



An Overview of Operations Research and HIV

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Operations Research

Definition (Wikipedia):

Operations Research (O.R.) is a branch of mathematics that uses mathematical models, statistics and algorithms to address problems in the decision making process. It allows for the analysis of decision making by accounting for scarcity of resources to determine how to optimize a defined objective, such as maximizing benefits and minimizing costs.

Its application in public health:

- Provides a quantitative approach that complements broad programmatic discussions
- Computerized models (simple or complex, developed in excel or other programs) that simulate global health programs
- It should be flexible, with assumptions and inputs that can be easily altered in order to observe the effect of these changes in the results
- Facilitates comparisons among multiple scenarios to better understand the influence of key factors

Topics that OR can clarify



How can we:

- Improve financial planning so that the appropriate quantities of materials are ordered?
- Ensure that medications, diagnostics and other supplies reach patients in rural areas?
- Facilitate decision making regarding health programs, based on data rather than politics?



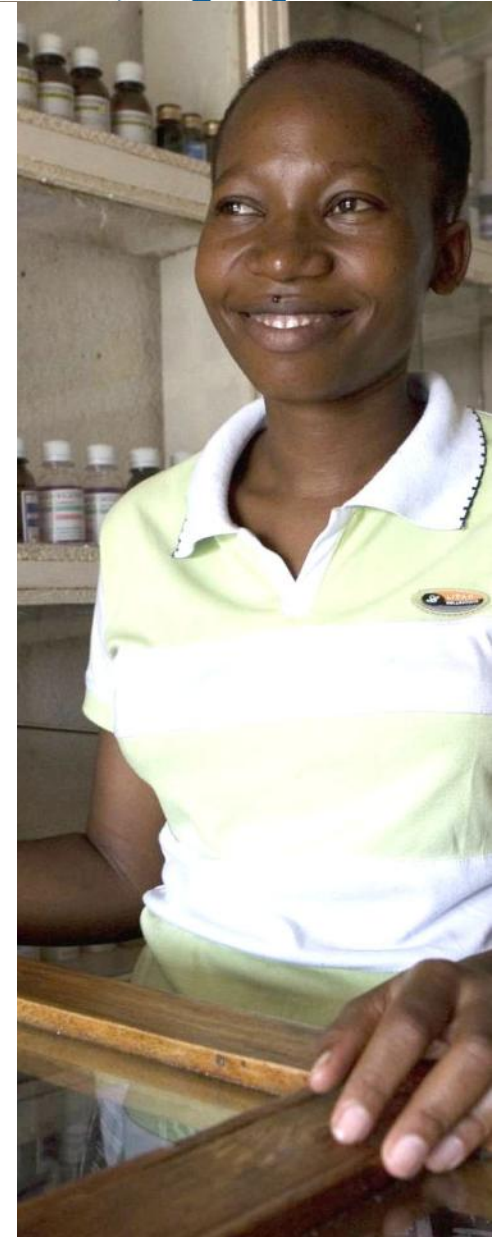
- Work to make interventions sustainable in the long term?
- Optimize doctors' and nurses' time to provide the best treatment possible?
- Reduce the time it takes patients to receive test results?

In the past, emphasis was placed upon growth but the focus must now be on efficiency



- Increasing costs of treatment combined with limited budgets require more careful distribution of resources
- The global recession requires more careful distribution of resources
- Millions of people lack access to adequate treatment or prevention measures
- Some places have expired medications; others have shortages
- The variety of treatment regimens can create supply chain inefficiencies

