USAID | DELIVER PROJECT

Economic Evaluation: Guide to Approaches for Public Health Supply Chains




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USAID | DELIVER PROJECT, Task Order 4
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Abstract
Decisionmakers in developing countries must continually choose between different courses of action as they pursue public health goals. Among their most critical choices are those relating to how best to strengthen commodity supply chains as a means towards more accessible, affordable, and higher quality products and services. Economic evaluation—studies that compare the costs and consequences of alternative supply chain investments—can be a critical tool to help in these decisions. This guide describes a framework to apply principles of economic evaluation to supply chain decision making. It defines main types of analyses including cost-effectiveness, cost-benefit, and return on investment, and provides examples of supply chain economic evaluation.

Cover photo: Clockwise from top left: in Zambia, a health worker counts out pills in the Kalomo District Hospital dispensary; in Zimbabwe, a logistics worker updates records as part of the Delivery Team Topping Up system; in Nigeria, a logistics staff person takes notes as part of the Direct Delivery and Information Capture system while clients wait for treatment; in Mozambique, a logistics worker processes inventory information. USAID | DELIVER PROJECT.

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Contents

Acronyms and Abbreviations

ACER	average cost-effectiveness ratio
ACT	artemisinin-based combination therapy
AIDS	acquired immune deficiency syndrome acquired immunodeficiency syndrome
BCG	bacillus Calmette–Guérin vaccine
CBA	cost-benefit analysis
CEA	cost-effectiveness analysis
CMS	Central Medical Stores
CYP	couple-years-of-protection
DALYs	disability-adjusted life years
DFID	Department for International Development, U.K.
DHO	District Health Office
DPT	diphtheria, pertussis, tetanus vaccine
DTTU	Delivery Team Topping Up
GDP	gross domestic product
GFATM	Global Fund to Fight HIV/AIDS, Tuberculosis and Malaria
HIV	human immunodeficiency virus
ICER	incremental cost-effectiveness ratio
LIAT	Logistics Indicators Assessment Tool
MOH	Ministry of Health
MSD	medical stores department, Tanzania
MSI	Marie Stopes International
MSL	Medical Stores Limited, Zambia
PBF	performance-based financing
ROI	return on investment
SDP	service delivery point
USAID	U.S. Agency for International Development
VMI	vendor-managed inventory
ZNFPC	Zimbabwe National Family Planning Council

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Introduction and Objectives

Public health supply chains in developing countries are channels for getting essential drugs, contraceptives, and other commodities to clients. They are generally—but not exclusively—government owned or managed. The focus of the USAID | DELIVER PROJECT is on strengthening these supply chains from the point where products enter a developing country through to health workers and their clients.

Decisionmakers in developing countries must continually choose between different courses of action in their pursuit of public health goals, including activities to strengthen the supply chain and improve its performance. The money invested in these activities can have an immediate and/or longer-term impact, with the end goal of more accessible, higher quality, and affordable products and services and, ultimately, better health.

When considering whether, how, and how much to invest in strengthening supply chains, decisionmakers face questions that include—

1. How much should we invest in supply chain strengthening versus another health system building block, such as information systems, service delivery, human resources, or leadership and governance?
2. Which elements of the supply chain strengthening should we invest in?
3. What is the most efficient way to organize our distribution system?
4. To what extent should our system be *integrated;* in other words, putting different products in the same warehouse and on the same delivery vehicles?
5. What is an appropriate time for us to introduce a vendor-managed inventory approach?
6. Should we outsource key supply chain functions—such as transport or warehousing—to the private sector?
7. Is the expense of a new, automated logistics management information system justified in terms of better supply chain performance and client satisfaction?
8. Should we close or rehabilitate the existing warehouses?
9. In redesigning our system, should we eliminate levels of the supply chain?
10. Should we invest in training staff in logistics management techniques?
11. Is the cost associated with introducing a pay-for-performance approach worthwhile in terms of expected savings and performance improvements?

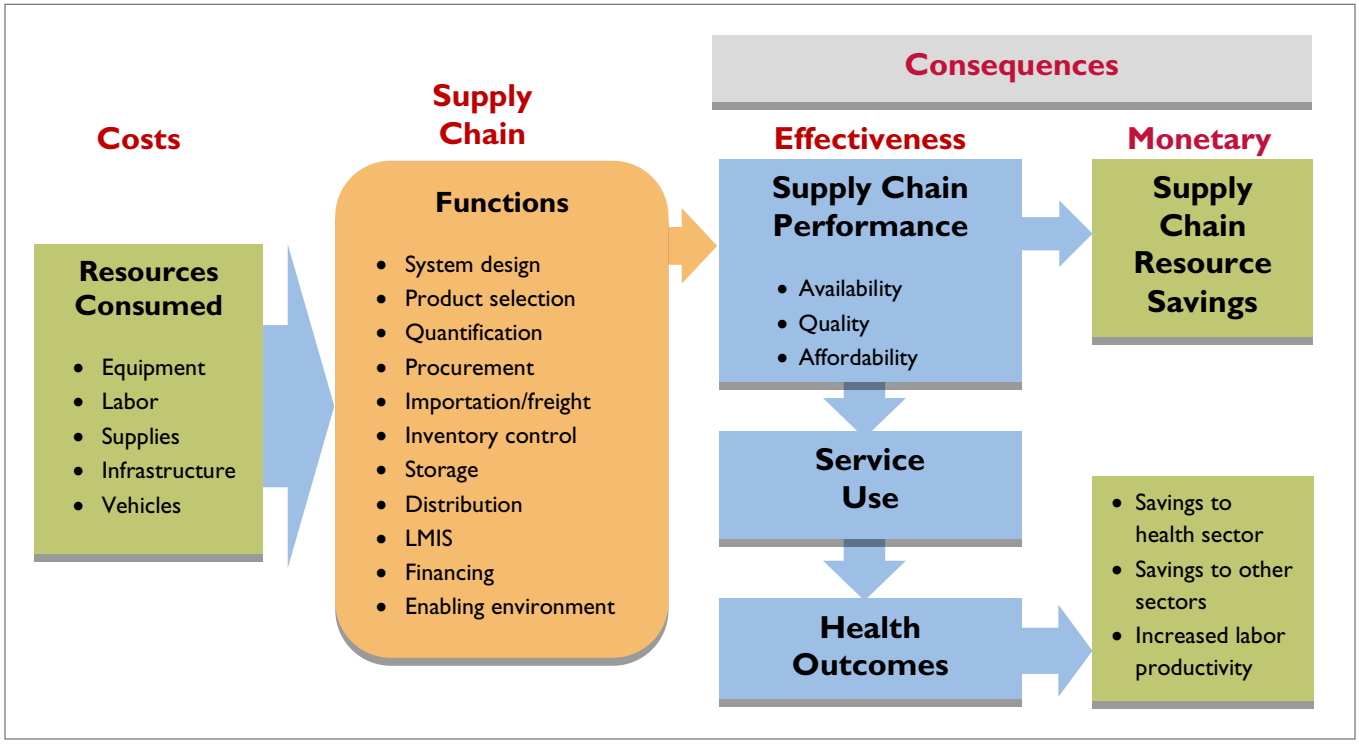
These questions address how to use scarce healthcare resources. One way to answer these questions is through economic evaluation, which can help decisionmakers make informed choices about the best ways to strengthen public health supply chains in developing countries. This guide aims to help decisionmakers understand the different forms of economic evaluation, and when they might be appropriate to employ.

Types of Economic Evaluation

Economic evaluation compares both the *costs* and the *consequences* of alternative courses of action as a way to guide decisions about the efficient use of scarce resources (Drummond et al. 2005; WHO 2008). Figure 1 shows how we can apply this thinking to public health supply chains by looking at these basic components:

- The *costs* of a supply chain investment might include any combination of resources: equipment, labor, supplies, infrastructure, vehicles, etc.
- The *functions* of the supply chain consume these resources. A supply chain strengthening activity may work through one or all of these functions.
- The *consequences* of a strengthening activity will be effectiveness, as measured by supply chain performance, use of health services, and health outcomes.
- These changes in effectiveness can also generate *monetary benefits* in two main ways. (1) Better supply chain performance can produce savings on the resources used to operate the supply chain, or to create a system that can manage larger volumes of commodities with the same amount of resources. (2) When improvements in health outcomes produce savings to the health system, savings for other sectors, or increased labor productivity.

Figure 1. Components of Economic Evaluation of Supply Chains



An economic evaluation is one of many useful ways to assess the performance of supply chains (see appendix 1 for a short description of other evaluation approaches). Economic evaluation encompasses two broad categories of analysis: cost-effectiveness analysis (CEA) and cost-benefit analysis (CBA). A third category, which incorporates some aspects of economic evaluation, is value for money analysis.

Cost-effectiveness Analysis

A cost-effectiveness analysis relates the costs of different approaches to a common measure of effectiveness, where the unit of effectiveness is closely associated with the objective of the program.

Some typical indicators of effectiveness of a supply chain intervention include—

- Supply chain performance:
  - stock status
  - quality
  - composite measure of performance
- Service use, assuming a link between performance and use of services:
  - family planning use—number of users, couple-years of protection (CYP), etc.
  - vaccinated child
  - dose delivered
  - patient receiving appropriate drugs
- Health outcome, by positing a relationship between use of services and one or more health outcomes:
  - births averted
  - deaths averted
  - disability-adjusted life years (DALYs) averted
  - broader social and economic benefits.

Questions that a CEA can help answer:

- What is the relative efficiency of one supply chain intervention over another in terms of achieving a level of supply chain performance, service use, or health outcome?
- To achieve the specified health outcome, are supply chain investments, or are investments in other health systems building blocks the most efficient?

Data requirements for this type of analysis:

- costs of the different interventions
- supply chain performance of each intervention

- use of services
- health outcomes.

