THE RAPID SYPHILIS TEST TOOLKIT

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IMPLEMENTATION 1

Guidelines for Cost Effectiveness Analysis of Syphilis Screening Strategies

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Guidelines for Cost Effectiveness Analysis of Syphilis Screening Strategies

Contents

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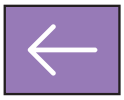

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Abbreviations

ANC: Antenatal care

CGHPS: Costing Guidelines for HIV Prevention Strategies

CHERG: Child health epidemiology reference group

DALY: Disability adjusted life year

FSW: Female sex worker

IEC: Information, education and communication

PMTCT: Prevention of mother to child HIV transmission

POC: Point of care

QA: Quality assurance

RPR: Rapid Plasma Reagin

RST: Rapid syphilis test

SDI: Sexually Transmitted Disease Diagnostics Initiative

STI: Sexually transmitted infection

TPPA: Treponema pallidum particle agglutination

WHO: World Health Organization

YLD: Years lived with disability

YLL: Years of life lost

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Summary

Objectives

These guidelines have been developed for use by programme managers and economists considering the introduction of syphilis screening and treatment. Specifically, they aim to support the:

1. estimation of the total incremental cost of adding syphilis testing and treatment to existing health services;
2. estimation of unit cost (e.g. cost per person treated) to understand the incremental cost of increasing access to treatment; and
3. approximation of the cost effectiveness (e.g. cost per adverse birth outcome averted and cost per disability adjusted life year (DALY) averted) of the intervention by linking the cost estimates to modelled effectiveness based on impact estimates obtained from the literature.

It also aims to provide sufficient background to allow its application to other projects, such as those adding syphilis screening onto existing prevention of mother to child transmission of HIV (PMTCT) programmes.

Methods overview

These guidelines are an adaptation of *The Costing Guidelines for HIV Prevention Strategies* (CGHPS) (Kumaranayake et al., 2000). They are intended to support the collection and analysis of financial and economic costs and modelling of the effectiveness. The total costs of implementing the intervention will include all relevant activities undertaken by the health service providers (such as: intervention start-up and training, health education, pre-test counselling, taking blood, preparing samples, reading and registering samples, providing test results and post-test counselling, and treating clients and their sexual partners with reactive tests, and when appropriate any quality assurance (QA) activities).

These guidelines use an ingredients-based costing approach in which quantities of resources used are multiplied by unit cost or price to obtain a total cost. As testing using rapid tests is being added on to existing antenatal care (ANC) services, incremental costs are appropriate. Cost collection methods can include reviews of administrative records, discussions with intervention staff and direct observation of intervention activities. Start-up costs, including training, will be collected retrospectively.

Average cost by intermediate outcomes (such as cost per woman screened, cost per woman treated, cost per person treated), will be used to understand project efficiency and economies of scale and to estimate the cost of scaling up the intervention beyond project communities.

Unit costs using disease-specific outcomes will be used to understand the relative cost effectiveness of syphilis screening strategies as compared to other interventions, or the relative cost effectiveness between two alternative screening strategies, such as rapid plasma reagin (RPR) and rapid syphilis tests (RSTs). Disease-specific outcomes will include adverse birth outcomes averted and generic health outcomes using disability-adjusted life years (DALYs) (Murray, 1996). DALYs will be estimated following the methods outlined by Fox-Rushby, et al. (Fox-Rushby and Hanson, 2001), based on an estimated proportion of adverse birth outcomes likely in untreated syphilis. The number of DALYs averted by the intervention will be estimated using disability and death averted due to preventing adverse birth outcomes and treating infected adults. In screening strategies targeting adults, the main outcome is the number of people treated, though guidance is provided on calculating a very rough estimate of DALYs averted due to adult treatment.

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1. Introduction

1.1 Background

The burden of curable bacterial sexually transmitted diseases (STDs) such as syphilis, gonorrhoea and Chlamydia remains high in many low-income countries. According to a World Health Organization (WHO) estimate, 12 million people are infected with syphilis each year, and 90% of these infections take place in low-income countries (WHO, 2007). Syphilis in pregnancy is a leading cause of adverse birth outcomes, and is believed to contribute to 650,000 foetal and neonatal deaths each year in developing countries (Kamb et al., 2010). In a recent study in Tanzania, 51% of stillbirths, 24% of preterm live births, and 17% of all adverse pregnancy outcomes were found to be attributable to maternal syphilis (Watson-Jones et al., 2005).

1.1.1 Syphilis in Adults

Syphilis is a systemic sexually transmitted disease, caused by the spirochete bacterium *Treponema pallidum*. Untreated infection typically has three stages; these are termed primary, secondary and tertiary syphilis (Holmes, 1984). The primary stage of infection is marked by a painless sore (chancre) at the site of infection. Because it is painless, the chancre often goes unnoticed in women and homosexual men. Syphilis is therefore most commonly diagnosed in the primary stage in heterosexual men (Holmes, 1984). The secondary stage marks the dissemination of *T. pallidum* and is usually marked by a rash on the palms of the hands and soles of the feet, alongside a low-grade fever and muscle pain (Gerbase et al., 2000, WHO, 2007). The secondary stage lasts two to six weeks in most people, and is followed by an often decades-long latent stage. The latent stage is entirely asymptomatic, and the probability of sexual transmission is low (Berman, 2004). About 40% of adult cases eventually progress to tertiary syphilis. Clinical syndromes associated with tertiary syphilis can take the form of neurosyphilis, cardiovascular syphilis, and late benign syphilis (Holmes, 1984).

1.1.2 Syphilis in Pregnancy

Much of the biology and epidemiology surrounding the impact of syphilis infection in pregnancy is still unexplained, however the impacts of maternal syphilis on birth outcomes are widely recognized to be significant. The primary source of congenital infection is believed to be the result of *T. pallidum* crossing the placental barrier, although an infant can also be infected at the time of delivery through direct contact with infectious genital lesions (Berman, 2004, Jenson, 1999). Foetal infection can result in adverse birth outcomes such as spontaneous abortion, stillbirth, and low birth weight, as well as neonatal or perinatal death and an infected infant (congenital syphilis).

The majority of infected infants are asymptomatic at birth, making early diagnosis and treatment of infected infants problematic. The most commonly recognized symptoms of early congenital syphilis develop in the third to eighth week of life and include hepatosplenomegaly, skin rash, rhinitis (snuffles), jaundice, hoarse cry, and failure to thrive (Holmes, 1984, Jenson, 1999, Watson-Jones et al., 2005). Syphilis infection in infants can also affect the liver, kidneys, bone, pancreas, spleen, lungs, heart and brain, leading to a wide variety of neurological, developmental and musculo-skeletal disabilities (Saloojee et al., 2004).

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The impact of syphilis in pregnancy is directly related to the stage of syphilis in the mother – primary and secondary syphilis in the mother are most likely to lead to adverse birth outcomes and congenital syphilis, while latent syphilis has less risk of impact on the foetus (Holmes, 1984).

1.1.3 Antenatal Screening and Treatment

Adverse birth outcomes due to maternal syphilis are preventable through identification and treatment of syphilis infection in pregnant women. Treatment of the mother with a single dose of benzathine penicillin 2.4MU is believed to be effective in prevention of vertical transmission of syphilis in 95-100% of maternal cases, depending on the stage of infection and gestational age at treatment. The recommended treatment for syphilis in adults is a single dose of benzathine penicillin 2.4MU for primary and secondary syphilis, and up to three doses for late latent syphilis or infections of unknown duration (Center for Disease Control and Prevention, 2006).

Because the natural history of syphilis includes long asymptomatic periods, and early symptoms are often not recognized in women, syndromic management is insufficient for identification and treatment of positive cases. Diagnostic screening is therefore critical to the management of syphilis and prevention of adverse birth outcomes associated with infection in pregnancy. Due to the severity of outcomes resulting from untreated syphilis in pregnancy, routine syphilis screening is therefore included in most countries' standard antenatal care policies. However, there is significant evidence that implementation of national syphilis screening policies is widely lacking. Only about 38% of ANC attendees in sub-Saharan Africa are routinely screened for syphilis (Gloyd et al., 2001). This represents significant 'missed opportunities' in prevention of neonatal deaths and congenital syphilis (ibid).

One of the critical barriers to the routine implementation of syphilis screening in many locations is the technical and logistical challenges to conducting Rapid Plasma Reagin (RPR) test. Rapid syphilis tests (RSTs) have the potential to alleviate a number of these challenges; they would remove the need for electrical equipment, such as a fridge to store the RPR reagent, a centrifuge and a shaker. Moreover, because they are rapid tests, they can be completed in the presence of the patient. This would allow for immediate treatment of patients with a positive result and should increase the uptake of screening and treatment.

Operational studies are being undertaken to assess the feasibility of introducing rapid tests into existing prenatal, PMTCT and sexually transmitted infections (STI) programmes. However, to ensure sustained delivery of syphilis screening, it is crucial that the costs of implementing the intervention are planned for. These data can also be used in a cost-effective analysis comparing alternative syphilis screening strategies and evaluating the value for money of these compared to alternative health interventions. These guidelines aim to provide a simple yet comprehensive tool that will allow programme managers to undertake costings and cost effectiveness analysis to inform health policy in their setting.

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1.2 Structure of the guidelines

These guidelines will first give an overview of the standard procedures for syphilis screening using the RPR test and using the new RSTs, and then consider how these are undertaken in different settings (ANC screening, population wide screening for remote communities and for high risk populations) and raise a few issues to consider when undertaking a cost effectiveness analysis. Subsequently, these guidelines will follow quite closely the structure of *The Costing Guidelines for HIV Prevention Strategies (CGHPS)*, upon which they are based. Chapter 3 provides the basic concepts of cost effectiveness, Chapter 4 discusses planning the costing, Chapter 5 covers the implementation of the data collection, and the final chapter guides the data analysis. This includes considerations for modelling the costs of scaling up from a pilot /feasibility study and sensitivity analysis. Accompanying these guidelines are two Excel workbooks. The first are empty spreadsheets to facilitate data analysis; the second is an example of a completed analysis.

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2. On-Site Syphilis Screening Strategies

In order to conduct a cost analysis of a project or programme, it is crucial to understand how the project functions. This background section provides an introduction to syphilis screening strategies with RPR tests and RSTs, and highlights factors that are important to the collection of cost data for each type of test.

2.1 Diagnostic Tools

There are two major categories of diagnostic tools commonly used for syphilis screening in primary health care settings: non-treponemal and treponemal tests. Non-treponemal tests such as RPR and the Venereal Disease Research Laboratory Test (VDRL) are simple and cheap to perform, but have several disadvantages: they must be used on serum, have a high false-positive rate and require refrigeration for reagents (Peeling and Ye, 2004). Treponemal tests, such as the *T. pallidum* particle agglutination assay (TPPA) and *T. pallidum* haemagglutination assay (TPHA), are highly specific and are therefore traditionally used for confirmation of RPR results (Aledort et al., 2006). They require expensive equipment and technical expertise, and are therefore not usually implemented in resource-poor settings. Furthermore, because antibodies remain in the body for a long period of time, treponemal tests do not distinguish between active syphilis infection and past or treated infection.

RSTs could improve the feasibility of implementing syphilis-screening policies in low-resource settings. These tests are quick to perform, can be used on whole blood, require no refrigeration, and can be done with minimal training. Most RSTs currently available are treponemal and will thus remain positive for life, resulting in a likelihood of over-treatment in high-prevalence settings. Where screening and treatment has not been available in the past, this does not pose a great problem; in the short term most positive cases will be current infections. The likelihood of false-positive diagnosis (and thus over-treatment) will increase as patients are screened repeatedly (Peeling et al., 2006). For people ever testing positive, alternative screening (or treatment) strategies would need to be developed. One option is to send samples to off-site laboratories for testing using RPR. In some settings, the only option may be presumptive treatment of 'ever-positive' clients.

The testing procedures for both types of diagnostic tests and the variables affecting their cost are described below.

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2.2 Testing strategies: Screening using the RPR test

The RPR test has until recently been the only test that could be performed relatively simply in clinics with limited, but some, laboratory capacity. The testing procedure entails eight main steps presented in **Figure 2 .1**. Each of these steps requires inputs, mostly a combination of labour, equipment and supplies.

It is not always possible to follow each procedure according to the guidelines due to lack of equipment (shaker or centrifuge), equipment breaking down, electricity failure, and/or supply shortages. Some of these are detrimental, such as RPR reagent stock outs, however other steps can be overcome by substituting capital with labour (i.e. electric shaker with a human shaker) or time (separation of serum).