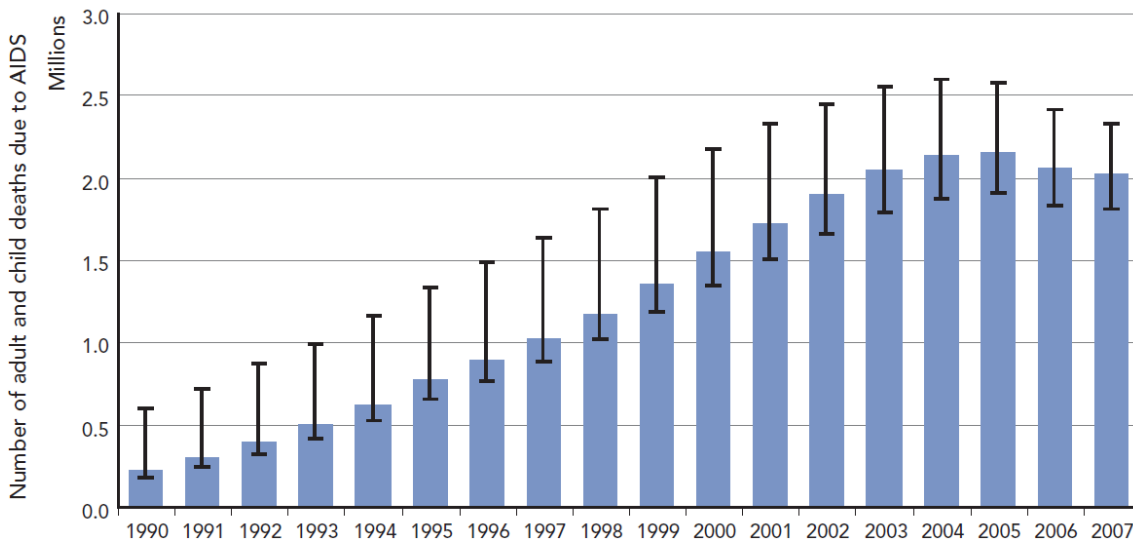
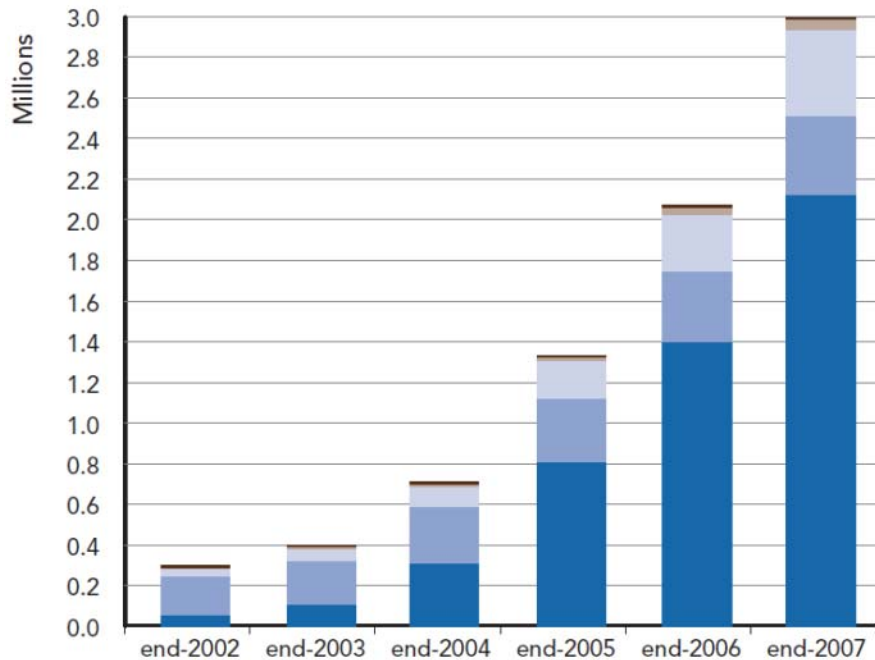
Operations Research should be a standard component of global health activities



Global HIV treatment implies an unprecedented increase in the management of chronic diseases



The amount of people needing ARVs therapy in low-income countries has increased rapidly



