GHCC

Reference Case for Global Health Costing

VERSION 2 - FINAL DRAFT FOR PILOTING AND EXPERT REVIEW FOLLOWING ADVISORY GROUP AND STAKEHOLDER MEETING

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SECTION A INTRODUCTION

BACKGROUND

Why a 'reference case'?

Estimates of the costs of global health interventions are required for the analysis of efficiency in service delivery, economic evaluations, priority setting, and the formulation of resource requirements at both the country and international levels. Currently, costs are estimated using a wide range of approaches, often combining research methods with analysis of routinely collected program data. There are numerous guidelines available to analysts, both for specific purposes (such as economic evaluation) and specific global health activities (such as primary care). However, there is no widely agreed-upon common guidance on principles, methods, and reporting standards for cost estimates across different global health areas.

The lack of consistency in both the methods and reporting of costs for global health interventions has long been recognised[1-3]. This inconsistency can have an impact on estimates of cost-effectiveness, which should be comparable across interventions[4,5]. A review of economic evaluations in the Tufts Medical Centre Cost-Effectiveness Analysis (CEA) Registry found a high level of variation in costing methods, although noted that consistency had improved over time[6]. Differences in data collection methods and in the application of analytic methods, a general lack of comprehensiveness, and inconsistent compliance to existing guidance were all observed[7]. As a result, reviews of global health costs conclude that methodological heterogeneity and lack of transparency make it impossible to compare studies over setting and time[8-11] and several papers point to the need to develop standardized methods for cost estimation in global health[12].

Aims

The reference case approach has its origins in the field of economic evaluation. The first US Panel on Cost-Effectiveness in Health and Medicine ('US Panel') proposed the use of a reference case "to improve comparability of cost-effectiveness analyses designed to inform decision-making while allowing analysts the flexibility to design studies that answer issues specific to a particular problem or industry". This concept has since been applied by the International Decision Support Initiative (iDSi) to economic evaluations in global health[13] and was recently extended by the second US Panel[14].

In line with these efforts, the goal of the 'Reference Case for Global Health Costing' is **to improve the relevance, use, and quality of cost estimates.** The reference case is a guide that helps ensure that the process of cost estimation is transparent and reflects best practices, so that those using cost data can interpret the findings properly and assess their quality (accuracy, precision, generalizability, and consistency). The reference case aims to provide a framework for analysts to ensure they fully consider how their methods may influence the interpretation and application of their estimates. It aims to do this in a way that is not onerous and permits innovation in the development and application of cost estimation methods.

Minimizing Limitations

While reference cases may facilitate the relevance, use, and quality of cost estimates, they can pose risks, such as potentially repressing innovation. To avoid this danger, this document outlines guidance and encourages consistent adherence to core principles, but it **does not restrict or exclude novel methods to improve or expand cost estimation**. Where methods are unclear or lack consensus, this reference case highlights reasonable options for the analyst to consider and focuses on highlighting the strengths and weaknesses of each, rather than prescribing any one.

A further risk is that reference cases may be too onerous. Unnecessary burden wastes time, may be ignored, and can impose a barrier for novices. However, this reference case should not be seen as a 'minimum standard' for the precision and accuracy of the cost estimate itself. Instead, the reference case offers standards for the design, implementation, and reporting of cost estimates. Further, we reduce burden in two ways. First, we provide tools, such as reporting tables, which can standardize and streamline the process. Second, we explicitly address the issue of prioritizing costing efforts: focusing limited resources for costing on the cost elements that matter most.

GUIDE THROUGH THE REFERENCE CASE

For whom is the reference case intended?

The reference case is intended for use by multiple constituencies, including both decision-makers and economic analysts who support them, working in national ministries, international donor and multilateral organizations, private foundations, research institutions, and non-governmental organizations.

For those who **fund cost estimation**, the reference case provides a minimum standard that can help design Terms of Reference (ToR).

For those who **use cost data,** the reference case provides guidance on how to assess whether a cost estimate is '**fit for purpose'.** Readers are also advised to focus on the introductory sections, and on the reporting matrix contained in Appendix 2 that provides quality indicators according to purpose.

For those who **produce cost data,** all sections of the reference case should be of interest. The sections on methodological specifications provide detailed guidance to achieve best practice in cost estimation.

Structure of the reference case

In line with the reference case on economic evaluation, the technical content of the reference case (both costing and reporting) is presented by defining principles and methodological specifications. **Principles** provide a set of rules that are sufficiently broad to gain consensus and apply in multiple settings. While the applications of principles may vary depending on the purpose of the costing, they should be universally applicable to any cost estimate.

Principles provide the conceptual frame for more specific methodological standards, where they are supported by evidence and theory, and standardized cost reporting. **Methodological specifications** are a set of options that enable the analyst to adhere to the principles. They may not be exhaustive, in that there may be other means to achieve the same principles. These methodological specifications are a work in progress and will be further refined by the GHCC over the course of the project.

After a brief introduction on costing, the following section presents a **general reporting standards checklist,** aligned to the principles to support generalizability of cost estimates across settings and diseases, along with straightforward methodological specifications for reporting. The final section provides additional specifics around the application of the reference case to tuberculosis (TB) services.

The process of reference case development

The approach to developing the reference case was based on previous work in developing reporting guidelines [15]. These outline the following stages of standards development. First it is important to identify the need for a guideline and examine whether existing guidelines can be extended. While the purposes of costing go beyond economic evaluation alone, we decided to 'extend' the previous guideline developed by iDSi on economic evaluation. The next stage is to review the literature. We conducted a bibliometric review (forthcoming) of all methodological literature on global health costing. We then organized a meeting, identifying participants through our networks but also identifying authors from the bibliometric review. We conducted a survey amongst participants on the need for a reference case and current methodological gaps prior to the meeting.

The GHCC core team wrote the first draft of this reference case as an explanatory document. It was then circulated to a list of technical advisors and stakeholders for review. In November 2016, a meeting was held to discuss the reference case and receive feedback. During the meeting, reviews of both the current quality of cost estimates and a systematic review of the literature on costing methodology were presented. In the case of the latter, the review included both academic papers and current costing guidance for global health. The meeting did not use a formal method to reach consensus, but all participants were asked to comment on the principles and suggest amendments. All suggestions were incorporated. Small groups met to discuss methodological specifications. In this case, some of the suggestions were incorporated, but where there was not agreement on methods specified, further working groups were established and the guidance has been left open. The reference case was then sent for review to all meeting participants. A list of all who contributed is contained in Appendix 4.

A publication and communication strategy will be developed to accompany the reference case. Both producers and users of cost data will also pilot the recommended guidance described in the reference case during 2017. The reference case will be made available on the GHCC website and updated as methods are further refined and developed.

Finally, it should be noted that several updates for the reference case have been identified and will be further developed in 2017/2018. These are:

a) *Sampling for cost estimation (principle 8)*

b) *Methods guidance on 'within country' cost functions (principle 15)*

c) *Methods guidance on how to identify the most important resource use to measure (principle 6)*

There is also work in 2017/2018 planned to extend the reference case to incorporate the estimation of costs of access and the cost of illness.

COSTING: AN INTRODUCTION

This reference case is intended for use by both economists and non-economists. To assist non-economists, a **full glossary of terms** related to cost estimation is included in **Appendix 1**. In some cases, economists also use terminology in different ways. Where this is the case, we have described this and identified the way in which we have used the term in the reference case in the glossary. There are however, some issues and concepts that are particularly important. We therefore here highlight the concepts, definitions, and terminology that are important to understand before using the reference case.

What is meant by costing?

The reference case on global health costing provides guidance on 'unit' cost estimates primarily derived from primary research. Unit costs can also be derived through routine program monitoring systems, such as hospital cost accounting systems that estimate expenditures on specific procedures or diagnoses. Where routine systems are used to estimate unit costs, the reference case can help assess the quality of the estimates produced, as the quality of routine systems can vary considerably[16]. The reference case can thus help determine whether additional data collection is required.

This reference case does NOT provide standards and methods for conducting further cost analyses that use 'unit' costs as inputs. Such analyses, also often referred to as 'costing', may include using costs to estimate budget impact at the population level, investment cases, or global price tags for a specific health technology or package of interventions.

Whose costs?

Currently, this reference case focuses on the **costs of providing services.** These can include items paid for by clients/patients. However, the costs of providing services are distinct from the **costs to clients accessing these services (which can include expenses such as transportation costs/productivity losses from time spent receiving care)**, and the **productivity losses from the symptoms of illness**. We refer to these costs when discussing perspective. However, in this version of the reference case, we do not offer methodological guidance on how to estimate these costs. This scope limitation is in part due to the parallel processes of the World Health Organization Task Force on the measurement of catastrophic costs. In 2017, these two pieces of work will be aligned, and this reference case may be extended to include guidance on access costs and productivity loss.

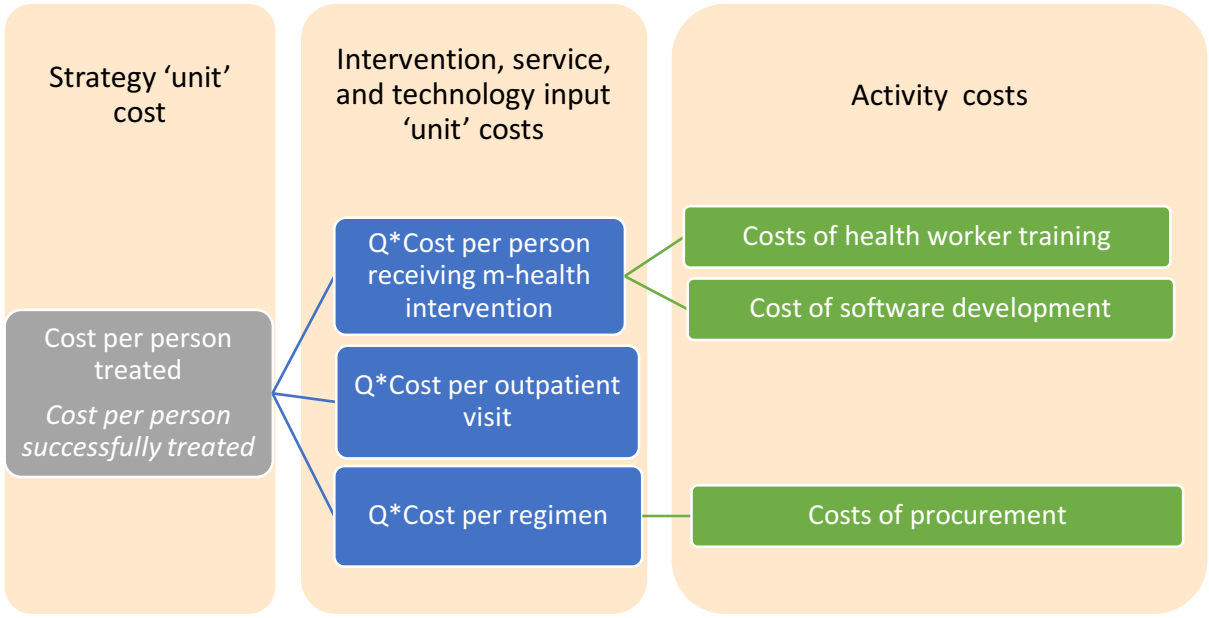
What is meant by a 'unit cost'?

The first term is the **definition of 'unit cost'** and its component inputs. 'Unit cost' commonly refers to the average cost of a service or output, but sometimes is used to mean the cost of a specific input, such as 'cost per test kit'. We adopt the former definition and refer to the latter as an "input price".