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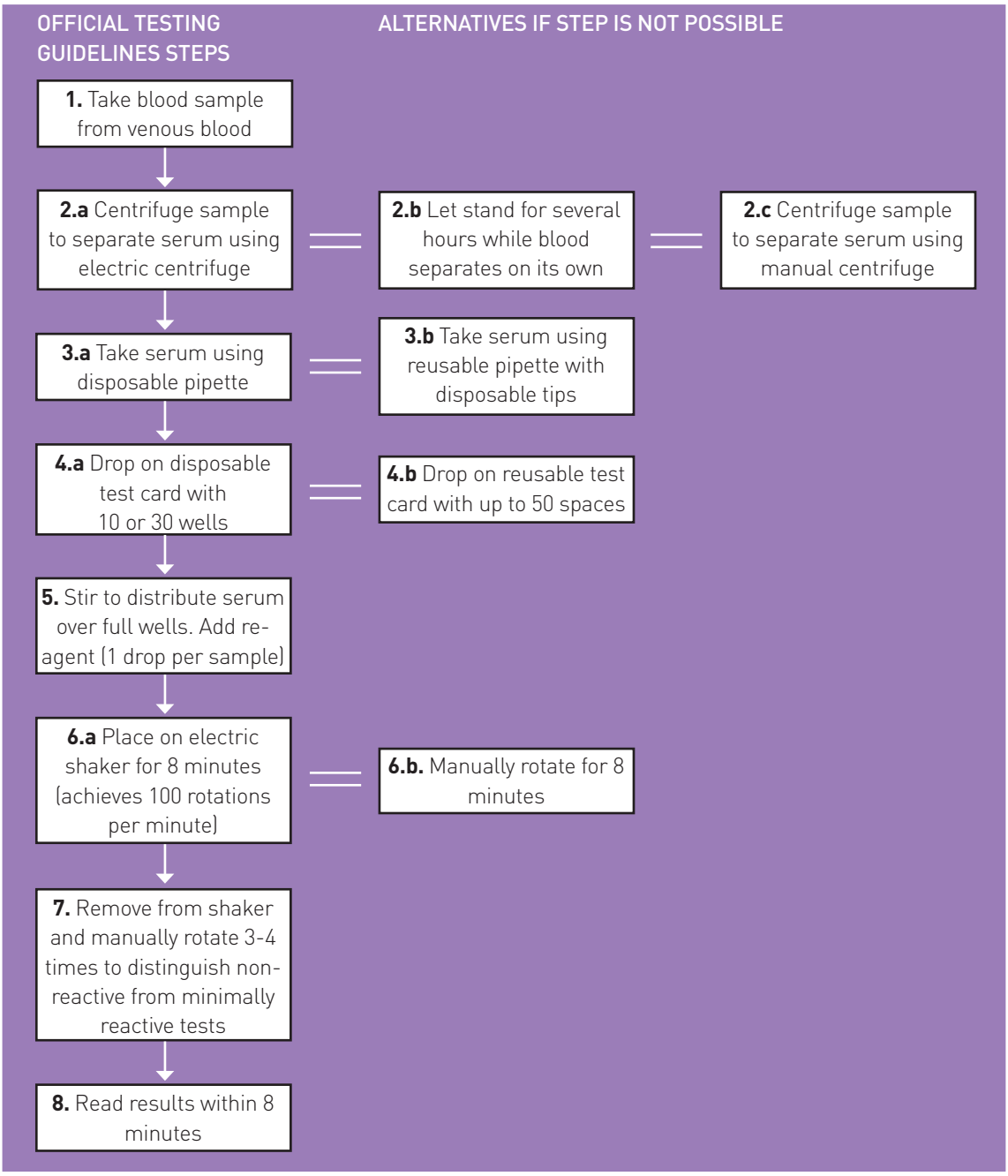
Figure 2.1 Steps in performing the RPR test



Each of the divergences from the guidelines can have consequences for costs and quality:

Step 2. Centrifuge versus letting stand: The centrifuge is a large capital cost and has recurrent electricity costs, while allowing to stand requires some space to put the specimens.

Step 3. There is a cost trade off between the slightly more expensive plastic pipettes and the disposal pipette tips, but the reusable pipette is a larger start up cost, so it depends on the volume of services, and the reliability of the supply of disposable pipettes versus disposable pipette tips.

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Step 4. The disposable cards can run out and are likely more expensive than the reusable card, though the reusable card needs to be cleaned, requiring labour and cleaning agents.

Step 6. An RPR shaker reaches 100 rotations a minute, which is impossible to achieve by hand. Though the literature states manual rotation is adequate, it must be acknowledged that it will likely contribute to greater variation in a test which is already challenging to read (Van Dyck et al., 1994). Moreover, there will be a trade off between the capital cost of the shaker (or fixing the shaker) and the recurrent labour costs related to manual rotation of samples. One key factor in this trade off will be the volume of tests undertaken each day. Manual rotation becomes more and more costly as client loads increase.

Further results can be obtained to better identify active syphilis cases. This is done using a quantitative test where the serum is repeatedly diluted and gives results called titres. The dilution at which the agglomeration of the reagent is no longer identifiable gives a quantitative strength of infection. When the test still gives a positive result when diluted 16 times, it is often considered a case of active syphilis while others tend to be considered old infections or false positive results for other reasons.

There are a number of bottlenecks to using the RPR test that need to be overcome to ensure testing can take place. Firstly, shortages in any of the supplies will cause a breakdown of service provision. Reagent supply is problematic in many countries. For example, in Tanzania shortages of reagent exist all the way up to the national pharmacy level. When stock does come in, it is quickly distributed and stock-outs re-emerge. Secondly, lack of working equipment (refrigeration and an RPR shaker) can deter testing. Reagent needs to be kept cool (2°C to 8°C) and expires 15 months from manufacture (Biotec Laboratories, 2009). Though studies have shown high levels of stability when stored up to a year at 36°C, surpassing its expiration date by 5 months (van Dyck et al., 2001), this does generally constrain on-site syphilis testing to health facilities with electricity and introduces the need for there to be a certain speed in the logistics of getting reagent out to clinics. Thirdly, testing can be time consuming, in particular if the facilities do not have an RPR shaker, and prioritisation of staff time can easily go to other activities, especially where syphilis is not perceived a large problem. Moreover, due to the time it takes key staff to perform the test, there may be less incentive to ensure consistent supply. There can be interactions with other infections (e.g. malaria) resulting in false positive results. The test results are often difficult to read correctly. Lastly, the test needs to be read quickly after shaking to ensure accurate results (results can change if left too long). This can lead to relatively large numbers of false positive and false negative results. Some of these bottlenecks may be relieved by use of point-of-care diagnostic tests, as discussed in the following section.

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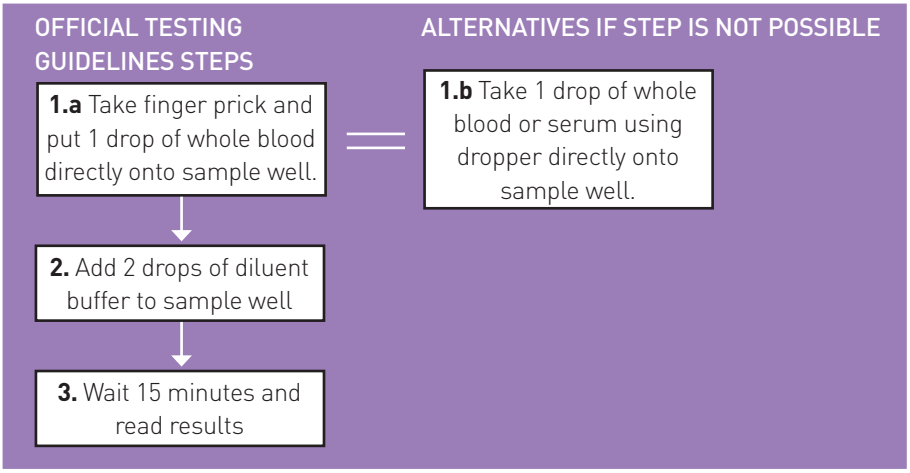
2.3 Testing strategies: Screening using the rapid test

The shortcomings of the RPR test have led to the search for tests that would improve access to syphilis screening. The WHO Sexually Transmitted Diseases Diagnostics Initiative (SDI) field tested a number of potential point of care (POC) tests and found seven that met their ASSURED criteria (Affordable, Sensitive, Specific, User-Friendly, Rapid/Robust, Equipment free, Deliverable), of which four could be performed using whole blood (Herring et al.). These do not require any equipment or electricity supply. There are far fewer steps to obtain the test result, facilitating quicker feedback to clients and subsequent treatment **(Figure 2.2)**. Blood can either be taken by finger prick specifically for the test, or from blood taken for other reasons, such as HIV testing. Whole blood can be used, allowing blood to be taken directly from the patient onto the test kit, rather than having to stand or be centrifuged to obtain serum. However, if serum is being used for other purposes, this is also appropriate and does improve test performance. When reading the test result one line shows the test is valid, two lines shows a positive result for syphilis, and no lines identify invalid test kits. Since the duration it takes to perform the test is similar to most rapid HIV tests, both tests can be done together.

Figure 2.2 Steps to performing the RST



It is likely that RSTs will solve a number of the problems related to performing RPR tests. The logistics of supplying the tests are easier as they do not require a cold chain, the amount of time required to perform the test should be less (although this needs to be assessed in clinical settings), and the test results are easier to read.

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Variables which affect costs

A key factor in the costs of screening using RSTs will be the cost of the tests themselves. The next critical factor to look at will be the use of human resources for the different tasks. RSTs do not require a blood draw, although some facilities may choose to continue with drawing blood rather than a finger prick. They are also far simpler and would not need a lab technician to read results, although staff roles may not change. Fewer economies of scale are likely to be observed with RSTs than with RPR tests where the efficiency of batching can reduce cost dramatically. However, efficiency gains can be made, due to economies of scope, if performed jointly with HIV testing. If confirmatory testing of the RST results are done, either on site or at an external lab, these costs must also be included. Where confirmatory testing is not done, it will be necessary to presumptively treat pregnant women who have previously tested positive for syphilis. These treatment costs will also need to be included.

Regardless of the type of test used, the prevalence of syphilis in the community will affect both costs and cost effectiveness (more on this later). The higher the prevalence the more positive cases will be found and cost per positive case will go down. The total cost of treatment will go up as more people are treated but the average cost per case treated will diminish as the costs of screening negative cases are spread over more positive cases.

2.4 Quality Assurance

It is recommended that any screening system incorporates a robust quality system in order to ensure the diagnostic accuracy of screening (Berte et al., 2004). A robust quality system will likely include the following activities:

1. Incoming Inspection
2. Internal Quality Control: measures the accuracy/validity of test kits
3. External Quality Assessment: measures the proficiency of nurses involved in testing.

Each of these activities is further detailed in this toolkit in the Quality Management System Guide for Rapid Syphilis Testing and summarised in its Appendix 2: Summary flowchart of a Quality Management System in place for Rapid Syphilis Testing in country.

The next sections will focus on the settings in which syphilis screening takes place within the syphilis diagnostics initiative: screening in antenatal care clinics (ANC) and give an example of two interventions targeting vulnerable populations: high risk groups in China and hard-to-reach populations in the Brazilian Amazon.

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2.5 Targeting strategies: pregnant women within the ANC

Antenatal syphilis screening and treatment is official policy in most countries. In the antenatal population, it is not only with concern for the health of the mother (and contacts), but also for the unborn child. Syphilis in pregnancy causes a number of adverse outcomes including stillbirth, miscarriage, neonatal death, low birth weight, and congenital syphilis. In the older literature it was common to assume that 1/3 of syphilis infected pregnancies would lead to stillbirth, 1/3 to congenital syphilis, and 1/3 to a birth with no adverse outcome. More recently, a panel of experts with World Health Organization (WHO)/child health epidemiology reference group (CHERG) has evaluated the literature on maternal syphilis, and come to a consensus on the likely adverse birth outcomes associated with untreated syphilis in pregnancy (Newman et al., 2011); these are presented in **Table 2.1**.

Table 2.1 Estimated adverse pregnancy outcomes resulting from maternal syphilis infection

Outcome	Outcomes averted due to treatment
Stillbirth	13.3%
Miscarriage	8.1%
Neonatal death (age 0-28 days)	9.3%
Prematurity or low birth weight	5.8%
Infant with clinical evidence of syphilis	19.4%
Non-neonatal infant death (age 29 days-365 days)	3.4%
Any adverse outcome	**48.7%***

* "Any adverse outcome" is less than the sum of the individual outcomes due to differences in weighting and variance that occur when doing a meta-analysis, as well as the possibility of an infant having more than one outcome.

Screening and treatment of women during pregnancy has been shown to bring adverse outcomes to the same level as that of women who were not affected by syphilis, thus fully averting the adverse outcomes (Watson-Jones et al., 2002). The cost effectiveness of antenatal syphilis screening and treatment using RPR tests was always very good (Hira et al., 1990, Jenniskens et al., 1995, Terris-Prestholt et al., 2003). However, due to the challenges mentioned above with the RPR test, screening is not consistently offered (Gloyd et al., 2001). RSTs have the potential to overcome some of the barriers associated with the RPR test.

