Methods for data collection and analysis: costing methods in global health

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Overview

- Review general concepts for costing methods
- Apply to an example for increasing access to PMTCT in Zimbabwe
- Insights for costs of scaled up programs

Millions of lives depend on whether spending is guided by evidence

Priority setting for new interventions or introducing new technologies, drugs, vaccines

Resource requirements and advocacy

Financial planning and budgeting

Improving technical efficiency

Prelude

- Bountiful costing terms and methods.
- Purpose determines the choice of methods.
- Time horizon and timing of costing matters.
- Perspective is about whose costs?
- Scale and scope will affect the total and unit costs.

Some basic concepts in costing

Fixed versus variable costs

Total, average, marginal, incremental…

Example: Deworming, Uganda*

- Brooker et al. Cost and cost-effectiveness of nationwide school-based helminth control in Uganda
- Vertical deworming program through MOH
- Began with 5 national workshops
- District level workshop for teachers and community drug distributors
- Tablets administered in schools by teachers with supervision

*Example courtesy of Sue Horton, University of Waterloo

Example: Cost of deworming

- Average cost per child was $0.52, but ranged from $0.41 to $0.91 by district
- Drug cost was 40% overall, balance labor

Example courtesy of Sue Horton, University of Waterloo

Fixed vs. Variable costs

- Using school-based deworming example
  - Some costs vary even in short-run with number of children treated
  - Some costs do not vary in short-run with number treated
  - In long run, some costs which are fixed in the long run become variable

Example courtesy of Sue Horton, University of Waterloo

Fixed vs. Variable

- Suppose variable cost is $0.20/child (drugs)
- Fixed cost is $1000/district (training session)
  - District 1 has 5000 kids
  - District 2 has 2000 kids
- Average cost per child is:
  - $0.40 in District 1 ($0.20 plus $1000/5000)
  - $0.70 in District 2)0.20 plus $1000/2000)

Total and marginal cost

- Total cost
  - District 1: $1000+(5000*$0.20)=$2000 (fixed plus variable costs)
  - District 2: $1000+(2000*$0.20) or $1400 (fixed plus variable costs)
- Marginal costs
  - District 1 and 2 are $0.20 ($0.20 more per child)
    - Unless run out of space at training session
    - Other fixed costs increase—reaching last mile.

Example courtesy of Sue Horton, University of Waterloo

Incremental costs

- Incremental costs are different than marginal costs.
  - We use incremental costs a lot in estimating costs of global health programs.
  - What is the cost of adding a new service or technology or intervention to current health services?
  - Not what is the cost of reaching one more person or producing one more output (marginal cost).