...while the frequency of deaths caused by AIDS has stopped growing

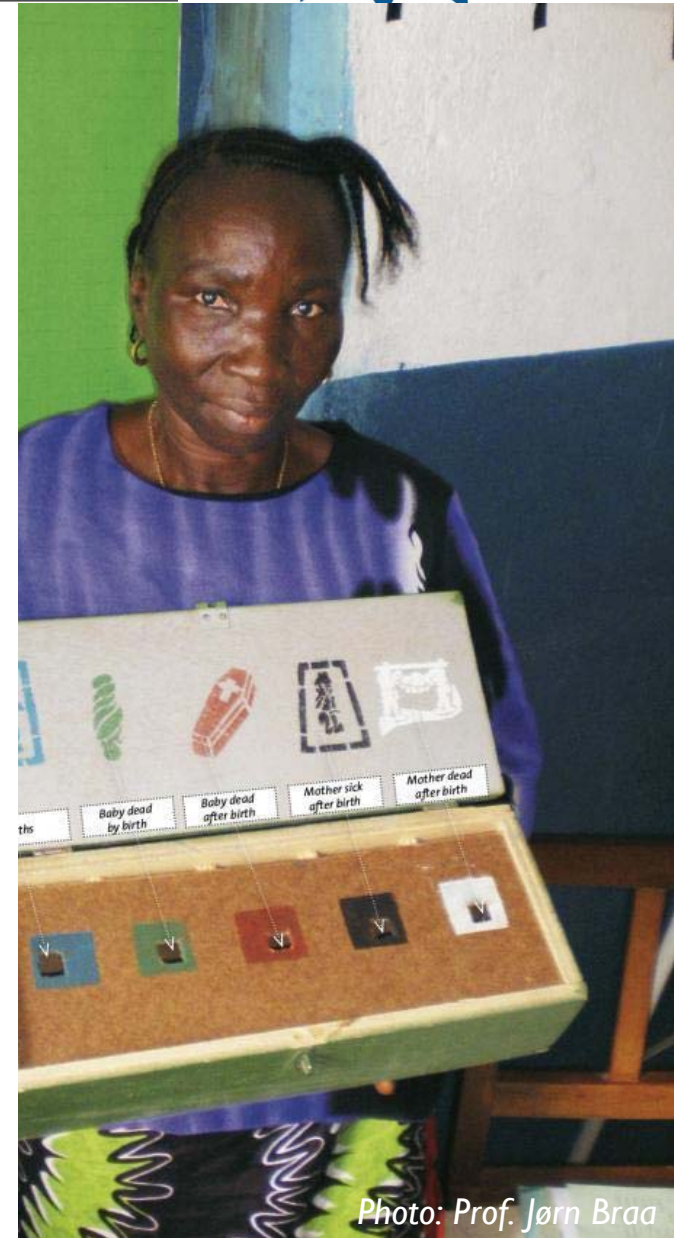
Source: UNAIDS Report 2008

Why has OR not been a more important component of planning and implementing global health programs?



Data is difficult to find:

- Health information systems are generally weak and not used
- The information that exists is not reliable



