## Key concepts in health economics and how to use health economic evaluations in immunization programmes

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Dr Palwasha Anwari, IVP/EMRO



Moderator's opening remarks	Gerald Sume/Wedyan
Welcome	Quamrul Hasan
Learning objectives	Palwasha Anwari
Q&A	
Key concepts of health economics	Palwasha Anwari
Q&A	
Health economics at the heart of vaccine policy	Palwasha Anwari
Economic evaluation tools and types	
Q&A	
Information on health economics needs assessment survey and	Gerald/Wedyan
next steps	



## Welcome

Quamrul Hasan, Unit Head IVP/DCD, WHO EMRO



## Learning Objectives

At the end of the session, you should understand:

□ some key concepts in health economics

- the motivation for conducting economic evaluations of vaccination programmes
- the basic economic methods used to inform investment decisions about vaccinations
- □ What type of health economics support to request from the regional office (IVP/DCD)







# What are some key words you associate with health economics?



# Key concepts of health economics





### **Concept 1: Scarcity**

Scarcity refers to the limited availability of resources\* compared to the vast healthcare needs of a population



#### > Scarcity is the central problem of economics

- Health administrators often view "health economics" as addressing financial issues in healthcare
- Health economics goes beyond monetary aspects, emphasizing the optimal use of limited resources to:
  - Provide care for the sick
  - Promote overall health
- Economic evaluations considers the trade-offs with alternative uses of these scarce resources<sup>\*</sup>



\*MushkinSJ. Toward a definition of health economics. Public Health Reports 1958; 73(9):785-94.

https://pmc.ncbi.nlm.nih.gov/articles/PMC1951624/pdf/pubhealthreporig00021-0025.pdf

### **Concept 2: Efficiency**

**Efficiency** = making most of what we've got

- Technical Efficiency: producing maximum benefit (outputs) from given inputs (resources), or given level of benefit from least inputs
  - Example: primary clinic combines inputs to provide "health" for a population (consultation rooms, treatment rooms, office space, doctor time, nurse time, etc.)- different combinations of inputs
    - A large waiting area and fewer treatment rooms, or more nurses and fewer doctors
    - Not possible to provide "health" to more patients without adding more resources
- Economic Efficiency: producing maximum benefit from given budget,
  - Combine inputs to provide "health" at a lowest cost
  - Even if primary care clinic is economically efficient, may produce too much or too little



#### **Concept 3: Opportunity cost**

- Deciding to *do* A implies deciding *not* to do B (i.e. to obtain the benefits from doing A we have to forego the benefits from B)
- e.g. deciding to *do* more breast cancer screening equivalent to *not doing* as much prostate cancer screening
- Important to consider whether the benefits from doing more 'A' are greater than benefits lost from doing less 'B'
- "The value of forgone benefit which could be obtained from a resource in its next-best alternative use."



Economic evaluations considers the trade-offs with alternative uses of these scarce resources\*



## **Concept 4: Rationing**

#### **Methods of Rationing**

- **Implicit:** Allocation limited by supply, but criteria by which decisions are made not explicit
  - **Example:** Limited access to essential medicines due to proximity to healthcare facilities
- **Price-based**: Willingness (and ability) to pay determines allocation
  - **Example:** Services provided based on ability to pay (e.g., tuberculosis tests in private clinics), free market
- Waiting lists: Willingness (and ability) to wait determines allocation
  - **Example:** Delays for specialized care due to limited specialists (e.g., cataract surgery)
- Needs-based: assessment of needs determines allocation

**Example:** Prioritizing high-risk groups for vaccines during outbreaks (e.g., cholera in flood-affected areas)



#### Rationing (or Priority setting):

A systematic mechanism to allocate limited healthcare resources in the most effective way to balance demand and supply



#### **Concept 5: Externalities**

#### What are Externalities?

Benefits and costs experienced by someone other than the person directly producing or consuming a product or services

#### **Types of Externalities in Immunization Programmes**

Consumption of vaccination can lead to:

#### **1. Herd Protection/immunity**

- When a certain level of target groups are vaccinated, it reduces the risk of disease spread to others
- 2. Economies of Scale
  - Larger vaccine production leads to lower costs, benefiting everyone



## How do you perceive the role of health - Or economics in immunizations and vaccination policies?



#### EPI vaccines are excellent value for many

#### > Bull World Health Organ. 1994;72(4):653-62.

## Design, content and financing of an essential national package of health services

J L Bobadilla <sup>1</sup>, P Cowley, P Musgrove, H Saxenian

Affiliations + expand PMID: 7923544 PMCID: PMC2486601

#### Abstract

A minimum package of public health and clinical interventions, which are highly cost-effective and deal with major sources of disease burden, could be provided in low-income countries for about US\$ 12 per person per year, and in middle-income countries for about \$22. Properly delivered, this package could eliminate 21% to 38% of the burden of premature mortality and disability in children



\*EPI plus consists of DTP, measles, polio, BCG and HepB vaccination as well as vit A supplementation for children Table 2: Cost-effectiveness of the health interventions (and clusters of intervention) included in the minimum package of health services in low- and middle-income countries

Interventions	Cost per beneficiary	Cost per capita	DALYs potentially gained <sup>a</sup> (per 1000 population)	Effectiveness <sup>b</sup>	Cost per DALY(\$)
Low-income countries					
Public health					
Expanded programme of immunization plus <sup>c</sup>	14.6	0.5	45	0.77	12–17
School health programme	3.6	0.3	4	0.58	20–25
Tobacco and alcohol control programme	0.3	0.3	12	0.14	35–55
AIDS prevention programme <sup>d</sup>	112.2	1.7	35	0.58	3–5
Other public health interventions <sup>e</sup>	2.4	1.4	_	-	_
Subtotal	—	4.2	-	_	14
II. Clinical services					
Chemotherapy against tuberculosis	500.0	0.6	34	0.51	3–5
Integrated management of the sick child	9.0	1.6	184	0.25	30–50
Family planning	12.0	0.9	7	0.70	20–30
STD treatment	11.0	0.2	26	0.42	1–3
Prenatal and delivery care	90.0	3.8	57	0.42	30–50
Limited care <sup>f</sup>	6.0	0.7	—	0.03	200–300
Subtotal	_	7.8		_	_
Total	_	12.0	_	—	_
Middle-income countries					
I. Public health					
Expanded programme of immunization plus <sup>c</sup>	28.6	0.8	4	0.77	25–30
School health programme	6.5	0.6	5	0.58	38–43
Tobacco and alcohol control programme	0.3	0.3	9	0.14	45–55
AIDS prevention programme <sup>d</sup>	132.3	2.0	15	0.58	13–18
Other public health interventions <sup>e</sup>	5.2	3.1	—	_	_
Subtotal	_	6.9	_	_	_
II. Clinical services					
Chemotherapy against tuberculosis	275.0	0.2	6	0.51	5–7
Integrated management of the sick child	8.0	1.1	21	0.25	50–100
Family planning	20.0	2.2	6	0.70	100–150

## Beyond EPI: new and underutilized vaccines

**1930s-1960:** polio, diphtheria, pertussis, tetanus, measles.

- Cheap, effective vaccines
- Common infections
- Delivered to infants or young children

#### 1970s-today

PCV, RV, dengue, HPV, COVID, RSV, Malaria, Typhoid, etc.

- Expensive (HPV, PCV, COVID-19)
- Less common infections (MenB)
- Partial or waning vaccine efficacy (Malaria, RSV, dengue, COVID-19)
- Often delivered to non-traditional risk groups (e.g., adults, adolescents)







#### New vaccines are beyond the reach of many



Bringing down barriers to affordable and adapted vaccines. 2nd edition – January 2015. Médecins Sans Frontières

World Health Organization Data from World Health Organization Global Health Expenditure database (apps.who.int/nha/database)