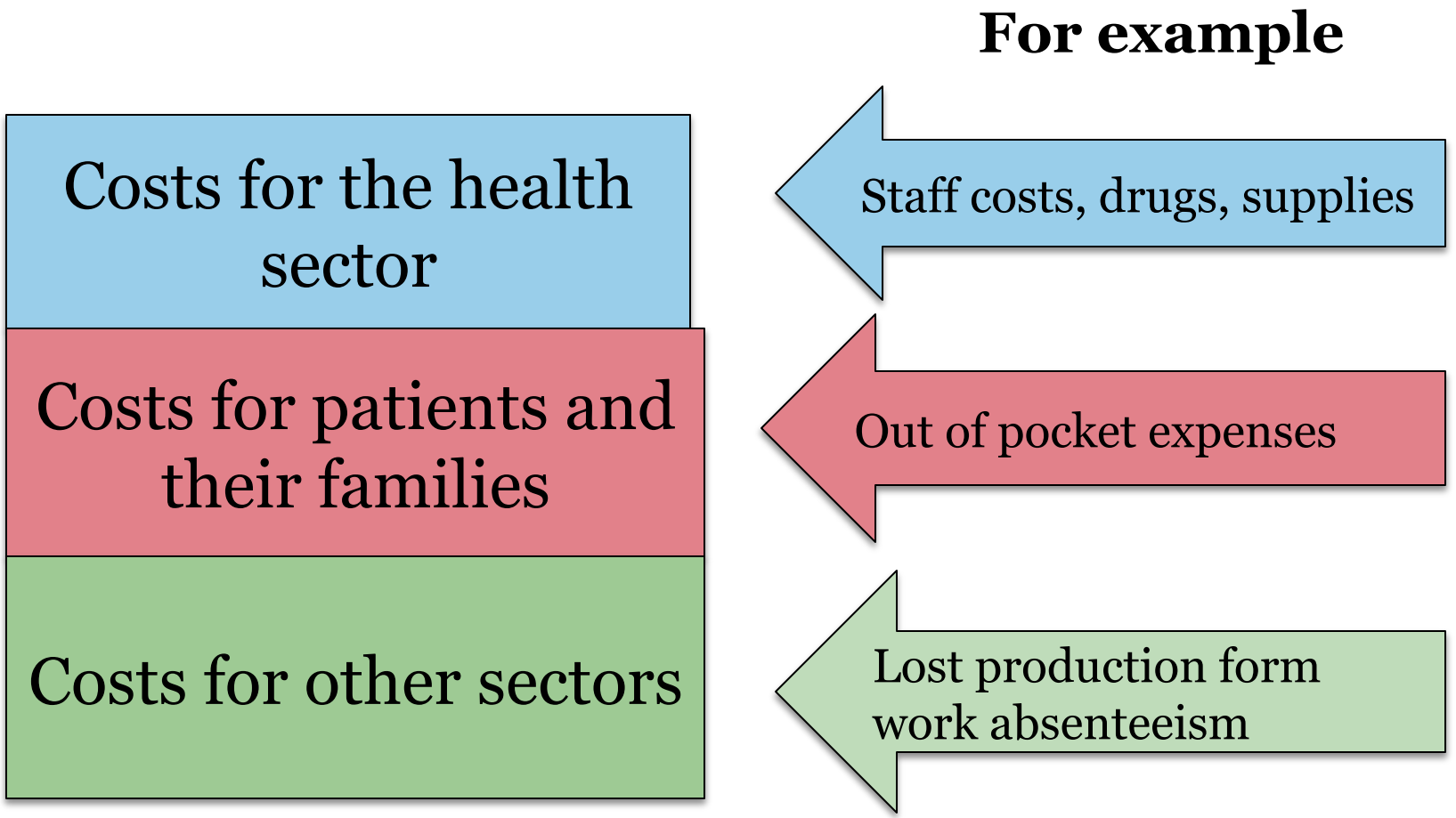
Basic principles

- Define the problem
- Identify
- Measure
- Value
- Aggregate

Identifying Costs- types of costs

- Direct Health Care costs
  - Treatment or preventative care
  - Hospital, facilities, communities, home
  - Medication, procedures, tests, equipment
- Direct Non-Health Care costs
  - Out-of pocket expenses- transportation, child care
- Productivity costs (Indirect costs)
  - Lost economic productivity due to disability or death

Identifying costs: Basic elements to consider



Measure: Broad cost methods

- Micro-costing methods
  - Bottom up costing
  - Quantify and cost out every input consumed in preventing or treating disease in an individual
- Gross costing or using average costs
  - Allocate the total budget (expenditures) to a particular department or service.
  - Top down costing
- Not mutually exclusive

Measure- Specific approaches

Step-down accounting

- Health facility level
- Identify major functions or cost centers of the facility

Dalaba et al. BMC Health Services Research 2013, 13:287
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BMC Health Services Research

RESEARCH ARTICLE Open Access

Cost of maternal health services in selected primary care centres in Ghana: a step down allocation approach

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Abstract

Background: There is a paucity of knowledge on the cost of health care services in Ghana. This poses a challenge in the economic evaluation of programmes and inhibits policy makers in making decisions about allocation of resources to improve health care. This study analysed the overall cost of providing health services in selected primary health centres and how much of the cost is attributed to the provision of antenatal and delivery services.

Methods: The study has a cross-sectional design and quantitative data was collected between July and December 2010. Twelve government run primary health centres in the Kassena-Nankana and Builsa districts of Ghana were randomly selected for the study. All health-care related costs for the year 2010 were collected from a public service provider's perspective. The step-down allocation approach recommended by World Health Organization was used for the analysis.

Results: The average annual cost of operating a health centre was $136,014 US. The mean costs attributable to ANC and delivery services were $23,063 US and $11,543 US respectively. Personnel accounted for the largest proportion of cost (45%). Overall, ANC (17%) and delivery (8%) were responsible for less than a quarter of the total cost of operating the health centres. By disaggregating the costs, the average recurrent cost was estimated at $127,475 US, representing 93.7% of the total cost. Even though maternal health services are free, utilization of these services at the health centres were low, particularly for delivery (49%), leading to high unit costs. The mean unit costs were $18 US for an ANC visit and $63 US for spontaneous delivery.

Conclusion: The high unit costs reflect underutilization of the existing capacities of health centres and indicate the need to encourage patients to use health centres. The study provides useful information that could be used for cost effectiveness analyses of maternal and neonatal care interventions, as well as for policy makers to make appropriate decisions regarding the allocation and sustainability of health care resources.

Keywords: Cost, Step-down allocation approach, Antenatal care, Delivery, Maternal health service, Ghana

Background

Reducing maternal and under-five mortality through the use of cost-effective strategies continues to be a challenge, particularly in developing countries. The worldwide maternal mortality ratio (MMR), or the number of women who die during pregnancy and childbirth per 100,000 live births, declined from 299 in 1990 to 202 in 2011, representing a 1.9% average annual rate of decline. Globally, under-five mortality also declined over the past years reaching 7.2 million in 2011 [1].

In Ghana, the MMR declined from 394 deaths per 100,000 live births in 1990 to 328 deaths per 100,000 live births in 2011, a 0.9% average annual rate of decline. Also under 5 deaths in the country was estimated at 47,600 deaths in 2011 [1]. In the Kassena-Nankana and the Builsa districts, however, the MMR was high at 367 and 259 maternal deaths per 100,000 live births in 2010 respectively [2,3].

Given the limited health care resources in Ghana, coupled with the wide range of maternal and neonatal

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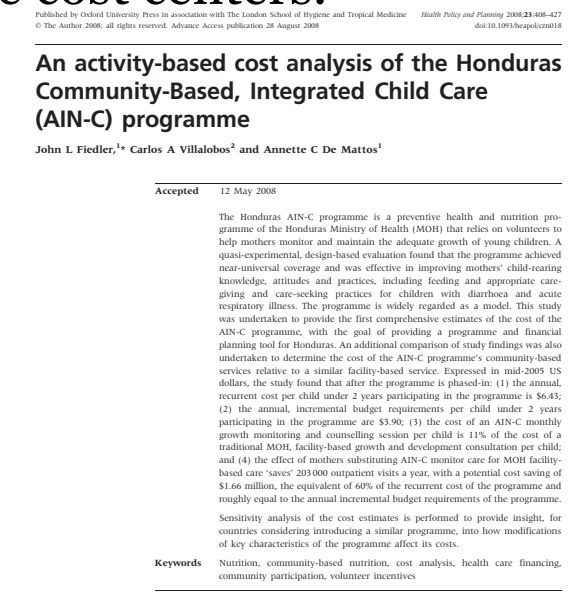
Activity based costing

- Program level (i.e. HIV, TB, immunization)
- Identify the major activities of each organizational level of the program and define these as the cost centers.