Tombodu, Sierra Leone

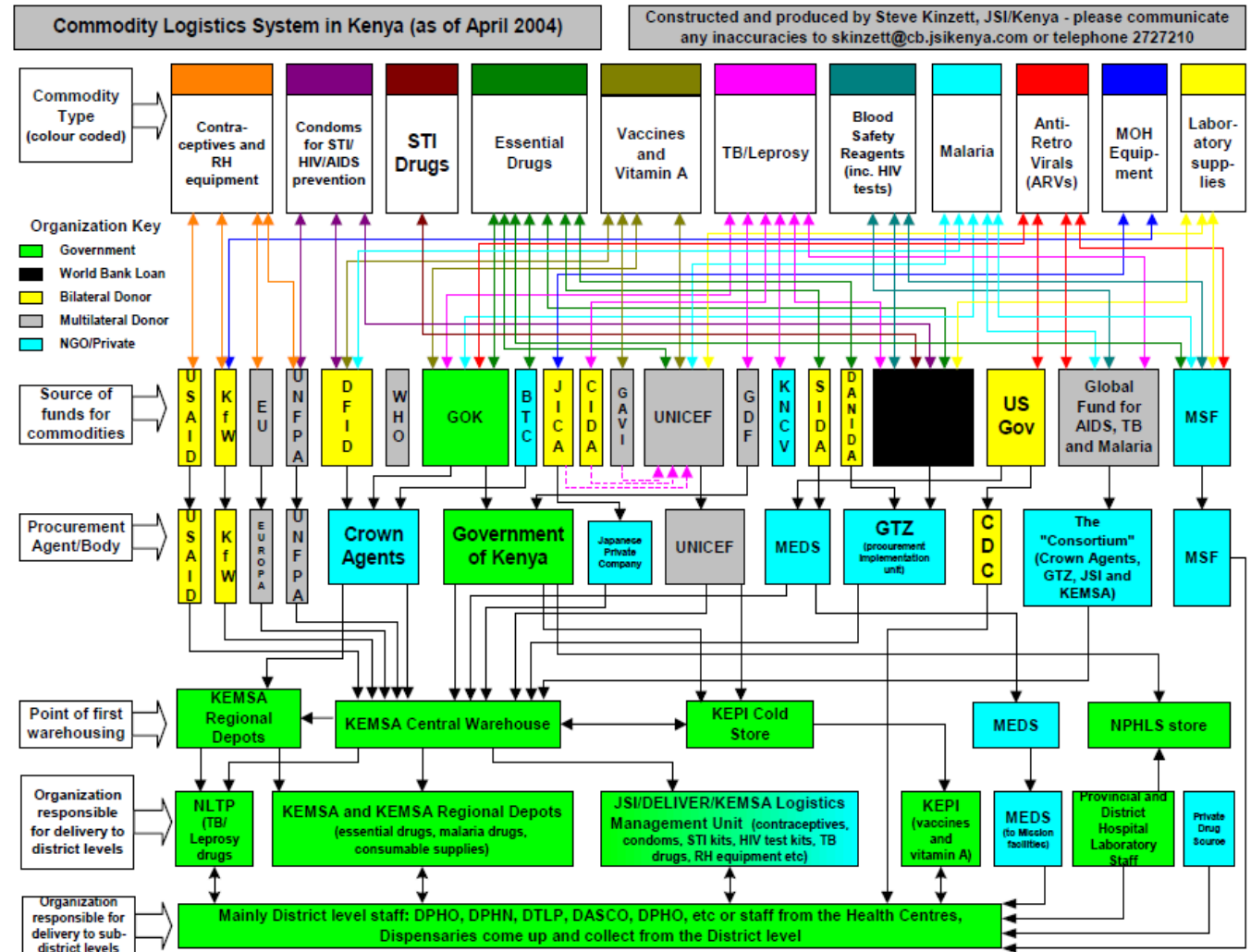
Photo: Prof. Jørn Braa

Why has OR played a less significant role in planning and implementing global health programs?



There is no single client

- Funding comes from different sources; many organizations acquire the same commodities
- Coordination and prioritization by those financing and implementing projects



Why has OR not been a more important component in planning and implementing global health programs?



Other obstacles:

- Clinicians are focused on implementation not theory, and may be reluctant to use complex mathematical analysis
- OR analysts often are unfamiliar with public health topics
 - Disease prevention modeling involves epidemiology, sociology, biology and politics



The global public health community is recognizing the importance of concrete data



- PEPFAR - 2008
 - Currently requires program monitoring and evaluation of impact
- Global Health Delivery (GHD) Project - 2007
 - Develops studies of treatment successes and failures
 - New OR group in IAS since 2009
- Cost effectiveness evaluations



Benefits of using computer tools



- Facilitates experimentation and making changes to a simulated health program. In the real world, making changes and experimentation tend to be expensive or impossible
- Identify program gaps by constructing a model and running a number of scenarios
- Help politicians understand, in concrete terms, results of a change in policy or program implementation
- Adaptable; uses the same model in different countries. However, it may not answer specific questions

	2009	2010	2011	2012	2013	2014	2015	Physicians	Length (hrs)	FTE minutes	Hours	Length (hrs)	FTE minutes	Hours	Cost
Argentina 1 New patients aPT	4,400	6,524	6,762	6,969	7,148	7,323	0	0	0	0	0	0	0	0	78,200
Argentina 2 Existing patients aPT	24,280	24,988	25,696	26,404	27,112	27,820	0	0	0	0	0	0	0	0	78,200
Brazil 1 New patients aPT	12,020	12,191	12,362	12,533	12,704	12,875	0	0	0	0	0	0	0	0	78,200
Brazil 2 Existing patients aPT	52,474	52,645	52,816	52,987	53,158	53,329	0	0	0	0	0	0	0	0	78,200
Cameroon 1 New patients aPT	12,228	12,400	12,572	12,744	12,916	13,088	0	0	0	0	0	0	0	0	78,200
Cameroon 2 Existing patients aPT	22,673	22,845	23,017	23,189	23,361	23,533	0	0	0	0	0	0	0	0	78,200
Cote d'Ivoire 1 New patients aPT	48,524	47,836	47,148	46,460	45,772	45,084	0	0	0	0	0	0	0	0	79,200
Cote d'Ivoire 2 Existing patients aPT	72,489	71,801	71,113	70,425	69,737	69,049	0	0	0	0	0	0	0	0	79,200
Egypt 1 New patients aPT	70,000	70,000	70,000	70,000	70,000	70,000	0	0	0	0	0	0	0	0	80,000
Egypt 2 Existing patients aPT	48,884	47,842	46,800	45,758	44,716	43,674	0	0	0	0	0	0	0	0	80,000
India 1 New patients aPT	8,429	8,488	8,547	8,606	8,665	8,724	0	0	0	0	0	0	0	0	68,400
India 2 Existing patients aPT	48,802	48,114	47,426	46,738	46,050	45,362	0	0	0	0	0	0	0	0	79,200
Kenya 1 New patients aPT	18,694	18,679	18,664	18,649	18,634	18,619	0	0	0	0	0	0	0	0	79,200
Kenya 2 Existing patients aPT	28,948	27,488	26,028	24,568	23,108	21,648	0	0	0	0	0	0	0	0	79,200
Nigeria 1 New patients aPT	16,478	16,478	16,478	16,478	16,478	16,478	0	0	0	0	0	0	0	0	89,700
Nigeria 2 Existing patients aPT	274,280	279,919	285,558	291,197	296,836	302,475	0	0	0	0	0	0	0	0	92,400
Romania 1 New patients aPT	75,621	76,122	76,623	77,124	77,625	78,126	0	0	0	0	0	0	0	0	85,640
Romania 2 Existing patients aPT	30,468	30,468	30,468	30,468	30,468	30,468	0	0	0	0	0	0	0	0	87,680
South Africa 1 New patients aPT	29,643	30,144	30,645	31,146	31,647	32,148	0	0	0	0	0	0	0	0	202,200
South Africa 2 Existing patients aPT	68,903	71,129	73,355	75,581	77,807	80,033	0	0	0	0	0	0	0	0	202,200
Tanzania 1 New patients aPT	48,541	48,124	47,707	47,290	46,873	46,456	0	0	0	0	0	0	0	0	85,640
Tanzania 2 Existing patients aPT	84,125	82,738	81,351	79,964	78,577	77,190	0	0	0	0	0	0	0	0	85,640
Uganda 1 New patients aPT	47,269	47,269	47,269	47,269	47,269	47,269	0	0	0	0	0	0	0	0	79,200
Uganda 2 Existing patients aPT	47,269	47,269	47,269	47,269	47,269	47,269	0	0	0	0	0	0	0	0	79,200
Zambia 1 New patients aPT	47,269	47,269	47,269	47,269	47,269	47,269	0	0	0	0	0	0	0	0	79,200
Zambia 2 Existing patients aPT	47,269	47,269	47,269	47,269	47,269	47,269	0	0	0	0	0	0	0	0	79,200