Principal measures of cost effectiveness:

The two principal measures of cost effectiveness are the average cost-effectiveness ratio (ACER) and the incremental cost-effectiveness ratio (ICER)—see simple examples in table 1.

- ACER divides total cost by the total effectiveness of an intervention.

ACER = (total cost of intervention) ÷ (total effectiveness of intervention)

- ICER compares the differences in costs and health outcomes of two alternative interventions competing for the same resources. The ICER is calculated as—

ICER = (cost of intervention A – cost of intervention B) ÷ (effectiveness of intervention A – effectiveness of intervention B)

Table 1. Example of Average and Incremental Cost-Effectiveness Ratios

Model	Total Cost	Total Effectiveness	ACER	ICER
A	$100	25	= ($100 ÷ 25) = $4.0	
B	$150	50	= ($150 ÷ 50) = $3.0	= ($150 – $100) ÷ (50 – 25) = $2.0

- *Other measures of cost effectiveness.* When analysts measure effects in terms of DALYs averted, these are *cost-utility analyses* (WHO 2008). *Cost minimization analysis* is when the analyst compares the cost of two or more programs that have the same outcome or consequence (Drummond et al. 2005; WHO 2008). The *marginal cost-effectiveness ratio* measures the specific change in cost and effectiveness when a program expands or contracts (WHO 2008).

Cost-benefit Analysis

A CBA is the second major category of economic evaluation. Like a CEA, a CBA measures costs and consequences of alternative approaches, but it measures them in money terms.

The monetary benefits of a supply chain intervention can include—

- Savings to the supply chain as a result of better system performance, for example—
  - lower drug costs resulting from reductions in inventory
  - fewer expired or spoiled products
  - reduced transportation or labor costs
- Savings from better health outcomes, for example—
  - health costs averted after proper treatment of an illness

- savings to other sectors; for example, when better health has a positive impact on learning
- when a healthier workforce translates to lower absenteeism and higher labor productivity.

Questions this type of study helps answer—

- Which supply chain investment provides the greatest economic benefit?
- How do the economic benefits of supply chain investments compare with investments in other health systems building blocks, or in other sectors outside health?
- What are the projected monetary savings from undertaking a specific intervention?

Data requirements for this type of analysis:

- costs of the different interventions
- monetary benefits from each intervention.

Typical cost-benefit measures:

- *Benefit-cost ratio.* Typically expressed as a number (2.5) or a ratio (2.5:1). In its simplest form, it is calculated by dividing all benefits by all costs (see table 2).

Benefit-cost ratio = benefit ÷ cost

Table 2. Example of Calculation of Benefit-Cost Ratio

Cost	$100
Benefit	$250
Benefit-cost ratio	= ($250 ÷ $100) = 2.5

- *Return on investment (ROI) analysis* in the public health field is usually synonymous with cost-benefit analysis. ROI analysis, a term borrowed from the business world, denotes a specific type of financial analysis that weighs investment gains against investment costs. A commercial enterprise measures gain in terms of additional sales or profit generated from the investment (see table 3). Of course, what distinguishes public health supply chains from businesses is that supply chains do not operate to earn a profit, but rather to provide a level of service. Therefore, a public health ROI analysis will measure gains in terms of the savings to the system that might accrue from the investment. ROI in its simplest form is expressed as a percentage; it is calculated using this formula:

ROI = (Gain from investment – cost of investment) ÷ cost of investment

Table 3. Example of Calculation of Return on Investment

Investment	$100
Gain	$250
Return on investment	= [($250 – $100) ÷ $100] = 150%

Value for Money Analysis

A value for money analysis incorporates some of the techniques included in economic evaluation, combining different measures of economic and program analysis in a "balanced scorecard" approach to assessment.

UK's DFID, which has been in the forefront of promoting the approach, defines value for money as "a term generally used to describe an explicit commitment to ensuring the best results possible are obtained from the money spent" (DFID 2012). A business case for a family planning project in Africa shows how DFID operationalizes the concept (DFID 2012). It specifies the following measures to assess value for money:

- *Economy in procurement of supplies* – i.e. getting supplies at the lowest cost.
- *Efficiency in service delivery*, through assessment of:
  - unit costs of service delivery for different target groups;
  - the impact of scale on unit costs
  - efficiency of method mix
  - stock availability
- *Effectiveness* in terms of additional CYP
- *Cost-effectiveness* in terms of cost per additional CYP delivered; marginal costs per CYP for reaching target groups; cost per pregnancy averted, cost per life of a woman or newborn saved, and cost per DALY averted
- *Cost-benefit analysis*, with monetary benefits calculated by valuing one DALY averted as the gross domestic product per capita.

The Global Fund to Fight HIV/AIDS, Tuberculosis and Malaria (GFATM), in its guidance for applicants preparing funding proposals, defines value for money as a combination of:

- *Effectiveness*, that is, proposed activities are technically well-designed and represent the best way to achieve the desired impact, outcomes, and sustainability given the prevailing conditions within the country context;
- *Efficiency*, i.e., desired outputs of proposed activities are obtained at least cost in terms of inputs; and
- *Additionality,* which means that the requested GFATM support is in addition to the existing efforts and will not substitute for other resources (national, private sector, or international) (GFATM 2012).

At this time, USAID does not precisely define value for money, but they use the term as a rough equivalent to *return on investment* or *bang for the buck*.

Measuring the Cost of Supply Chain Investments

Economic evaluation requires knowledge of the costs for the supply chain interventions that you are evaluating. Although this guide is not a how-to costing manual, the following brief guidelines will explain how to obtain and measure the costs of your supply chain interventions.

Ingredients costing. Ingredients, or activity-based costing, is a good way to determine detailed costs for an existing supply chain; but, it is usually more time-consuming and expensive than the other methods. This approach typically examines a supply chain according to its main components or functions—storage, transport, etc.—then collects survey data on the level of resources and their associated prices. One example of a tool to help in carrying out such an ingredients costing is the *Supply Chain Costing Tool* developed by the USAID | DELIVER PROJECT. Two of the project's publications, *Guide to Public Health Supply Chain Costing: A Basic Methodology* (McCord, Tien, and Sarley 2012) and *Supply Chain Costing Tool User's Manual* (Tien, Sarley, and McCord 2012) provide further details on this approach.

Budget data. If ingredients costing is too time-consuming or costly, you can use less precise supply chain budget data to estimate costs. Often, such data will be available for discrete entities, such as a Central Medical Store (CMS). However, finding budget data for other elements of the supply chain, such as district storage depots or supply chain activities at hospitals and health centers, may be more difficult.

Using costing benchmarks. Another approach is to estimate costs using benchmarks drawn from other studies. For example, publications, such as *Estimating the Global In-Country Supply Chain Costs of Meeting the MDGs by 2015* (Sarley, Baruwa, and Tien. 2009) offer guidance on estimating supply chain costs based on the monetary value of commodities that move through the system. The publication *Last Mile Costs of Public Health Supply Chains in Developing Countries: Recommendations for Inclusion in the United Nations OneHealth Model* (Rosen et al. 2012) provides similar estimates, but with a focus on last mile costs. The USAID | DELIVER PROJECT recently compiled information on supply chain costs from a wide range of studies: the publication, *Compendium of Public Health Supply Chain Cost Data,* is available on the project's website (USAID | DELIVER PROJECT 2013).

Modeling. When you do not have actual cost data, or the program you are evaluating has not been implemented, you may choose to model supply chain costs. Typically, your model will draw on data from either an ingredients costing done elsewhere, from budgets, or from national or international benchmarks.

Measuring the Consequences of Supply Chain Investments

As noted, an economic evaluation necessarily involves measuring the consequences of an intervention, either in terms of effectiveness or in monetary terms.

Getting Data on Effectiveness

As we saw in figure 1, effectiveness traces a logical path from supply chain performance, to service use, to health outcome. Measuring each type of effectiveness presents the analyst with multiple challenges.

Supply chain performance. There is no single, agreed-upon measure for supply chain performance; and many different indicators exist (Aronovich et al. 2010). Although stock availability is commonly thought of as a *bottom-line* measure of performance, performance more broadly encompasses availability, quality, and affordability. Thus, most analysts recommend a *balanced scorecard* approach to performance measurement that aggregates different indicators. An example is the Logistics Indicators Assessment Tool (LIAT) index, developed by the USAID | DELIVER PROJECT (Karim, Bieze, and Chimnani 2008). In the end, the indicator you select to measure supply chain performance should closely reflect the objectives you have set for your program. For example, if the aim is to improve the procurement function, performance indicators should relate primarily to procurement.

Service use. No definite rule links supply chain performance to service use, but analysts are continually searching for ways to quantify this connection. One example is the effort to link stock availability to family planning use. One estimate, based on DHS data, found a 6.5 percentage point increase in modern contraceptive prevalence associated with each additional method consistently available at service delivery points (SDPs) (Futures Institute 2011). A study in Zambia used a decision tree framework to link supply chain improvement to health outcomes for malaria (World Bank 2010). In Mozambique, analysts included a measure of service use impact in their comparative analysis (VillageReach 2009).

Health outcomes. After you make the link from supply chain performance to service use, linking to health outcomes—births or deaths averted, DALYs averted, etc.—is relatively easy because conversion factors are already established. An example of these for family planning programs are the conversion factors embedded in the Marie Stopes International Impact2 Calculator (MSI 2013). Using these factors, the analyst can convert the number of unintended pregnancies averted into the number of averted live births, unsafe abortions, child and maternal deaths, and DALYs (USAID | DELIVER PROJECT Task Order 4 2013).

Getting Data on Monetary Benefits

For CBA, you will need to express in money terms the consequences of a supply chain investment. As with measuring effectiveness, the analyst faces multiple challenges in placing a monetary value on these investments.