The activities typically involved in an antenatal syphilis screening and treatment programme are presented in **Figure 2.3.**

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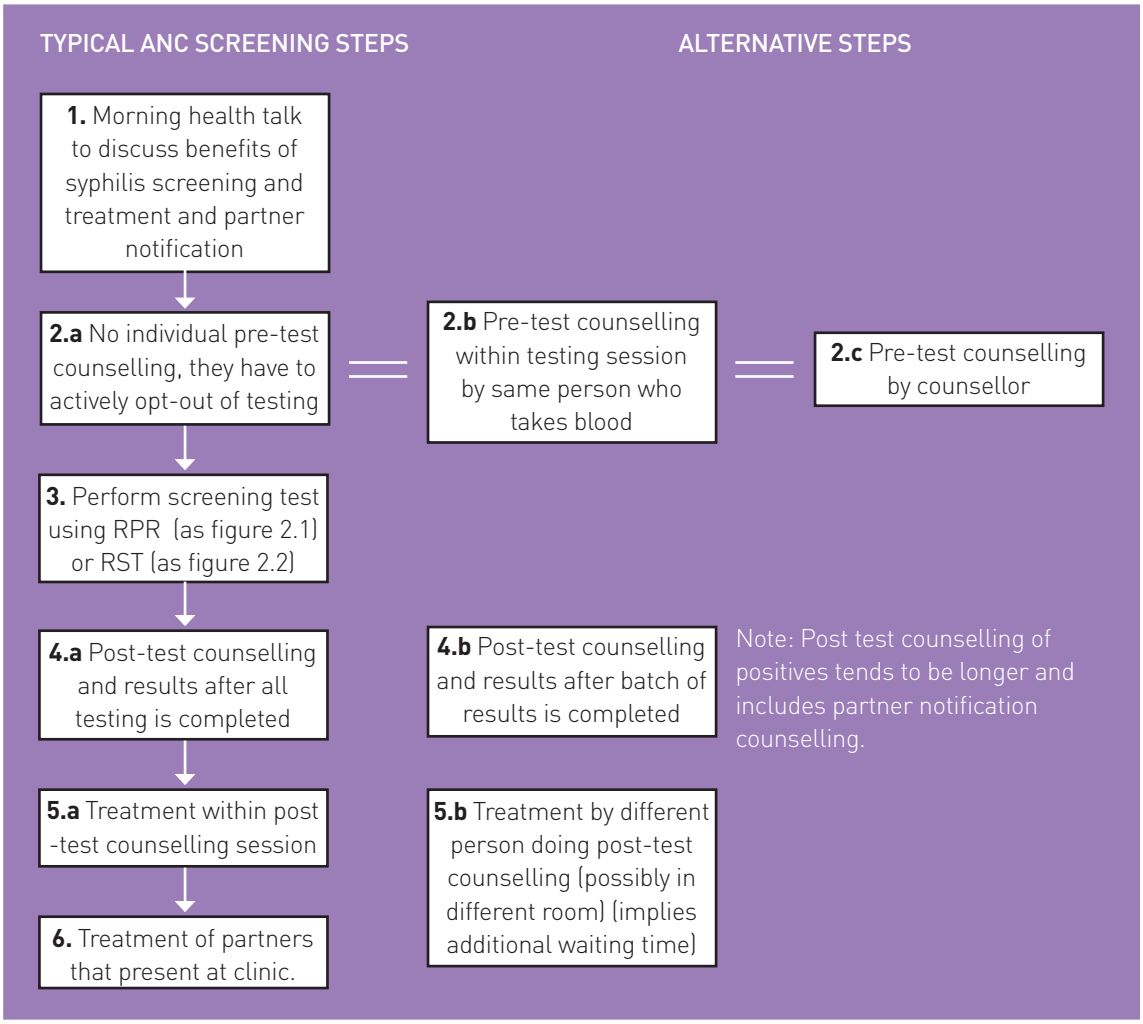
Figure 2.3 Steps to antenatal syphilis screening and treatment



While women arrive and wait to be seen in ANC clinics a health talk is often given. The health talk typically includes general health information for pregnant women, and when syphilis screening is available also includes a component on the benefits of syphilis screening, treatment, and partner notification (step 1). There may be other ANC services offered during this time. The service may assume the woman got all the information needed to accept testing from the health talk (step 2a). Additional individual pre-test counselling may be provided either by the same HCW who does the testing (step 2b) or by a counsellor in a separate room (step 2c). Alternatively, if a special counsellor is used, women may have to wait again for the blood sample to be taken for testing (step 3).

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Once the test is complete, women are given their test results along with post-test counselling. This is often very brief for women testing negative, and longer for those with positive results, which should include partner notification counselling. The timing for test result feedback is an important factor in the cost effectiveness of the intervention. If results are given quickly, more women are likely to remain at the clinic to receive their results. If results are not given until the end of the day, it is more likely that some women will have left in order to attend to other business. The loss to follow-up of women has implications for the costs and cost effectiveness of the intervention, as the opportunity to treat positive women is lost, while the costs of screening for these women are still incurred. Treatment can be performed by the person giving test results. If it is given by a different person in a different room, this may require additional waiting time and introduces the possibility of women not receiving treatment. Lastly, partners should be treated to prevent re-infection. This is usually done presumptively, without testing.

Variables which affect costs

Key variables affecting costs are the type of staff performing the different activities, and any loss to follow-up between the activities. If loss to follow-up is high it may be advantageous to rearrange services to have fewer distinct contact points and a more integrated service delivery model. Use of RSTs can simplify the testing procedure, thereby reducing loss to follow-up.

2.6 Targeting strategies: Syphilis testing within PMTCT settings

Despite being a much older intervention, there is renewed interest in introducing syphilis testing, now as an add-on to existing PMTCT programmes. The nature of the two interventions pose great potential for achieving economies of scope: the target group is the same, both tests require patient education about the potential of perinatal transmission, and both involve a blood test. The key variable that will affect the costs of such projects is the extent to which the activities are done in an integrated manner. Analysis of the cost effectiveness of combining these interventions will require careful consideration in order to define the incremental portion of the intervention and allocate shared costs (see Chapter 3).

2.7 Targeting strategy examples: High risk groups and hard to reach populations

Though ANC is the most widespread of syphilis screening, there are arguments for broad screening among other populations. However, these programmes can vary widely in their screening approaches in practice. In **Box 2.1** an example is given of screening different populations in China and Brazil.

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Box 2.1 Reaching vulnerable populations

China

Reaching out to female sex workers (FSWs)

In China, there has been a very rapid increase in the prevalence of syphilis, especially in areas experiencing economic booms. In Guangdong Province in Southern China primary syphilis rose from 0.88 per 100,000 population in 1995 to 7.61 in 2008 (Yang et al., 2010). This is concentrated among high risk groups, more specifically female sex workers (FSW) and men who have sex with men (MSM). To reach FSWs, an outreach team works in the evenings providing health education and condoms and offering both syphilis and HIV rapid testing.

RPR based screening of FSWs required blood samples to be retrieved and taken back to the lab for testing. Under this strategy, the uptake of screening was low because women were suspicious of what would be done with their blood. Using RSTs the blood is put directly onto the test kit in women's view. This has made women more willing to be tested. For confidentiality, women received their test result by text message on their phone. Due to potential penicillin allergy, it is not possible to treat women on site; women who tested positive were invited into the clinic for free treatment.

Variables that affect the cost and cost-effectiveness

- Strategies to gain access to women are highly site specific and costs will vary widely from one setting to another. For example, it might be necessary to pay brothel bosses to allow the outreach team to talk to women. For street-based FSWs considerable staff time may be required to gain their confidence before providing screening services.
- The density of the population will affect the travel time of outreach workers, i.e. screening all women in a brothel will obtain more economies of scale (thus be cheaper per woman screened) than screening street-based FSWs one by one.
- The need to invite women into clinics for treatment means the rate of women presenting at clinics and the speed with which they present for treatment will greatly affect the cost effectiveness of the outreach programme.

Brazil

General population screening in hard to reach regions

In the Brazilian Amazon, there are many small, very remote indigenous communities which are only periodically reached by health services. A health worker travels by boat, then by foot to reach the different communities. These populations were never previously screened as the RPR test could not be performed in such settings. The introduction of RSTs provided a new opportunity to reach these communities. Population based (both male and female) testing for both syphilis and HIV was provided during the periodic visit of the health worker. All supplies had to be transported in and waste transported out.

Variables that affect the cost and cost-effectiveness

- Transportation costs are important as all supplies must be brought in and waste must be carried out again or managed within the communities. Waste management then needs to be included along with its costs for transportation out of the community.
- Within this indigenous health programme there is a very high staff turn-over, so additional recurrent training may need to be included.
- The wide variation in syphilis prevalence between communities means that though the cost per person screened may not vary widely, their cost effectiveness may.

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3. Concepts of Cost Analysis

This chapter reviews the fundamental concepts underlying cost analyses, and is taken directly from the Costing Guidelines for HIV prevention, with small additions and including more relevant examples. It highlights that there are several choices regarding the type of cost analysis that will be undertaken.

3.1 What are costs?

Economists define a cost as the value of resources used to produce a good or service. However, the way these resources are measured can differ. There are two main alternatives with respect to measurement of these resources: financial and economic costing.

Financial costs represent actual expenditure on goods and services purchased. Costs are thus described in terms of how much money has been paid for the resources used in the project or service. In order to ascertain the financial costs of a project we need to know the unit price and quantity of all the resources used, or alternatively the level of expenditure for these goods and services.

Economic costs are broader than financial costs as these also include the issue of *opportunity costs*, recognising that resources spent means resources foregone elsewhere.

"The basic idea is that things have a value that might not be fully captured in their price. It is not difficult in many health programmes to identify resource inputs for which little or no money is paid: volunteers working without payment; health messages broadcast without charge; vaccines or other supplies donated or provided at a large discount by organisations or individuals" (Creese and Parker, 1994, p.57). Thus the *value* to society of these resources, regardless of who pays for them, is measured by opportunity cost.

Economic costs thus include the estimated value of goods or services for which there are no financial transactions and the price of a good does not reflect the value of using it productively elsewhere. The main ways that financial and economic costs differ is in the way they treat:

- donated goods and services
- other inputs whose prices are incorrect or distorted
- valuation of capital items

The calculation of economic costs will be discussed in detail in Chapter 5.

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The choice of whether to use financial, economic or both approaches depends on the objectives of the analysis. If the purpose of the costing exercise is to compare expenditure against budget allocations or to explore affordability of the project, only financial costs needs to be recorded. In this instance the cost of a consumed resource for which nothing was paid, for example a donated good, is zero. If, however, the purpose of the exercise is to address project sustainability or consider replicating the project elsewhere, the concern will be to record the costs of all resources consumed, whether or not they were paid for from the project budget. In this instance the economic costs of donated goods and services, valued by their equivalent market prices, are used in the analysis. "Analyses using economic costs does thus not replace those using financial costs, but supplement them with additional information useful for decision-making" (Creese and Parker, 1994, p.57). These guidelines recommend estimating both financial and economic costs.

3.2 Whose costs? Society, provider, and household costs

A societal perspective would encompass strategy-related costs incurred by all members of society, including the private sector, the public sector and private consumers (e.g. households and individuals). A provider perspective would exclude costs incurred by consumers or households. A public sector perspective would exclude costs incurred by the private sector and by households and collate only those costs incurred by the public sector in implementing the strategy. These costs can be considered as the costs of providing particular programmes, and are borne by the organisation delivering the services (although this does not mean that the organisation finances the entire cost of the services).

As well as providing funds directly through the payment of user fees, households may contribute to financing service delivery through the provision of goods. For example, if the clinics have stock outs of antibiotics patients may need to purchase their own to be treated. Further costs may be incurred for transportation. The opportunity cost of time (e.g. lost productivity, etc.) may also be considerable; this is sometimes referred to as indirect costs.

Including full household costs would mean including a wider range of private costs, such as travel and time costs. This is generally outside the scope of these guidelines. Module 8 of the Primary Health Care Manual (Creese and Parker, 1994) should be referred to for further information on measuring the costs that households incur in accessing services.

3.3 Full and incremental costs

A full cost analysis estimates the costs of all resources that are being employed in running a project or programme, including basic infrastructure. An incremental analysis looks at the cost of adding or implementing the additional project or programme to existing services and does not attempt to provide cost estimates for existing services. An incremental analysis accounts for the major "new" inputs that are required by the new intervention. However, since it assumes that the organisational infrastructure already exists, an incremental costing will underestimate costs that are of a general administrative nature borne by the organisation, (such as accountancy). These are sometimes referred to as "overhead costs". It is also more difficult to generalise from incremental cost analyses, unless the prior level of existing services and infrastructure is clearly specified.