Pregnancy	regnancy Infants and children Adolescents Adults Elderly					
i regitaticy		Addicatents	Addits			
<ol> <li>Cytomegalovirus</li> <li>Influenza Group B</li> <li>Streptococcus Infection</li> <li>Hepatitis B Virus</li> <li>Meningococcal A, B, C Y, W vaccine</li> <li>Pertussis</li> <li>Respiratory Syncytial Virus</li> </ol>	<ol> <li>Diphtheria</li> <li>Influenza Group A</li> <li>Streptococcus Infection</li> <li>Hepatitis A Virus</li> <li>Hepatitis B Virus</li> <li>Haemophiles Influenza Type B</li> <li>Inactivated Polio Virus</li> <li>Meningococcal A, B, C, Y, W Vaccine</li> <li>Pertussis</li> <li>Pneumococcal Vaccine</li> <li>Rotavirus</li> <li>Respiratory Syncytial Virus</li> <li>Tetanus</li> </ol>	<ol> <li>Cytomegalovirus</li> <li>Diphtheria, Tetanus, &amp; Pertussis (DTP) Vaccine</li> <li>Epstein-Barr Virus Influenza</li> <li>Herpes Simplex Virus</li> <li>Human Papilloma Virus</li> <li>Meningococcal A, B, C, Y, W Vaccine</li> </ol>	<ol> <li>Diphtheria</li> <li>Influenza</li> <li>Hepatitis B Virus</li> <li>Meningococcal A, B, C, Y, W Vaccine</li> <li>Pertussis</li> <li>Respiratory Syncytial Virus</li> <li>Tetanus</li> </ol>	<ol> <li>Influenza Group B Streptococcus Infection</li> <li>Meningococcal A, B, C,Y, W Vaccine</li> <li>Pneumococcal Vaccine</li> <li>Respiratory Syncytia Virus</li> <li>Zoster</li> <li>Candida Clostridium Difficile</li> <li>Escherichia Coli</li> <li>Klebsiella</li> <li>Pseudomonas Aureus Infection</li> <li>Vaccines for some cancers</li> </ol>		
-3 (	8 0	3 1	18	55 90		
Months			Years			
World Health Target population for vaccines in the 21st century with a listing of representative vaccines for each population segment. Rappuoli et. 2011 Organization						

### Revond FPI: target nonulations for vaccines

Eastern Mediterranean Region

## Questions?





## Economic evaluation tools and types



### What economic tool can address vaccine investment decisions?

Affordability	<ul> <li>Vaccine delivery cost is \$10 per vaccinated person</li> </ul>	Costing study
Sustainability	Vaccination costs \$2 million a year but will save the public sector \$500,000 per year	Budget impact analysis
Impact on disease	<ul> <li>Vaccination will prevent 100 deaths a year after 2035</li> </ul>	Epidemiological model
Value for money	<ul> <li>Vaccination costs \$10,000 per death prevented</li> </ul>	Full economic evaluation
Price setting	<ul> <li>The price of vaccine is \$20 a dose</li> </ul>	Threshold price analysis



## 1. Cost of Illness study & 2. costing study





## Cost of illness study

- Answers the policy question "What is the economic burden that a vaccine-preventable disease or condition imposes on society?"
  - including direct costs (e.g., hospitalisation, outpatient visits, medication, diagnostics)
  - and indirect costs (e.g., lost productivity)
- Conveys 'the size of the problem', so often used for advocacy
- Partial analysis does not consider what should be done about the problem or how much of the problem is modifiable
- Should provide context of cost of disease in relation to overall health





## Elements of costing for costing studies

Costing categories	Intervention costs/direct cost	Cost of vaccine (s); and cost of vaccination activities (administration and program management, training, communication, community mobilization	
	Indirect cost	Productivity losses associated with potential earnings forgone from travel time and vaccination	
	Adverse event-related costs	Surveillance and reporting of adverse events Treatment of adverse events	
Costing perspective	Health sector	Costs to the healthcare provider (could be: Federal and State Governments, Private health insurers)	
	Societal	Costs to all payers, including Health sector, family/patient out-of-pocket costs, travel costs, productivity losses	
Costing	Full	Costs of all resources that are used for the intervention are included	
approach	Incremental	Cost of additional resources used directly by the intervention in relation to a baseline	
Costing type	Financial cost	is the total monetary expenses required to achieve a goal	
	Economic cost	Relates to <b>opportunity cost</b> : What must be sacrificed to achieve a goal	



## 3. Budget impact analysis

- What are the additional costs and savings associated with an intervention?
- What is the impact on health (or immunisation) budgets?