However, there are many different types of health service outputs, so in practice, the term 'unit cost' may be used to describe quite different costs. Health service 'outputs' can range from public health strategies, to courses of treatment, and to delivering one consultation or diagnostic test. The term 'unit cost' can be used to define the average cost of any of these. However, when standardizing unit costs, to support comparability, some further clarity is required. To provide this clarity, we adopt the following terminology:

Strategy 'unit' cost	Mean cost of the entire strategy per person (or other relevant unit). Can include several services and supportive interventions. For example, there may be a broad strategy of expanding TB treatment that may include both the provision of treatment, but also interventions such as social support.
Intervention 'unit' cost	Mean costs of interventions that support the delivery of care/health services (e.g., cost of adherence program per person reached) per person or other unit
Service 'unit' cost	Mean cost per output produced to provide services and outputs (e.g., outpatient visit, diagnostic test, inpatient bed-day)
Activity cost	Cost for each action required to provide interventions or services (may also be expressed as a unit costs, e.g., per health worker trained, in some circumstances)
Input/resource use	The quantities of resources (labor, buildings, etc.) used to produce activities and services.
Input price	Value of an input/resource (e.g., wage rate or amount paid for a test kit).

Appendix 3 demonstrates how these distinctions can be applied to standardize the reporting of unit costs of tuberculosis programs. We also provide an example, in the figure below. Here we describe an economic evaluation looking at a new TB treatment 'strategy'. The economic evaluation aims to estimate an incremental cost of the strategy compared to the standard of care. The strategy includes an m-health 'intervention', but also will increase both the volumes of TB diagnosis and treatment. Therefore, the incremental cost will include the 'service' unit costs below. When calculating the 'unit cost of TB treatment', the analysis will include estimating the 'unit' cost for 'services' such as outpatient visits, unit costs of inputs such as regimens and then multiplying them by the quantities of required for each service. Likewise, the cost of the m-health 'intervention' may involve estimating the 'activity' costs of training health workers.



Not every costing will involve such complexity, and sometimes the analyst will need to concentrate on services only or specific activities. However, it is important to note that 'unit' costs may be very different depending on the area and scope of work, and thus presents challenges for standardization and understanding for both users and producers of cost data.

Unit costs and cost functions

For our purposes, costing is defined as **the process of estimating the value of resources used for a global health strategy, intervention, or services**.

This reference case pertains to the process of estimating the 'unit' costs of the above (or their components). As above, typically, for global health strategies, interventions and services 'unit' costs are estimated as the average costs either per person (e.g., cost per person tested or receiving an outpatient visit) or a combination of persons and time (cost per person-month of treatment). These 'unit' costs are a core building block for economic evaluations and financial plans.

Cost functions describe how cost varies with input prices, the level of strategy, intervention or service provision (scale), and other factors such as quality. Cost functions reflect production functions that describe how the factors of production, or 'inputs', are combined to produce services and interventions. Sometimes the production function exhibits constant returns to scale, when increasing the amount of all inputs used increases the amount of health services/interventions that can be produced to the same extent. An **average cost function** describes how unit (or average) costs vary as the level of service/intervention increases. Average cost functions exhibit different shapes. In some circumstances, average costs stay constant for all levels of service and intervention provision. In this case, the total cost is equal to the quantity of output multiplied by the average or 'unit' cost.

However, average costs often vary non-linearly as scale increases. In the short run, some inputs used may stay constant, or 'fixed', as the level of output increases. Therefore, the average cost function often has a 'U' shape. At low levels of production, fixed costs (e.g. buildings) are spread across fewer persons, and so the average cost is relatively high. As production increases, fixed costs are spread across more persons and average costs decrease. The average cost curve may slope downwards, corresponding to the downward slope of the 'U'. As the production process becomes constrained, because, for example, it becomes increasingly costly to recruit persons, average costs increase, corresponding to the rising part of the 'U'.

Average cost functions behave differently depending on how much flexibility there is to change the mix of inputs. In the short run, there are inputs that cannot be increased (such as buildings) as described above (fixed costs). In the long run, no costs are fixed; all costs are variable – and their quantities are subject to the decisions of programmed managers. For example, as the level of a service increases, putting pressure on existing resources, managers may invest in new buildings or hire new staff. Yet average costs may still demonstrate a 'U' shape. Depending on the production process, some health interventions may display 'economies of scale' or demonstrate lower average costs as production increases. At a certain level, average costs may also begin to increase or exhibit 'dis-economies of scale' as service provision becomes more complex and therefore more expensive to manage. For further definition of the term economies of scale, please refer to the glossary.

In summary, unit costs are at least in part determined by the relationship between inputs and outputs and may vary by both the level of output (or service provision) and time. **While in some cases this cost function can be characterized using a single unit cost value, in many cases it cannot. If costs vary, costs at a single point in time at a specific level of service provision may have limited usefulness in planning new services and many other programmatic uses of cost estimates.** Therefore, when referring to 'unit cost' estimation, this reference case aims to provide guidance both on the estimation of single point estimates of unit costs **and average 'unit' cost functions**.

Average, incremental, and marginal (unit) costs

The reference case principles apply equally to the estimation of average total costs, average incremental, or marginal costs. For some purposes, a user may be interested in comparing the costs between two or more programs. The average **incremental cost** is the difference in cost between two or more interventions or programs. In global health settings, this usually means adding or introducing a new health technology or service to reach more beneficiaries or to reach them differently. In economic terms, the **marginal cost** is the cost of producing one additional unit of output. While these terms are sometimes incorrectly used interchangeably, they measure different things. As with average costs, average incremental and marginal costs are not necessarily constant as levels of service provision and interventions increase. As production increases, the incremental or marginal costs of producing each one extra output or service often decreases depending on economies of scale, but may, in theory, also increase.

Economic and financial costs

It is important to be clear on the differences between '**economic**' and '**financial**' unit costs. Financial costs capture the resources that are 'paid' for. They are thus contingent on the extent to which

payment is made, rather than the value of resources – and thus only can be generalized across settings with similar payment structures. Economic costs aim to capture opportunity costs, that is, the full value of all resources used, and will include all resources whether paid for or not. For example, if in one setting, drugs are donated, the financial costs of these drugs would zero, but the economic costs of the drugs would value them at market prices.

Economic and financial costs are different from **expenditures** in how they represent resource use over time. In any one year, financial (and economic) costs represent the annual cost of capital inputs "smoothed out" across the years of use of that input, in contrast, to 'lumpy' expenditures that record cost at the year of purchase of the capital input. Economic costs use different methods than financial costs in regard as to where to spread these expenditures over time and incorporate discounting (see below) to capture full opportunity cost. Finally, in some guidelines, the term fiscal cost is used. Fiscal expenditure/cost refers to public expenditures/cost.

Terminology around costing methods

There are a number of areas where terminology to describe costing methods may be used inconsistently in the literature, e.g., the use of '**top-down' vs 'bottom-up'** costing, and of **'gross' vs 'micro'** costing. These terms are sometimes used interchangeably and in other cases are distinguished from one another. Micro-costing focuses on a granular accounting of inputs, whereas gross costing considers only aggregate costs. A micro-costing disaggregates the costs of a particular output into the specific items consumed, such as nurse time, and consumable supplies. A gross costing approach simply estimates all relevant costs, typically estimated from program expenditure data, and divides by the associated outputs such as patient episodes. Gross costing may also be done using tariffs and fees[17].

In contrast, 'bottom-up' or 'top-down' refers to the way in which resource are allocated to each unit being costed. 'Top-down' costing divides overall program cost or expenditures, often including those above the service level, by number of outputs to calculate unit cost, while bottom-up costing measures input quantities at the client or activity level. Gross costing is commonly done top-down. Micro-costing usually has a bottom-up element, measuring both service and resource use directly at the patient level.

Many cost studies are hybrid bottom-up micro-costing for some inputs (e.g., personnel effort) and top-down gross for others (e.g., administrative overhead). A specific hybrid form of micro-costing is 'activity-based costing' or 'time-based activity costing'. This is not consistently defined as 'bottom-up' or 'top-down' in the literature. In some cases, it describes a 'top-down' process using a set of rules that allocate overall expenditures firstly to activities and then to services[18]. In other reports it is described as a bottom-up approach[19], which assesses the actual amount of resources to produce each service, usually by identifying activities and the staff time spent and allocating costs according to this staff time use.

REFERENCE CASE APPROACH - COSTING FOR PURPOSE

What makes a 'good' cost estimate?

Fundamentally, costing is an estimation process. Any reference case therefore needs to be rooted in the scientific principle of what defines 'good estimates'. However, as with any estimate, the extent to which cost estimates need to meet any quality criteria depend on the intended purpose for the estimates, which can be complex to define.

So, what is meant by a 'good' cost estimate? In statistical terms, the quality of an estimate can be defined along two dimensions, often referred to as internal validity**:**

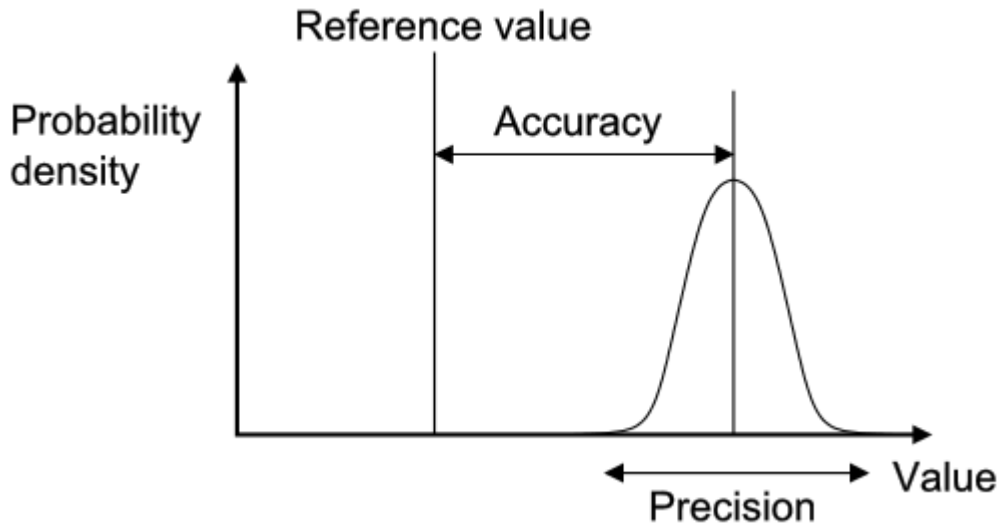
Accuracy – This reflects the extent of bias in an estimate and how far the estimate is from the true value of the population mean.

For example, a cost estimate that systematically excludes overhead cost is biased downwards.

Precision – This reflects the narrowness of clustering of the measurement around the central estimate, such as the mean.

For example, if a small sample is used to measure unit costs, then it may have a high margin of error.

These concepts are illustrated in the figure below[20].



Clearly, greater precision and accuracy are both desirable. However, defining an agreed minimum level of precision and accuracy is problematic and relies on the purpose behind making the estimate. Unit costs may be used for a range of purposes from routine financial management to estimates of a 'global price tag' to scale up global health interventions (see the first section in the reference case

below). These diverse purposes may require different degrees of precision and accuracy for different levels of aggregation (e.g., total vs. component costs). Moreover, costing itself can be expensive. The 'cost of getting it wrong' therefore needs to be weighed against the 'cost of getting it right'.

There are some formal analytical techniques, such as the 'expected value of perfect information' that can help those considering how much to invest in improved cost estimates for specific purposes such as economic evaluation[21]. However, these analyses may be beyond the realm of many conducting costing. Given the wide range of purposes and the lack of formal approaches available, there remains no simple way to define 'a universal minimum standard of precision and accuracy' for cost estimation in global health.