Monetary benefits related to supply chain resource use

Calculations of supply chain resource savings usually rely on assumptions about what the impact a particular process change will have on resource use. Analysts often use modeling to measure the potential impact of such changes (for evaluations carried out *before* a decision is made, as in the Tanzania example in the following section) or collect actual data on the resource impact (for evaluation carried out *after* a new intervention starts, as in the Mozambique example in the following section).

Monetary benefits related to health outcomes

The other type of monetary benefit you can measure is associated with the improvement in health outcomes that result from the supply chain investment. Analysts typically calculate three types of savings associated with better health, either alone or in combination.

1. *Savings on healthcare costs*. These savings in healthcare costs are associated with better health. For example, the Marie Stopes International Impact2 model translates increased family planning use into savings on antenatal care, delivery care, post-abortion care, and treatment of pregnancy and birth-related complications (MSI 2013).
2. *Savings on costs from other sectors*. Models, such as RAPID, translate family planning use into savings in education and other sectors (Futures Institute 2012).
3. *Savings on labor productivity from better health*. For example, people who get sick from malaria often miss work and lose wages. Preventing or treating malaria can reduce these losses. Analysts have generalized findings from various studies to establish a rule of thumb that averting one DALY is equivalent to saving one year of gross domestic product (GDP) per capita. Averting one DALY in Zambia, for example, would save about $1,700.

Deciding What Approach to Take to Economic Evaluation

Economic evaluation of public health supply chain investments in developing countries can help decisionmakers answer the questions posed in the introduction. However, under what circumstances is a particular type of analysis relevant and appropriate? To help decide which approach to use, you can review the considerations for undertaking economic evaluation listed in table 4.

Table 4. Considerations for Undertaking Economic Evaluation of Supply Chain Investments

		If answer is yes, type of analysis that might be appropriate			
		Cost-Effectiveness Analysis		Cost-Benefit Analysis	
Question	**Consequences Measured In Terms of:**	**Supply Chain Performance**	**Service Use, Health Outcomes**	**Supply Chain Savings**	**Other Savings**
Consideration of alternatives					
Are you comparing at least two alternative supply chain activities?		X	X	X	X
Are you interested in comparing both the costs and consequences of the activity?		X	X	X	X
Assessment of consequences					
Will you be able to measure the effectiveness of the supply chain investment in terms of supply chain performance?		X			
Will you be able to link supply chain performance to service use or health outcome?		X	X		
Do you want to know if the investment might generate savings for the supply chain?				X	
Do you plan to link increases in service use of health outcomes to savings in healthcare costs or savings in other sectors outside health?				X	X
Types of efficiency you are interested in					
Are you comparing among alternative supply chain investments in terms of which are more efficient in achieving a level of supply chain performance?		X			
Are you comparing among alternative supply chain investments in terms of which are more efficient in achieving a higher level of performance for a given budget?		X			
Are you interested in comparing supply chain investments to investments in other health systems building blocks?			X		X

Application of Economic Evaluation to Public Health Supply Chains

The following are brief descriptions of applying economic evaluation techniques to supply chain investments in developing countries. They include examples of CEA and CBA.

Zambia: Comparing the Cost Effectiveness of Standard Versus Two Models of New Distribution Systems for Essential Drugs

Problem

A large percentage of facilities are stocked out of contraceptives and other reproductive health commodities.

Policy question

Is it worthwhile to invest in supply chain strengthening to improve performance, even if it might cost more?

Study objective

Compare the cost effectiveness of the standard system versus two models of the new supply chain systems.

Comparison

Intervention Alternative	Features
Standard	System pushes health center kits from the central level based on a national allocation system and not on reported consumption at the facility level.
Model A	• Health centers and posts place orders to District Health Office (DHO), which sends all individual health center and post reports and one aggregated monthly order for the district (i.e., all data for all service delivery posts are still visible at the MSL and CMS). DHO receives an aggregated order for the entire district from MSL, stores the commodities, and supplies centers and posts monthly. • Districts assemble orders for the centers and posts and coordinating delivery between the district and centers and posts.
Model B	• Centers and posts place orders directly to MSL through the DHO. • Orders are packed at MSL in sealed packages for each individual facility. • Districts act as a cross-dock where orders packaged for individual facilities are transferred from a larger vehicle from the MSL to smaller vehicles that will deliver to the facilities. The districts are only responsible for coordinating delivery or pick up of orders between the district and the centers and posts.

Cost measures

Incremental costs of labor, communication, commodity transport, administration, and training

Effectiveness measures

Category of Effectiveness	Indicators
Supply chain performance	Stock availability (percentage of time facilities had stock of 15 essential medicines)
Service use	Use of malaria services
Health outcome	Malaria deaths averted, DALYs averted

Results: Effectiveness

Both models A (82 percent) and B (91 percent) produced better stock availability compared with the standard model (79 percent). Model B performed significantly better than A.

Results: Costs

Both model A and model B were about twice the cost of the standard model. The largest contributor to additional cost was the introduction of a district Commodity Planner, a new cadre responsible for coordinating orders from the health facilities and stock management at the district.

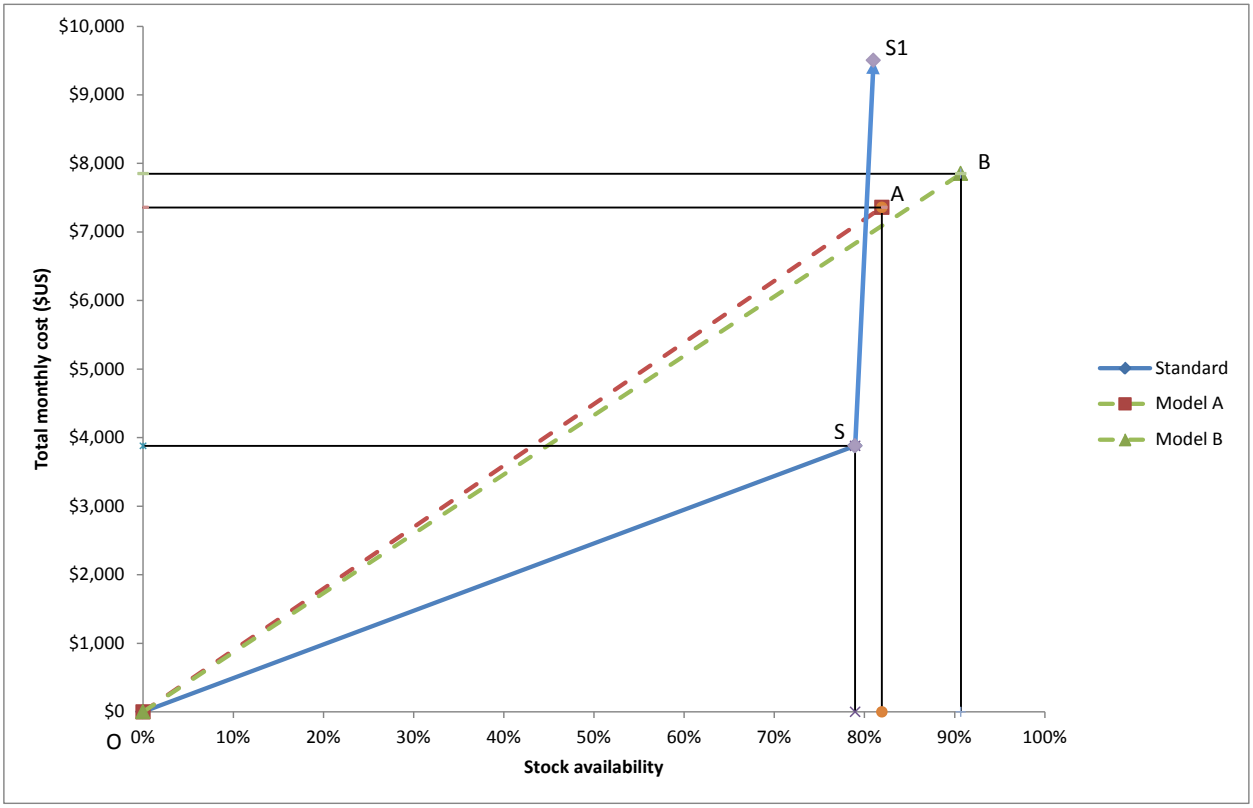
			Cost Effectiveness	
Model	District Monthly Supply Chain Cost	Average Stock Availability	ACER	ICER
Standard	$3,878	79%	$49	
A	$7,357	82%	$90	$14.50
B	$7,849	91%	$87	$4.18

Results: Cost effectiveness

The standard model has the lowest average cost-effectiveness ratio—$49 per percentage point of stock availability—compared with model A ($90) and model B ($87). The incremental cost-effectiveness ratio for model A compared to the standard model was $14.50, significantly higher than the incremental cost-effectiveness ratio for model B ($4.18).

On a graph (see figure below), the respective average cost-effectiveness ratios are the slopes of the line O – S (standard model), O – A (model A), and O – B (model B). The incremental cost-effectiveness ratio of model A is the slope of line S – A, while for model B the ICER is the slope of the line S – B.

Comparison of Average and Incremental Cost Effectiveness of Three Models of Essential Medicines Supply Chains, Zambia



Interpretation

Models A and B are more effective than the standard model, but they are also more costly. Average cost-effectiveness ratios are also higher for A and B than for the standard model. However, additional investment in the standard model is unlikely to produce much more in terms of performance. This is shown graphically by the line S – S1, which shows, hypothetically, that even a large addition to the cost of the standard model will only increase performance by a few percentage points. If decisionmakers are focused on increasing performance, either model A or B are better than the standard model, with model B superior to A because of its higher performance, lower average costs, and lower incremental cost-effectiveness ratio compared to model A.