Disadvantages



- The results are as good as the data used
- *Users could become over dependent on the results of a model- models should not be used for exact results. They should serve as a platform for discussion. The absolute number is less important than the change relative to the magnitude of the result (for example, small increases to data X can create big changes in result Y)*
- It is only a model of the real world and it is difficult to capture subtleties of different situations
- Manipulating models may require advanced technical skills

Estimate impact of PMTCT programs



Define questions:

- How do the new OMS guidelines compare to the 2006 guidelines?
- How does option A compare to option B?
- What is the cost of infections averted for each regimen?
- How many pediatric infections from each regimen option?
- What are the short-term effects of decisions regarding PMTCT on long-term costs of pediatric programs?

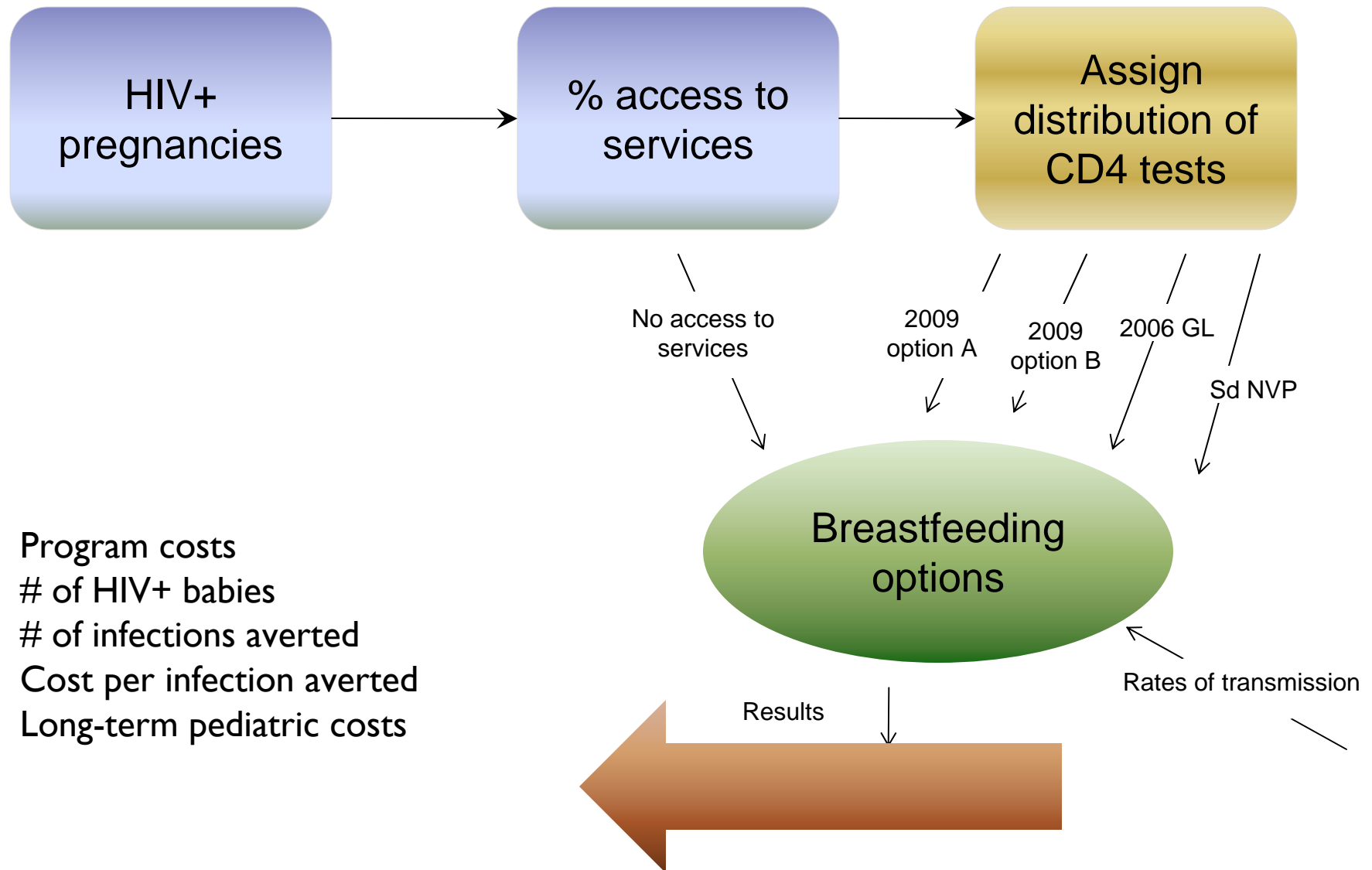
Example – Estimated impact of PMTCT programs