There are two other important characteristics of cost estimates that may be relevant for specific uses. The first US Panel stated that a core rationale for reference cases is to facilitate the comparison of the results of different studies, so that "each study contributes to a pool of information about the broad allocation of resources as well as to the specific questions it was designed to address"[14]. This aim is particularly important in global health costing, where resources to collect data are scarce. Thus, two other properties of cost estimation that the reference case aims to facilitate are:

Generalizability – the extent to which the cost estimate can be applied to other programmatic settings (often referred to as external validity)

Comparability – the extent to which the features (for example the perspective and the resources included) of one cost estimate are similar to another

Unlike precision and accuracy, achieving generalizability may not be universally desirable. In some situations, the benefits of arriving at an accurate and precise *context-specific* estimate (internal validity) may override the benefits of a less precise but more generalizable estimate (external validity). Comparability, if narrowly defined as an identical estimation process, it may also not always be desirable for the same reasons as generalizability. However, comparability is less problematic, if it reflects improved transparency that permits analysts to adjust estimates in order to compare. So in summary, while generalizability is desirable in most circumstances, as with precision and accuracy it is hard to set minimum standards without examining the intended use of the cost estimate. Comparability may, however, be improved simply through improved reporting, without adverse consequences.

The focus of a reference case therefore is not to set specific minimum standards for each of these characteristics of a 'good' cost estimate, but instead to define the **'best methodological practice' to support a cost estimation process that is fit for purpose and efficient given the funding available.** It concentrates on providing a framework for analysts to structure their choices around study design and methods and to consider how their methods influence the quality of their estimates so they can make efficient choices given their resources available to conduct the cost estimation. In doing so, it aims to improve both the precision and the accuracy of estimate for the funding available.

The reference case is more prescriptive however in terms of setting **minimum reporting standards to improve the transparency of cost estimation.** While it does not suggest specific methods are used, it provides standardized 'units' and 'results tables', in addition to a methods checklist, to improve both the comparability and generalizability of cost estimates going forward.

SECTION B THE REFERENCE CASE

DEFINING THE PURPOSE OF COST ESTIMATION

The starting point for the reference case is to define the different purposes for which cost estimates are used. Ideally, any cost estimate could be used for multiple purposes (accepting that some adjustments may need to be made). In principle, the use of high quality cost data can result in the improved allocation of resources to global health strategies, interventions, and services that maximize health gain and financial risk protection. Improved cost data can also result in cost savings and efficiency improvements that ultimately can be used to fund additional health improvement related activities. Moreover, if cost data are used to inform the equity of financing (and costs) between different payers, then ultimately good cost data can be part of reducing any negative poverty impact associated with ill-health.

In practice, budgets for cost estimation projects are often set with a particular purpose in mind, and the methodological choices will be driven by that purpose. Each of these purposes may require different approaches to definition and measurement (e.g., the scope, frequency, and unit of the cost reported), and there may be different emphases in areas such as sampling.

We have therefore **indicated throughout the reference case where principles may apply differently depending on purpose**. The starting point is to define the purposes. For simplicity, four 'buckets' of purposes are defined:

1. Economic evaluation and/or priority setting

This purpose is defined as the use of cost estimates in analytical approaches to assess allocative efficiency of investment and resource allocation decisions. These include, for example, cost-effectiveness analysis, health technology assessment, essential package definition, and investment cases, etc.

In the area of economic evaluation and/or priority setting, cost data are often a central component of the analysis. Incremental cost-effectiveness ratios are now recognized as a core piece of information in decisions around whether to invest in new technologies, or set priorities across different strategies and interventions. For example, cost data are often critical in shaping the design of health care benefit packages provided by governments or insurers and, as many low-income countries move towards national insurance schemes, are needed to estimate reimbursement levels.

2. Technical efficiency analyses

This purpose describes the use of costs to explore differences and drivers of technical efficiency between providers and/or modes of delivery (integrated services, platforms, level of decentralization, etc.) of delivering health interventions or services.

Unit cost data from studies that help to estimate technical efficiency provide critical information for improving the value for money on the supply side, such as identifying the minimum efficient scale of operation, or providing insights into areas of efficient or inefficient practices. For example, WHO, UNICEF, and GAVI use unit cost data to identify and design efficient supply chain logistic systems in immunization.

3. Medium and long-term financial planning and resource requirements estimation

This purpose describes the use of cost estimates to predict expenditures in the medium (3 to 5 years) and longer term. Examples include using costs to inform budget impact analyses, support medium term expenditure frameworks, inform budgets for national strategic plans, develop investment cases, and produce 'global price tags'. These analyses both support national planning but can be used in both national and global fundraising efforts. For example, since 2009, the Health Economics and Epidemiology Research Office (HE^2RO) in South Africa has been working with the South African government to analyze the cost of the South African national public sector antiretroviral treatment (ART) program. Cost data enabled the Department of Health and the Treasury to commit to the proposed guideline and operational changes in 2010 and 2011 and more than double the budget for ART (in real terms) since 2008.

4. Budgeting

This purpose describes the use of costs to predict expenditures by specific budget holders. This could include annual budgeting by managers for routine health services, or a particular provider, or could refer to an investment case for a project or a funding application.

For each of these purposes, there may be different theoretical and practical reasons why a certain type of cost or methodological approach is preferred. For example, where countries are moving towards universal health coverage, the need to generate reimbursement rates and to understand the comparative value of new technologies is creating a demand for unit cost data that are comparable across diseases and health services, follow a standardized methodology, and reflect the full economic cost, including the patient perspective.

In contrast, cost data for efficiency studies may need larger sample sizes, have a different perspective, and need additional information about cost determinants collected in order to enable analysis. For the purposes of financial planning and resource requirement estimates, financial costs are generally needed rather than economic costs, and disaggregation of prices and quantities in unit cost reporting is helpful; in the South Africa example above disaggregated estimates were used to estimate the impact of changes such as introducing task-shifting to lower staff cadres and opening the South African antiretroviral drug market to international competition.

Where recommended methodological approaches differ by cost purpose, these differences are explained in the reference case and illustrated throughout using two examples of costing exercises. The first example is based on an economic evaluation of condom distribution using community health workers in India, the Avahan program. The second example is based on an exercise to help the South African Government to plan roll-out of the Xpert MTB/RIF diagnostic for tuberculosis. These are only two examples and should be interpreted as illustrations rather than any prescription of methods but will hopefully serve to highlight where methods choices may differ according to purpose.

The reference case is comprised of a total of 17 methodological principles across four main topics: (1) study design; (2) resource use measurement; (3) pricing and valuation; and (4) analyzing and presenting results. For each principle, we provide an explanation as to why it is important and provide information on the methods specification.

1. STUDY DESIGN

Once the purpose has been determined, this section outlines the five principles and methodological specifications relevant for study design. The various steps/choices to be made when designing a cost estimation are outlined in the diagram below. A summary of the principles to be applied in each step is also provided in Table 1. Table 1 also includes guidance on how study design may be influenced by the purpose of study and the availability of data. A statement of each principle and its methodological specifications follows the summary table.

	PRINCIPLE 1 - The purpose of the study, population, and strategy service should be clearly defined.	PRINCIPLE 2 - The perspective of the cost estimation should be stated and justified relevant to purpose.	PRINCIPLE 3 - The type of cost estimated should be defined and justified relevant to purpose	PRINCIPLE 4 - The 'units' in the unit costs should be defined, relevant for the costing purpose, and generalizable.	PRINCIPLE 5 - The time horizon should be of sufficient length to capture all costs relevant for purpose
	Economic evaluation Efficiency analysis Financial planning Budgeting	Societal perspective Provider perspective Payer perspective	Financial cost Economic cost Net of future costs Real world costs Guideline Incremental costs Full costs	Intermediate outcomes Service use / outputs Units of coverage	Capture all relevant costs Length of financial plan One budget cycle Minimum one year
Example #1: Avahan	What is the purpose of the study?	What perspective should I take?	What type of cost should I estimate?	What units should I cost?	What time horizon should I use?
	Economic Evaluation - **Cost-effectiveness analysis** of HIV prevention in India.	A **societal perspective**, and estimate all costs and benefits incurred by providers and by clients.	We estimate the **economic cost** We estimate the **real world** costs of implementation We estimate a **gross cost**, due to the numbers of sites We evaluate the **incremental costs**	Costs **per person reached** (as community intervention)	**Four-year** time frame to capture start-up until full coverage
Example #1: Planning scale-up of Xpert for TB diagnosis in South Africa	What is the purpose of the study?	What perspective should I take?	What type of cost should I estimate?	What units should I cost?	What time horizon should I use?
	Financial planning of the government of South Africa for roll-out of Xpert MTB/RIF across the country	Cost data were collected from the **payer perspective** to help the National Health Laboratory Service (NHLS)	**Financial cost** data was collected to reflect anticipated expenditures by the NHLS We estimate the **real world** costs as best predictor of expenditures We estimate a **micro-cost** as there was good record keeping We estimate the **full costs** of Xpert as additional funding required varied by site	Costs **per test**	Costs were estimated for the **length of financial plan**, over two years

Table 1 – Study Design - Statement of Principles and Guidance by Purpose

		Economic evaluation	Financial planning	Budgeting	Efficiency analysis
Study design					
1	The **purpose, the population, and the strategy, service or intervention** of the cost estimation should be defined.				
2	The **perspective** of the cost estimation should be defined.	*Societal and provider*	*Provider*	*Payer*	*Provider*
3	The **type** of cost estimated should be defined in terms of **economic vs financial, real world vs guideline,** and **incremental vs full cost,** and whether the cost is **net of future cost savings;** and justified relevant to purpose**.**	*Economic cost* *Incremental cost*	*Financial cost*	*Financial cost*	*Financial cost* *Full cost*
4	The '**units**' in the unit costs for strategies, services, and interventions, should be defined, relevant for the costing purpose and generalizable.				
5	The **time horizon** should be of **sufficient length** to capture all costs relevant to intervention and purpose, and consideration should be given to disaggregating costs into separate time periods where they vary over time.	*To capture all costs*	*Length of financial plan*	*One budget cycle (usually one year)*	*Minimum one year*

METHODOLOGICAL PRINCIPLE 1 – DEFINING THE PURPOSE AND SCOPE

The principle

The **purpose, the population, and the strategy, service or intervention** of the cost estimation should be defined.

Why is defining the purpose and intervention important?

As outlined in the introduction of the reference case, cost estimates may be used for multiple purposes, and the characteristics of a 'sufficient estimate' will vary accordingly. For example, an economic evaluation may require a full economic cost, while financial planning may require a financial cost from a specific payer's perspective. If a cost estimate is used for the wrong purpose, or if its limitations are not described, it can be misleading. Therefore, it is important to be clear on the purpose for which the cost estimate is intended.

The requirement that the population and strategy, service, or intervention be clearly described complies with standard economic evaluation guidelines, such as the US Panel recommendations and the iDSI reference case[14]. This information is essential for costs to be used appropriately and generalized to other settings and provides the basis for determining the methods used for measurement.

Method specification

The introduction of the reference case provides examples of purposes that may be used. These are: economic evaluation, financial planning, budgeting, and efficiency analyses. The purpose should also identify both the relevance for health practice and policy decisions and the intended user(s) of the cost estimate, if known.

Ideally the strategy, service, or intervention should be defined within context describing:

- Main activities/technologies involved
- Target population
- Coverage level or phase (pilot, implementation, post scale up)
- Delivery mechanism (health system level/facility types/community/ownership/where relevant integration with other services)
- Epidemiological context (incidence/prevalence of the illness being addressed)

The comprehensive production process of a strategy, service, or intervention (i.e. the processes and activities, plus key technologies) should be outlined in the first instance, and if any parts of process are excluded (for example above site activities) these exclusions should be clearly reported.

METHODOLOGICAL PRINCIPLE 2 – DEFINING PERSPECTIVE

The principle

The **perspective** of the cost estimation should be defined.