Source: (World Bank 2010; Zambia Logistics Steering Committee 2011)

Mozambique: Comparing Cost Effectiveness of Traditional Versus Dedicated Logistics System for Childhood Vaccines

Problem

The child vaccine supply chain is underperforming.

Policy question

Will changes in the organization of the supply chain result in a more efficient, better performing system?

Study objectives

Compare effectiveness, costs, and cost effectiveness of two different supply chain approaches to vaccinate children in Mozambique.

Comparison

Intervention Alternative	Features
Traditional system	Mixed and inconsistent logistics system combining collection and distribution activities, which varied by location and month
Dedicated logistics system	Active logistic delivery system; vaccines were reliably delivered to the health facilities each month.

Cost measures

Transport, cold chain, and vaccine costs

Effectiveness measures

Category of Effectiveness	Indicators
Supply chain performance	Stock availability of childhood vaccines
Service use	Doses of DPT3 (diphtheria, pertussis, tetanus) vaccine delivered Children covered Coverage rates
Health outcome	Not measured

Results: Effectiveness

The dedicated system performed better than the traditional system. Sites in the traditional system reported 67 percent vaccine stock availability versus 99 percent in the dedicated system. The number of doses administered was 889,152 in the dedicated system versus 489,624 in the traditional system.

Results: Costs

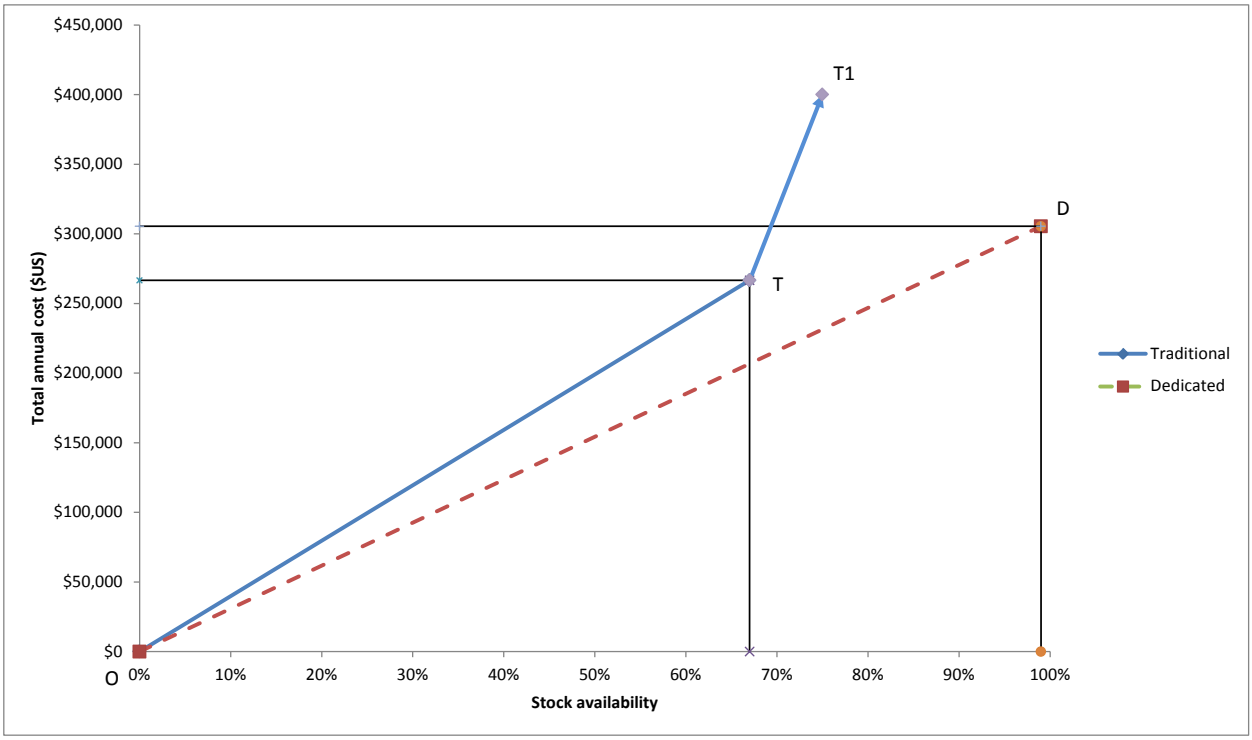
The dedicated system cost more: $305,418 annually versus $266,563 under the traditional system.

Measure	Model	
	Traditional	Dedicated
Costs		
Total vaccine logistics cost	$266,563.04	$305,418.80
Vaccine and supplies cost	$123,806.00	$187,616.51
Cost per child under 5	$1.48	$1.01
Effectiveness		
Percentage of sites reporting stock available	67%	99%
Vaccine doses delivered	489,624	889,152
DPT3 coverage rate	70.0%	95.4%
Average cost-effectiveness ratios		
Cost per percentage point of stock availability	$3,978.55	$3,085.04
Cost per dose delivered	$0.54	$0.34
Cost per percentage DPT coverage rate	$3,808.04	$3,201.45
Incremental cost-effectiveness ratios		
Cost per percentage point stock availability	n.a.	$1,214.24
Cost per dose delivered		$ 0.10
Cost per percentage point DPT coverage		$1,529.75

Results: Cost effectiveness

The dedicated model had lower average cost-effectiveness ratios compared with the traditional model, as measured by cost per percentage point of stock availability ($3,085 versus $3,978), per dose delivered ($.34 versus $.54), and per percentage point of diphtheria, pertussis, tetanus (DPT) coverage ($3,201 versus $3,808). The incremental cost-effectiveness ratios of moving from the traditional to the dedicated model were $1,214 per point of stock availability, $0.10 per dose delivered, and $1,529 per percentage point of DPT coverage. As shown in the following figure, the average cost effectiveness of the traditional model is the slope of the line O – T, while the average cost effectiveness of the dedicated model is the slope of the line O – D. The incremental cost-effectiveness ratio is the line T – D.

Comparison of Average and Incremental Cost Effectiveness of Traditional and Dedicated Models of Vaccine Supply Chains, Mozambique



Interpretation

The dedicated model has higher absolute costs, but it performs better and has lower average cost effectiveness. Decisionmakers seeking to improve vaccine supply chain performance should consider the dedicated model as a better performing, more efficient alternative to the traditional model. Decisionmakers could use the ICER to compare the investment in supply chain strengthening with other investments that have the same aims.

Source: (VillageReach 2009)

Impact of Supply Chain Investment on Contraceptive Method Availability, Family Planning Use, Births Averted, and Maternal and Infant Deaths Averted

Problem

Supply chains in low-income countries are not consistently providing the full range of contraceptive methods.

Policy question

If countries were to invest in supply chain strengthening to ensure full availability of contraceptive methods, what would the impact be on contraceptive use and health outcomes?

Study objectives

Determine the cost effectiveness of investing in supply chain strengthening to achieve full and consistent supply of family planning methods.

Comparison

Intervention Alternative	Features
Do nothing	Underperforming supply chains that only achieve partial method availability
Investing in supply chains to support full stock availability	Well-performing supply chains that achieve full method availability

Cost measures

- commodity costs
- supply chain costs
- associated service delivery and other system costs.

Effectiveness measures

Category of Effectiveness	Indicators
Supply chain performance	Average number of contraceptive methods in stock
Service use	Modern contraceptive prevalence rate; number of contraceptive users
Health outcome	• Unintended pregnancies averted • Induced abortions averted • Maternal deaths averted • Infant deaths averted • DALYs averted

Results: Effectiveness

Independent of any other program effect, moving from partial- to full-stock availability of contraceptives methods in 66 low-income countries would increase modern contraceptive use by about 9.5 percentage points—from 45 percent to 54.5 percent—resulting in an additional 26.6 million family planning users annually (2010 estimates). This additional use translates into 7.4 million unintended pregnancies averted; 4.1 million induced abortions averted; 8,400 maternal deaths averted; 106,000 infant deaths averted; and 6.6 million DALYs averted.

Results: Costs

The total additional cost of the supply chain strengthening would be $634 million, including $120 million for additional commodities; $36 million for supply chain costs; and $479 million for service delivery and other associated system costs.

Results: Cost effectiveness

The incremental cost-effectiveness ratios associated with the supply chain investments are $86 per unintended pregnancy averted; $154 per induced abortion averted; $75,211 per maternal death averted; $5,989 per infant death averted; and $97 per DALY averted.

Cost	
Additional commodity costs	$120 million
Additional supply chain costs	$36 million
Additional service delivery costs	$479 million
Total additional costs	$634 million
Service Use	
Additional family planning users	26.6 million
Health Outcome	
Unintended pregnancies averted	7.4 million
Induced abortions averted	4.1 million
Maternal deaths averted	8,400
Infant deaths averted	106,000
DALYs averted	6.6 million
Incremental Cost-effectiveness Ratio	
Per unintended pregnancy averted	$86
Per induced abortion averted	$154
Per maternal death averted	$75,211
Per infant death averted	$5,989
Per DALY averted	$97

Interpretation

An additional investment in supply chains to reach full contraceptive availability costs about $97 per DALY averted. Compared to the cost per DALY averted from other health investments, supply

chain investments are highly cost effective. Decisionmakers should invest in supply chain strengthening.

Intervention	Cost per DALY averted in $U.S.
Insecticide-treated bed nets	13–20
Malaria prevention for pregnant women	29
Tuberculosis treatment (epidemics)	6–60
Family planning supply chain strengthening	***97***
Antiretroviral therapy (Africa)	252–547
Bacille Calmette–Guérin (BCG) vaccination of children	48–203
Oral rehydration therapy	1,268
Cholera immunization	3,516

Source for interventions other than supply chain strengthening: (Singh et al. 2009)

Source: (Futures Institute 2011)

Tanzania: Cost Effectiveness of Improving Supply Chain Performance of the CMS

Problem

The medical stores department (MSD) currently operates at a suboptimal 60 percent order fill rate, which adversely affects product availability at the SDPs.