## Why is budget impact analysis a useful financial tool?

- Essential part of a comprehensive economic assessment of a health care intervention
- Addresses the financial consequences (i.e. expected changes in the expenditure) to a healthcare system after the adoption of a new intervention (e.g., vaccine introduction) to help understand the **financial feasibility** and **sustainability** of an intervention
- While an intervention may be an efficient use of funds (i.e. cost-effective), it may be <u>unaffordable</u> due to the impact of the intervention adoption on the healthcare budget
- Note that healthcare decision-makers often require evidence on *both* cost-effectiveness analysis and budget impact assessment



#### **Economic evaluation**

An economic evaluation compares the incremental costs and consequences of an intervention compared to a comparator







### Questions that economic evaluations can answer:

- Is the change in costs justified by the change in outcomes?
- What is the value for money, or cost?
- Are the (health) benefits worth the additional costs of the intervention?
- Is the intervention **good value for money**?
- Is the intervention cost-effective?
- What is the cost-effectiveness of the intervention?



### Key metrics in economic evaluations

Terms	Definitions
DALY (Disability-Adjusted Life Year)	A measure of the overall disease burden: years of healthy life lost due to illness or death DALYs represent lost years of life and time spent with illness ( <i>we want to</i> <i>minimize DALYs</i> )
QALY (Quality-Adjusted Life Year)	A measure of disease burden adjusted for quality of life, combining length and quality of life QALYs represent healthy years of life in full health (we want to maximize QALYs)
ICER (Incremental Cost-Effectiveness Ratio)	Ratio comparing the cost per additional health outcome of one intervention vs. another
Economic Threshold	The maximum ICER value a country is willing to pay for a health benefit (e.g., cost per DALY)
CEA Plane (Cost-Effectiveness Plane)	A graphical representation of cost-effectiveness, plotting costs vs. effects of interventions



## Model compares scenarios

#### Without vaccination Cases DALYs Deaths Pop \$ Visits Visits Average cost per visit \$ Hosps. Hosps. Rates per Average cost per hosp 100,000 per yr With vaccination Cases DALYs Deaths Pop \$ Visits Visits Average cost per visit \$ Hosps. Hosps. Rates per Average cost per hosp 100,000 per yr - -



## Example of Incremental Cost Effectiveness Ratio (ICER)

 $ICER = \frac{Cost with vaccine - Cost without vaccine}{Outcome with vaccine - Outcome without vaccine}$ 

Incremental cost Incremental health gain

□ From the government perspective, ICER = US\$82 per DALY averted

82	=	Vaccine programme costs 55,008,967	-	Healthcare costs averted 1,353,709
			651,283 DALYs averted	

□ From the societal perspective, ICER = US\$80 per DALY averted

80 =	Vaccine programme costs 55,008,967		Healthcare costs averted 2,779,578			
	=		651,283 DALYs averted			
					All figures discoun	ted



#### The cost-effectiveness plane



#### Recap: Different economic tools answer different questions Cost of illness study No intervention What are the costs Costs only associated with disease? Economic burden ✓ "The cost of disease is estimated at \$1.3 billion." One intervention Costing study/analysis What is the cost of an Costs only intervention? ✓ "The cost of the vaccine program is \$15 per vaccinated girl." Cost composition Intervention versus comparator Budget impact analysis What are the monetary Costs only, including costs associated with outcomes consequences of the Affordability $\checkmark$ "Vaccination costs \$2 million a year but will save the health system intervention? **Sustainability** \$500,000 a year." Intervention versus comparator Is the intervention cost-Full economic evaluation effective? Are the additional Costs and outcomes costs worth the outcomes? ✓ "Vaccination costs \$10,000 per death prevented." Value for money Efficiency World Health Organization