Why is defining the perspective of the cost estimate important?

Once a purpose and user of the cost estimate is defined, it is important to address the perspective of the estimation. The perspective describes which payers' costs are included in the estimate. Some users, who make decisions on behalf of a population, may need to use a societal perspective that captures all costs incurred as a consequence of the intervention, regardless of who pays the costs. For other analyses a more limited perspective may be taken. For example, to set a budget, it may only be important to estimate the costs that fall on a specific payer.

The requirement that the perspective should be described complies with standard economic evaluation guidelines, such as the US Panel[14] recommendations and the iDSI Reference Case[13]. There are increasing calls for economic evaluations to adopt a societal perspective, including the recent recommendation by the Second US Panel to report two reference cases, one from a provider and one from a broader societal perspective[22].

Method specification

Most textbooks in costing and economic evaluation categorize perspective into two types: societal and provider. However, in practice, these terms are used to describe a multitude of payers. For example, a provider perspective may include costs incurred by health service providers, non-health service providers, and be limited to specific payers. A societal perspective may also include client costs to access a service, costs to the household, costs to community, and in some cases even costs to the macro-economy. Therefore, a simple category or either defining societal or provider perspective is insufficient to generalize or compare costs.

The methodological specification is therefore to define perspective as **societal** or **provider**, but in addition to **listing the groups/payers** whose cost has been captured in the estimate. For a provider perspective, this should specify whether both health and non-health providers are included. For a societal perspective, this should specify whether it is cost to the client only, or more broadly to the household, community, or society.

METHODOLOGICAL PRINCIPLE 3 – DEFINING THE TYPE OF COST

The principle

The type of cost being estimated should be defined, in terms of **economic vs financial, real world vs guideline, incremental vs full cost,** and whether the cost is **net of future savings** or not – and justified relevant to purpose.

Why is defining the type of cost estimate important?

For different purposes, different types of costs are required. For example, economic evaluation requires an incremental economic cost, in order to ensure that opportunity cost is appropriately estimated[13]. Conversely technical efficiency analyses may be interesting in examining the full cost, in order to identify any resource use that is inefficient. Different types of costs will require different measurement methods and therefore for both reasons of measurement design, but also comparability it is important to begin any cost estimation process with a clear definition of what cost is being estimated.

Method specification

There are four characteristics that must be defined. First is the distinction between economic and financial cost (see introductory text and glossary). Whether the cost is **economic** or **financial**, will dictate which resources should be included and how they should be valued.

The next issue is whether the aim is to estimate the cost of an intervention conducted according to **guidelines** or whether the aim is to provide a cost estimate that reflects the costs of implementing an intervention in the '**real world'**, (that may include inefficiencies or exclude intervention components). In some cases, this will also be a mixed picture, with some aspects of the 'real world' being included, but not all. Transparency around this issue is particularly important in the case of economic evaluations. Costs for economic evaluation are commonly collected from clinical trial sites, where the cost may include a number of activities to ensure adherence to a guideline, which may also contribute to the effect size used in the incremental cost-effectiveness ration (ICER) estimation. It is therefore important to be clear that the costs include activities to ensure guideline adherence.

It is also important to clarify whether the cost estimate is a **full** cost or **incremental** to current health provision, or a standard of care. The difference between the two is outlined above in the introductory section. In practice, defining incremental cost may be challenging unless the analyst has a sound data on current health service delivery capacity. Further guidance on defining resources to be included in cost estimates is provided in methodological specification six below.

Finally, many global health interventions are preventative, and therefore it is important to report whether costs are **net of future cost savings for health providers** or just the costs of the immediate intervention.

METHODOLOGICAL PRINCIPLE 4 – CLEAR DEFINITION OF 'UNITS'

The principle

The '**units**' in the unit costs for strategies, services and interventions, should be defined, relevant for the costing purpose and generalizable.

Why is using clearly defined and standardized units important?

A critical challenge in transferring and synthesizing cost estimates in the past has been the lack of **standardized 'unit costs'** for interventions, episodes of care, and service use. This has created difficulty in assessing efficiency across settings, made past and existing efforts to conduct systematic reviews problematic, and impeded the creation of global datasets of costs that can be used to extrapolate costs to settings where data is currently absent. A key aim of this reference case is to address this gap by developing a standardized set of units for different disease and intervention areas, in the first instance for TB and HIV unit costs.

Method specification

The introduction section above describes the categories of unit costs that may be defined (strategies, intervention and service units). As part of this reference case we also provide examples of **standardized units for TB and HIV**, based on the 'units' of strategies, services, and interventions that countries are reporting activity on globally. There is also guidance available in other areas, such as immunization, often developed in conjunction with global agencies working in specific areas.

In all cases these units should be reported, although in some circumstances it may be relevant to report additional units. For new interventions, or interventions with new components, other units may need to be developed beyond the standardized unit costs in this reference case. In some cases, the management information systems that report on the various 'units' will not align with the standard definitions; if this is the case, effort should be taken to collect the necessary additional data to adjust this reporting, or clearly explain any bias in terms of standardized reporting units.

Finally, in some circumstances the use of **quality-adjusted 'units'** or other options may be considered in addition to standardized units. Analysts wishing to use 'unit' costs to examine the efficiency of technical services may wish to ensure that they are comparing the cost of services reaching a similar quality. For example, an analyst may wish to compare the cost per person *completing* treatment, rather than the cost per treatment month. We recommend some options for TB and HIV in this respect but these should be seen as additions to the standard set of non-quality-adjusted 'units'.

METHODOLOGICAL PRINCIPLE 5 – DETERMINING THE APPROPRIATE TIME HORIZON

The principle

The **time horizon** should be of **sufficient length** to capture costs relevant to the purpose, and consideration should be given to disaggregating costs into separate time periods where they vary over time.

Why is specifying time horizon is important?

The iDSi Economic Evaluation Reference Case[14] states that time horizon used in an economic evaluation needs to be carefully considered because any decision made at a point in time will have intervention benefits and resource use extending into the future. An economic evaluation should therefore use a time horizon that is long enough to capture all costs and effects relevant to the program or policy decision. Economic evaluation reference cases and guidance more generally emphasizes that the time horizon should not be limited by the availability of empirical data. In some cases however, it is not possible to measure future costs and economic evaluations may include imputation of data that are incomplete or missing[23], with a number of analytical methods being available to address the specific issue of censored data[24].

Other uses of cost data may have more circumscribed time periods related to financial planning periods, but nevertheless it is important to state the time period clearly for those wishing to compare and generalize costs across settings. Finally, it may make sense to disaggregate unit costs into different time periods. Costs may change during different phases of an intervention, and therefore an average unit cost over the entire intervention may have limited use for other analysts using cost data for specific phases of activities, particularly in financial planning.

Method specification

For costs estimated for economic evaluations the time period should follow the methodological specifications in the iDSi Reference Case[13]. For other purposes, the time frame should follow the planning cycle, (e.g., medium-term financial planning typically projects costs for 3 to 5-year periods, while longer term efforts to estimate resource needs to reach global targets may project costs for a 10 to 15-year period).

For interventions that are being piloted or at the early stages of implementation, costs should be disaggregated into those in a 'start-up' phase and those in an 'implementation' phase at a minimum, with the start-up phase being treated as a capital investment (see principle 12 below). For clinical services like TB treatment or ART treatment, there may also be clinically related phases, such as intensive and continuation phases. Even within phases of treatment costs may vary. For example, hospital admission costs vary over the course of treatment (the first few days are often higher cost)[25].

2. RESOURCE USE MEASUREMENT

The second part of the reference case focuses on resource use measurement, and the methods used to capture the quantities of resources used to provide a strategy, intervention, or service. Five principles are defined, represented in the figure below and in Table 2.

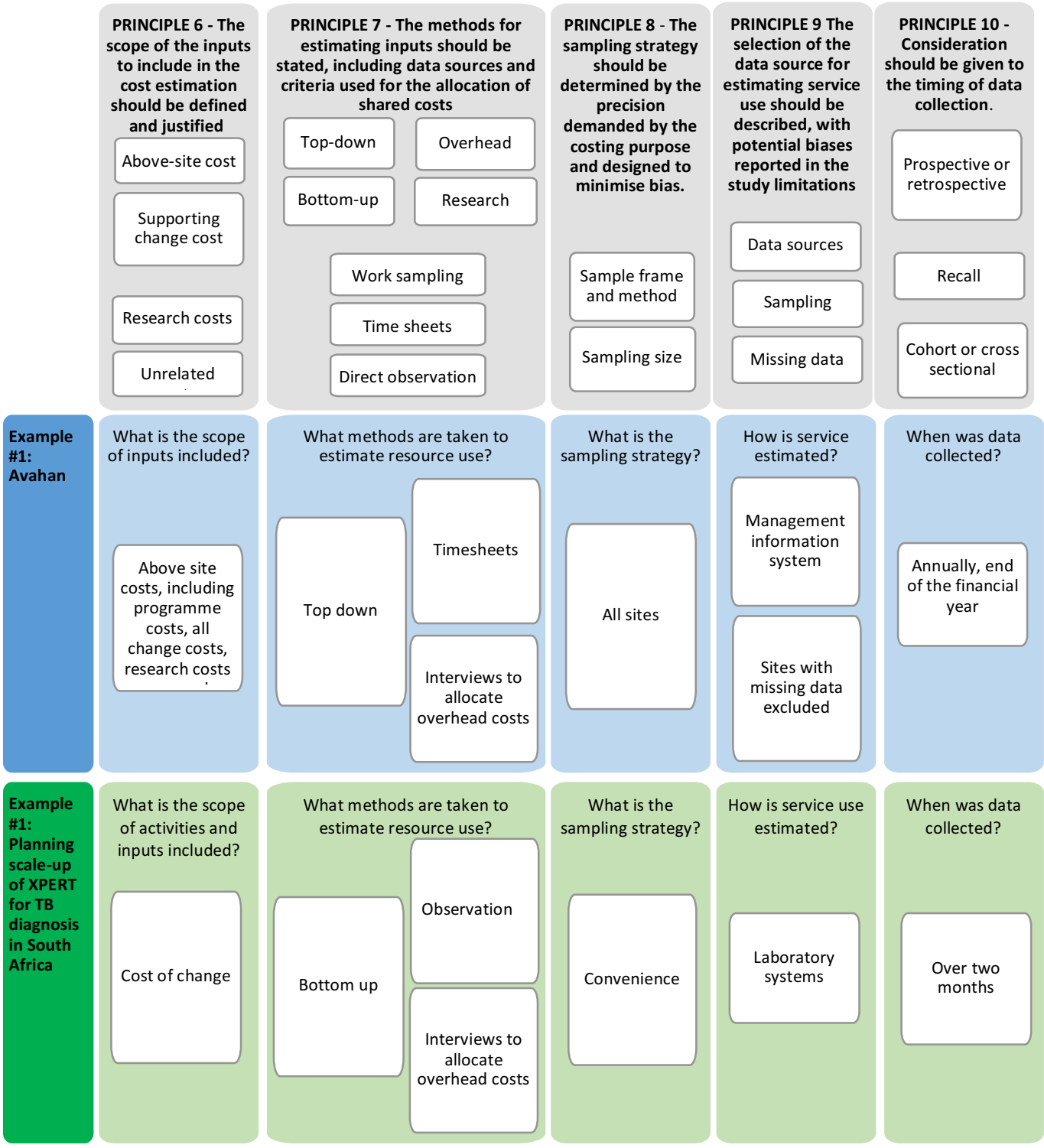


Table 2

	Service and resource use measurement	*Economic Evaluation*	*Financial Planning*	*Budgeting*	*Efficiency analyses*
6	The scope of the **inputs** to include in the cost estimation should be defined and justified relevant to purpose.	*All costs defined as incremental, but the analysis can address omissions or uncertainty*	*Depending on purpose and time-frame*	*All inputs for the relevant budget holder*	*All inputs identified in the production process being analyzed*
7	The methods for estimating the **quantities of inputs** should be described, including methods, data sources and criteria for allocating shared costs.				
8	The **sampling frame, method and size** should be determined by the precision demanded by the costing purpose and designed to minimize bias.	*Consider methods that used for establishing differences in ICERs*	*May required costs collected for different types of service providers*		*May consider sample sizes that establish significance of specific cost determinants*
9	The **selection of the data source and methods for estimating 'units'** should be described, with potential biases reported in the study limitations.				
10	Consideration should be given to the **timing of data collection** to minimize recall bias and, where relevant the impact of seasonality and other differences over time.				