Policy question

Officials recognize that a significant investment will be required to operate MSD at a 100 percent fill rate, but they are unsure about whether the system will operate more efficiently at higher levels of performance. Is it worthwhile to invest in improving supply chain performance in Tanzania?

Study objective

Model the cost effectiveness of moving from a 60 percent to a 100 percent order fill rate for the CMS in Tanzania.

Comparison

Intervention Alternative	Features
Do nothing	Underperforming supply chain operating at 60 percent order fill rate.
Investing in supply chains to support full stock availability	Well-performing supply chains operating at 100 percent order fill rate.

Cost measures

Transport and warehousing costs

Effectiveness

Category of Effectiveness	Indicators
Supply chain performance	MSD order fill rate
Service use	Not measured
Health outcome	Not measured

Results: Effectiveness

The model set the order fill rate at either 60 percent or 100 percent.

Results: Cost

Total cost for the system is higher under the 100 percent fill rate scenario versus the 60 percent fill rate scenario ($36 million versus $24 million).

Results: Cost effectiveness

The average cost-effectiveness ratio is lower under the 100 percent fill rate scenario versus the 60 percent fill rate scenario ($361,381 versus $394,436). The incremental cost-effectiveness ratio of moving from 60 percent to 100 percent is $312,547.

	Order Fill Rate	
	60 percent	100 percent
Warehousing cost	$ 16,130,042	$ 23,658,098
Transportation cost	$ 7,536,118	$ 12,509,956
Total cost	$ 23,666,160	$ 36,168,054
Cost effectiveness		
Average cost per percentage point of fill rate	$ 394,436	$ 361,681
Incremental cost per percentage point of fill rate		$ 312,547

Interpretation

Reaching a 100 percent fill rate will cost more, but it will result in a supply chain that is more efficient than the one currently operating at a 60 percent fill rate. If decisionmakers are willing to spend more, they can construct a higher-performing, more efficient system.

Source: (USAID | DELIVER PROJECT 2011)

Zimbabwe: Cost Effectiveness of Bimonthly Versus Quarterly Resupply in a Vendor-Managed Inventory System

Problem

How to maintain the high level of performance of the Delivery Team Topping Up (DTTU) approach to ensure availability of 11 HIV and AIDS prevention and reproductive health products.

Policy questions

Would the system operate more efficiently if it changed from a bimonthly to a quarterly distribution schedule? How would a DTTU with an additional 44 primary healthcare commodities compare to the traditional pull distribution system in which health facilities order their own primary healthcare supplies?

Study objectives

Compare the cost effectiveness of the bimonthly versus the quarterly distribution system. Compare the cost effectiveness of the DTTU versus the traditional pull model, including delivering an additional 44 commodities.

Comparison

Comparison 1:

Intervention Alternative	Features
Current bimonthly distribution	Bimonthly distribution
Quarterly distribution	Quarterly distribution

Comparison 2:

Intervention Alternative	Features
Quarterly DTTU delivery of 55 commodities	Delivery team carries out stocktaking, decides on ordering and replenishment at the SDP.
Quarterly delivery of 55 commodities using a traditional pull ordering system	Managers at the SDP carry out stocktaking, decide on ordering and replenishment.

Cost measures

Procurement, management, storage, and transport costs

Effectiveness

Category of Effectiveness	Indicators
Supply chain performance	Percentage availability of contraceptives and HIV and AIDS condoms
Service use	Not measured
Health outcome	Not measured

Results: Effectiveness

The study assumed a product availability rate of 95 percent under all scenarios.

Results: Cost

Comparison 1: Total national cost for the bimonthly distribution is $2.089 million versus $1.95 million for the quarterly system.

Comparison 2: Total cost for DTTU delivery of 55 products is $3.45 million versus $3.69 million using the traditional pull system.

Results: Cost effectiveness

Comparison 1: Average cost-effectiveness ratio is lower under the quarterly versus bimonthly distribution scenario ($20,489 versus $ 21,985).

Comparison 2: Average cost-effectiveness ratio is lower for the DTTU than for the traditional pull ordering system ($36,313 versus $38,890).

	Total Supply Chain Cost	Performance (product availability)	Average Cost-Effectiveness Ratio
Comparison 1			
Bimonthly distribution	$ 2,088,564	0.95	$ 21,985
Quarterly distribution	$ 1,946,457	0.95	$ 20,489
Comparison 2			
Quarterly DTTU delivery of 55 commodities	$ 3,449,751	0.95	$ 36,313
Quarterly delivery of 55 commodities using traditional pull ordering system	$ 3,694,524	0.95	$ 38,890

Interpretation

The quarterly distribution system is a more cost-effective approach than the current bimonthly system. Because it is less costly and achieves the same level of product availability, decisionmakers should consider moving to the quarterly distribution system.

The DTTU is a more cost-effective approach than the traditional pull ordering system for delivering a basket of 55 commodities. The DTTU costs less and achieves the same level of product availability. Decisionmakers should consider adding 44 primary healthcare commodities to the current DTTU.

Source: (Sarley et al. 2010; USAID | DELIVER PROJECT 2010; USAID | DELIVER PROJECT 2008)

Nigeria: Cost-Effectiveness Analysis of Delivery-Based Versus Collection-Based System of Artemisinin-Based Combination Therapy Distribution

Problem

Malaria patients do not have good access to malaria drugs; in part, because of underperforming collection-based supply chains that rely on lower levels to pick up drugs from higher levels.

Policy question

Can a delivery-based system, in which a central entity is responsible for the delivery of drugs to SDPs, improve patient access to malaria drugs, at a reasonable cost?

Study objective

Compare the cost effectiveness of the delivery-based system versus the collection-based system.

Comparison

Intervention Alternative	Features
Delivery-based system in Borno and Imo states	A central entity delivers the malaria drugs directly from the State CMS to the local government authorities and primary health centers.
Collection-based system in Bayelsa and Ogun states	Local government authorities pick up malaria drugs from the state CMS. Primary health centers collect ACTs from the local government authorities.

Cost measures

Vehicle, supervisory and driver labor, and malaria drugs

Effectiveness

Category of Effectiveness	Indicators
Supply chain performance	Number of malaria drug treatments distributed
Service use	Percentage of fever patients treatable: total number malaria drug treatments distributed ÷ reported number of fever patients
Health outcome	Not measured

Results: Effectiveness

The systems in the two states with delivery-based supply chains delivered significantly more malaria drug treatments than the two states with collection-based systems. When adjusting for the relative size of the population with a need for malaria treatment, the two states with delivery-based systems

performed considerably better. In those two states, the percentage of fever patients treatable with malaria drugs was 111 percent versus only 12 percent and 34 percent in the two states with collection-based systems.

Results: Cost

Total costs were significantly higher in the two states with delivery-based systems, largely reflecting the cost of the greater number of malaria treatments distributed.

Results: Cost-effectiveness

The cost per malaria treatment delivered was significantly lower in the two states with delivery-based systems. The cost per percentage of treatable fever patients was slightly higher in the two states with delivery-based system versus one of the states with a collection-based system (Ogun). In Bayelsa, however, cost per percentage of fever patients treatable was more than three times as high as in the other states.

	System			
	Delivery-Based		**Collection-Based**	
Characteristic/Comparison	**Borno**	**Imo**	**Bayelsa**	**Ogun**
State characteristics				
Population	4,151,193	3,934,899	1,703,358	3,658,098
Size	70,898 km²	5,100 km²	10,773 km ²	16,762 km²
Number of health facilities in state	795	943	183	252
Number of facilities distributed to in sample	270	252	184	252
Reported number of fever patients	259,247	259,246	568,441	94,208
Costs				
Total annual distribution system costs	29,557,445.89	28,357,275.78	10,627,127.36	7,770,314.97
Transport	2,251,072.31	2,410,968.89	1,649,099.27	1,963,892.13
Personnel	3,453,833.33	2,093,766.64	3,150,528.09	3,142,422.84
Commodities	23,852,540.25	23,852,540.25	5,827,500.00	2,664,000.00
Effectiveness				
Number of ACT treatments delivered	286,517	286,517	70,000	32,000
Percentage of fever patients treatable with ACT	111%	111%	12%	34%
Cost effectiveness				
Cost per fever patient	114.01	109.38	18.70	82.48
Cost per ACT delivered	103.16	98.97	151.82	242.82
Cost per percentage of fever patients treatable	267,442	256,582	862,985	228,758

Costs in naira; exchange rate of 150 naira per $U.S.

Interpretation

The supply chain systems in the two delivery-based states clearly were able to reach a larger percentage of fever patients than the two collection-based states. However, this greater reach came at a significantly higher cost. That meant that the delivery-based system costs slightly more per percentage of fever patients treatable in one of the two collection-based systems. Assuming that it is unlikely that the collection-based systems will ever reach the performance levels of the delivery-based system, decisionmakers should select the delivery-based system.

Source: (i+Solutions, MIT Zaragoza, Transaid, and VillageReach 2010)

Application of a CBA

Mozambique: CBA of System Redesign to Improve Vaccine Logistics

[Note: This analysis examines the same program discussed in the section titled Mozambique: Comparing Cost-effectiveness of Traditional Versus Dedicated Logistics System for Childhood Vaccines]

Problem

The child vaccine supply chain is underperforming

Policy question

Does it make sense to switch from the traditional to the new vaccine logistics system?

Study objective

Prospectively, compare the costs and monetary benefits of the traditional system versus implementing the dedicated logistics system.