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An activity-based cost analysis of the Honduras Community-Based, Integrated Child Care (AIN-C) programme

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The Honduras AIN-C programme is a preventive health and nutrition programme of the Honduras Ministry of Health (MOH) that relies on volunteers to help mothers monitor and maintain the adequate growth of young children. A quasi-experimental, design-based evaluation found that the programme achieved near-universal coverage and was effective in improving mothers' child-rearing knowledge, attitudes and practices, including feeding and appropriate care-giving and care-seeking practices for children with diarrhoea and acute respiratory illness. The programme is widely regarded as a model. This study was undertaken to provide the first comprehensive estimates of the cost of the AIN-C programme, with the goal of providing a programme and financial planning tool for Honduras. An additional comparison of study findings was also undertaken to determine the cost of the AIN-C programme's community-based services relative to a similar facility-based service. Expressed in mid-2005 US dollars, the study found that after the programme is phased-in: (1) the annual, recurrent cost per child under 2 years participating in the programme is $6.43; (2) the annual, incremental budget requirements per child under 2 years participating in the programme are $3.90; (3) the cost of an AIN-C monthly growth monitoring and counselling session per child is 11% of the cost of a traditional MOH, facility-based growth and development consultation per child; and (4) the effect of mothers substituting AIN-C monitor care for MOH facility-based care 'saves' 203 000 outpatient visits a year, with a potential cost saving of $1.66 million, the equivalent of 60% of the recurrent cost of the programme and roughly equal to the annual incremental budget requirements of the programme.

Sensitivity analysis of the cost estimates is performed to provide insight, for countries considering introducing a similar programme, into how modifications of key characteristics of the programme affect its costs.

Keywords Nutrition, community-based nutrition, cost analysis, health care financing, community participation, volunteer incentives

Measure-empirical data collection methods

Ingredients approach

- Collect information on quantities and the prices used to value all resources.

Expenditure approach

- Use total expenditure from budget or expense reports from Ministry of Health, implementing organization (i.e. NGO), or donor.

08/03/11	169	Communication	5000	0	5000	0	0	0	0
10/03/11	170	Motorbike Maintenance	4000	0	0	0	0	4000	0
12/03/11	171	Safari allowance	9375	0	0	0	0	0	9375
24/03/11	172	Baseline Survey/Home visits	8000	0	0	8000	0	0	0
25/03/11	173	Quarterly Meeting	8000	0	0	0	8000	0	0
25/03/11	174	Logistical support	2325	0	0	2325	0	0	0
25/03/11	175	Safari allowance	9375	0	0	0	0	0	9375
25/03/11	176	Salaries for March	33125	33125	0	0	0	0	0
28/03/11	177	Stationery	5000	0	5000	0	0	0	0
28/03/11	178	Fuel	8000	0	0	0	0	0	8000
01/04/11	179	Training Ag Extension Officers	79320	0	0	0	79320	0	0
02/04/11	180	2nd Vine Multiplication	30000	0	0	30000	0	0	0
02/04/11	181	Purchase of Fertilizer	24500	0	24500	0	0	0	0
11/04/11	182	Communication	5000	0	5000	0	0	0	0
12/04/11	183	Fuel	8000	0	0	0	0	0	8000
14/04/11	184	Safari Allowance	9375	0	0	0	0	0	9375
14/04/11	185	Logistical Support	2325	0	0	2325	0	0	0
15/04/11	186	Follow-up Visits	5000	0	0	0	0	0	5000
19/04/11	187	Stationery	5000	0	5000	0	0	0	0
21/04/11	188	Salaries for April	33125	33125	0	0	0	0	0
21/04/11	189	Labels for beneficiaries	8000	0	0	0	0	8000	0
24//04/11	190	Stakeholders Meeting	5000	0	0	0	5000	0	0
26/04/11	191	Demo plot Establishment	89850	0	0	0	0	89850	0
TOTAL AMOUNT IN LOCAL CURRENCY (*)			**682768**	**132500**	**97500**	**100520**	**152220**	**121153**	**78875**
TOTAL AMOUNT IN US$ DOLLAR (**)			**8753.43**	**1698.72**	**1250**	**1288.72**	**1951.54**	**1553.24**	**1011.22**

REPORT PREPARED BY:
NAME: LYDIA AKINYI
TITLE: ACCOUNTANT

SIGN__

In practice, it is a combination of both methods

Measure: Sources & methods for collecting quantity and price data

- Administrative data bases
  - From health facility
  - Project expense reports
  - MOH centralized records

- Standardized reporting forms
- Surveys for providers and beneficiaries
- Review of patient charts
- Observation or time-motion studies
- Expert panel
- Published price lists

Value: Estimating capital costs

- Large expenditures that last over one year.
- Could be a hospital, vehicle, laboratory equipment.
- Also often investments that must occur at the beginning of a project or program.
- Depreciation is included in costs.

Multiple year cost calculations

- Inflation
  - Make sure dollars are worth the same amount in terms of what they can purchase
- Discounting
  - Make sure that the dollar value is expressed in terms of the money that is needed at the present time, rather than the total cash flow.
    - Discounting takes into consideration time preference (now is better than later)
    - Related to real interest rate

Value: Estimating volunteer labor

- Community health workers (CHW) provide a lot of support at both the community and health facility level.
- Economic or opportunity cost

How to value volunteer time?