METHODOLOGICAL PRINCIPLE 6 – SCOPE OF THE COSTING

The principle

The scope of the **inputs** to include in the cost estimation should be defined and justified relevant to purpose.

Why is defining the scope of the study important?

Being transparent and justifying the scope of the cost estimate in terms of which inputs are included is critical for comparability and can allow others to determine bias. The risk of bias from excluding components of cost (e.g., program administration, a personnel category, or off-site support) leading to inappropriate conclusions from costing studies is well-recognized and one of the core challenges in cost estimation[26].

Method specification

The list of inputs to be included in the cost estimate will in the first instance be defined by purpose, perspective, timeframe and type of cost being estimated. For example, inputs such as volunteer time may be omitted where measuring a financial cost (see principle 14 below). However, additional omissions may also occur as analysts balance the cost of data collection with potential bias from omitted inputs.

There is a range of methodological guidance that can be used to comprehensively identify the inputs associated with a strategy, service, or intervention. These commonly build from a **description of the production process** (principle 1 above). Both providers and patients can be involved, and there are formal methods that may be employed to **map the full range of resource use** associated with production[27]. In the first instance, analysts should use these tools to identify important inputs. In addition, in some cases, analysts may know of the cost structure from prior studies and can make informed judgements as to where primary data collection is most beneficial. Many studies also first pilot data collection instruments in a few sites to determine data availability and improve their understanding of the time and cost required to collect data on different inputs. All of these practices are recommended where feasible[1].

However, there are also some areas of scope that are commonly excluded on arbitrary grounds, and should not be. Recent reviews of studies[28] where **above site costs** have been included demonstrate that these costs can form a substantial part of intervention costs and yet are often not considered. "Above (delivery) site" activities include various support services provided by the central administration (e.g. Ministry of Heath) such as training, education and outreach, demand generation campaigns and central laboratory services. Most cost studies exclude these costs or where they do

[1] In the coming years, the Global Health Cost Consortium will seek to develop further guidance and tools to support analysts in the area of TB and HIV carry out this process.

include them, use inconsistent measurement methods. It is recommended that these costs should be considered in the same way as on-site costs, rather than arbitrarily omitted.

A further area, that warrants specific mention are the **costs of supporting change**. The costs of many interventions are estimated for rapid and substantial scale-up in low- and middle-income countries, and the associated costs of implementing change may also be important. Examples include the costs of changing guidance on drugs regimens or providing health systems strengthening to enable managers to re-organize services. Where relevant these inputs should be included.

Where costs are estimated for economic evaluation or long-term financial planning, including future costs, it may be advisable to include both the health care costs directly related and **unrelated** to the particular condition being addressed by the intervention. For example, when working out the costs of a program that keeps alive those persons with TB or HIV, analysts may wish to consider the future costs of treating any future chronic illness[29]. There is currently no consensus on whether these costs should be included, nor is there strong evidence of their importance, so they may be omitted. Nevertheless, analysts should state (if the costing includes future costs) whether unrelated costs are omitted and discuss any resulting bias in their projections or results.

Finally, when estimating incremental costs, **determining the scope of the additional cost** can be challenging[30]. There is no consensus methodological recommendation in this area. However, studies that compare different methods, for example statistical case control methods versus directly estimating attributable cost using mechanistic cost models, find that the method chosen does influence results[31,32]. In low- and middle-income settings, an important consideration is the extent to which the intervention can be absorbed within existing under-capacity within the health system. For example, it should not be assumed that additional human resources are available at zero cost. If current services are already operating at full capacity, a change in human resource use will have an opportunity cost within the health sector, both in terms of the direct employee and anyone supervising them. Analysts are therefore recommended to **report any assumptions about existing capacity** when describing the scope of 'incremental' cost.

METHODOLOGICAL PRINCIPLE 7 – MEASURING RESOURCE USE

The principle

The methods for estimating the quantities of inputs should be described, including methods, data sources, and criteria for allocating shared costs.

Why is describing the resource measurement methods important?

The methods used to estimate the levels of inputs used in an intervention can bias estimates, and therefore should be reported. Broadly, analysts can select either a **gross** or **micro**-costing approach, or a combination of both. Gross costing is defined as a process by which input use is estimated in total, and micro-costing where the analyst aims to estimate the usage of each input separately. In the main, micro-costing tends to be more comprehensive and capture more input usage, with studies that compare micro- and gross costs finding that gross estimates tend to underestimate costs[33].

The choice of using **bottom-up** or **top-down** allocation methods has also been shown to affect both the cost estimate and its applicability. While gross costing is done top-down (usually total costs divided by service unit levels), micro-costing may use both approaches to allocating resources. Bottom-up methods use approaches such as observation to estimate levels of input usage for a service, whereas top-down methods focus on allocating out the total amount of inputs used in facility, ward or clinic between services. Differences in cost estimates using bottom-up compared to top-down approaches are due both to measurement issues[34] and to differences in the included inputs[35]. Top-down methods may capture some inputs where resource use cannot be observed, for example electricity. Top-down methods may also better capture inefficiency or down time. In comparison, bottom-up approaches allow for more understanding of individual service provision and may characterize variation in practice better[36]. They may also identify inputs that would be missed in a top-down allocation, by improving the understanding of analysts of the production process.

In addition, there is increasing evidence that **above service and overhead costs** that may have been conventionally allocated using simple 'top-down' techniques, may require more complex allocation approaches, given the substantial proportion of these costs for some global health interventions[37]. The choice of allocation methods may also be particularly important when costing hospital care[38]. One option to improve accuracy is to use techniques such as step-down methods[39] or activity-based costing. These methods first assign costs to departments and activities and then assigns to those activities, department costs to services, rather than using person-hours directly working on the service [40-42]. In some cases, it may also be possible to use regression methods and matched comparisons to identify costs for a particular service, where total costs are available for sites (and patients) with and without the intervention [43 44].

Human resources often make up the largest proportion of cost of global health interventions. Yet, health professionals, including community health workers, are often working in different services such as clinic and outreach settings. Measuring the human resources spent on an intervention is therefore one of the most important and challenging aspects of cost estimation and can substantially influence results.

Finally, a further important issue is the allocation of costs between **research** and interventions. Many cost estimates for novel interventions are conducted in trial or demonstration settings. There is an extensive literature highlighting the limitations of using cost estimates from these settings to model the costs of intervention implementation in the 'real world'. While many cost estimates carefully remove research costs, the difference between 'research' and 'implementation' cost can be hard to define. Activities such as 'routine monitoring' may require judgement as to whether they would be required if the intervention were scaled up. Moreover, it may be easy to remove items such as survey costs but harder to determine where the costs of any adjustments made to the intervention design for research purposes. For example, trials commonly need to conduct additional activities to ensure protocol adherence or to reduce loss to follow up. Thus, the intervention cost during a trial may create a distorted estimate[45]. Even where these activities can be distinguished, research site selection may be biased[46] and have different levels of efficiency than other sites. In some cases, costs can be adjusted to reflect real world inefficiencies[47].

It should be noted that although the removal of research costs is desirable for some purposes, there are exceptions. In the case of economic evaluation, the effect size observed (and then used in the incremental cost-effectiveness ratio) may in part be due to these research driven activities. If these costs were removed, then this would change and bias the incremental cost-effectiveness ratio.

Method specification

While micro-costing is seen as a gold standard by some, we do not recommend it in this reference case as a minimum methodological specification. In many cases, the required level of disaggregation for levels of use by input may be unnecessarily onerous, or gross costs may be available from routine systems that have already been validated. Micro-costs are, however, particularly useful in situations where costs may need to be disaggregated and routine systems are weak. Moreover, the disaggregation of cost components allows for adaptation of costs to other settings and can assist the assessment of heterogeneity across patient groups [48].

In practice, many analysts use a mixed methods approach. For example, a recent guideline for disease-specific costing, which was applied in Nigeria, combines micro-costing for some elements with more feasible gross costs for others[49]. Given the burden of data collection and the need to capture all resource use, bottom-up measurement may not be required for all inputs. Those cost components which have the greatest impact on costs (labor and inpatient stay) may warrant more accurate allocation methods [50]. Analysts should therefore **state the allocation method used for each input, including clearly describing if these are 'top-down' or 'bottom-up'**.

In all cases, the methods/criteria used to allocate shared resources should reflect usage of each input and should be explicit. Where allocations have been made 'top-down' either to sites or within sites to services, or above site or overhead costs have been allocated, the criteria used and the relevant data sources should be explained. The bias inherent in any data source used to allocate input usage should aim to reduce bias. For example, recall by medical staff of time spent on intervention activities may be accurate when the intervention occurs in large regular blocks, such as every Tuesday morning. However, staff recall may be unreliable when the intervention activity is interspersed with other responsibilities in irregular ways. In such instances, an appropriate contemporaneous recording of activities using "time and motion" methods may be warranted to get sufficiently precise and unbiased data.

More specifically, careful attention should be paid to methods used to allocate human resource costs. Several methods are commonly employed to estimate time spent on a service or interventions. These include focus group discussions, interviews with providers or patients, examining patient records, time sheets, direct observation of practice, and work sampling. There is no 'gold standard' as each of these methods has biases. Several of the methods are subject to 'self-reporting' or 'observer' bias that may result in more 'desirable' behavior. All methods may be subject to incompleteness. Approaches relying on patient records or reporting may not fully capture non-contact time (such as management and supervision costs), whereas approaches relying on self-reporting may be overly burdensome and may be under-reported in busy periods.

Given the variety of methods, and the lack of a 'gold standard', the methodological specification for allocating costs, including human resource and research costs, focuses on reporting, and aims to ensure that biases are considered when designing the data collection method. A **comprehensive description of methods, data sources, and allocation criteria by input** should be reported for any cost estimate.

METHODOLOGICAL PRINCIPLE 8 – SAMPLING

The principle

The **sampling** frame, method, and size should be determined by the precision demanded by the costing purpose and designed to minimize bias.

Why is a sampling strategy linked to purpose and consideration of bias important?

Depending on the purpose of the cost estimation, the sampling frame may involve the selection of countries, geographical regions within countries, sites within regions, patients within sites, and different client groups. The purpose will also determine the appropriate sampling method and size. For example, some financial planning processes will require the collection of data from different site types. For economic evaluation, the aim is usually to compare the 'intervention' with the 'comparator' and this will determine the method used.

Due to logistical challenges and budget constraints, most cost estimates in low- and middle-income countries have been typically conducted on a small number of sites (<10), though in recent years, larger studies have emerged, particularly in HIV. Where large studies have occurred, they have demonstrated a high variation of costs, suggesting that the common practice of estimating costs on a small sample may produce highly unrepresentative results[51]. However, even if a few sites are selected, explicit consideration (and transparency) of the sampling frame and method can help others apply cost estimates to other settings.