Intervention Alternative	Features
Traditional	Provincial vaccine program under the traditional logistics systems
New dedicated logistics system	Provincial vaccine program under the dedicated logistics system

Cost measures

Transport, cold chain, and vaccine costs

Benefit measures

Category of Benefits	Indicators
Supply chain resource savings	Savings in yearly running costs
Savings to the health system, to other sectors, or to productivity	Not measured

Results: Costs and benefits

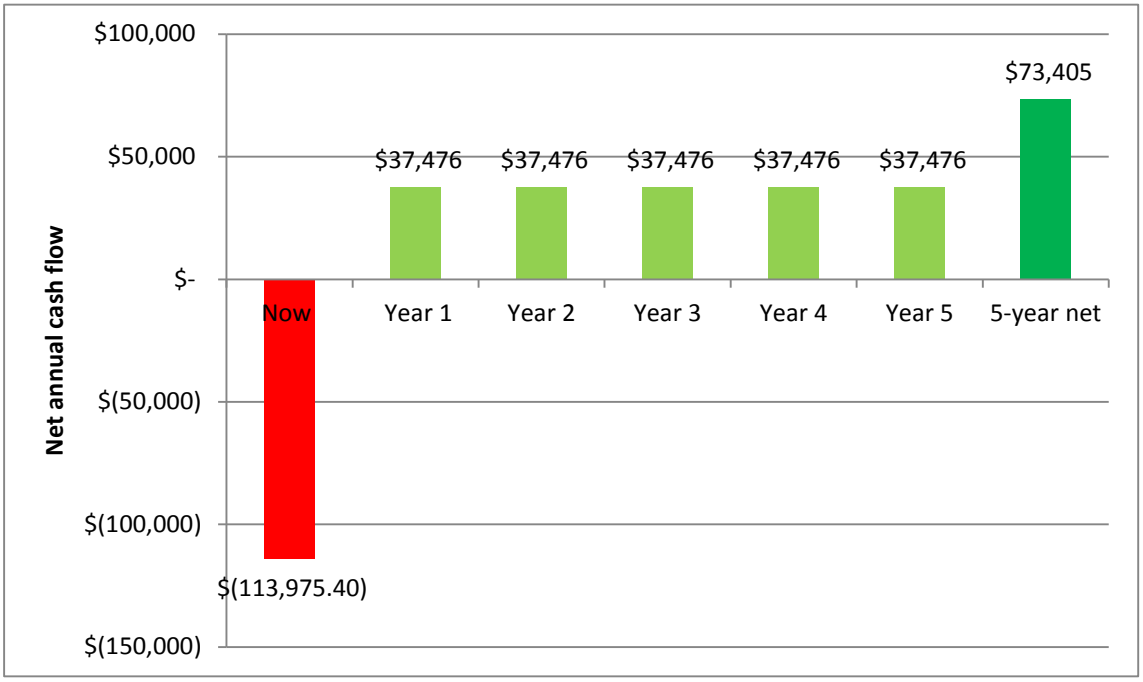
Yearly running costs under the traditional model are $266,563 versus $229,087 under the new model, which is a yearly savings of $37,476. Meanwhile, switching to the new model requires an initial investment of $113, 975 for vehicles.

	Initial Investment	Year 1	Year 2	Year 3	Year 4	Year 5	5-year Net
Net cash flow	$(113,975.40)	$37,476	$37,476	$ 37,476	$37,476	$37,476	$73,405
Gain		$37,476	$74,952	$112,428	$149,904	$187,380	
Benefit: cost ratio		0.33	0.66	0.99	1.32	1.64	
Percentage ROI		-67%	-34%	-1%	32%	64%	

Results: Benefit-cost ratio and return on investment

The savings over five years translate into a cumulative gain of $187,380, which, after subtracting the initial $113,00 investment equals a total five-year net cash flow of $73,405. This represents a benefit-cost ratio of 1.64:1, or a five-year return on investment of 64 percent. Note that the investment only *pays off* after three years (when the benefit-cost ratio is greater than one or the ROI is positive).

Net Cash Flow from Switching from Traditional to Dedicated Logistics System, Mozambique



Interpretation

Switching from the traditional to the new model will raise performance (see section: Mozambique: Comparing Cost-effectiveness of Traditional Versus Dedicated Logistics System for Childhood Vaccines) and save on annual running costs. After three years, the initial investment in vehicles for the new system will result in net savings for the Ministry of Health (MOH). After five years, net gains will be significant. This is another reason why the ministry should strongly consider switching to the new model as a way to save money and improve supply chain performance.

Source: (VillageReach 2009; Hasselback, Spisak, and Crawford 2012)

Cost-Benefit Analysis of Investing in Supply Chain Strengthening to Improve Family Planning Method Availability and Use

This analysis extends the example in the section titled Impact of Supply Chain Investment on Contraceptive Method Availability, Family Planning Use, Births Averted, and Maternal and Infant Deaths Averted by examining the monetary benefits associated with family planning supply chain strengthening.

Problem

Supply chains in low-income countries are not consistently providing the full range of contraceptive methods.

Policy question

Are investments in family planning supply chains an efficient way to improve health outcomes?

Study objective

Compare the costs of investing in family planning supply chains with the monetary benefits associated with improvements in health outcomes.

Comparison

Intervention Alternative	Features
Do nothing	Underperforming supply chains that only achieve partial method availability
Investing in supply chains to support full stock availability	Well-performing supply chains that achieve full method availability

Cost measures

- contraceptive commodity costs
- all supply chain costs (procurement, storage, transport, management) associated with the additional commodities
- associated service delivery and other health system costs.

Benefit measures

Category of Benefits	Indicators
Supply chain resource savings	Not measured
Savings to the health system, to other sectors, or to productivity	DALYs averted, valued at one year's gross domestic product per capita per DALY

Results: Costs

Moving from partial- to full-availability of family planning methods in developing countries would cost an additional $634 million per year; which includes $120 million for additional commodities, $36 million for supply chain costs, and $479 million for service delivery and other associated system costs.

Results: Benefits

As noted above, moving from partial- to full-availability of family planning methods in 66 low-income countries would result in an additional 6.6 million DALYs averted. If each DALY saves $732 (one year's GDP per capita, on average, in least developed countries), this is a total monetary benefit of $4.8 billion.

Results: Benefit-cost ratio

The ratio of benefit to cost is 7.58:1 ($4.8 billion ÷ $634 million).

Cost	
Additional commodity costs	$120 million
Additional supply chain costs	$36 million
Additional service delivery costs	$479 million
Total additional costs	$634 million
Health outcome	
DALYs averted	6.6 million
Benefits	
Per DALY averted	$732
Total benefits	$4.8 billion
Cost-benefit analysis	
Benefit-cost ratio	7.58:1

Interpretation

Investing in family planning supply chain strengthening will cost an additional $634 million per year in 66 low-income countries, but will generate benefits of $4.8 billion annually. The benefit-cost ratio of 7.58:1 is high. Decisionmakers should invest in family planning supply chain strengthening.

Source: (Futures Institute 2012)

Cost-Benefit Analysis of Outsourcing Logistics Function

Problem

The MOH transport operations suffer from low performance; vehicles are frequently unavailable for delivery because of maintenance and scheduling problems.

Policy question

Should the MOH outsource the transport function or improve its in-house transport function?

Study objective

Conduct a CBA to determine the financial implications of outsourcing compared to performance improvement.

Comparison

Intervention Alternative	Features
Strengthening current transport function	Upgrade in-house transport through staff training and recruitment and infrastructure improvements
Outsourcing transport function	Contracting a third party transport provider; managing the contractor

Cost measures

- current cost of in-house transport
- cost of improving or expanding in-house transport performance
- cost of outsourcing transport.

Benefit measures

Category of Benefits	Indicators
Supply chain resource savings	Net savings from outsourcing
Savings to the health system, to other sectors, or to productivity	Not measured

Results: Costs and Benefits

The in-house transport function currently costs $55,000 annually. To upgrade the in-house transport function requires an initial investment of $100,000, followed by yearly investments of $40,000. Outsourcing would cost a total of $90,000 a year, including $40,000 to manage the contract and $50,000 for the outsourcing contract.

Results: Cost-benefit analysis

The analysis calculated a five-year net savings of $85,000 from outsourcing the transport function. Most of these savings ($65,000) would be realized in year 1 because of the large initial investment of $100,000 that would be required to upgrade the in-house transport function. Savings in subsequent years would be $5,000 annually.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Cost of running transport function						
In-house	$ 155,000	$ 95,000	$ 95,000	$ 95,000	$ 95,000	$ 535,000
Current running costs	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 275,000
Upgrade costs	$ 100,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 260,000
Outsourced	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 450,000
Management cost	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 200,000
Outsourcing contract	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000
Net savings from outsourcing	$ 65,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 85,000

Interpretation

The cost savings from outsourcing influenced the decision of the stakeholder group to contract transport services from the third party logistics provider identified during the bid process. The group agreed that, even though annual savings from outsourcing were relatively small after the first year, the non-quantifiable benefits of outsourcing—including the ability to see improvements sooner and to efficiently handle short-term changes—made outsourcing the more desirable option.

Source: (USAID | DELIVER PROJECT, Task Order 1 2010)

Zimbabwe: Cost-Benefit Analysis of Outsourcing Transport

Problem

The MOH asked the Zimbabwe National Family Planning Council (ZNFPC) to take on distribution of HIV/AIDS related commodities, including condoms, other contraceptives, and essential medicines.

Policy question

Should the ZNFPC manage the condom and contraceptives distribution system in-house or contract out to a private, commercial firm?

Study objective

Compare the cost of contracting out delivery with the cost of in-house distribution.