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The incremental approach is particularly appropriate to use when the intervention or project is not the major component of the organisation's overall cost structure.

The definition of existing services will have an impact on the resulting costs. For example, an analysis of the incremental costs of adding a syphilis screening programme on to a well-functioning HIV-screening programme will exclude all costs that are already accounted for by the HIV programme (such as building space, staff time for the blood draw, etc.). This will result in a lower incremental cost than would be found if the costs for these inputs were shared equally between syphilis and HIV screening.

The availability and ease of data collection as well as organisational structures may heavily influence whether a full or incremental costing is undertaken. This is further discussed in Chapter 4.

3.4 Total, average and marginal costs

The total cost represents the cost of producing a quantity of services or output for a particular project or programme. This can be the result of a full or incremental cost analysis.

The average cost is then the total cost per unit of output, and is calculated by dividing total cost by the units of output produced.

The marginal cost is the additional cost of producing one more unit of output. This should not be confused with incremental costs that look at the additional cost of adding an entire service or project.

Again the purpose of the cost analysis will determine whether to focus on average or marginal costs. If the aim is to look at differences in costs between different providers or clinics, average costs should be compared. If the aim is to look at the impact of expanding services (e.g. number of people tested), then marginal costs need to be considered (Drummond et al., 2005).

3.5 Capital versus recurrent costs

Capital inputs. Capital goods are defined as inputs that last for more than one year. If expenditure is only studied in one particular year, it could be easy to get a distorted view of long-term average annual costs. For example, a great deal of equipment might have been purchased in the year before a project, with no expenditure on capital at all during the project period. One way to estimate the actual resources used each year is to annualise or spread the costs. This is done differently for financial and economic costs. To estimate financial costs, straight-line depreciation is used. This entails dividing the price of the good (or expenditure if it is training or start-up) by the estimated useful life of the good:

$$\text{Financial cost of capital good} = \frac{\text{cost of good}}{\text{useful life}}$$

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With economic costs, straight-line depreciation of capital items is not adequate as the value of alternative opportunities for using the resources tied up in the capital inputs needs to be taken into account.To calculate the economic cost of capital on an annualised basis, use the following approach:

- *Current value*. Estimate the current value of the capital item, as the amount needed to pay to purchase a similar item now (i.e. the replacement value rather than the original price).
- *Useful life*. Estimate the total number of years of useful life the item can realistically be expected to have (from the time of purchase).
- *Discount rate*. Find out the discount rate used by the economic planning office or Ministry of Finance.
- *Calculation of annual cost*. Calculate the annual cost by dividing the current value of the item by the annualisation factor.

$$\text{Economic cost of capital good} = \frac{\text{current value}}{\text{annualisation factor}}$$

The annualisation factor is determined by the discount rate and useful life of the item. Consult a standard table (See Table 3.2) to find the correct annualisation factor. As an alternative to looking up the annualisation factor in a table, the Excel command =PMT (rate,nper,pv,fv,type) will calculate the economic annual costs automatically.
There is a wizard which guides completion of the function. Table 3.1 provides the details on how to use the function for the purpose of calculating annualised capital costs.

Table 3.1 How to use the Excel PMT function to calculate annual economic costs

Function argument	Help definition	What to enter to obtain our annual economic costs
Rate	is the interest rate for the loan	*[discount rate]*
Nper	is the total number of payments for the loan.	*[useful life]*
Pv	is the present value, or the total amount that a series of future payments is worth now; also known as the principal.	*- [current value]* Note: it is -1* the current cost as it is a positive value not a debt for which this function is intended
Fv	is the future value, or a cash balance you want to attain after the last payment is made. If fv is omitted, it is assumed to be 0 (zero), that is, the future value of a loan is 0.	*0*
Type	is the number 0 (zero) or 1 and indicates when payments are due.	*leave empty*

For a single $10,000 piece of equipment with a useful life of 5 years and using a discount rate of 10%, the annual capital cost is as follows:
Financial cost: $10,000/5 years= $2,000
Economic cost: Using Table 3 2, the annualisation factor can be found for a 10% discount rate with a useful life of 5 years: 3.79. Then the annual economic cost is $10,000/3.79 = $2,638 per year (rounded figure).

"The investment of funds up front to pay for the equipment in full at the start of its use raises the annual economic cost." (Creese and Parker, 1994, p. 59-61).

Table 3.2 Annualisation Factors

	Discount Rate																			
n	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	29%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106
4	3.902	3.808	3.717	3.630	2.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870
21	18.857	17.011	15.415	14.029	12.821	11.764	10.836	10.017	9.292	8.649	8.075	7.562	7.102	6.687	6.312	5.973	5.665	5.384	5.127	4.891
22	19.660	17.658	15.937	14.451	13.163	12.042	11.061	10.201	9.442	8.772	8.176	7.645	7.170	6.743	6.359	6.011	5.696	5.410	5.149	4.909
23	20.456	18.292	16.444	14.957	13.489	12.303	11.272	10.371	9.580	8.883	8.266	7.718	7.230	6.792	6.399	6.044	5.723	5.432	5.167	4.925
24	21.243	18.914	16.936	15.247	13.799	12.550	11.469	10.529	9.707	8.985	8.348	7.784	7.283	6.835	6.434	6.073	5.746	5.451	5.182	4.937
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.823	9.077	8.422	7.843	7.330	6.873	6.464	6.097	5.766	5.467	5.195	4.948
26	22.795	20.121	17.877	15.983	14.375	13.003	11.826	10.810	9.929	9.161	8.488	7.896	7.372	6.906	6.491	6.118	5.783	5.480	5.206	4.956
27	23.560	20.707	18.327	16.330	14.643	13.211	11.987	10.935	10.027	9.237	8.548	7.943	7.409	6.935	6.514	6.136	5.798	5.492	5.215	4.964
28	24.316	21.281	18.764	16.663	14.898	31.406	12.137	11.051	10.116	9.307	8.602	7.984	7.441	6.961	6.534	6.152	5.810	5.502	5.223	4.970
29	25.066	21.844	19.188	16.984	15.141	13.591	12.278	11.158	10.198	9.370	8.650	8.022	7.470	6.983	6.551	6.166	5.820	5.510	5.229	4.975
30	25.80	22.396	19.600	17.292	15.372	13.765	12.409	11.258	10.274	9.427	8.694	8.055	7.496	7.003	6.566	6.177	5.829	5.517	5.235	4.979

N=Number of remaining years of useful life

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3.6 Joint costs

The resources that are being costed may not be fully used in the specific project or programme that is being examined (e.g. a person may be working on a number of projects, some not dealing with syphilis screening and treatment). They may be used jointly with other on-going projects, such as PMTCT programme or general ANC. In this case, a decision needs to be made about what proportion of the resources should be allocated to the specific project or programme that is being costed. The way the resources should be allocated will vary according to the type of resource. This will be discussed further in Chapter 4.

3.7 Adjusting for inflation

Inflation is the process whereby the general price level is rising and money is losing its value, i.e. a dollar in 1900 is not the same as a dollar in 2015. As expenditures many not all occur in the same year (e.g. start-up, equipment purchases, etc.), it is often necessary to adjust for inflation. This allows one to make calculations with costs from multiple years, e.g.: to estimate total costs for a project spanning multiple years; it makes the costs from different years comparable; it allows one to understand if differences in costs are due to differences in real resource use or just differences in price levels; and is necessary to predict future costs.

To adjust for inflation, the cost must be multiplied or divided, depending if the adjustment is to the future or the past, respectively, by (1+ inflation rate) for each year of adjustment. When using an average inflation rate over a number of years, you can use a short cut and have the years as the exponent of (1+inflation). For example adjust $10 in 2009 USD with the average inflation rate between 2005 and 2010 being 5%:

From 2009 to 2010: $10*(1+inflation rate)$^{\text{years of adjustment}}$ =$10*1.05^{1} =$10.50
From 2009 to 2005: $10/(1+inflation rate)$^{\text{years of adjustment}}$ =$10/1.05^{4} =$7.83.

Inflation rates are presented as either a consumer price index or a GDP deflator - either can be used. These can be obtained from the countries' central bank statistics, IMF statistics, or the World Development Report. For more details on inflationary adjustments see Kumaranayake (2000).

3.8 Classification of costs

To estimate a health programme's costs, it is necessary to classify its components. Cost items can be broken down in several ways, as illustrated below. A good classification scheme depends on the needs of the particular situation but there are three essential rules:

- It must be relevant to the particular situation.
- The components must not overlap.
- The components chosen must cover all possibilities.

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Resources used for programmes can be described in many different ways. For example, a syphilis screening programme might be described as using the following items: personnel, money from external sources and community mobilisation. These categories are well defined and their meaning is clear. However, they do not constitute a very useful way of thinking about the resources used in this programme. The main problem is that the categories overlap; money from external sources can be used to pay for personnel, and personnel are likely to be involved in community mobilisation activities. If the value of these three categories are added up, they may well come to more than the total cost of the programme.

One reason why the categories above are difficult to use is that they confuse different dimensions of resources. Activities (in this case 'community mobilisation') are mixed with sources ('money from external sources') and physical inputs ('personnel').

The main type of cost-classification is by inputs. Inputs are considered as either recurrent items (those that are used up in the course of a year and are usually purchased regularly) and capital items (those that last longer than a year). A scheme for classifying costs by inputs (with examples of each category) is shown in the box below.

Box 3.1 Classification of costs by inputs

Capital costs

Start-up and Training Costs

- Start-up activities: activities of which the benefits are likely to last the life-time of the project such as production of materials, recruitment of staff
- Community mobilisation: e.g. publicity campaigns that occur only once or rarely
- Training: training activities for personnel that occur once or rarely

Other Capital Costs

- Vehicles: bicycles, motorcycles, four-wheel-drive vehicles, trucks
- Equipment: refrigerators, sterilisers, manufacturing machinery, scale
- Buildings: health centres, hospitals, training schools, administrative offices, storage facilities

Recurrent costs

- Personnel: supervisors, administrators, lab technicians, casual labour and volunteers
- Supplies: drugs, vaccines, syringes, educational materials, condoms
- Vehicles, operation and maintenance: petrol, diesel, lubricants, tyres, spare parts, registration, insurance
- Buildings, operation and maintenance: electricity, water, heating, fuel, telephone, telex, insurance, cleaning, painting, repairs to electrical supply/appliances, plumbing, roofing and heating
- Training, recurrent (e.g. short in-service courses)
- Community mobilisation
- Other operating costs not included above

Other possible ways of classifying components are by:

- Function/activity
- Organisational level (e.g. national, district, community)
- Source of funds (e.g. national and local governments, donors, non-governmental organisations).

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3.9 Measurement of outcomes, unit costs and cost-effectiveness

In general, we can classify three types of outcomes:

- Primary outcome, which measures the final effect or impact on health status due to the intervention of the project
- Intermediate outcome, reflects intermediate changes due to the intervention of the project, necessary before there is a health impact
- Immediate or process measure, which measures the activities of the intervention

For syphilis screening and treatment interventions, the primary outcome depends on the aim of the programme. For ANC screening programmes the primary outcomes tend to focus on averting the impact on the baby, i.e. averting stillbirths, neonatal deaths, low birth weight births, and congenital syphilis cases. These can be modelled relatively simply using estimates of the relative probability of these birth outcomes in untreated maternal syphilis. When targeting remote communities, as in the Brazilian example in **Box 2.1**, the main focus is on averting congenital syphilis; however, adults have little access to alternative sources of treatment and the project may want to consider the impact of adult infections treated as well. In high risk populations, the main project aim is to avert adult infections; this is where the adult outcomes become crucial to portraying its cost effectiveness.

There are a number of practical problems in determining the number of syphilis infections averted. First, the most direct way to measure infections averted is through clinical trials, which are both expensive and rarely implemented, and randomization is not possible for ethical reasons. Second, in order to calculate the full impact of the intervention, both infections averted for those people involved in the intervention as well as secondary infections averted, because the chain of transmission has been broken, need to be considered. This requires information about the epidemiology, behavioural patterns and transmission efficacy in the specific population.

To address some of these challenges, intermediate or process outcome measures have been used. **Table 3.3** discusses the strengths and weaknesses of the different measures that have been used in measuring outcomes of syphilis screening strategies. Using intermediate outcomes, DALYs averted can be estimated and disease transmission models can be developed. Model-based evaluation has developed as a means of estimating syphilis infections averted. These models attempt to capture the dynamic nature of this transmission, as well as epidemiological and behavioural patterns. The models are used to provide simulations about the possible impact of syphilis screening strategies on the total number of syphilis infections averted (including secondary infections) (Watts et al). The development of the models can be quite complex.