- Is the cost of volunteer labor zero?
  - Even if unemployed, they could be doing something else (leisure or productive) with their time
- How to value?
  - Use the value of similar employed resources
  - Use a single wage regardless of their actual employment (maybe agricultural wage rate?)

Aggregate costs

- Total costs
- Unit costs
- Cost profiles

Aggregate: Cost categories

Different way to consider costs categories

- Inputs
- Cost centers/function/activities
- Source of funding
- Level of service delivery
- Start-up costs verses recurrent
- Intervention specific costs verses joint or shared costs
- Combine categories inputs by activity

Assessing costs and effectiveness of expanding high quality PMTCT services by community and facility strengthening in Mashonaland Central Province, Zimbabwe

Example

Zimbabwe ARISE Project: Intervention objectives

- Increase access to the WHO's recommended PMTCT prophylaxis regimen, including highly active antiretroviral therapy (HAART) to all pregnant women who need it for their own health.
- Increase community access to and uptake of PMTCT services.
- Evaluate the effectiveness of the intervention by measuring the decrease in HIV infection among HIV exposed infants.

Research Objectives

Economic evaluation objective:

- Determine the *CIDA funded frontline cost* per infant infection averted
- Sub-objectives:
- Costs: Estimate the *incremental program costs* incurred to provide Option A in Mashonaland Province
- Impact: Calculate the incremental cost-effectiveness, measured as cost per infection averted

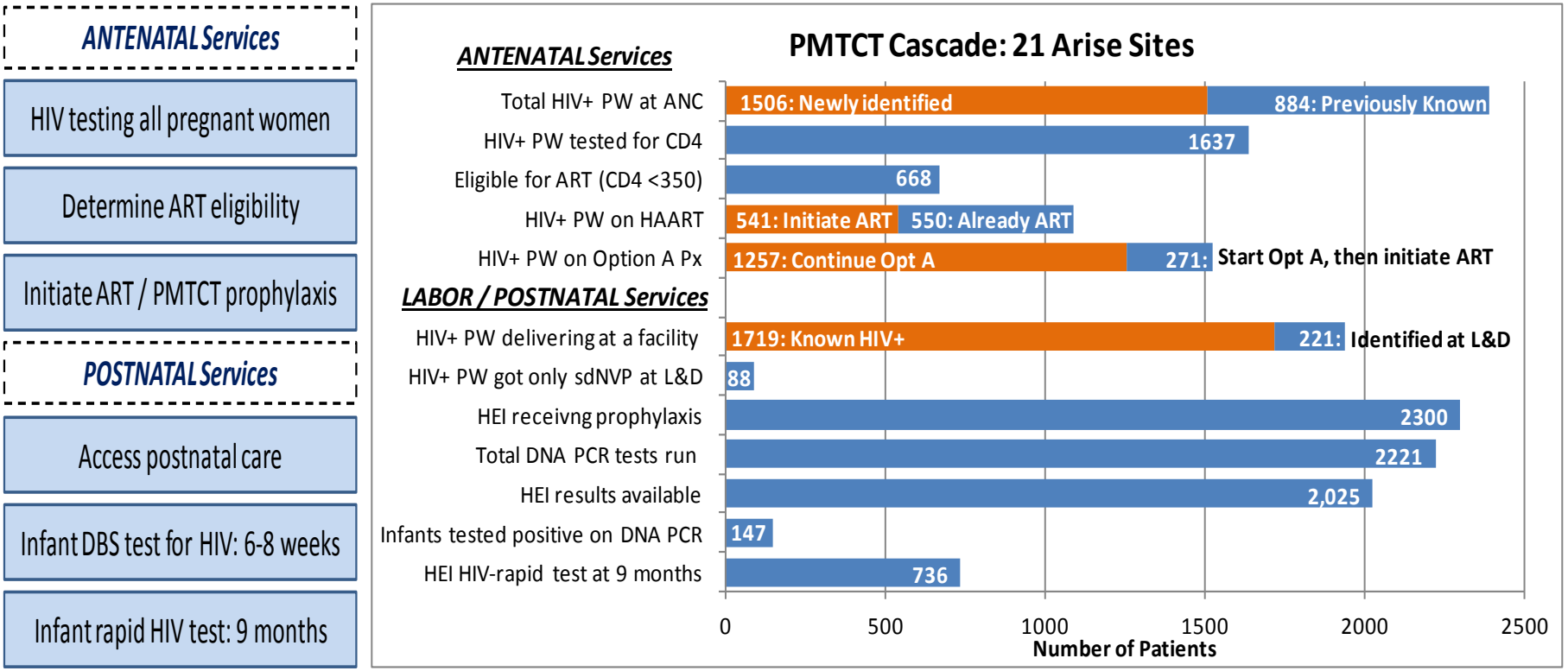
Comparison of PMTCT options

Table 1: Comparison of Zimbabwe's WHO 2006 ("MER-28") and WHO 2010 Option A ("MER-14") guidelines for HIV-positive women and their HIV-exposed infants1

WHO 2006, Prophylaxis	WHO 2010, Option A Prophylaxis	WHO 2010, ART
Mother (CD4>350):	**Mother (CD4>350):**	**Mother (CD4<350):**
• ANC: Single-dose nevirapine (NVP) or dual-drug prophylaxis regimen containing zidovudine (AZT) starting at 28 weeks gestation until BF cessation	• ANC: 2x/daily AZT starting at 14 weeks gestation through pregnancy • Labor: Single dose NVP at labor, plus initiation 2x/daily AZT+3TC for 1 wk postpartum	• Triple ARV therapy starting at 14 weeks gestation and continued for life. • TDF+3TC+EFV is preferred regimen
Infant:	**Infant:**	**Infant:**
• Daily AZT from birth until 6 wks age (irrespective of feeding method)	• Breastfeeding (BF): Daily NVP at birth through 1 wk after BF cessation • Non-BF: Daily NVP at birth until 6 wks age	• Daily NVP or 2x/daily AZT from birth until 6 wks age (irrespective of feeding method)

1 Fasawe, O, Avila C, Shaffer N, et al. Cost-Effectiveness Analysis of Option B+ for HIV prevention and treatment of mothers and children in Malawi. *PLoS ONE* 2013, 8(3).