Comparison

Intervention Alternative	Features
In-house distribution	Distribute commodities using ZNFPC staff, vehicles, and other resources
Contracting out distribution	Hire outside freight firm

Cost measures

Vehicle running expenses, travel, and subsistence allowances

Benefit measures

Category of Benefits	Indicators
Supply chain resource savings	Savings in yearly running costs
Savings to the health system, to other sectors, or to productivity	Not measured

Results: Costs and Benefits

The study showed that the in-house cost of delivery by ZNFPC to the district level would have a national annual cost of Z$5,740,000. The cost of delivery using a private commercial carrier would be Z$13,201,824, not including 15 percent sales tax that might be applied and with only minimal insurance coverage. In addition, the commercial firm reportedly did not offer service to some districts in the country.

Mode of Distribution	Annual Cost (Zimbabwe dollars)
Outsourced distribution	13,201,824
In-house distribution	5,740,000
Net savings from outsourcing	-7,461,824

Results: Cost-benefit analysis

Outsourcing to a commercial firm would more than double the cost of distribution.

Interpretation

The study team concluded that commercial delivery of commodities was an expensive option for Zimbabwe. At the same time, commercial distribution might offer advantages for greater reliability and lower storage costs at the district level—assuming commercial deliveries could be synchronized with deliveries to health facilities. The team recommended further discussions with the commercial firm to determine service coverage areas and possibly to negotiate lower charges.

Source: (Vian 2003)

Nigeria: Cost-Benefit Analysis of Outsourcing Logistics Functions in Kano State

Problem
An underperforming public-sector essential drugs supply chain

Policy question
Can outsourcing transport save money?

Study objective
Compare the cost of contracting out delivery with the cost of in-house distribution.

Comparison

Intervention Alternative	Features
In-house distribution	Distribution carried out by MOH
Partial outsourcing of transport	Distribution outsourced

Cost measures
Transport, supply chain personnel, commodities, third party logistics contract

Benefit measures
The study defined benefit as the net savings from outsourcing, using the indicators.

Category of Benefits	Indicators
Supply chain resource savings	Savings in the accounts of the primary health centers Savings to the MOH in supply chain assets or personnel available for other activities
Savings to the health system, to other sectors, or to productivity	Not measured

Results: Costs and Benefits
As shown in the following table, the cost of the current distribution system is 62,177,288 naira versus an estimated cost of 51,045,676 naira under the outsourced system.

	Annual Cost		Savings from Outsourcing
	In-House	Outsourced	
Transport costs			
Vehicle breakdown	33,922	3,539	30,383
Public transport	439,764		439,764
Fuel	1,384,789	129,399	1,255,389
Vehicle depreciation	1,834,828	477,782	1,357,046
Scheduled maintenance	369,815	63,704	306,111
Insurance	688	1,800	(1,112)
Total transport	4,063,806	676,224	3,387,581
Total personnel costs	30,614,899	21,977,230	8,637,669
Total commodity costs	27,498,583	27,276,275	222,308
Third party logistics contract costs		1,115,945	(1,115,945)
Grand total	**62,177,288**	**51,045,674**	**11,131,613**

Costs in naira; exchange rate of 147 naira per $U.S.

Results: Cost-benefit analysis

Outsourcing transport is projected to save slightly more than 11 million yearly, an 18 percent reduction over the current cost.

Interpretation

Outsourcing saves a considerable amount of money. The Drug Management Authority in Kano state should pursue outsourcing as a way to save money on supply chain costs.

Source: (MIT Zaragoza, Transaid, and VillageReach 2011)

Case Examples of Economic Evaluation of Supply Chains

This section includes two examples that illustrate some of the mechanics of carrying out an economic evaluation and how to interpret and use the results.

Cost-effectiveness Analysis of a Vendor-managed Inventory Program

This example describes how to carry out a CEA that compares a vendor-managed inventory (VMI) approach to a standard supply chain system for essential medicines.

Background

Taking into consideration the upcoming elections, politicians in one country were pressuring the MOH to improve health indicators for the population. The MOH, after reviewing its health systems, found that the availability of essential drugs in its facilities was erratic and unreliable. After a careful analysis of the various options available for system design, the MOH decided to try a VMI approach to improving drug availability. Under the traditional inventory management approach that the MOH used, when a health facility needs commodities, the health facility manager calculates the needed quantities and places an order with the provincial medical stores. The facility manager controls the timing and the size of the order. Under the VMI approach, the provincial store manages the timing and amount of stock for replenishment at each facility. Facility managers maintain physical possession of the stock that arrives from the provincial stores, and they continue to be responsible for stock receipt, storage, and disbursement to clients. The VMI system transfers responsibility for forecasting and procurement for replenishment from the facility to the provincial stores.

Before going nationwide with the approach, ministry officials wanted to see how VMI would work in one part of the county. They anticipated seeing VMI boost commodity availability, but suspected the new system might entail more costs than the current system.

The MOH decided that a CEA would help them answer some of the questions they had about the feasibility of the VMI and whether it made sense to scale up nationwide. To carry out the CEA, the MOH knew it would have to collect information on both the costs and the effectiveness of the current system, as well as the VMI system.

Measurement of costs and effectiveness

Using the approach outlined in the USAID | DELIVER PROJECT publication, *Guide to Public Health Supply Chain Costing: A Basic Methodology* (McCord, Tien, and Sarley 2012) (see section titled Measuring the Costs of Supply Chain Investments), the MOH found the total cost of operating the current system in the state was $800,000 per year. To measure performance of the current system, the MOH used information from the country's logistics management information system that

showed, on average, the current system was performing at a 65 percent level of product availability; i.e., 65 percent of products, on average, were available to clients on a given day.

To determine the cost of the VMI approach, the MOH commissioned a special study to model the projected costs of the approach at the province level. A successful VMI approach reduces supply chain inventory levels and associated expenses, such as handling and storage. The VMI shifts the cost of inventory management from the SDP to the team at the provincial medical stores, and increases the supervision cost. Transport costs are expected to be slightly higher as the province moves from an ad hoc system, which mixes pick up with delivery to SDPs using relatively low-cost transport. Better transport and more reliable, better-trained drivers, who can manage simple inventory control tasks, will also require somewhat higher expenditure. Also, central-level management costs will likely increase, to replace management functions at the health facility.

The VMI approach also requires a larger investment in information systems, replacing the somewhat haphazard approach. In addition, VMI was expected to boost system performance, thus generating additional throughput (volume of commodities), and putting upward pressure on some storage, distribution, and management costs. Modeling the effect of these changes found that successful implementation of VMI would increase the total cost of operating the supply chain by about 25 percent, to $1 million annually; shifting a significant percentage of costs from the SDP to the province level (see table 5).

Table 5. Cost by Tier, Traditional Versus VMI

	Cost by Supply Chain Tier		
	Province	Service Delivery Point	Total Cost
Traditional Supply Chain			
Management	$ 150,000	$ 250,000	$ 400,000
Storage	$ 25,000	$ 75,000	$ 100,000
Transport	$ 100,000	$ 200,000	$ 300,000
Total	$ 275,000	$ 525,000	$ 800,000
VMI Approach			
Management	$ 350,000	$ 200,000	$ 550,000
Storage	$ 15,000	$ 35,000	$ 50,000
Transport	$ 400,000	$ -	$ 400,000
Total	$ 765,000	$ 235,000	$ 1,000,000

MOH officials projected that the VMI approach would perform significantly better than the traditional system, producing product availability rates of 90 percent compared to 65 percent under the current system. Using these estimates, officials then compared the cost of the two approaches with their effectiveness (see table 6). Under the traditional system, the system performs at a level of 65 percent stock availability, for a cost of $800,000 yearly. That translates to an average cost effectiveness of $12,308 per percentage point of stock availability. The VMI approach has a higher total cost, but also a higher effectiveness rate, with an average cost effectiveness of $11,111 per percentage point of stock availability.

Table 6. Cost-Effectiveness Comparison of Traditional Versus VMI Approach

	Total Cost	Effectiveness	Cost Effectiveness
Traditional	$ 800,000	65%	$ 12,308
VMI	$ 1,000,000	90%	$ 11,111

Interpretation and use of results

These results showed officials that the VMI will probably be more costly than the traditional supply chain system, but will produce a much higher level of performance, as measured by stock availability. As a result, average cost effectiveness is lower in the VMI model versus the traditional supply chain system. MOH officials used the CEA to help them decide to move forward with the VMI approach. They also analyzed actual VMI costs and effectiveness during the first year of operation of the new approach, then used the results to help them decide whether it made sense to introduce the VMI model in other states.

For more information on VMI see (Watson, Serumaga, and McCord 2012; USAID | DELIVER PROJECT, Task Order 4 2012).

Cost-benefit Analysis of a Performance-based Financing Program

This example describes how to carry out a CBA for introducing performance-based financing (PBF) in a CMS.

Background

The CMS in a developing country was looking for ways to increase its funding and improve critical supply chain functions. The Board of Directors of the CMS proposed incorporating a performance-based financing element into the funding it received from the MOH. The MOH already had several years experience with PBF schemes to improve health services at health centers and hospitals; and they were interested in applying PBF to its supply chain operations.

In part, drawing on the principles outlined in *Options Guide: Performance-Based Incentives to Strengthen Public Health Supply Chains* (Eichler et al. 2012), the board convinced the MOH to make an additional $1,000,000 available, contingent on the CMS achieving a set of key supply chain performance targets. This amount represented about 10 percent of the CMS annual operating costs. Based on a quarterly assessment of how well it was achieving the six targets, CMS was eligible to receive up to $250,000 per quarter. CMS had substantial autonomy in how it used the additional funds to improve performance. By making payment contingent on performance, the PBF scheme aimed to motivate CMS management and staff to work better and more efficiently, thus contributing to overall organizational performance improvements. The board also expected the PBF scheme to save costs through better supply chain practices and greater efficiencies. To measure whether the scheme was achieving this cost-saving effect, the board commissioned a type of CBA known as a return on investment (ROI) analysis, which compares the costs of the PBF scheme with benefits, as measured by system savings.