Determine key data:

- # of pregnancies
- # of pregnancies among HIV+ women
- Coverage of PMTCT programs
- Local breastfeeding practices
- Transmission rates
- Cost of medication / laboratory supplies
- Etc.

Establish Methodology



- Program costs
- # of HIV+ babies
- # of infections averted
- Cost per infection averted
- Long-term pediatric costs

Calculations



Design of tools—

- Determine users /usability
- Computer program or Microsoft Excel tool
- Designed to be easy to use but will require training and some quantitative experience

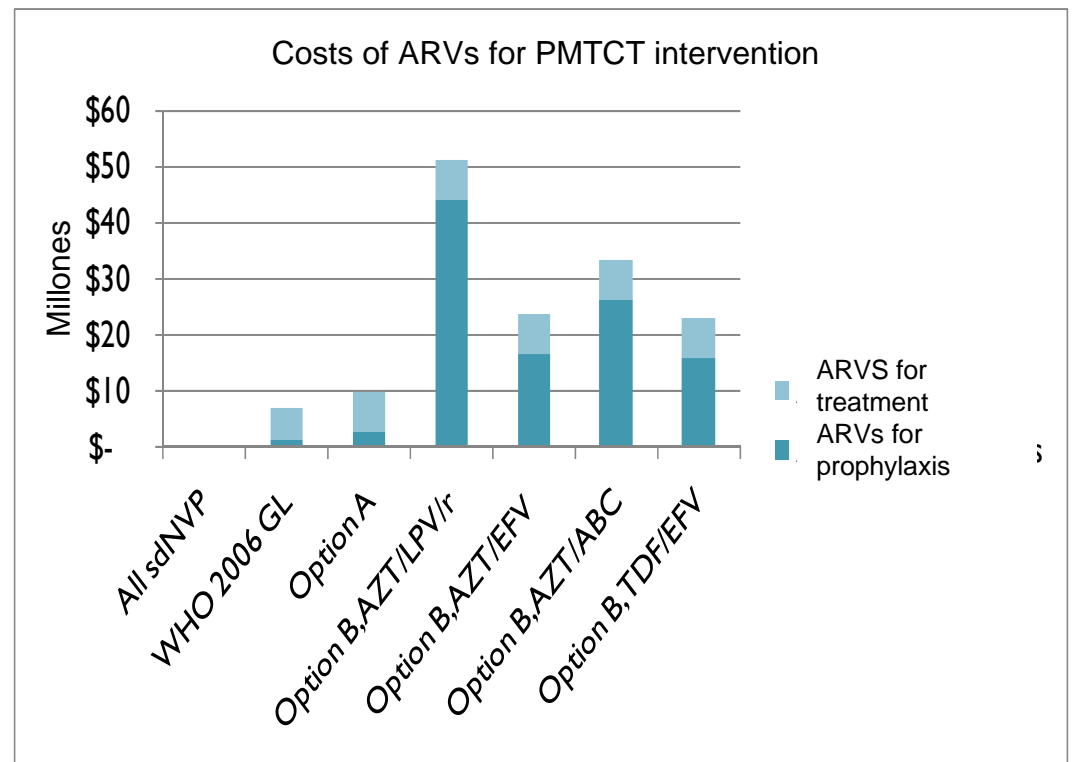
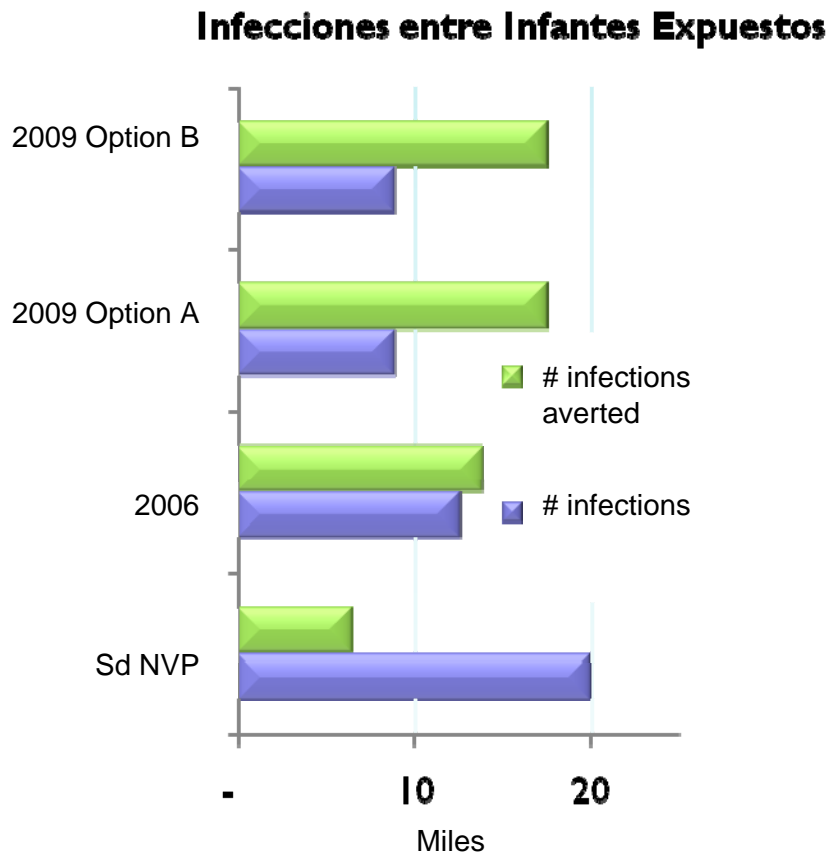
Popular database—