Method specification

Guidance on determining the optimal sampling approach for cost estimation is scarce and therefore the methodological specification for this principle focuses on transparency and encouraging explicit consideration of each element the sampling approach, in line with recommended practice on sampling more generally[2].

First, any sampling should begin with a **sampling frame** of sites or the population from which the sample is to be taken. Even if random sampling or other methods cannot be used, the sampling frame can assist analysts in describing the bias in any eventual sample.

Given the high costs and logistics of data collection, cost estimation frequently employs convenience-sampling **methods**. However, these are likely to biased, and techniques such as stratified sampling by facility size/type/ownership (or funding) and type of location (urban vs. rural) may offer practical alternatives. Sampling strategies should avoid convenience sampling wherever possible. Even where convenience is an issue, techniques to avoid bias should be considered (for example random sampling within convenient locations). In some cases, purposive or stratified sampling will be preferred (for example where costs are used for financial planning and scale up across different facility types), or maximum variation sampling where costs bounds are of interest.

[2] The GHCC will be developing further guidance in the area of sampling for cost studies

Finally, where cost data is being collected from individuals, it may be appropriate to sample clusters of individuals, rather than individuals. In all cases the sampling methods chosen should be clearly explained and justified.

Due to the lack of clarity as to what level of precision is acceptable for specific purposes, it remains unclear whether or when large **sample sizes** should be considered standard practice, and difficult to recommend specific methods of sample size calculation. Having said this, in many cases it may be feasible and appropriate to formally determine sample sizes. In economic evaluation, methods have been developed to establish a threshold level of difference in cost-effectiveness between the intervention and the comparator [52,53]. Studies on efficiency may use a sample size calculation based on establishing the significance of particular determinants of costs. Likewise, in TB programs, the sample size of national patient cost surveys supported by the World Health Organization was determined using an 'acceptable' level of precision around the extent of change over time of catastrophic costs. Guidance may also be drawn from the literature around sampling for multi-country studies that compare different sampling approaches (for example for cross country studies – whether few sites and more countries is more efficient than the converse[54]). As with the frame and sampling method, the approach to establishing the sample size should be described and justified.

METHODOLOGICAL PRINCIPLE 9 – MEASURING 'UNITS'

The principle

The **selection of the data source(s) and methods for estimating the 'units'** should be described and potential biases reported in the study limitations.

Why careful selection of the source of data for estimating units is important

Much of the costing methods literature from high-income countries focuses on methods used to estimate service utilization. This need for methods guidance has arisen due to limits of using routine systems, particularly where patients are seeking care from multiple providers, including private providers. While some interventions are 'one-stop', in many areas (like TB and HIV) they require multiple and complex service use. In some cases, aggregate data (such as the number of patients completing TB treatment) may be available from routine systems, yet the numbers of visits/services utilization may not be, or where it is, it may be biased or incomplete. Of specific concern is where performance is either judged or incentivized based on routine reporting because these systems may be biased by over-reporting, leading to an underestimation of unit costs.

Method specification

It is hard to define a 'gold standard approach' for primary data collection that can be applied to health service utilization, community outreach, and general population-based behavior change campaigns. The literature from high-income countries comparing agreement in estimates from medical records, encounter logs, and patient reports may provide insights on an approach for low- and middle-income countries. Some have argued that medical record extraction is the gold standard, but in low- and middle-income countries these records may not be available, or may be held by the patient. In other cases, service providers keep logbooks that may provide a useful source of data. Others recommend patient interviews, the use of diaries or a resource use log[55]. There is some evidence suggesting a high degree of convergence between methods[56]. But others point to the fact that even where there is agreement between records and patient self-reporting, there are different omissions (with patients reporting more outside core service use, but less reporting of more core service use than medical records)[57]. Other studies have found that patients may also misclassify use[58].

Moreover, different populations may have different responses. One study found over reporting amongst men and those with higher frequency of visits[59]. Elderly patients may under-report[60]. There are particular issues for the very sick and for children regarding the reliability of reporting by their guardians. Finally, responses may be different for different types of services. Reporting may be reliable for services like hospitalizations, but less so for general outpatient visits[61]. It may also be easier for patients to report visits, but not the use of medications and other care products[62]

There are often trade-offs between accuracy and precision when selecting the appropriate method. Some propose regular phone surveys since they reach larger populations and hence can improve precision[63] but these may have poorer reporting than face-to-face interviews. Where people are

insured, claims data may be an option. Claims data (as with other routine reporting systems) can cover longer periods and larger samples but may cover fewer cost categories[64]. Simpler methods such as Delphi pan estimation using focus groups may also be considered where resources are too constrained for patient surveys[65].

In summary, there is no 'gold standard' approach but it is important to consider characteristics of the sample population, their cognitive abilities, recall time frame (see below), type of utilization, and frequency of use[66]. Comparing data from different sources may improve comprehensiveness of results. In some cases it may be useful to adopt formal analytical approaches to address biases caused by misreporting or incomplete data[67]. The methodological specification is therefore to **report the source of data, where report the approach used to sample or fill missing data and justify why the approach was selected** given the potential for bias described above.

METHODOLOGICAL PRINCIPLE 10 – TIMING OF DATA COLLECTION

The principle

Consideration should be given to the **timing of data collection** to minimize recall bias and, where relevant, the impact of seasonality and other differences over time.

Why is considering the timing of data collection important?

There are several issues to consider when deciding upon the timing of data collection. The first issue is whether data on resource use should be collected prospectively or retrospectively. Prospective data collection is often preferable, as it allows for direct observation of resource use and avoids recall bias. However, while prospective data collection may be more comprehensive and unbiased, there is a risk that the data collection methods may influence resource use[68]. Alternatively, retrospective data collection may be sufficient and more practical if relevant written records are available to track the way resources are allocated and any recall period is kept to a minimum.

Where input and service use data are collected from clients or patients, recall bias may also impact the quality of the resulting cost estimate. Several studies have examined how accurately patients recall service use. Some suggest that a two to three months recall period can provide reliable estimates[69], but point to differences amongst different types of health service use. For example, for studies concentrating on hospitalizations, the recall period may be longer [70] but for community services, there may be under-reporting as the recall period is extended (4 to 8 months)[71]

In comparison, little is known about the accuracy of recall for health care workers, and this is likely to vary depending on characteristics of the time use (e.g., two half-day sessions per week vs. intermittent 10 to 15 minute blocks scattered throughout the work week).

In addition to deciding whether resource use will be collected prospectively or retrospectively, it will therefore be important to consider the frequency of data collection over the course of the intervention being assessed. For many interventions, consideration should be given to the variation in costs across the project period as well as recall bias. For example, in addition to capturing costs during start-up on-going operations, other factors may affect the costs during the course of a year. In particular, seasonal fluctuations in service use may result in under or over estimation if costs are measured for less than one year

Method specification

In general, analysts should consider whether **retrospective versus prospective** is most appropriate, and whether the costs of the strategy, intervention, or service will evolve over time. Where data is collected from patients/clients at different points in time analysts should report whether this was cross sectional or a cohort. Where data is collected from interviews, consideration should be given to **recall period**, and where recall periods are longer than 3 months, these should be justified. For interventions where provision or service use may vary **exhibit seasonal variation**, a minimum of one year's period of cost measurement should be captured through either on-going record-keeping, or intermittent data collection efforts. In line with the principle on time horizon, for new programs, and

especially demonstration projects or pilots, it will be important to time data collection to capture costs during both the start-up and implementation phases of the project, as these may differ substantially. In terms of frequency of data collection, it will be important to obtain information on resource use at the start of the project to capture start-up costs, followed by a field visit after the intervention has been running for three to six months to collect resource use for recurrent costs. Depending on seasonality and other factors affecting the supply and demand of services, subsequent visits may be needed to capture changes in service volume and resource use over the course of the project period.

3. PRICING AND VALUATION

	PRINCIPLE 11 - The sources for price data should be listed by input, and clear delineation should be made between local and international price data sources, and tradeable and non-tradable goods	PRINCIPLE 12 - Capital costs should be appropriately annuitized or depreciated to reflect the expected life of capital inputs	PRINCIPLE 13 - Where relevant an appropriate discount rate, inflation and currency conversion rates should be used, and clearly stated.	PRINICPLE 14 - The use and source of shadow prices, for goods and for the opportunity cost of time, should be reported.
	Local price data sources International price data sources Tradable goods Non-tradable goods	Expected life years Depreciation	3% discount rate Currency and year Inflation rate source Currency conversion rate source	Volunteer time Adjustments to input prices
Example #1: CEA of condom distribution in India	What is the source for price data?	How are capital costs annuitized?	How are discount rates, inflation, and currency conversion handled?	How are shadow prices estimated?
		3% annuitization	3% discount US$ 2014 GDP deflator	Minimum wage Adjustment to condom prices as subsidised
Example #1: Planning scale-up of XPERT for TB diagnosis in South Africa	What is the source for price data?	How are capital costs annuitiized?	How are discount rates, inflation, and currency conversion handled?	How are shadow prices estimated?
	Ministry of Health	Straight line depreciation	No discount US$2011 Mean exchange rate US:ZAR 2011	No adjustments

Table 3 - Statement of Principles

		Economic evaluation	Financial planning	Budgeting	Efficiency analysis
Valuation and pricing					
11	The sources for price data should reflect the **full value** of the input and be described for each input in a way that allows for **adjustment across settings**.				
12	**Capital costs** should be appropriately annuitized or depreciated to reflect the expected life of capital inputs	*Annuitization*	*Depreciation*	*Depreciation*	*Depreciation*
13	Where relevant an appropriate **discount rate, inflation, and currency conversion rates** should be used and clearly stated.	*3% should be used as well as local rates*			
14	The use and source of **shadow prices**, for goods where no market price exists, and for the opportunity cost of time should be reported.	*Shadow prices should be applied to reflect full opportunity cost*			

METHODOLOGICAL PRINCIPLE 11 – SOURCES OF PRICE DATA

The principle

Sources of price data should reflect the full value of the input and be described in a way that allows for adjustment across settings.

Why transparency about the sources of price data is important?

Providing information on prices (including sources and methods used for salaries and wages) is a central aspect of transparency, and enables costs to be adjusted across settings with different prices.

Method specification

Prices should reflect the full (financial or economic) value of a resource. In some cases, some adjustments may need to be made from the price given in the original data source. For example, for wage and salary costs, adjustments may need to be made to ensure all benefits and remuneration is included and that gross price is captured. For example, efforts may need to be made to capture all the monetized benefits that public servants receive when pricing human resources. In the case of drugs and supplies, it may be appropriate to mark-up prices by transportation costs.

To enable the transfer of costs across settings, it is also important to distinguish local from international price sources and between tradable and non-tradable inputs. Non-tradable inputs will always have local prices. Tradable goods may have both a local price and a price listed on global websites etc. Wages are an example of “non-tradable” inputs; pharmaceuticals and lab testing equipment are often “tradable” inputs. Defining inputs as tradable and non-tradable and listing their price source is required information to transfer costs across settings and to convert costs, where relevant, to international dollars.

METHODOLOGICAL PRINCIPLE 12 – VALUING CAPITAL INPUTS

The principle

Capital costs should be appropriately annuitized or depreciated to reflect the expected life of capital inputs.

Why is transparency around valuing capital inputs important?

Capital costs potentially have two components: depreciation and opportunity costs. The opportunity costs of capital reflect the lost opportunity to invest in another area. Economic costs aim to capture opportunity cost, whereas financial costs will only capture depreciation. Depending on the proportion of capital costs of total costs, differences in the method used to spread the cost over years can substantially impact unit costs[72].