Measurement of costs and benefits

The board set up a system to measure the cost of implementing the PBF scheme in the first year. They used information from the CMS financial records and financial information from the organization the board contracted to design and manage the scheme. The analysis considered the cost of the system design, including the incentive payments, management, and monitoring and evaluation of the PBF scheme. Together, these costs totaled $1,125,000 for the first year of the scheme (see table 7).

Table 7. First Year Costs of Performance-Based Financing Scheme

Cost Element	Amount Invested
One-time design costs of PBF scheme	$ 50,000
PBF incentive payments	$ 1,000,000
Management of PBF scheme	$ 25,000
Monitoring and verification of results	$ 50,000
Total first year costs	$ 1,125,000

The analysis measured benefits over the first year of the PBF scheme using the financial records of the CMS. Benefits were measured in terms of savings in five categories: drug cost, product waste, labor cost, maintenance, and transport. The analysis found that the PBF scheme generated total yearly savings of $1,320,000 (see table 8).

Table 8. Yearly Savings from Performance-Based Financing Scheme

Type of Savings	Amount Saved
Reduced cost of drugs from improved procurement practices	$ 500,000
Reduction in product waste from expiry from improved quantification	$ 150,000
Lower labor costs due to increased productivity	$ 200,000
Decreased maintenance costs from more efficient practices	$ 220,000
Decreased transport costs from greater efficiency	$ 250,000
Total yearly savings	$ 1,320,000

Using the information collected on costs and benefits, analysts calculated a simple benefit-cost ratio of 1.17, based on net savings of $195,000 (see table 9).

Table 9. Simple Benefit-Cost Ratio Calculation

Benefit (savings from PBF scheme)	$ 1,320,000
Cost of PBF scheme	$ 1,125,000
Net savings	$ 195,000
Benefit-cost ratio (benefit ÷ cost)	1.17

Analysts also calculated a simple ROI of 17 percent for the PBF scheme (see table 10).

Table 10. Simple Return on Investment Calculation

Gain from investment (savings to system from PBF scheme)	$ 1,320,000
Cost of investment (cost of PBF scheme)	$ 1,125,000
Return on investment (gain from investment – Cost of investment) ÷ Cost of investment	17%

Interpretation and use of results

Together with findings from a CEA and a qualitative evaluation to determine what organizational changes may have taken place, the board used the findings from the return on investment analysis to decide to continue to implement the PBF scheme for the following year. The board fully expected the PBF approach to continue to generate similar savings into the future. It also expected to see a higher ROI in subsequent years from lower PBF design costs and increased efficiencies in the management of the PBF scheme.

For more information on performance-based financing for supply chains see (Eichler et al. August 2012; Serumaga, Rosen, and Smith 2012; Stewart et al. 2012).

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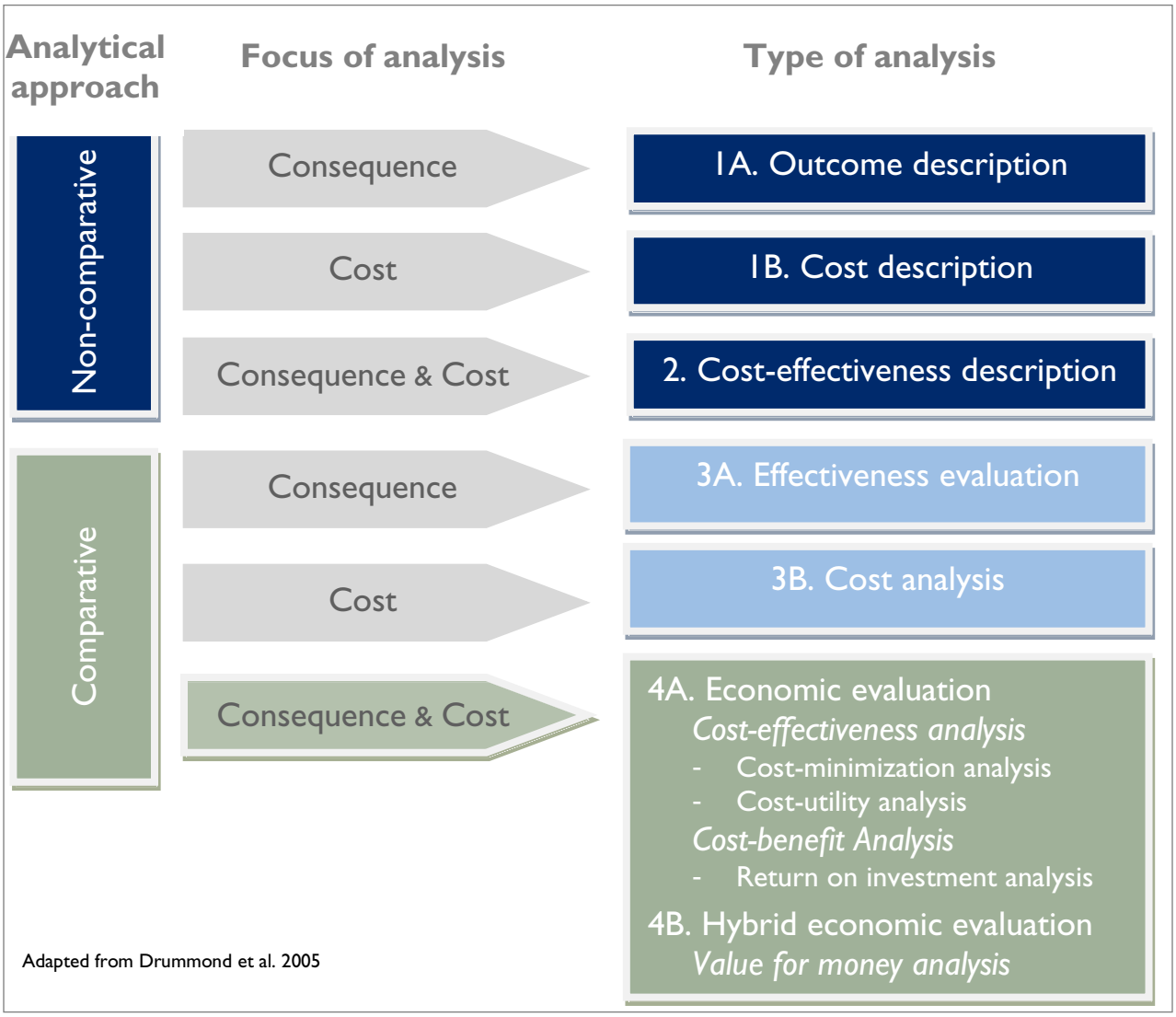
Appendix 1

Techniques for Evaluating Public Health Supply Chains

In addition to economic evaluation, there are many other ways to assess supply chain performance (see figure 2).

Figure 2. Different Types of Evaluation of Public Health Supply Chains



Evaluation techniques that do not compare between two or more alternatives include—

Outcome description. This approach describes a single program or approach in terms of its outcome or effectiveness. When applied to a supply chain in its entirety, these include exercises that quantitatively—for example, using the Logistics Indicator Assessment Tool—or qualitatively—using the Logistics System Assessment Tool—measure system functioning. It also includes evaluation exercises, such as end-use verification that measure supply chain performance; studies on the performance of specific aspects of the supply chain (warehousing, transport, procurement); studies that use information from routine logistics management information systems; and studies that link supply chain performance to the use of health services and health outcomes.

Questions this type of study helps answer—

- What is the overall performance of the supply chain?
- What is the performance of a specific supply chain function?
- How does supply chain performance translate into service use, health outcomes, and impacts?

Data requirements for this type of analysis include—

- Supply chain performance measures
- Measures linking performance and service use, health outcomes, etc.

Cost description. Includes most of the costing work carried out under USAID | DELIVER PROJECT in Nigeria, Zimbabwe, Zambia, Ghana, and Rwanda in which the costs of a single program or approach is analyzed without comparing it to alternative approaches.

Questions this type of study helps answer the questions—

- What is the total cost of running the supply chain?
- What are the costs by level, type of input, and supply chain function?
- What are the main supply chain cost drivers (those elements that contribute most to costs)?
- What are appropriate supply chain fees to cover costs?
- What are possible ways to cut costs?

Data requirements for this type of analysis include—

- supply chain costs by level, function, input type, etc.

Cost-effectiveness description. Describes both costs and outcomes of a single supply chain program or intervention, but does not compare alternative interventions.

Questions this type of study helps answer:

- What level of outcome does the supply chain produce for the current cost?

Data requirements for this type of analysis:

- supply chain costs
- supply chain outcomes.

Two other evaluation approaches compare alternative interventions, but examine effectiveness or cost alone:

Effectiveness evaluation. This type of evaluation compares only the consequences, and not the costs, of two or more alternative supply chain interventions. For example, a study could compare two different distribution systems in terms of their impact on supply chain performance—measured via stock status and other performance indicators. A study in Zambia compared two different distribution systems for essential health commodities; it showed that one approach performed significantly better than another in terms of drug stockouts (USAID | DELIVER PROJECT 2011).

Questions this type of study helps answer:

- Which supply chain intervention results in better performance?

Data requirements for this type of analysis

- Supply chain performance for the interventions being studied.

Cost analysis. This type of study compares only costs across alternatives, with no attention to output or effectiveness of the various interventions. An example of this is the comparison in Zimbabwe of the DTTU versus the traditional distribution system of the MOH for family planning and some HIV products (Sarley, Baruwa, and Tien 2010).

Questions this type of study helps answer—

- Which supply chain intervention delivers product at a lower cost?

Data requirements for this type of analysis:

- Supply chain delivery cost for two or more interventions.

For more information, please visit deliver.jsi.com.

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