Figure 1. PMTCT cascade[1] and corresponding mother-infant patient volumes during the costing period, February 2012-January 2013.



Source: Campbell J, Shelley K, Mangwiro A, Antoinette Bhattacharya A, Gaurav Bhattacharya G and Levin C. 'Assessing costs and effectiveness of expanding high quality PMTCT services by community and facility strengthening in Mashonaland Central Province, Zimbabwe.'Final Report for ARISE Enhancing HIV prevention programs for at-risk populations, CHAI, ZAPP, Population Council, PATH, CIDA 2013.

Perspective and cost definitions

- **Donor perspective (CIDA)**
  - Frontline (financial) costs represent actual project expenses paid for by the project to deliver goods and services
- **Ministry of health perspective (MOH Zimbabwe)**
  - Economic or opportunity costs value all resources used to provide services even if not paid for in the current project budget:
    - Donated goods and services, volunteer labor, contribution of goods and services by MOH

Start up activities

- Intervention
  - Microplanning
  - Development and prodn of IEC materials
  - Development and prodn of training materials
  - Sensitization and awareness raising
  - Training

Recurrent activities

- Health system strengthening
- Procure CD4 machines
- Mentoring program
- Training and capacity strengthening
- Procurement
- Health Service Delivery (MOH)
- Community activities to increase demand for services
- Continuous awareness raising and sensitization
- Supervision

Cost input/activity categories

Variable costs

- Health commodities
- Transport
  - Fuel, parking, maintenance, repairs, taxis, tolls, insurance)
- Personnel
- Office facilities
- Management meetings
- Training/supervisory meetings
- Overhead costs