Method specification

The definition of a capital cost is any input with a useful life of more than one year and can include non-equipment inputs such as training and bed linen. Start-up costs can also be considered as capital costs, given that their usefulness is typically longer than one year. Like all costs, capital costs should be valued according to the type of cost - 'economic' or 'financial' - being estimated. Financial cost estimates should use straight-line depreciation (simply dividing the total cost by the years of useful life) and economic costs should use an annualization factor that adjusts the years of life for opportunity cost. It does this adjustment using a discount rate, and a 3% is recommended, plus local rates where relevant (see principle 13). Standard tables are available to conduct this adjustment[73].

The determination of the useful life of capital can also be problematic where the setting characteristics, such as the availability of repair and maintenance infrastructure, may influence the length of potential use. This is also the case for novel technologies where useful life has not yet been observed. It is therefore important to report useful life years used, even if assumption based, so that costs can be generalized and adapted to other settings and sensitivity analyses can be conducted.

In summary, the **method of depreciation and capturing opportunity cost**, **the discount rate,** and the **useful life (length and data sources)** should be reported for each major capital input category and for new capital technologies by input.

METHODOLOGICAL PRINCIPLE 13 – DISCOUNT, INFLATION AND CONVERSION RATES

The principle

Where relevant an appropriate **discount rate, inflation, and exchange rates** should be used to adjust costs over setting and time.

Why is transparency around price adjustments important?

As above in principle 11, transparency around prices is essential; therefore any adjustments made to adapt costs across setting and time need to be reported. The iDSi reference case for economic evaluation[13] also states that when projecting costs into the future, costs need to be discounted to reflect their value at the time the decision is being made.

Method specification

In line with the iDSi reference case, a 3% annual **discount rate** for costs should be used as a minimum specification**.** Additional analysis exploring differing discount rates appropriate to the decision problem can also be used, depending on the purpose and end user. In many cases an analysis that reflects the discount rate using the rate at which the national government can borrow funds on the international market (i.e. the rate used by the Treasury) may be preferable for national level users. In this case, an adjustment for inflation may need to be made to reflect the real rate of return.

To enhance generalizability of cost estimate as stated above, we recommend **at a minimum to present costs in US dollars**, specifying the currency year. In some cases, it may also be advisable to present results in international dollars. International dollars, using a purchasing power parity conversion, remove some of the distortions and fluctuations inherent in currency markets and may better represent 'economic' value. However, for purposes such as financial planning, exchange rates are likely to be better estimates of price to be paid. In most cases, it may be necessary to also present costs in local currency. Where costs are reported over a time period the mean exchange/ conversion rate over that year or time period should be used. The source of the exchange rate should be specified.

Where prices need to be adjusted across time, gross domestic product (GDP) deflators or the Consumer Price Index (CPI) should be used for local goods (GDP deflators measure inflation in locally produced goods, rather than locally consumed goods). However, for inputs that are tradable, such as global health commodities (e.g., testing machines and anti-viral drugs), GDP deflators or the CPI does not capture price changes. Many global health commodities experience *decreasing* prices over time. For these tradable goods, where feasible, commodity-specific price changes should be used.

There is a specific issue when adjusting costs over time and currency as to whether one first converts the local currency to U.S. dollars and then inflates, or vice versa, as this may make a substantial difference to the estimates. For non-tradable local goods, it is preferable to inflate local currency and then convert. Conversely, for tradable and often globally purchased and priced goods, (where current prices are not available) it is preferable to inflate using the US dollar GDP deflator and then convert into local currency.

METHODOLOGICAL PRINCIPLE 14 – USING SHADOW PRICES

The principle

The use and source of **shadow prices** to value inputs without a market price and the opportunity cost of time should be reported.

Why is shadowing pricing important?

Shadow prices are required where there is no market price paid for an input. For economic evaluation and other 'economic' rather than financial analyses, shadow prices are important as they can help capture opportunity cost. In most instances the use of shadow prices will involve adjusting the price paid to reflect the opportunity forgone, often using a hypothetical market price.

One common area in global health costing requiring shadow pricing is for donated inputs, such as contraceptives, and volunteer time. Likewise, some inputs may be partially subsidized. For example, ISPOR guidelines state the drugs costs should include rebates and other drug price reductions[74] Regulatory requirements may also distort drugs costs[75].

Likewise, there is an opportunity cost to the use of time by family and community members for the provision of health care. In some cases, this may be forgone leisure time but time may also be forgone for other productive activities such as housework, where there is no formal wage. For these costs, there are several approaches to estimating the value of lost productivity with different theoretical and conceptual bases (e.g. human capital vs. friction costing[76]). Depending on the approach, the value applied can use occupational and gender-specific wages, or equal replacement wages. Each of these can produce quite different estimates, and therefore the methods used should be made transparent.[77] In some cases, the method of valuation includes normative aims, such as ensuring the equal valuation of time between men and women within a household.

Method specification

For economic costs, the **prices of donated or subsidized goods** need to be adjusted to reflect opportunity (economic) cost, often using market prices paid by other consumers, or if tradable goods international prices can be used. The valuation of donated or subsidized goods should, where practical, be based on an average of multiple estimates of local market prices; purchase price paid by the donator; or if neither of these approaches was used, an alternative approach should be described.

Where shadow pricing is used for the valuation of inputs with **no market prices (volunteer time, household time),** goods and volunteer time should be valued at a minimum according to a proxy or hypothesized market value (e.g. local economy/domestic service wage rates), and the method should be described. Valuation may also include normative adjustments, and these too should be explicated.

4. ANALYSING AND PRESENTING RESULTS

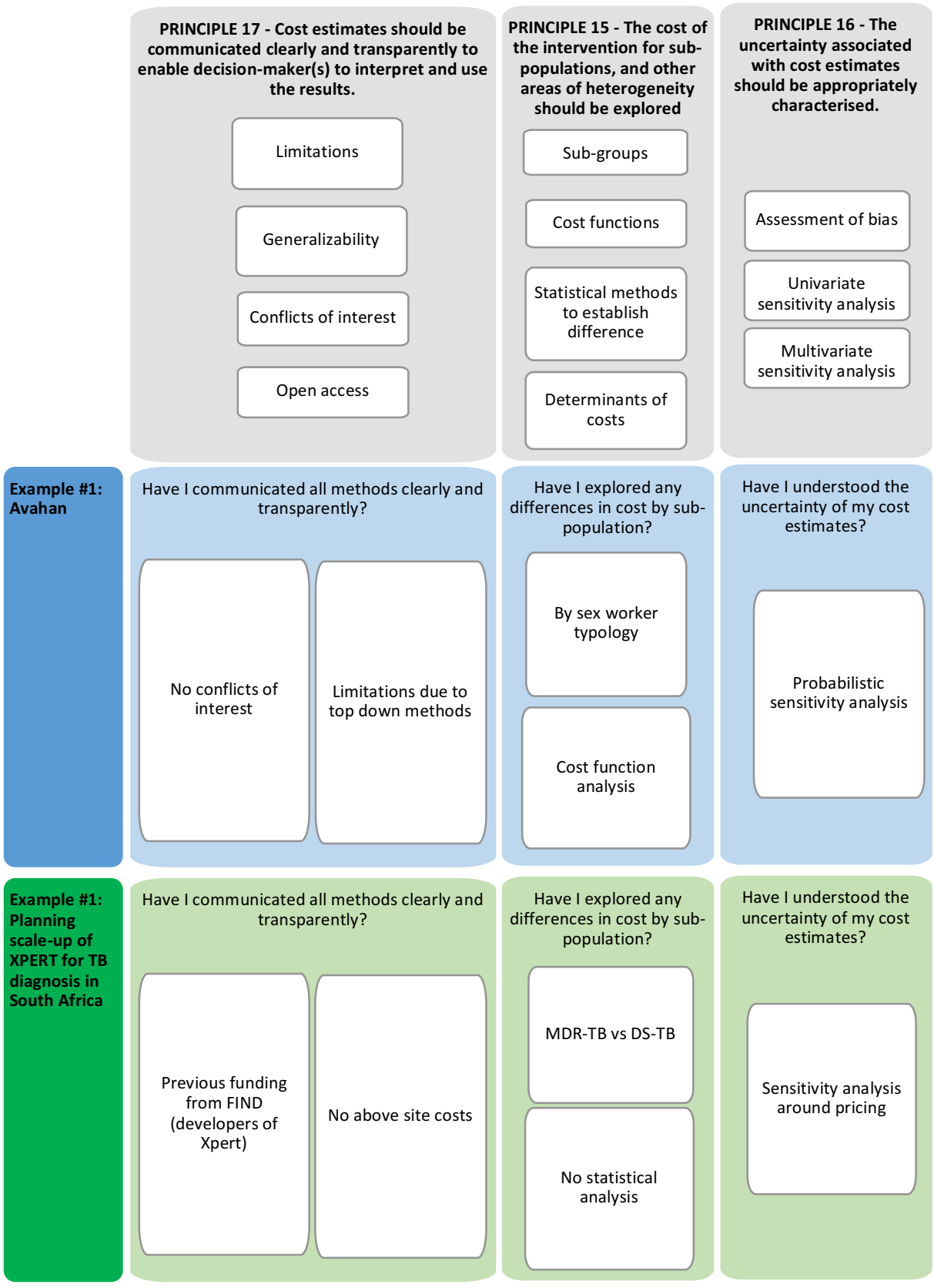


Table 4 - Statement of Principles

		Economic evaluation	Financial planning	Budgeting	Efficiency analysis
Presenting results					
15	Variation in the cost of the intervention by site size/organization, sub-populations, or by other **drivers of heterogeneity** should be explored and reported.	*Methods may need to consider correlation with effectiveness*			*Cost function analysis to understand drivers of costs*
16	The **uncertainty** associated with cost estimates should be appropriately characterized.	*Simple and probabilistic sensitivity analyses*			
17	Cost estimates should be **communicated clearly and transparently** to enable decision-maker(s) to **interpret and use** the results.				

METHODOLOGICAL PRINCIPLE 15 – EXPLORING COST FUNCTIONS AND HETEROGENEITY

The principle

Variation in the cost of the intervention by site size/organization, sub-populations, or by other drivers of heterogeneity should be explored and reported.

Why is understanding heterogeneity within cost estimates important?

As the introduction section of the reference case explains, unit costs are rarely constant over scale (or other organizational characteristics), and in many cases, may not be similar for different sub-groups of populations. Hence, where granular data are available, it is important to explore differences in cost by site and population group. Exploration and reporting of these heterogeneities will also assist in extrapolating costs from the study to other settings and scales of delivery.

With respect to population group, in some cases presenting aggregate unit costs may be highly misleading if others apply the unit costs to populations with different characteristics. For example, applying an average cost of treatment for drug susceptible (DS) TB and multi-drug resistant (MDR-TB) patients would only be relevant to settings with approximately the same prevalence of TB and MDR-TB. In this case, the unit cost of treatment for each different patient group would be more useful. In addition, it will be important to consider underlying conditions or co-morbidities that may impact health care costs for other diseases[78].

Method specification

While it is preferable to estimate a cost function rather than a single 'unit cost' the data needs to do this are substantial. In the main, the statistical requirements to estimate functions require relatively large sample sizes (number of facilities or other sample unit>30), which may be beyond the funding available[3]. We therefore do not recommend this as a minimum standard. Nevertheless, we recommend the reporting of unit costs by site together with a set of site characteristics (see minimum reporting standard and example tables in Appendices 2 and 4). Mean unit cost estimates can also be presented by other categories that may drive heterogeneity including service delivery platforms or type of setting (e.g. rural and urban) and quality of care. Heterogeneity should be explored in subgroups of the population where the differences are likely to have an important influence on costs.