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Table 3.3 The Strengths and Weaknesses of Different Outcome Measures

Outcome measure	Strengths	Weaknesses
Numbers tested for syphilis - process outcome measure	■ Ease of collection, these measures are often part of routine monitoring of programmes ■ Reflects operational efficiency of programme ■ Can identify most efficient method of delivery	■ No measure of impact on syphilis transmission ■ Does not account for variations in populations' syphilis sero-prevalence ■ Gain achieved may not reflect real change in impact
Number of cases treated - intermediate outcome measure	■ Relative ease of measurement and interpretation ■ Reflects operational efficiency of programme ■ Can identify most efficient method of delivery	■ No measure of impact on syphilis transmission ■ Gain achieved may not reflect real change in impact
Syphilis infections averted or Adverse birth outcomes averted (stillbirths, neonatal death, low birth weight, congenital syphilis cases) – primary outcome	■ Comparisons across different testing and treatment strategies are possible ■ DALYs can be derived easily with adequate information on age at incident infection and life expectancy	■ Unable to compare across health interventions ■ Unless measured through randomised controlled trials, may need sophisticated modelling to assess impact in general population
Disability adjusted life years (DALY) averted - primary outcome	■ Cross-sector, cross-programme and cross-intervention comparisons are possible. ■ Ability to assess impact of combined clinical management and prevention strategies ■ Morbidity and mortality effects combined in one measure ■ Ability to measure consequences of clinical management when death is certain outcome	■ Based on subjective measures of disability ■ Possible over simplification ■ Derived from and dependent on the primary outcome of the intervention ■ Debate over their validity ■ Not widely recognized outside the health sector ■ Would not traditionally incorporate stillbirths

Source: Adapted from (Kumaranayake, Pepperall et al. 2000).

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3.10 Average costs and cost effectiveness

Given the variation in outcome measures, there can be a number of average costs derived for a particular project or programme. Average costs using primary outcomes tend to be referred to as cost effectiveness. For example, let us assume that the total costs of an ANC screening and treatment project were $30,000 for one year, where there were 10,000 women tested in that year, of which 1040 women were correctly diagnosed and properly treated. Given the estimated adverse birth outcomes in untreated syphilitic pregnancies from **Table 2.1**, an estimated 503 (=1040*48.7%) adverse outcomes would be averted through treatment. For this intervention the following type of average costs could be derived:

- an intermediate service or process (output): cost per woman tested
  = $30,000 / 10,000 women
  = $ 3.00 per woman tested

- an intermediate effect: cost per woman treated
  = $ 30,000 / 1040 women treated
  = $ 28.85 per woman treated

- a primary outcome on health status: cost per adverse birth outcome averted
  = $ 30,000 / 503 adverse outcomes averted
  = $ 59.60 per adverse outcome averted

It may be possible to calculate average costs by activity within a project or programme if activity-specific outputs are available (for example if we know that training activities cost $5000 and there were 60 people trained, then the cost per person trained is $83.33). In practice, the calculation of the final impact can be quite difficult and depends on the nature of the strategies being considered. For a strategy such as ANC syphilis screening it is possible to estimate the adverse outcomes directly prevented. However, to estimate the number of secondary infections averted requires model-based evaluation. Thus for most studies process or intermediate average costs are often presented (e.g. cost per woman treated). However, it is recommended that the calculation of average cost should try and use outcome measures that are closer to the health impact end of the spectrum. Thus for the syphilis screening projects, reporting 'costs per true syphilis case treated' will be more useful in terms of extrapolating health impact than 'cost per woman screened'.

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3.11 Cost-effectiveness analysis (CEA)

"Cost effectiveness analysis is a tool which enables programme managers to make informed decisions about resource allocation. By measuring and comparing the costs and consequences of various interventions, their relative efficiency can be assessed." (UNAIDS, 1998)

The key feature of cost effectiveness analysis is that it is used to examine alternatives which all meet the same objective. The results of the analysis are described in terms of the cost per unit of effectiveness for each alternative. The cost effectiveness ratio is calculated for each alternative by dividing cost by the unit of effect (e.g. congenital syphilis case averted). Then a comparison of these ratios is made. "The alternative with the lowest cost per unit of effectiveness is the most cost-effective and is generally to be preferred on grounds of economic efficiency" (Creese and Parker, 1994, p. 67). "Cost analysis is one of the key building blocks for cost effectiveness studies and unit costs based on intermediate outputs can be thought of as preliminary cost effectiveness results, more ambitious cost effectiveness analyses are directed at health status impacts" (ibid p. 54). More detailed discussion on undertaking and interpreting cost effectiveness analysis are available from a number of sources (Creese and Parker, 1994, Drummond et al., 2005, Rowley and Anderson, 1994, Phillips et al., 1993).

In the context of introducing rapid syphilis tests, cost and cost effectiveness analysis can help consider how rapid syphilis tests can contribute to reduce the burden of disease of syphilis in adults and congenital syphilis in a range of diverse settings and help prioritise the optimal screening strategies. Moreover, the collection of site specific costs generates data necessary to model the costs of scaling projects up regionally or nationally. It will also contribute to exploring the best use of optimal screening techniques (rapid tests versus RPR, where feasible) and more generally aid decisions about the best use of present and new resources for antenatal screening and/or STI/HIV interventions.

This chapter has covered the basics of cost analysis. The rest of the guidelines are geared specifically toward the data collection and analysis of the costs of screening strategies: syphilis screening using rapid tests and its comparator screening using the RPR test or no syphilis screening. Consideration will also be given to joint HIV and syphilis testing services.

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4. Planning the Costing Exercise

4.1 Overview

The following three chapters will discuss the planning and collection of data and analysis of costs. The general steps to costing are:

1. Define the question, objectives and scope of the analysis
2. Understand how the intervention works
3. Determine inputs used to implement the intervention
4. Attach costs to each input
5. Analyse the data

To encourage a consistent approach to costing syphilis screening and treatment interventions, standard worksheets for field use are provided in Annex 1. An Excel spreadsheet version of these tables is available on the accompanying file. These worksheets can be used directly on paper, or form the basis for creating spreadsheets in Excel. In the next three chapters we discuss in detail how to use these forms. The forms have been developed to allow cost data to be built up in the field, but where accurate expenditure data are already collated and available they can be entered into the forms directly. An example of a completed costing exercise with its costing sheets is also available in the accompanying file POC cost sheets example. These can be helpful to guide one through the necessary calculations. To view the formula you can press CTRL and ` .

4.2 Defining the question, objectives and scope of the analysis

Analysis of the costs of syphilis screening strategies may be undertaken for a number of reasons. Before making preparations for a costing study, a manager should be clear about the questions s/he is seeking to answer, the purpose of the planned work and the use to which the work will be put. These will help to establish the boundaries for the costing exercise.

Objectives of a cost analysis can include considering the programme's:

- efficiency
- sustainability
- scale up

The following sections discuss these in more detail.

4.2.1 Examining the efficiency of a project

The objectives of the costing exercise may be to analyse on-going costs of an established project to identify potential cost savings and to improve the efficiency of the service. Within a programme, a manager may want to analyse expenditure by input to understand which areas of the programme are high or low spending. In this case start-up costs may be excluded.

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4.2.2 Modification/Sustainability

If the initiative to conduct the costing exercise is coming from the programme itself, managers may want information for one, or a combination, of the following objectives: improving budgeting; monitoring costs; planning improvement of the current system, and improving the future of the strategy. A manager may, for example, be particularly concerned about the sustainability of the syphilis prevention programme and be seeking an accurate estimate of the budget necessary to maintain it. If charging for services is an option, information on costs can help to establish appropriate prices. Cost analysis may also be used in discussions about the feasibility of scaling up/expanding the programme. If sustainability is the main concern, start-up costs can be excluded. If the expansion of a programme is being considered, there may be aspects of start-up activities that need to take place and should therefore be included in the analysis.

4.2.3 Replication

If the impetus for the costing exercise is coming from outside the programme, objectives are more likely to concern replicability of the programme and extrapolation of results to other situations. However, local managers will probably give considerable time to the field work phase and it is important that the resulting data are also of use and value to them.

If the objective is to provide information on the total costs of the strategy with a view to replication, both on-going and start-up costs should be collected. Start-up costs include any development and production of training materials as well as dissemination of diagnostic and treatment protocols and equipment, IEC, and recruitment of workers.

4.3 Identify the alternatives to be compared

Though for costings, it is not necessary to compare the costs with alternative interventions or programmes, it is the core of cost effectiveness analysis. For syphilis screening programmes there are three main alternatives that can be considered: syphilis screening using the RPR tests, screening using RSTs, and no syphilis screening. It is important to realize that doing nothing is also a valid alternative. When the comparator has been identified, each must be described in detail as done in Chapter 2. Furthermore, screening can be implemented independently or jointly with HIV testing. The degree of integration with HIV screening will have implications for cost, and should be clearly identified.

4.4 Decide on the data timeframe

"Usually, you should attempt to measure the costs incurred over one full calendar year. This is likely to be consistent with the records of most types of relevant data, such as expenditure on personnel and services provided. A one-year period avoids any distortions that might be caused by seasonal effects. Occasionally, limitations of information, e.g. for a new programme, or the duration of the research study might make it necessary to choose a shorter period. If you study costs for less than one year, you will probably need to discuss ways of avoiding serious distortions with other knowledgeable persons.

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In general it is recommended that to enhance accuracy and relevance of cost data, you should choose the most recent year for which cost data are likely to be available. If the year chosen is too far in the past, important information may be lost. If the year is too recent, some routinely collected statistics may not yet be available. Sometimes the financial year (the period for which routinely collected expenditure data are summarised) is not the same as the calendar year (the period for which output statistics are likely to be aggregated). If this is the case, see whether it is possible to obtain disaggregated data for each month covering costs or output, so that you can construct either annual output data for the financial year or expenditure figures for the calendar year." (Creese and Parker, 1994, p. 26). If data are being collected for more than one year, care must be taken to track the timing of expenditures. Remember to collect outcome data over the same period as the cost data.

When undertaking a costing exercise, cost data can be collected retrospectively from such sources as accounting records, questionnaires and interviews. Alternatively, information systems can be specially established to collect costing data prospectively over a suitable time period. Once collected, these data will also be analysed retrospectively.

Costs are likely to vary during the course of a project's implementation, especially if there are high initial start-up costs. These costs are associated with activities conducted at the beginning of a programme and rarely repeated, such as staff recruitment or training. For example, development of standard diagnostic protocols may be one of the start-up costs of a STI treatment strategy. If start-up costs are being included in the costing, they should be treated in the same way as capital costs and annualised over the expected lifetime of the project.

Different timeframes for data collection may be chosen according to the objectives of costing studies, in particular:

- Concern with operational efficiency and modification of on-going projects may mean that start-up costs can be ignored and only on-going recurrent and annualised capital costs collected. If only on-going costs of regular services are being considered, it is recommended that annual costs be collected for a recent appropriate year. They should include recurrent costs and annualised capital costs.

- If the study is seeking information on total project costs, costs should be recorded for all years in which they were incurred. These costs will include start-up costs such as planning, staff recruitment and project site identification.

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- If the costing exercise is addressing future modification or sustainability of the project, the costs of on-going activities (including depreciation of capital inputs) should be collected from a routine phase of the project. These should be costs for the most recent year for which data are available. If costs are taken from a period early in the project it is important to exclude one-off start-up costs that would inflate estimates of the resources needed to sustain the project in the future.

- If information is required on the costs of replicating the project, all costs incurred over the history of the project since its inception should be collected. This includes both start-up and on-going activities. Costs incurred in all years of the project should be recorded, including the costs of organisational changes made as part of the syphilis prevention strategy.

- The selected time-frame may also depend on the maturation of the project. If the strategy is of limited duration, a costing exercise may want to encompass all costs, including those incurred by start-up activities. If the strategy has become institutionalised and is now an established operation, the costing exercise may be interested in investigating on-going costs only.

To undertake cost effectiveness analysis it is important that data on both costs and effectiveness are linked in such a way that only the incremental costs of those resources that produce the incremental effects are measured. It is usually recommended practice to estimate both costs and effects over the period of a year. Nonetheless, consideration needs to be given to what is most appropriate for a particular strategy. One year of cost data may be appropriate for prevention activities that are on-going, for example blood screening programmes. However, in some strategies, such as mass media campaigns, costs may be incurred over a shorter time period and effects may happen over a longer time period in the future. In all cases it is essential that a record be made of the timeframe that data refer to.

If cost data have been collected from more than one year, it will be necessary to convert them to a constant Base Year value (i.e. adjust for inflation) before adding them together. The chosen Base Year should normally be the most recent year for which data are available.

4.5 Select a sample

Sometimes it may be necessary to cost a national programme that consists of geographically widespread and multiple units, for example a national blood transfusion service or STI programme. In this case it may be practicable to cost only a sample of facilities from each organisational level or levels. Even when costing a more localised project such as a peer education project, it may be necessary to use sampling, for example to sample time allocations of representative members of staff during representative weeks of the year.