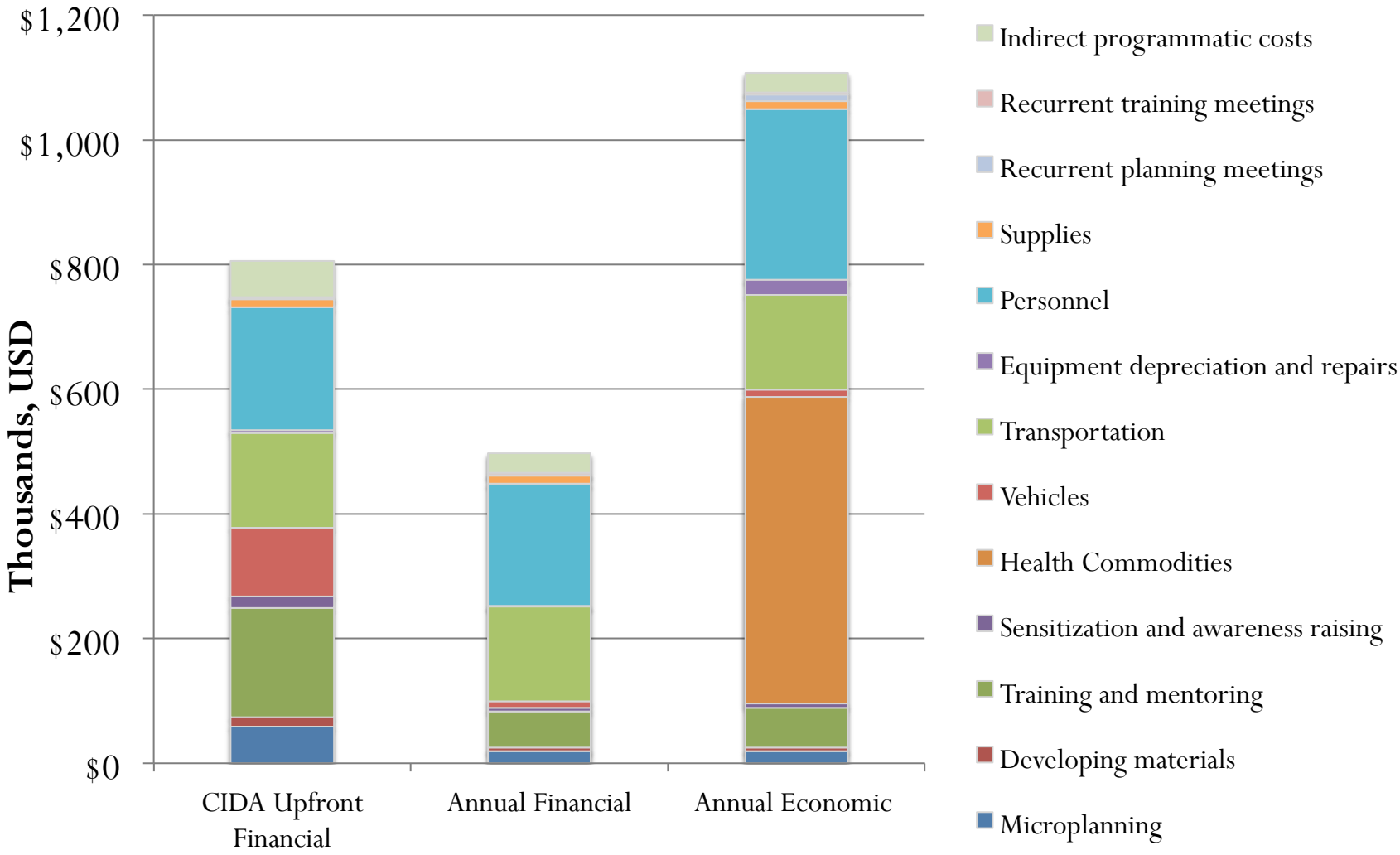
Fixed or capital goods

- Vehicles
- Equipment
  - CD4 machines
  - Computers
- Start-up activities
  - Microplanning
  - Developing materials
  - Training
  - Sensitization and awareness raising

Cost outcomes

- Total intervention cost
- Cost profile (share of costs to inputs or activities)
- Cost per pregnant woman screened for HIV
- Cost per HIV positive woman treated
- Cost per infant infection averted

Arise Zimbabwe project: Costs of strengthening access to PMTCT (US $2012)



Start-up and recurrent costs by implementing partner (US 2012)

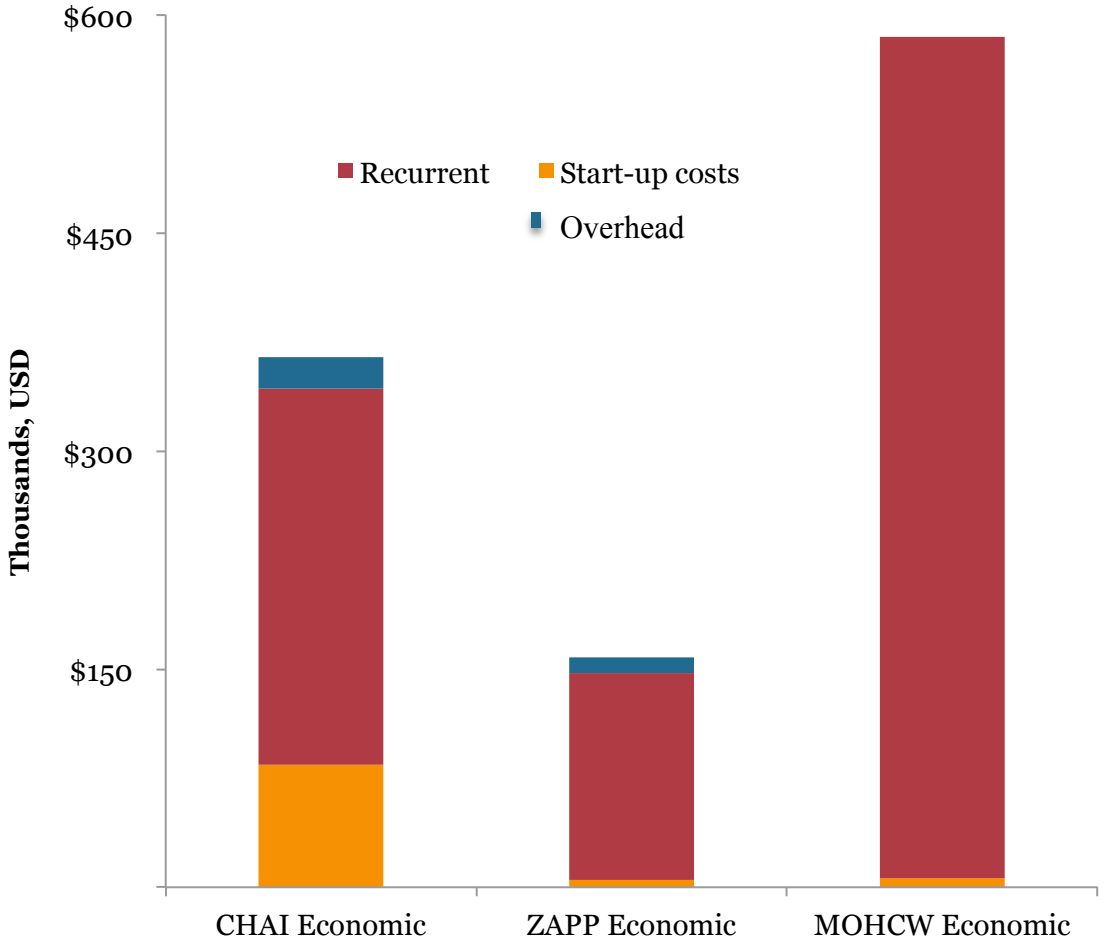


Table 1: Annual financial and economic costs by cost category (US $2012)

Cost Category	Unit costs US $ 2012
# of beneficiaries	**20,954**
Start-up	
Microplanning	$ 0.93
Developing materials	$ 0.24
Training and mentoring	$ 3.08
Sensitization and awareness raising	$ 0.31
Sub-total Start-up	$ 4.57
Recurrent	
Health Commodities (consumable supplies)	$ 23.46
Transportation	
- Capital (vehicles annualized depreciation)	$ 0.60
- Recurrent (Fuel, parking, maintenance, repairs, taxis, tolls, insurance)	$ 7.24
Equipment (CD4 machines, computers annualized depreciation)	$ 1.13
Personnel - implementation staff (excludes management team)	$ 13.09
Office facilities (supplies and communication, such as copying, telephone, postage, stationary, registers, support to PMTCT program)	$ 0.61
Project management meetings	$ 0.48
Training/supervisory meetings	$ 0.16
Sub-total Recurrent	**$ 46.76**
Overhead	$ 1.52
Total Cost per beneficiary	$ 52.85