- When possible use local and national or regional data
- Look for research data
- May be able to use ranges if necessary

Interpreting results

How do the number of infections and number of infections averted differ for each PMTCT policy?

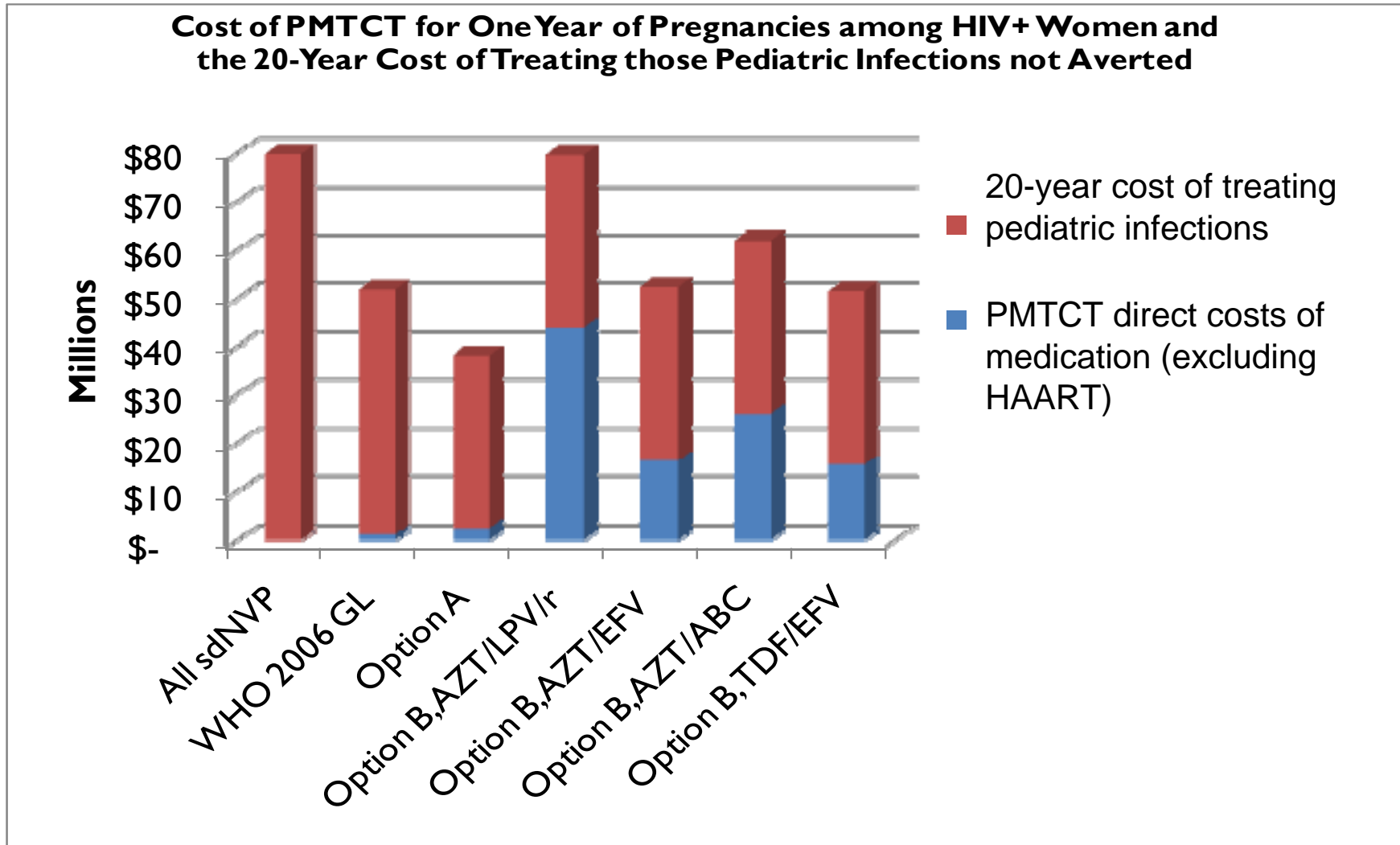
What are the costs for each program option?