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TIP-OF-THE-TRADE: Selection of samples

"There are several ways in which you can make your selection. Usually, in taking a sample, you are not just interested in the particular units you select. You wish to be able to draw conclusions about the population as a whole. If this is the case, there are certain rules you must follow. Statisticians have devised many different approaches to satisfy the conditions necessary to allow valid conclusions to be drawn about the population from samples. Four of these approaches are described below. For each of them, the size of the sample drawn will influence the degree to which inevitable statistical variation will affect the confidence to be placed in the estimate for the whole population. Disregarding expense and other problems, the larger the sample, the greater the confidence (i.e. the smaller the range of probable error). Another factor is the extent of variation among units of the population; smaller variations permit a smaller sample size. You might wish to consult a statistician about these matters.

One of the customary approaches to selection is random sampling. This is a good technique to use if you can feasibly list (and number) all the elements of the entire population and if there are no subgroups you are particularly interested in. You could, for instance, use it in selecting health centres within a district. Having decided on the sample size, you would select the required number of units at random from a numbered list, using a table of random numbers.

Systematic sampling is a second approach. It is easier to use than simple random sampling, and is most useful when there are large numbers in the population (say, patients attending a hospital).
The procedure is as follows:

- Obtain a list of all the units (n) (in no systematic order) from which the sample is to be selected.
- Decide on the size of the sample *(s)*.
- Calculate the ratio *n/s* (= k). Select every kth item on the list, starting at any point. For example, say you want a sample of *50* patients (i.e. *s = 50*) out of 2000 attending the clinic in a year (i.e. n = 2000). Then k = 2000/50 = 40, and you would then select every 40th patient. If *s* does not divide exactly into n. e.g. k = 40.54, then round k up or down to the nearest whole number.

If you were interested in the health centre costs of a PHC programme in the country as a whole, studying a random (or stratified) sample would probably require a lot of travelling and effort, since these units are likely to be widely dispersed. An alternative approach is to first select a sample of districts and then to look at the health centre costs only in those districts. This is called *cluster sampling*. It gives less valid results than pure random sampling, but can have major logistic advantages. First select a random sample to determine the clusters (in this case, districts) to be studied; then, in the selected clusters, either select all the units (health centres) or a random sample of them.

A fourth approach with a formal statistical basis is *stratified sampling*. You may wish to ensure that you include units with particular characteristics in your sample (e.g. health centres in both rural and urban areas), so that you can compare them. To do this, first divide the total population (in this case, all the health centres) into subgroups (urban and rural); then take a random or systematic sample or even a clustered sample in each subgroup.

While the mathematical merits of the above approaches are well known to specialists, there are situations when a less formal, but more practical, sampling technique might be used, which may be referred to as *judgement sampling*. In a substantial number of practical cases, barriers to statistical sampling might exist, for example excessive costs or limited co-operation from staff in specific delivery units. When one of these problems occurs, random sampling may not be possible, and you may need to use your own judgement to select a reasonably typical group of units for study. The practical advantages of this method are evident, but the inability to draw general conclusions about the entire population on a formal statistical basis is a clear drawback to the use of a judgement sample. It is offered as a less than ideal, but occasionally practical, approach to the task of choosing your sample" (Creese and Parker, 1994, p. 27-28).

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The basis upon which any sample is selected should be explicitly reported in the presentation of results. When the costs of the sample facilities or activities are analysed, it will be necessary to multiply these data up to acquire costs for the population that the sample represented.

4.6 Work Itinerary

"Three important ground rules in the process of data collection are:

- Collect the information at the highest organisational level at which it is available for main service delivery (if it is of reasonable quality) to minimise study time and expense.
- Be careful to avoid counting the same cost element (input) twice ("double counting") when you have obtained data at more than one level (for example, when staffing or salary figures have been provided at both the delivery-unit and higher levels).
- Put your greatest efforts into finding (and using) information on the largest input categories (such as personnel costs rather than the smaller, less important categories (such as building operation in most programmes). The latter can often be handled by rough calculations, perhaps based on rules of thumb, such as assuming operating costs of buildings to be equal to a certain percentage of their annual capital costs" (Creese and Parker, 1994, p.29).

4.7 Analysis plans: country examples

Table 4.1 present the draft economic analysis plans from Tanzania, Uganda and Zambia and China. Such an overview is extremely helpful in defining the programme and its boundaries for the economic analysis.

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Table 4.1 Summary of project from an economics perspective

A.Cost effectiveness analysis plan: Uganda, Zambia, and Tanzania

Project description	The overall goal of this project is to reduce disease burden associated with syphilis in pregnancy. The project has three primary objectives: (1) To determine the feasibility of increasing access to antenatal syphilis screening along with rapid HIV testing using a Same-Day Testing And Treatment (STAT) strategy; (2) To determine the acceptability of introducing rapid syphilis testing for control programmes to health care providers and clients; (3) To determine the cost-effectiveness of introducing quality-assured rapid syphilis testing into existing ANC and PMTCT care facilities.
Costing analysis aims to address	(1) Estimate unit costs per woman screened and per woman treated; (2) Assess the incremental cost-effectiveness of introducing rapid syphilis testing in antenatal care and PMTCT programmes.
Target Population	Pregnant women initiating their 1st visit to ANC and their male partners
Scope	(1) Incremental to the HIV screening programme; (2) Joint costs of HIV and RST testing.
Perspective	Provider
Cost type	Financial and economic
Time frame	1 year (Start-up 3-6 months; Intervention 12 months)
Outcomes	Number of women treated for syphilis
Site selection	Combination of health facilities at hospital, health centre, and dispensary level. Selection based on urban/rural setting, high/low clinic volume, and high/low syphilis prevalence.
Site Specific Issues and Challenges	Project issue ■ Motivating staff for extra work, especially where RPR was not done before; Economic evaluation issues ■ Deciding the sample size; ■ Training research assistant to collect and follow cost data; ■ Following requisitions at smaller clinics; ■ Allocating time between joint syphilis and HIV activities.
Assumptions	■ Incremental analysis, therefore, no building capital costs (already existing); ■ In PMTCT sites, rapid syphilis testing programme will be an "add-on" to existing rapid HIV testing. Therefore, while costs are shared jointly it will not be an even split and need to observe clinic setting to estimate extra supplies and labour time shares; ■ In non-PMTCT sites, syphilis testing may be a new programme or be a replacement of RPR.

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B. Cost effectiveness analysis plan: China

Key question analysis aims to address	To determine the incremental cost-effectiveness of introducing rapid syphilis testing into existing medical care facilities, outreach services and other intervention strategies in prevention and control of syphilis.
Target population	■ Women attending antenatal care ■ High risk population (female sex workers (FSWs), patients attending STI clinics)
Setting	■ Township hospitals and ANC clinics where syphilis testing was not possible prior to the introduction of RSTs. ■ Pregnant women attending maternal and child (M&C) hospitals where testing happened using TPPA.
Perspective	Government/ Provider
Cost type	Financial and economic cost
Timeframes	Start up and Year 1
Estimated intervention scale	■ 1 STI clinic. ■ 1-2 township hospitals site. ■ One maternal and child hospital.
Outcomes	■ People tested. ■ People treated. ■ True cases treated. ■ Syphilis infections averted. ■ DALYs averted.
Comparator	■ Comparison of FSW served by outreach service alone with outreach service plus rapid test. ■ Comparison of STI clinic attendees selected for syphilis test with universal screening.

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Chapter 5. Data Collection

5.1 Data collection approaches

To understand how the intervention works, a number of data collection approaches may be applied. The data tend to be easiest to collect through interviews, observations and reviews of the routinely collected register data and accounts. To facilitate interaction with providers it tends to be best to start with the interviews and observations, and then move to reviewing the registers and requesting cost data from the accounts office.

During the interviews and observations, one aims to understand the client flows and the inputs used at each step of the testing and treating procedure. A similar description is expected for each clinic included, highlighting the differences in procedures (i.e. what is done by whom using how much of what). Reviews of project documents, client registers and accounts are used to supplement the description of the intervention, to collect project outputs, and inputs and prices.

5.1.1 Interviews

Who to interview?
Generally, the different staff members involved in syphilis testing. Remember before starting to always greet the person in charge of the clinic/ screening site and explain the study.

When to interview?
This can be done in between clients, while doing observations; alternatively interviews are very suitable to being undertaken during the afternoons when clinics tend to be quieter.

What to ask?
For each clinic aim to write a detailed description of intervention activities. To do so, it is helpful for the clinicians to describe in detail each of the steps. During this description, notes on all inputs can be taken either into a notebook, or the worksheets can be printed out and used as data collection forms. This can be a handy way of organizing the interviews, and having prompts about what to ask. It is also helpful to ask about where and from whom prices and quantities for each input can be obtained.

5.1.2 Observations

Observation of clinical practice is used to understand in detail how the programme works. It also allows for taking an inventory of inputs used, and gives an impression of the staff time allocated to the different steps of the intervention. Observation of actual clinical practice may not always be feasible/ethical; as an alternative to actual observation of the client provider interaction, it is reasonable to ask the clinician to talk the health economist through the intervention. It is often helpful to role play the intervention. During site visits, inventories of equipment can be taken (including checking they are working) and room sizes can be estimated.

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5.1.3 Review of project documents

Project documents provide many valuable sources of data. Minutes from project meetings with stakeholders provides one of the costs of starting up the intervention. Financial costs include the direct cost in running the meetings (such as per diems, catering, and transportation). Don't forget to include participants' market wage rate in the economic cost of the meetings. Routine monitoring and evaluation reports can provide the intermediate output and process indicators needed to estimate unit costs. These are also obtained from clinical registers.

5.1.4 Time and motion studies

Time and motion studies aim to determine how to allocate staff times across different activities. There are a number of different ways to collect this data.

1. Researcher measured: A researcher observes the provider in their full day of activities. The advantage is that it can be quite detailed. The disadvantage is that it is very expensive to collect many observations. In particular, one might not observe time spent on activities that are rarely undertaken (e.g. treatment in low prevalence areas).
2. Provider measured: a timesheet is kept for the different activities the staff member undertakes, either for a day or a week, depending on how much variation is in their activities. This can be done a few times over the year to account for seasonality and/or variation in patient numbers.
3. Researcher elicited: Ask providers how much time they spend on average on all their different activities.

The allocation of personnel time for each activity is then: $\frac{\text{activity time}}{\text{direct patient time}}$

REMEMBER: The denominator of the time allocation percentage is direct patient time. This is not the same as the average working day of a provider. Providers might spend on average 5 hours with patients and do many other non specific activities such as paper work and management. This can be seen as a type of 'overhead' on salaries and must be included. It is for this reason that we use 'time spent on syphilis screening and treatment'/'direct patient time'. This will give a fairer, albeit higher, estimate of time spent on the intervention than if the full number of hours worked in a day is used.

5.2 The costing sheets

From the above data collection approaches a detailed description of the service will have been written. By the time unit costs are being entered, the first column in the costing sheets, with the inventory of all the inputs used for the intervention, will already be completed. These categories follow standard costing methods in economics. The costing forms from CGHPS have been adapted to include a few new forms: training, waste management, and quality assurance. Please do remember that these are tools that should be sufficiently flexible for adaptation for your use. The Excel format has no formulae in it and rows can be freely added for other inputs.

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There are three main sets of forms:

Start-up
S1a and S1b) Training
S2a and S2b) Other start-up

Capital
A) Buildings and storage
B) Equipment
C) Vehicles
D) Other capital costs

Recurrent
E) Personnel
F) Supplies
G) Vehicle operation and maintenance/transportation
H) Building operation and maintenance
I) Recurrent training
J) Waste management
K) Quality assurance
L) Other recurrent costs

Other cost information
PC) Private costs: Patient fees

These are then compiled in the summary sheet that provides the cost profile. In addition, there are a few more worksheets in the Excel file:

Background: This provides a space to put standard programme information such as location, data collection period, base year, exchange rates, discount rate used.

Assumptions Log: Though assumptions/decisions made during the work seem perfectly logical, they are very easy to forget and can then be difficult to reconstruct. Linking the cost sheets back to the assumptions made will also make it easier to change these assumptions in the sensitivity analysis. For example, one might put the full time allocations estimates of different staff members here.

Project Outputs DALY Inputs: This worksheet provides a template for collecting project outputs and estimating the impact of the intervention in terms of adverse outcomes averted and links to the **DALYs** sheet.

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TIP-OF-THE-TRADE: Activities as Inputs

Another cost which may appear as an input category is start-up activities. Although this is really an activity, adding activities to the input list can be justified in certain cases. "If one activity is clearly separate from the others, both financially and administratively, it may be easier not to attempt to break it down into its component physical inputs, but merely to record the total cost. For example, start-up, training, consultancies and quality assurance activities are treated as categories of inputs and included along with personnel, vehicles and the like. When this is done, it is assumed that all the resources required for the activity (e.g., personnel and vehicles) are included in that category (e.g. training) and not under the separate categories of personnel, vehicles, and so forth. Thus, the full cost of all inputs used for these activities is estimated and used as the value for that category" (Creese and Parker, 1994, p. 9). Start-up, training and quality assurance activities whose impact is expected to last more than one year are treated as capital items.