Summary of ARISE Zimbabwe intervention costing methods

- Micro-costing approach
- Bottom up approach
  - Combine activity based costing, ingredients approach and budget expenditure data
- Payer perspectives
  - Donor and Ministry of Health
- Multi-level:
  - National (NGO), health facility, community
- Sub-sample of project intervention health facilities
- Incremental cost to existing PMTCT services

Limitations of micro-costing data

- Using data from demonstration projects may have limited information on cost of actual nationwide introductions
  - Scope
  - Coordination with national program
  - Health system capacity
- Projections of cost of scaling-up are based on assumptions
  - Demographic, health system, utilization

Going to scale: project verses program-what is the difference?

- Scale and time horizon (returns to scale)
- Demonstration project informs scaled up program
- Integrated with other programs
- Donor driven or externally funded
  - Abundance of planning meetings, awareness raising and sensitization activities
  - Capital expenses to support project
  - International technical expertise

Concluding remarks

- There is general concensus on the principles of costing
  - Define the problem
  - Describe the intervention
  - Identify resources
  - Measure resources
  - Attach a value to resources
- There are multiple ways to value resources—or measuring ‘costs’ and there is no single “right” way to do it.
  - All have advantages and disadvantages

Best practice depends on…

- Purpose of the study
- Perspective
- Type and complexity of the health intervention or technology
- Precision required
- Generalizability and representativeness required
- Feasibility and costs of measurement method

Thank you !

PMTCT labor summary cost per client						
PMTCT Cascade	**Average time spent by primary care counselor (minutes)**	**Average time spent by primary care nurse (minutes)**	**Average time spent by registered general nurse (minutes)**	**Average time spent by registered midwife (minutes)**	**Average time spent by community mobilizer (minutes)**	**Total labor cost per HIV + PW or HIV - PW**
General ANC care (health education only)		1				
Testing for HIV (pre-test counseling, HIV test, post-test counsel, return results)						
HIV positive PW		45				
HIV negative PW		20				
Enroll all HIV+ PW in care (Begin on MER 14 prophylaxis)		30				
Determine ART eligibility (CD4 testing, return CD4 results)		32				
Initiate ART for eligible PW (ART prep sessions 1, 2, 3 and initiaition		135				
Follow-up during ANC (time for drug dispensing during ANC only)		25				
Labor and delivery		25				
Access postnatal Care (3 days, 7 days, 6 weeks)		60				
Re-test HIV negative PW (with results older than 3 months)						
Drug dispensing (Nevirapine prophylaxis and Contrimoxalzole)-		45				
Determine HIV status of infant at 6 weeks (DBS sample, counsel, document)		50				
Return HIV result to caregiver						
Rapid HIV Test for HIV-exposed infants at 9 months		20				
Initiate HIV+ baby on pediatric ART		20				
Drug dispensing pediatric ART		45				
Total clinical time HIV + PW (minutes)	0	533	0	0	0	
Total clinical time HIV -PW (minutes)	0	21				
Cost per minute	$ 0.03	$ 0.07	$ 0.08	$ 0.08		$ 37.64
Total clinical cost HIV + PW	$ -	$ 37.64				$ 1.48
Total clinical cost HIV -PW	$ 0.00	$ 1.48	$ -	$ -	$ -	$ 18.86
Total clinical cost of HIV+ partner		$ 18.86				$ 1.41
Total clinical cost of HIV- partner		$ 1.41				

Methods for data collection and analysis

How to choose which health economic analysis to do?

Types of economic evaluations

Method of analysis	**Cost Measurement**	**Outcome measurement**
Cost-Effectiveness (CEA)	$	Natural units (life-year gained, case averted, blood pressure); single outcome
Cost-Utility (CUA)	$	Life years adjusted for quality of life, captures mortality and morbidity; multiple outcomes
Cost-Benefit (CBA)	$	$; multiple outcomes combined into one value

Choosing the appropriate economic evaluation method

- What is the research question?
- Who is your audience?
- How will you use the information?
- When do you need it?
- How much money do you have?