Interpreting results



- Translate into long-term costs



Other potential questions



- Subpopulations stratification (for example, by gestation period, opportunistic infections, among others)
- What would be the human resource impact of broader PMTCT norms?
- How would PMTCT programs affect pediatric programs?
- What is the impact on the laboratory system?
- How will new policies affect the treatment of mothers and children exposed to ARVs?

Examples of OR in Public Health

PROBLEM: How will Rwanda face human resource shortages?

- Limited number of health professionals given demand
- How can the available resource be used more efficiently given training limitations and clinical skills?

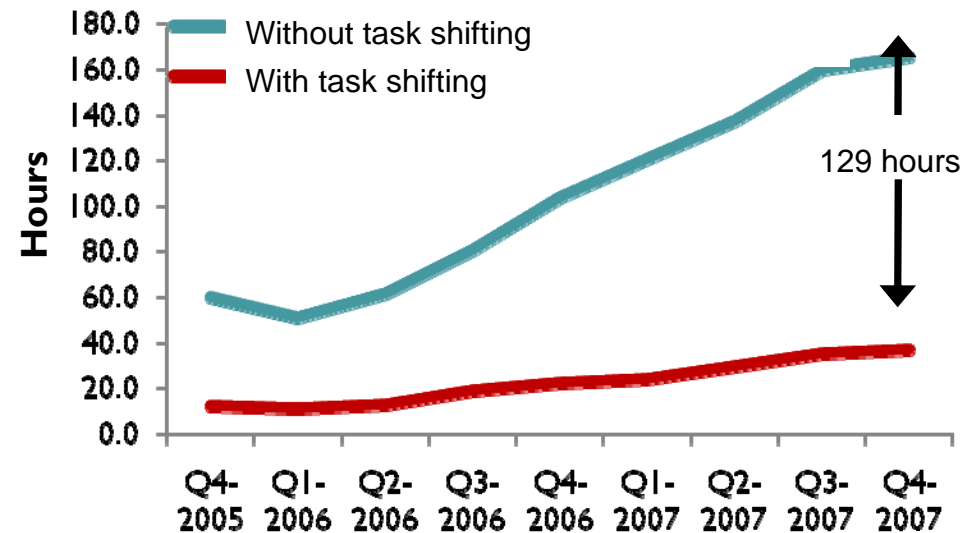
ANALYSIS

- A simulation was conducted in order to quantify the impact on physician time of HIV treatment provided by nurses



IMPACTO

- Transferring basic HIV care to nurses significantly reduced the demand for physician time
- Rwanda is implementing treatment managed by nurses, including recent legislation that allows nurses to prescribe ARVs



Conclusion



- Designing a model can help organizations understand their programs, programs plan and politicians visualize program needs and impact
- Quantitative analysis can help strengthen program planning and programs must be motivated to use tools as much as possible
- Model results should be used to complement discussions



Thank you