5.3 Training and start-up costs

All costs for start-up and training activities are treated in the same way as capital costs, i.e. annual costs need to be calculated, because the duration of the effect is generally longer than one year. As explained in the section on capital costs (section 3.5), these costs should be estimated for one year using straight-line depreciation for financial costs, and an annualisation factor for economic costs.

5.3.1 Training (Forms S1a and S1b)

Training is treated as a separate category because it has a relatively high impact on the cost estimate of the start-up (and in some programmes on the recurrent costs as well) and is helpful as an output in itself that can feed into programme planning.

Central costs aggregate all capital, transport and supply costs incurred by the implementing organisation or at the central level. Several details about personnel payment should be taken into account in form S1b.

Financial costs

- Rent (if rented), occasional hire fees.
- For transport, be sure to include any fuel and maintenance expense.
- Include any other training supplies used for this activity, even if it is not detailed in the form.
- If per diem payment or subsistence is paid by year (included in the salary), divide them to get a day rate.
- Efforts need not be made to cost the capital overheads of other organisations with partial involvement in the strategy. Any agency to which work is contracted out is in any case likely to include a proportionate share of its overheads, including buildings, in its fees.

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Economic costs

- Use of some premises may be provided free of charge; their value can be estimated in a similar manner. See Building and Storage costs below for details on estimating costs for the training venue.
- When entering data assigned to Equipment, double check if all items have been included such as video cameras, televisions, video players, slide projectors, flip-chart, overhead projectors and computers. If owned, then the cost of hiring the equipment is the economic value of their use.

Allocation

Often training may be undertaken for a whole region, with more participants than those who are active within the specific programme sample being costed. The total training costs can be divided by the number of participants to obtain an average per person training cost, which can then be allocated as to the clinic by its number of participants.

5.3.2 Other start-up (Forms S2a and S2b)

Use forms S2a and S2b to report other start-up costs, including consultancies, building and storage costs, equipment, vehicles, supplies and other costs.

5.4 Capital costs

5.4.1 Buildings and storage (Form A)

In syphilis screening programmes, the incremental building costs are likely to include clinical space and storage. Form A can be used to record this value: each building being used should be listed in the buildings/storage space column. There may also be field offices located in other cities, whose costs should also be counted. The actual annual rent or equivalent rent for a similar unfurnished building should be recorded in its column. Ten percent (10%) of the annual rent price can be recorded to cover the costs of furnishings, or the actual value if known. The total of these two costs can then be summed to obtain annual cost for each building.

Financial cost

- Annual rent (if rented).
- If there are buildings that are only hired occasionally for implementation of the strategy, the hire fees over the course of a year should be recorded.
- If owned, an estimation of the annual price charged for renting similar space should be recorded. The estimate should distinguish between furnished and unfurnished buildings and between air-conditioned and non-air-conditioned space.

Economic cost

Use of some premises may be provided free of charge. Although this entails no financial cost to the project itself, the provision of such premises does represent an economic opportunity cost. An economic analysis should value that space in case free provision is not sustainable in the future; for example if the space is allocated to another project. The cost at market rates to hire or rent such space, as and when it is needed, over the course of a year should be recorded in annual rent/hire_econ. (the total cost, include costs of furnishings should be recorded in annual cost_econ).

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However, it is possible that if an organisation had to pay rent they would choose to relocate to a different, cheaper, area. It may be necessary to make a couple of estimates of opportunity cost, e.g. rent in city centre as well as rent out-of-town. Efforts need not be made to cost the capital overheads of other organisations with partial involvement in the strategy. Any agency to which work is contracted out is in any case likely to include a proportionate share of its overheads, including buildings, in its fees.

Allocation

If buildings are shared, a proportion of their costs should be allocated to syphilis prevention (testing, treatment and counselling) on the basis of floor space used, or as a percentage of total floor space for which rent is being quoted and/or by the share of time that that space is used for the syphilis prevention work. Multiply the allocation factor by the annual financial and economic costs to obtain your annual programme costs.

5.4.2 Equipment (Form B)

"Capital equipment refers to supplies that last one year or more. Use the current cost for a similar piece of equipment, not the original purchase price. The cost should include freight charges. Sources of cost data could include recent government contracts, supply records from donors, or local dealer estimates. The working life of a piece of equipment can be ascertained by asking individuals who operate it how long this type of equipment generally lasts before it is beyond repair" (Creese and Parker, 1994, p. 33-34). Consider any new equipment if laboratory services are to be part of the strategy as well as diagnostic equipment present in the health units. For RPR testing, this would include a shaker, centrifuge and a refrigerator, if present. For RSTs equipment should be minimal, if any.

A handy cut-off is to classify all capital equipment according to a unit price of $100 or more (unless national accounting procedures specify a different cut-off point). Equipment with a unit price of less than $100 is then treated as a recurrent input and the cost recorded on Form F.

Financial cost

The price of the equipment should be recorded under "Cost". If the equipment is imported, the foreign exchange price, including freight and insurance, should be noted. The cost should be converted to the currency used in the costing and included in the cost column. The life expectancy or working life of the equipment when new should be recorded in column 4. When such an estimate cannot be provided, a 5-year life can be assumed for most equipment. The average annual financial cost should be calculated by straight-line depreciation and entered in column 5.

Equipment, such as audio-visual equipment, may need to be purchased for the development of the educational materials. If the equipment will continue to be used over the length of its life then a proportion of its annualised costs should be allocated to the strategy or campaign being costed. If the equipment will have no further use at the end of the project, its capital cost should be annualised over either its own life expectancy, or the length of the project, whichever is shorter.

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For example, if the campaign is implemented from beginning to end in eight months, then two thirds of the annualised cost of any equipment used exclusively for the strategy should be allocated to the campaign. If, however, equipment purchased to produce the campaign has no foreseeable future use, the total capital costs of that equipment should be written off against the eight-month period.

Economic cost

If the market replacement value is significantly divergent from the price paid for the equipment, an economic cost can be estimated and entered in cost_econ. This might be the case where equipment is imported and there is a distorted foreign exchange rate. The annualised economic cost of equipment can be calculated following the methodology described in section 3.5 (using the PMT function in Excel) and entered in Form B annual cost column.

Allocation

If equipment is shared between the syphilis activities (for instance test kits for RPR in a fridge with other tests) and other laboratory activities, costs should be allocated by the proportionate share of a relevant activity measure or by the proportion of time that the equipment is used for each. The allocated percentage and the resulting annual programme costs should be entered in the relevant columns.

5.4.3 Vehicles (Form C)

Depending on how the programme is implemented, there may be additional transportation costs involved. This category refers to the capital costs of all forms of transportation vehicles including:

- Airplanes
- Bicycles
- Boats
- Cars
- Four wheel-drive vehicles
- Motorcycles
- Trucks

This estimation involves in particular supply management and transportation of samples for confirmatory testing (training and QA will be treated separately). Use the original expenditure (adjusted for inflation) for the financial costs. For Economic cost use the current cost for a similar vehicle, not the original purchase price. Recent government contracts, supply records from donors, or local dealer estimates are useful sources of information. The cost should include freight and any import duties or taxes. The working life of a vehicle will vary considerably, depending on vehicle type, terrain, use and maintenance. Consequently, try to obtain a local consensus on the expected working life of each type of vehicle. Ask several people who use, drive or service cars for an estimate of how long this type of vehicle has lasted in the past (i.e. how long before the vehicle reached a stage where it was not worth repairing). For consistency, it is best to use the same time period (e.g. three or five years) for a given type of vehicle for the entire analysis, unless there are major differences in terrain, etc. that would justify the use of different figures.

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In the event that some of the data described above are not available, a rough approximation to annual vehicle capital costs can be obtained from local rates for hiring vehicles. In such a case, the cost of vehicles looks like a recurrent rather than a capital item, but it should still be considered a capital cost, like capital building costs. This ensures that cost profiles can be compared across programmes/ clinics.

Financial costs and economic costs should then be calculated using the standard methods for calculating annual capital costs (e.g. straight-line depreciation and annualisation). The capital and recurrent costs of any vehicles purchased for the strategy should be included in the costing exercise. The recurrent costs belong in Form G. If the strategy opportunistically uses other vehicles that are available (e.g. borrowed from elsewhere), the actual expenditure incurred by using them for strategy activities (such as costs of fuel) should be included as financial costs. In addition, any economic analysis should include an appropriate share of the capital and recurrent economic value of the use of these vehicles.

It is important not to double count vehicles that travel between different organisational levels. For example, if the cost of a vehicle is included at district level then none of its cost should be recorded at the field level to which it makes supervisory visits.

Allocation
If a vehicle is shared between implementation of the syphilis strategy and other work, the capital costs of that vehicle should be apportioned accordingly. If a vehicle log book exists, the kilometres driven by different tasks can be used to allocate vehicle costs between different programmes.

5.4.4 Other capital costs (Form D)

This form captures any residual capital cost over $100 that was not considered in previous capital forms. For most syphilis prevention strategies this cost category will be relatively insignificant, however, it is important to record and include them.

5.5 Recurrent Costs

Recurrent costs are costs for those resources that are expected to be consumed (or replaced) within one year.

5.5.1 Personnel (Form E)

Personnel costs include salaries, wages, and other expenses associated with personnel directly involved in the activity (e.g. nurses, health unit worker (in the indigenous community, aides, supervisors) and other support staff such as managers, administrators, cleaners, security guards, and drivers). People regularly contributing time to the project without pay (such as volunteers or community health workers) should also be included here. If staff are paid on contract, include the cost of the contract.

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The full cost of employing someone is represented by the individual's gross earnings-that is, the take-home pay, plus any additional benefits, such as contributions to health insurance, social security, pension plans, and payroll tax. These earnings should include any incentive payments, overtime, hardship bonuses, holiday and sick pay, and allowances for uniform, housing and travel. If the worker receives any additional commodities, housing or other non-monetary benefits, the value of these should also be estimated, using the prevailing prices of similar items (e.g. the current market rent for similar housing).

Financial cost

List in the first column of Form E the category of personnel who contribute to the activities of the strategy being costed. The first column should include both voluntary and paid staff and staff who are in support roles, as well as those directly implementing the strategy. In small-scale operations this list might be by staff name and grade; in larger scale operations by staff category and grade. For *Gross annual salary*, the mid-point of the salary range can be used where actual data are not available. An estimated financial value for all allowances and fringe benefits, whether received in cash or kind, should be entered in *Cost of annual allowance*. These may include, for example, money payments for overtime or travel time, imputed rent for free accommodation, estimated cash values for uniforms or health care provided to staff.

Salaries and allowances for long-term expatriate inputs should be distinguished from local salaries. Where these salaries and allowances are paid in foreign currency this should be recorded and converted to the currency used in the costing exercise. NGO service providers may make substantial use of volunteers. Financial costs should also include any incentives paid to them or benefits in kind.The costs of staff in other organisations to which strategy work is contracted out may be included in fees charged to the lead organisation and should not be double counted. Note that the forms are designed to collect annual personnel costs. If costs for an alternative time period are presented this should be clearly indicated.

Economic cost

Since the long-term sustainability of relying on volunteers may be uncertain, a value for the time of volunteers should be included in the economic cost analysis. Volunteers could be asked what they would be earning in the next most likely use of their time. This might range from very little in areas of high unemployment, up to full salaries. This shadow wage should then be entered as an economic cost in *gross annual salary_economic*.

If expatriate inputs are being subsidised by part or full payment of salaries and allowances by external funders, the value of these subsidies should be included in their costs. In considering the economic costs of expatriate inputs, thought should be given as to whether an equally qualified national could be engaged for the same work at a different cost. If this would be feasible, underneath the line stating the expatriate salary cost, record the cost of hiring a similarly qualified national or put it in your *assumptions log* sheet. A sensitivity analysis could be conducted to assess the effect this change would have on the overall costs and cost effectiveness of the project.

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If it is felt that the salaries being paid by the project are highly divergent from market rates, enquiries should be made locally about the market value of the work. For example, civil servants may be overpaid through minimum wage settlements or underpaid compared with the private sector. In these instances consideration should be given to substituting shadow prices for these inputs and recording them in column 4 (see the beginning of this chapter). In practice, the need to do this will rarely be encountered and it should be done with care, as estimation of economic value of work can be complicated. For example, an apparently underpaid government worker may work less hard or for fewer hours than his/her equivalent in the private sector, and so the salary paid may in fact be a reasonable representation of the true value of their time.

Allocation (time and motion studies)
Use time and motion studies to collect staff time allocations. See section 5.1.4.