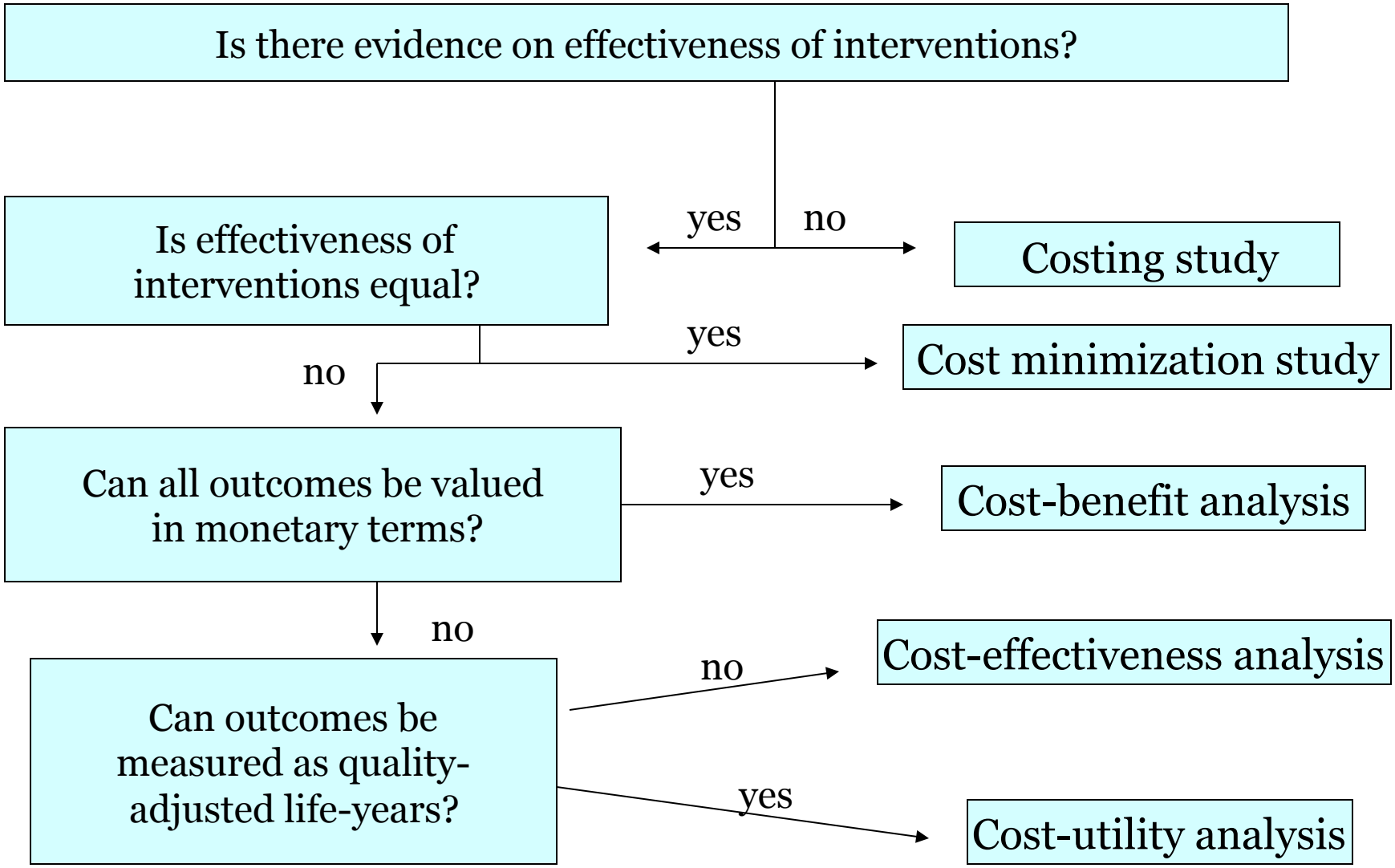
What is the objective of the economic evaluation?

- Comparing costs and effects of alternative interventions using CEA or CEU?
- Costs of a new health intervention or technology?
- Costs of a demonstration project?
- Costs associated with project impact?
- Costs associated with scaling up?
  - What it would cost a national program to achieve a planned impact? (i.e. 70% coverage of ART therapy for HIV positive individuals).
- One or more of the above?

Basic types of health care evaluations

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="3">Are both Costs and Outputs measured?</th></tr>
<tr><th colspan="2">NO</th><th>YES</th></tr>
<tr><td rowspan="3">Compare two alternatives?</td><td rowspan="2">NO</td><td>Examines Consequences Only</td><td>Examines Costs Only</td><td rowspan="2">Describe Costs and Outcomes</td></tr>
<tr><td>Describe Outcomes</td><td>Describe Costs</td></tr>
<tr><td>YES</td><td>Efficacy or Effectiveness Evaluation</td><td>• Cost Analysis</td><td>• Cost-Effectiveness Analysis
• Cost-Benefit Analysis</td></tr>
</table>

Source: Drummond et al.



Source: Gray, A. Economic Evaluation in Dawes, et al. Ed. Evidence Based Practice: A primer for health care professionals. 2001.

Defining the economic evaluation

Describe	***Questions to consider***
Study objective(s)	What is the specific research objective for the economic evaluation?
Study design	How will costs and effects be evaluated as part of the overall monitoring and evaluation strategy?
What is being evaluated?	• Health outcomes • Health outputs (coverage, utilization) • Other performance or operational indicators • Costs
Health outcomes	Which health outcomes will be evaluated? 1. Cases averted 2. Deaths averted 3. Disability averted
Health outputs	What additional intermediate output indicators will be evaluated? • Number of target group reached by intervention • Number of target group tested • Number of target group diagnosed (number positive, number negative) • Number of individuals treated

Defining the economic evaluation

Describe	***Questions to consider***
Performance or operation indicators	What operational indicators will be evaluated? 1. Quality or other performance indicators 2. Number of tests correctly identifying individuals for treatment. 3. Number of target group correctly treated. 4. Loss to follow up
Costs	Which costs will be included in the analysis? 1. Intervention costs 2. Medical treatment costs averted 3. Client costs incurred or averted
What will this data reveal?	• Cost per case or death averted • Cost per individual (in target group) reached • Cost per person screened • Cost per person treated • Cost breakdown (cost profiles) for intervention components (inputs/activities) • ***Information for program planners on the costs and benefits of proposed intervention.***
How will the data be used?	• Used in cost-effectiveness analysis to compare new intervention to status quo • To consider introduction or scaling up existing prevention or treatment activities in the country • To evaluate financial sustainability or affordability to the government

Getting started- a few ideas

- Integrate cost analysis into on-going evaluation.
- Depending on resources and when analysis is needed, may consider a rapid approach.
- Focus efforts on obtaining data on the largest input categories.
- Work closely with local counterparts to collect basic data and cost information.
- Look for local health economists who can direct you to resources.

Thank you.