[3] The GHCC will be further exploring methods to estimate 'within country' cost functions and further guidance will follow

Categorical or subgroup formation should be informed by both the characteristics of different populations and determinants that may influence unit costs such as geographic location. Where feasible the identification of these characteristics can be aided with formal statistical testing of differences. Where differences are found, unit costs should be presented by sub-group and a weighted average constructed for the whole population. It should also be noted that the presentation of unit costs by sub-groups may also be desirable from a programmatic perspective (e.g. where programs may be interested in a stigmatized or high risk population).

Where sample sizes are larger econometric approaches to characterizing cost functions can be used. It is beyond the scope of the reference case to provide guidance on these methods at this time.

METHODOLOGICAL PRINCIPLE 16 – DEALING WITH UNCERTAINTY

The principle

The **uncertainty** associated with cost estimates should be appropriately **characterized**.

Why is characterizing uncertainty important?

Since many global health-costing studies have a handful of sites, there is often no formal method used to characterize the precision of the estimate. Even measures of dispersion are rarely presented. However, there is likely to be considerable uncertainty due to both bias and lack of precision, in any cost estimate. It may be misleading if the uncertainty is not fully characterized, and the user is not made aware of the possible space between the estimate and reality. Further, exploring the implications/sensitivity of the cost to any assumptions or exclusions made can enhance generalizability of results.

Method specification

The uncertainty of any cost estimate should be fully characterized. Where feasible this should include an assessment of precision (e.g. confidence intervals, or percentiles). **Basic or more complex sensitivity analyses** should be applied in standard ways (see economic evaluation textbooks).

It is particularly important to **characterize the bias** in the estimate by referring to:

- Sampling that may reflect higher or lower cost sites or populations disproportionately
- Completeness – what elements of costs are missing (inputs, service use, providers)
- Possible under or over reporting of elements such as service and time use due to the data collection methods or program features
- Distortions or incompleteness in the prices of inputs

While it may not always be feasible to quantify bias the characteristics and direction of any bias should be reported in the study limitations.

Finally, any discussion section should include **recommendations in terms of the generalizability** of estimates to other settings and scales. For example, it may be importation to highlight how service delivery may differ between the studied program (often a demonstration or pilot) and scaled-up operation (which may achieve efficiencies in staffing or different input prices).

METHODOLOGICAL PRINCIPLE 17 – TRANSPARENCY

The principle

Cost estimates should be **communicated clearly and transparently** to enable decision-maker(s) to **interpret and use** the results.

Why is transparency important?

Cost estimates may be used for multiple purposes, for policy development and broader economic analysis. The characteristics of a 'good estimate' will vary depending on its purpose. If a cost estimate is used for the wrong purpose, or if its limitations are not described, it can be misleading. Moreover, the most methodologically robust costing will not be informative if the methods and results are not reported clearly.

Importantly, for a cost estimate to be transferable over setting and time, analysts and users require transparency about its components, any assumptions made, its uncertainty and its limitations. In particular, it needs to be clear how an intervention cost is constructed from its components, commonly: data on service use, the unit costs of that use and, the quantity and prices of inputs that determine that unit cost. This will allow analysts in other settings to adjust for differences in prices or other factors that affect the cost of delivery[79]. This clarity is also required to meet the minimum academic standard of replicability.

To facilitate the transfer of costs across setting or time, a clear description of setting is also important. For example, economies of scope and scale often affect cost[80], so understanding the coverage and integration will assist others in applying the cost estimate elsewhere. In addition, providing breakdowns of cost by activity may assist those adapting the intervention to their setting in identifying where they may have some activities already in place, or help in the financial planning of scale up.

Finally, given the levels of public investment in these data, there are increasing requests for the full dataset to be provided using open access facilities and it is good research practice to declare conflicts of interest.

Method specification

The reference case details Minimum Reporting Standards in the next section, which outline the aspects that need to be reported to ensure minimal compliance with the transparency principle. These reporting standards reflect the method specifications provided above and state that the purpose of the costing should be fully and accurately described, that the choice of costing to address the purpose should be justified, and that the intervention and context should be clearly characterized. The limitations of any method and their likely effect on particular estimate should be fully transparent and, as with any scientific report, declarations of conflicts of interest should be made.

Where total costs are reported, both the number of units and the unit cost should also be reported.

Where unit costs are comprised of unit costs for services (e.g., visit costs) multiplied by service use (e.g., number of visits), these **'P's** ('prices') and '**Q's** ('quantities') should be reported. This should be done using **standardized** unit costs where available. This reference case includes examples of standardized reporting formats for TB and HIV services that include a list of units.

Where relevant cost data should be either provided by site or measures of dispersion presented and disaggregated by input and activity.

These should be considered minimum reporting standards to ensure minimal compliance with the transparency principle. Minimum Reporting Standards do not impose any additional methodological burden on researchers as they draw on information and data that must normally be considered in estimating costs.

Finally, it is strongly recommended that analysts feedback the results to the sites and organizations from whom data has been collected. This can create buy-in and also provides an additional process of validation to any results.

SECTION C APPENDICES

APPENDIX 1 - GLOSSARY

Capital costs are one-time costs for items that have a useful life of over one year – such as buildings, vehicles or medical equipment.

Cost is a general term that refers to the value of resources/inputs used to produce a good or service. This can refer to financial, economic, unit or average, or other types of costs depending on the ingredients included (see below). Costs may be incurred by health care providers (provider costs), but may also include costs incurred by patients or society (societal costs).

Cost function shows the relationship between costs and components of cost (e.g., personnel, capital) or cost and the determinants/ drivers of costs (e.g. scale, coverage, type of provider, time etc.)

Discount rate – the rate at which future costs are discounted to account for time preference

Economic costs (aka opportunity costs) reflect the full value of all resources utilized producing a good or service. Economic costs are sometimes referred to as "opportunity costs" since they represent resources actually consumed, thus preventing the opportunity to devote those resources to another purpose.

Economies of scale occur when long run average cost decreases as output increases. After minimum efficient scale is achieved, long run average cost may increase (diseconomies of scale). Economies of scale are also used in some texts to describe any increase in cost associated with site size or scale, even where some costs are fixed (short run). In other text this is referred instead to as 'economies of capacity'.

Expenditures reflect the financial outlay that an agent (e.g., government, donor or individual) spends during a period of time for goods and services. Expenditures can refer to the entire sum required by specified health services, or it may pertain only to those outlays incurred by a subset of the organizations involved in delivering the service. For example, the PEPFAR Expenditure Analysis initiative focuses only on that portion of costs that are incurred by PEPFAR. Note that expenditure data are usually reported using the cash basis method of accounting, that is, no amortization to capital goods is applied; all capital goods expenditures are recorded in full as they are incurred.

Financial costs reflect financial outlays for goods and services needed to carry out a public health or medical intervention (in the context of global health), and as such are similar to expenditures. However, in contrast to expenditure data, financial costs do amortize capital expenditures over time. In addition, financial costs are usually measured for the entire good or service, rather than reflect a particular agent's financial outlays.

Fixed costs are those costs that do not vary with scale (changes in the level of output). These costs would be incurred even if the output was zero. Examples may include items such as buildings and equipment but also may include administrative costs that consist mainly of personnel.

Incremental cost is the cost of adding a new or a batch of services or intervention over and above an existing program. In some texts incremental costs may be referred to as *marginal* costs.

Marginal cost is the cost of producing one more unit of a service/output.

Non-traded goods – services and commodities which cannot be traded on the international market.

Overhead costs refer to costs that cannot be directly traced to the provision of a service, such as administration, security personnel, buildings and general equipment. These costs may be referred to in some texts as *indirect* costs.

Recurrent costs are the value of resources/inputs with useful lives of less than one year.

Start-up costs are the one-time commitment of resources required to establish a program to the point where service delivery can begin. Some of these resources may be donated or subsidized; thus, the financial costs may be less than the full economic costs. Start-up costs typically includes some capital costs, but also include activities related to planning, staff training, materials development, infrastructure expansion, legal fees, or personnel recruitment. Some start-up costs should be amortized; for example, if staff training needs to be repeated every five years, training costs would be spread over five years.

Unit costs (aka average costs) are the mean cost of producing one unit of a good or service, dividing total costs by total output in a specified time period. For example, if an HIV treatment program costs $1 million annually to provide 1,000 patient-years of ART, the unit cost would be $1,000 per patient-year. Unit cost is thus the average cost per unit of service of a particular type of good or service.

Variable costs are those costs that vary with scale (changes in the level of output). An example is expendable supplies such as test kits in an HIV counselling and testing program. Service delivery personnel costs are usually considered variable, since a substantial increase in caseload will require more staff, though small increases can often be accommodated within the existing staffing pattern.

Shadow price - the estimated price of a good or service for which no market price exists.

APPENDIX 2 – PRINCIPLES AND METHODS REPORTING CHECKLIST

This section contains checklist for reporting standards that are aligned to the principles above.

< SEE EXCEL SPREADSHEET 1>

APPENDIX 2 STANDARDIZED TB UNIT COSTS

< SEE EXCEL SPREADSHEET 2 >

APPENDIX 4 STANDARDIZED REPORTING TEMPLATES

< SEE EXCEL SPREADSHEET 3 >

APPENDIX 5 – ADVISORS AND STAKEHOLDERS

ADVISORY GROUP

	Last	First	Association
1	Barasa	Edwine	Kenya Medical Research Institute
2	Bertram	Melanie	World Health Organization
3	Bistline	Kate	PEPFAR-OGAC
4	Borowitz	Michael	Global Fund
5	Dandona	Lalit	Public Health Foundation of India
6	Garcia Baena	Ines	World Health Organization
7	Glassman	Amanda	Center for Global Development
8	Gorgens	Marelize	World Bank
9	Guinness	Lorna	London School of Hygiene and Tropical Medicine
10	Hunger	Johannes	Global Fund
11	Izazola	Jose Antoio	UNAIDS
12	Manca	Andrea	University of York
13	Martinelli	Silvio	Global Fund
14	Masiye	Felix	University of Zambia
15	Menzies	Nicolas	Harvard University
16	Meyer-Rath	Gesine	Boston University
17	Minh	van Hoang	Hanoi Medical University
18	Nandakumar	Allyala	PEPFAR
19	Ombam	Regina	NACC Kenya
20	Over	Mead	Center for Global Development
21	Reuben	Elan	USAID
22	Sangrujee	Nalinee	Center for Disease Control and Prevention
23	Sculpher	Mark	University of York
24	Teerawattananon	Yot	Health Intervention & Technology Assessment Program
25	Vasan	Arjun	US Treasury
26	Walker	Damian	Bill & Melinda Gates Foundation
27	Wilson	David	University of New South Wales
28	Zhang	Shufang	Global Fund

STAKEHOLDERS

	Last	First	Association
1	Barnabas	Ruanne	UW
2	Basu	Arniban	UW
3	Birungi	Charles	UNAIDS
4	Bratt	John	Family Health International
5	Brenzel	Logan	Bill & Melinda Gates Foundation
6	Cashin	Cheryl	Results for Development
7	Conteh	Lesong	Imperial College
8	Dayo Obure	Carol	African Development Bank
9	Griffiths	Ulla	UNICEF
10	Johns	Benjamin	ABT Associates
11	Larson	Bruce	BU
12	Leroueil	Pascale	Global Fund
13	Levin	Ann	Consultant
14	Muheki-Zikusooka	Charlotte	HealthNet Consult

15	Mvundura	Mercy	PATH
16	Mwai	Daniel	Health Economist, Kenya
17	Ozaltin	Annette	Thinkwell
18	Resch	Stephen	Harvard University
19	Revill	Paul	University of York
20	Selvaraj	Sakhtivel	PHFI, India
21	Sohn	Hojoon	Johns Hopkins University
22	Tedosi	Fabizio	Foundation for Technical Excellence (STI)
23	Wilkinson	Tommy	International Decision Support Initiative
24	Weaver	Marcia	UW

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