, nous avons appliqué cette méthode au programme de vaccination des nourrissons contre l'hépatite B en Gambie.

Méthodes Nous avons fait la synthèse de données sélectionnées et mis au point un modèle informatique pour évaluer le rapport coût/efficacité pour la société d'une part et pour ceux qui financent le programme d'autre part de la vaccination systématique des nourrissons contre l'hépatite B en Gambie par rapport à l'absence de vaccination.

La principale mesure des résultats programmatiques est le coût par année de vie corrigée de l'incapacité évitée (DALY), exprimé en US$ de 2002.

Dans le cadre de l'analyse d'incertitude, nous avons étudié l'accessibilité économique du programme pour ceux qui le financent par des méthodes de Monte Carlo, ce qui nous a permis d'établir une courbe d'accessibilité économique et des courbes rapport coût/efficacité en fonction de l'accessibilité économique pour ce programme.

Résultats En Gambie, le rapport coût/efficacité de la vaccination des nourrissons contre l'hépatite B est très bon.

Par comparaison avec la situation en l'absence d'intervention, ce programme vaccinal devrait coûter US$28 par DALY évitée pour la société ou US$ 47 par DALY évitée pour ceux qui le financent.

Ce programme pourrait aussi être abordable économiquement en débasant avec un budget relativement faible de US$ 160 000 par an.

Si l'on combine ces deux dimensions de la mesure de résultats, la probabilité que cette vaccination des nourrissons soit à la fois d'un bon rapport coût/efficacité et abordable économiquement est de 40% pour un budget annuel du programme de US$ 182 000 (coût total estimé du programme pour ceux qui le financent), sachant que la valeur seuil du rapport coût/efficacité est de US$ 47 par DALY évitée.

Conclusion Face aux incertitudes quant aux conséquences tant sanitaires qu'économiques d'un programme de vaccination et quant à la disponibilité et à l'ampleur des ressources nécessaires pour financer ce programme, les présentes courbes coût/efficacité fonction de l'accessibilité économique peuvent fournir aux décideurs des indications sur la probabilité qu'il soit à la fois d'un bon rapport coût/efficacité et abordable, ces deux aspects étant distincts, mais tout aussi pertinents l'un que l'autre dans les pays à faible revenu.


Broughton EI.

Abstract

Background Haemophilus influenzae type B (Hib) causes significant morbidity and mortality in children under five years of age. A safe and effective vaccine is available but is not in general use in developing countries. This paper evaluates the cost-effectiveness of introducing Hib vaccine in Indonesia as an addition to the country's current DTP-Hepatitis B vaccination program.

Methods The economic analysis uses a societal perspective and is based on a 1-year birth cohort of 4.234 million. The disease status of children with and without Hib vaccination is modeled for the year, and health consequences are modeled over the expected life of the child. One-way, two-way, probabilistic and worst-case sensitivity analyses were performed to evaluate the robustness of the results.

Results Implementation of Hib vaccination in Indonesia would avert approximately 76,700 cases of invasive infection, more than 7,150 deaths and 273,000 disability-adjusted life years (DALYs). Compared to no vaccine, the incremental cost-effectiveness ratio (ICER) is US $67 per DALY averted based on UNICEF pricing, whereas the program would save US $3.7 million with GAVI pricing. The result is not sensitive to uncertainty in disease incidence, costs of treatment or the probability of developing immunity.

Conclusion The model demonstrates significant cost-effectiveness of implementation of a Hib vaccination program for Indonesian society.
Estimating the economic value to societies of the impact of health research: a critical review

Buxton M, Hanney S, Jones T.

Keywords
Health services research/economics; Cost-benefit analysis; Delivery of health care/economics; Cost savings; Longevity; Economic development; Review literature (source: MeSH, NLM).

Abstract
Estimating the economic value to societies of health research is a complex but essential step in establishing and justifying appropriate levels of investment in research. The practical difficulties encountered include: identifying and valuing the relevant research inputs (when many pieces of research may contribute to a clinical advance); accurately ascribing the impact of the research; and appropriately valuing the attributed economic impact. In this review, relevant studies identified from the literature were grouped into four categories on the basis of the methods used to value the benefits of research. The first category consists of studies that value the direct cost savings that could arise from research leading either to new, less-costly treatments or to developments such as vaccines that reduce the number of patients needing treatment. The second category comprises studies that consider the value to the economy of a healthy workforce. According to this "human capital" approach, indirect cost savings arise when better health leads to the avoidance of lost production. The third category includes studies that examine gains to the economy in terms of product development, consequent employment and sales. The studies placed in the fourth category measure the intrinsic value to society of the health gain, by placing a monetary value on a life. The review did not identify any consistency of methodology, but the fourth approach has most promise as a measure of social value. Many of the studies reviewed come from industrialized nations and a proposal is made by the present reviewers for an international initiative, covering developed and developing countries, to undertake further methodological analysis and testing.