Vaccine

**PLOS** ONE

#### Volume 38, Issue 6, 5 February 2020, Pages 1352-1362

#### Potential health impact and costeffectiveness of bivalent human papillomavirus (HPV) vaccination in Afghanistan

Palwasha Anwari <sup>a 1</sup>, Frédéric Debellut <sup>b 1</sup>  $\stackrel{\circ}{\sim}$ , Elisabeth Vodicka <sup>c</sup>, Andrew Clark <sup>d</sup>, Farhad Farewar <sup>e</sup>, Zubiada A. Zhwak <sup>f</sup>, Dastagger Nazary <sup>g</sup>, Clint Pecenka <sup>c</sup>, D. Scott LaMontagne <sup>c</sup>, Najibullah Safi <sup>h</sup>



#### RESEARCH ARTICLE

Introduction of rotavirus vaccination in Palestine: An evaluation of the costs, impact, and cost-effectiveness of ROTARIX and ROTAVAC

Frédéric Debellut<sup>1</sup>\*, Samer Jaber<sup>2</sup>, Yaser Bouzya<sup>3</sup>, Jehad Sabbah<sup>4</sup>, Mustafa Barham<sup>5</sup>, Fakhr Abu-Awwad<sup>6</sup>, Diaa Hjaija<sup>3</sup>, Assad Ramlawi<sup>3</sup>, Clint Pecenka<sup>7</sup>, Andrew Clark<sup>8</sup>, Mercy Myundura<sup>7</sup>

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10.1016/j.vaccine.2013.10.022

#### Cost-Effectiveness of a new Rotavirus Vaccination Program in Pakistan: a **Decision Tree Model**

Hiten D Patel<sup>a,b</sup>, Eric T Roberts<sup>c</sup>, Dagna O Constenla<sup>d</sup>

▶ Author information ▶ Article notes ▶ Copyright and License information PMCID: PMC3865920 NIHMSID: NIHMS533187 PMID: 24176497

Epidemiology and medical cost of hospitalization due to rotavirus gastroenteritis among children under 5 years of age in the central-east of Tunisia



#### Abstract

Data on the economic burden of rotavirus infection in Tunisia are needed to

inform the decision to include rotavirus in routine childhood immunizations. This study aimed to describe the epidemiological profile of rotavirus disease in central-east Tunisia and to estimate its hospital cost. In the first stage - the prospective collection of epidemiological data - we enrolled all patients < 5 years old who were hospitalized for acute diarrhea at 5 university

C Export

#### Highlight the support IVP/DCD offers to countries in the region

- > Building in-country capacities through workshops and webinars
- ➢ Providing training on using economic evaluation tools like Excel-based models
- Assisting countries in designing and conducting economic evaluation to priorities new vaccine introduction
- ➢Offering one-on-one technical advice to NITAGs and EPI teams
- Providing technical assistance to improve the quality of health economics data collection and analysis
- Facilitating regional collaboration to share experiences and lessons learned in health economics evaluation
- Providing access to global health economics tools, guidelines, and resources developed by WHO and other partners



### Take home messages

Health economic evaluation is used to ensure that resource allocation decisions are made on explicit, evidencebased and needs-based criteria



Economic evaluation of vaccination requires familiarity with both *health economics and the epidemiological features* of vaccine-preventable diseases



It is important to understand the assumptions and limitations behind different types of economic models as these can have a large impact on model results



It is unethical NOT to consider economic aspects of an intervention, because it acknowledges that the resources used to treat one patient could have been used to help other patients and their benefits are lost as a result.



## Acknowledgement

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**Melbourne University** – Slide deck produced for the WHO on the Beginner MHealth Economics Module for NITAGs



### Questions?





# Information on health economics needs assessment survey and next steps

For more information, please contact: Palwasha Anwari, DrPH, MSc, MD Health Economist Consultant anwarip@who.int



Time to complete health economics needs assessment survey questionnaire

- Scan the QR or use link to join
- One questionnaire per country

Survey Questionnaire: Health economics and vaccine financing needs assessment, IVP, EMRO



#### https://forms.office.com/e/PzymL63cWr