5.5.2 Supplies (Form F)

"Supplies are materials that are used up in the course of a year. Equipment costing under $100 (unless national accounting procedures specify a different cut-off point) can also be treated as supplies even if they will last longer than the year. All categories of supplies consumed should be listed in the first column of Form F. In some instances, it will be useful to identify separately, and summarise, major supply categories or categories of particular interest (i.e., calculate subtotals for drugs, materials used for testing, stationery).

The full cost of supplies should include the cost of transport to the point of use (i.e. any freight charges for import of materials), but make sure not to double count transport in supply management costs. The cost should be that of all the material consumed, including any that is lost or wasted as well as that which is not actually used for its intended purpose. Losses can result from misplaced shipments, damage (e.g. from water or rodents), pilfering and materials becoming out of date. This loss has to be paid for by the programme, and should be included in the estimates.

Unless expenditure records are very detailed, they are unlikely to be useful for estimating the costs of most of the materials specific to the screening programme. Instead, information on quantities and prices is needed.

Quantities: Supplies to be costed do *not* include those that are distributed but kept in store (as inventory stocks) for the following year. Only those that are consumed (used) in the year of the costing should be counted. For many supplies, there will be stores at different levels (national, regional, health centres), which will usually have their own inventory records. The quantity distributed from these stores during the year will be equal to the inventory at the beginning of the year plus the quantity received during the year *less* the inventory at the end of the year. The amount distributed is not necessarily the amount consumed: commodities may be stored at a lower level. Only at the lowest level of the distribution system, such as the health centre, are supplies dispensed the same as supplies consumed.

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However if only consumption at the lowest level is measured, any wastage that has occurred will not be accounted for.

Prices: Supply invoices, order forms, price lists and catalogues are sources of information about purchase prices or replacement prices. Costs of international and internal transport should be included. International freight costs can usually be readily determined (supply invoices and order forms should include them) and should not be overlooked, since they often add a further 10-20% to the original price. It may be more difficult to estimate internal transport costs; in fact, if supplies are transported by vehicles belonging to the programme, the costs will be included in the vehicle running costs and should not be included here" (Creese and Parker, 1994, p36-38).

Financial cost

If detailed expenditure records are available, the financial costs of supplies consumed should be entered directly in column 3. These costs should include transportation of the supplies to the point of use. Where reliable expenditure records are not available, costs should be calculated from quantities consumed, including loss and wastage (column 2), and unit costs (column 3/4). If quantities consumed are not available, it may be necessary to estimate consumption based on output. For example, to estimate the consumables used in blood collection and testing, an inventory of all the consumables needed per unit of blood could be costed, and then multiplied by the number of units of blood collected. If modelling supply usage, be sure to allow a margin (e.g. 10%) for loss and wastage.

Imported supplies should be grouped together and where purchased in foreign exchange this should be recorded in a footnote on the form. The equivalent local currency costs should be calculated.

Remember if materials have a life longer than a year, these materials should be treated as capital items; then their value will need to be annualised over their life expectancy. However, you **do not need to** annualise any supplies that are small (less than $100).

Economic cost

Market prices should be taken as the economic unit costs of donated goods and these prices should be entered in *unit costs_econ*.

Allocation

Data, especially when taken from expenditure records, may aggregate supplies consumed by syphilis prevention and other work. It may, therefore, be necessary to allocate only a proportion of the costs of the supplies to syphilis prevention. The appropriate allocation factor will depend on the type of supply. For example, gloves for testing HIV and Syphilis could be allocated by the number of tests of each performed.

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5.5.3 Vehicle operating and maintenance and transportation (Form G)

Many syphilis programmes rely on vehicles (remember this includes boats, etc. as well) to distribute supplies, permit co-ordination and supervision, and otherwise implement the provision of care. Often, transport is a weak link; vehicles are available but fail to operate efficiently because of a lack of fuel or spare parts. It is important to know what it costs to operate and maintain vehicles. Unfortunately, these costs are among the most difficult to measure.

The costs of operating, maintaining and repairing vehicles should all be measured. These will include materials, such as fuel, lubricants, insurance and registration fees, tyres, batteries and spare parts. The cost of drivers should be recorded under personnel. If a mechanic is assigned to the programme, the cost will also be included under personnel. However, where repairs and maintenance are contracted out, or where they are performed by a different office or agency, their cost should be included under vehicle operating costs (i.e. total repair costs should be estimated, including an allowance for the mechanic's salary, rather than including the salary under personnel costs).

Expenditure records may give some indication of the cost of operating and maintaining vehicles, but it is likely that drivers and mechanics will need to be interviewed and logbooks consulted to get a sufficiently detailed picture. Fuel consumption is one input for which records are probably reasonably good. If not, fuel consumption can be estimated based on the mileage. Logbooks should indicate distance travelled (say 5000 kilometres), and drivers should be able to estimate the average distance travelled per litre of fuel consumed for that particular type of car in the prevailing conditions (say 10 km per litre). Total consumption is then 5000/10 = 500 litres. The price paid per litre for fuel multiplied by the number of litres used gives the total cost of the fuel. If logbooks and other information sources are not adequate for the calculations suggested (which is all too often the case), alternative data sources can probably be employed. For example, the ministry's central motor pool personnel may be able to provide a rough estimate of the total annual cost of operating and maintaining each type of vehicle. With information on the vehicles used (and the fraction of their time devoted to the programme) a "rough and ready" calculation can be made.

Oil and filter changes and other maintenance may be done irregularly or on a routine basis, either after a set number of kilometres or at regular time intervals (e.g. once a year). If these inputs cannot be estimated in the same way as fuel, fuel costs can simply be increased by a set percentage (e.g. 15%) to allow for them. Again, the central motor pool may be able to assist with this.

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Financial cost
Form G summarises the main inputs for operating, maintaining and repairing project vehicles. The easiest and preferred method is to access expenditure records for vehicle running costs. If such expenditure records are not available, log books and staff interviews should be used. If log books are not available, staff interviews alone will have to provide the necessary information. If no reliable information can be gleaned from any of the above, the least preferred method is to apply the value of standard government mileage allowances to the mileage undertaken in implementation of the strategy. These mileage allowances are devised to reimburse officers for official use of private vehicles or to charge them for private use of official vehicles and are deemed to cover running costs plus depreciation. In this situation it is important to ensure that the capital costs of the vehicles are not double counted between this form and Form C.

Economic cost
Where financial costs are clearly different from opportunity costs, for example where mechanics work voluntarily on vehicles, estimated economic costs can be entered in column 3. *Where vehicle running costs are a relatively small component of overall costs, limited time should be spent trying to calculate economic costs and shadow prices.*

Allocation
Some vehicles may be used exclusively for implementing the syphilis strategy. Most, however, are likely to be shared between the strategy and other programmes and their running costs must be apportioned accordingly. Allocate the cost associated with the programme in the specific column. It is recommended that all inputs on Form G, apart from personnel, be allocated by mileage undertaken for the strategy as a proportion of total mileage in a sample month. If log books are not available from which to derive this information, staff should be interviewed to ascertain the proportion of days in a sample month that the vehicle is used to implement the strategy. If the programme is fully integrated, e.g. with a PMTCT programme, the costs should be shared. If there is a QA/QC programme, make sure not to count transportation costs in both sections (i.e. double counting).

The way in which all the above allocations are made should be recorded either in the assumptions log worksheet or as a footnote on the worksheet.

5.5.4 Building operating and maintenance (Form H)
Operation and maintenance for buildings should include charges for lighting, water, telephones, heating, insurance, cleaning materials, painting, and repairs to plumbing, roofing, heating and office furniture.

"Operation and maintenance of inputs is quite easily handled. Although observers are sometimes concerned with utility expenses, these do not form a large proportion of the total. If it is difficult to obtain information, draw on past experience (and other opinions) to obtain a rough estimate of building operation and maintenance as a proportion of the annual market rent. Multiply the annual rent by this proportion to obtain an amount for operation and maintenance.

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As previously noted, the salaries of guards, cleaners, etc. should be counted under personnel.

This is one category where recorded expenditure data are sometimes quite adequate. Recurrent costs for buildings will normally be listed under such headings as utilities, maintenance or cleaning, and security." (Creese and Parker, 1994, p.40).

Financial cost
If expenditure information is available, please complete Form H. Information should ideally be recorded for a full year to allow for seasonal fluctuations in utility expenditure. If annual utility expenditure figures are available then a total figure can be inserted for the year in the *annual programme cost* row rather than being built up by month. If expenditure information is not available, then a percentage of the rental value of the building should be used to cover these costs. The appropriate percentage should be estimated by local managers and will vary according to the quality of building construction, the age of the building and the nature of the services being provided there. This rough estimation is acceptable, as these costs are unlikely to be significant in the overall profile of costs.

Economic cost
If it is felt necessary to substitute any shadow prices for financial costs, clear footnotes should indicate where and why this has been done.

Allocation
If a building is shared between syphilis prevention and other work, the running costs of that building will need to be allocated accordingly. This should be done by calculating the proportion of floor space used by the syphilis work as a proportion of the total floor space of the building that the running costs relate to, and/or by the share of time that that space is used for the syphilis work, as is done with capital building cost.

5.5.5 Recurrent training costs (Form I)
In settings where there is a high turn-over of health workers, training may not be a one-off event, but will be occurring as needed. In this case, further training of staff, after the initial training must be considered. The same form for training is used but total costs are not annualised. The quantity of annual retraining needed should be included here.

Estimation of *Financial* and *Economic* costs and *Allocation* of these costs follow the same structure as those defined in the previous sections.

5.5.6 Waste Management (Form J)
The introduction of a new programme will require the assessment of the waste management system to deal with biohazard disposal and possible incineration of needles, syringes, test kits, reagents, sharp materials, expired drugs, used test kits and others.

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In some countries, high-temperature incineration and autoclaving are often used in order to secure the safe and environmentally friendly destruction of syringes and other health care waste. However, in low-income countries more low cost feasible options, such as the instalment of small-scale incinerators at selected health centres and district hospitals, should be considered. Elsewhere, it is just the costs of burning and burying the waste. This is an activity as an input and should include the annualised value of any capital inputs, such as incinerators. Recurrent costs include those associated with incinerator fuel and maintenance, training, and salaries of staff. Transportation costs for safety boxes should also be taken into account. If waste management is shared with other programmes, a proportion of this cost related to syphilis work should be taken.

Financial cost
If available, cost information should be taken from expenditure records and recorded in Form J. If unavailable, rough estimates of costs should be made from quantities of inputs consumed and prices. Information should ideally be recorded for a full year. If a private company manages the wastage, the value stipulated in the contract should be entered.

Economic cost
If it is felt that the financial costs do not represent the full value of the resources used for waste management, make sure to take notes on the rationale for doing so and the assumptions made.

5.5.7 Quality Assurance/ Quality Control (QA/QC) (Form K)

In order to enable the analysis of the costs and cost effectiveness of QA/QC activities as a part of the introduction of Rapid Syphilis Tests, QA/QC is considered an 'input' rather than an 'activity' (as with training above). All resources required for QA/QC activities (e.g. personnel, vehicles, supplies) are therefore included in the QA/QC input category, and not under the separate input based categories of personnel, vehicles, etc. The QA/QC cost sheets are intended to help identify the different costs associated with quality assurance and quality control within the project.

For each activity, costs are incurred through use of equipment, personnel time, vehicles, etc, each of which can be calculated in the same way as in other parts of the costing. For example, the annual equivalent cost of capital items (vehicles and equipment) should be estimated over their expected life using straight-line depreciation for financial cost and an annualisation factor for economic costs. Time and motion studies can be conducted to estimate the proportion of time spent by health facility staff on QA /QC activities.

Two columns will not have been seen in previous cost sheets. These are:

- *Allocation to Clinic*: As cost collection is at the clinic level, we are concerned not to double-count costs for activities affecting more than one clinic. For example, if DTS samples are manufactured together for 10 similarly sized clinics, the clinic allocation for this part of costs should be 10%; alternatively the proportion of sample received by each clinic can be used.

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- *Allocation to QA/Supervision*: Some costs will be shared between QA activities and general supervision (for example, when samples are distributed during a supervisory visit). In this case, we wish to separate the part of costs which are not attributable to QA and feed them back in to our input-based cost sheets.

The QA sheets are set up to calculate all costs for one External Quality Assurance Scheme (including the process of manufacturing and distribution of samples, testing, and feedback of results). Once a total cost has been calculated per scheme, it can be multiplied by the total number of schemes which have occurred during the costing period in order to find a total QA cost, if the cost of each scheme is thought to be similar.

5.5.8 Other recurrent costs (Form L)

"This is the residual category.

- Cost of spares for maintenance and repairs.
- Other categories might include postage, printing, photocopying and the costs of operating and maintaining equipment, but not stationery, which is counted under supplies.

Expenditure records may contain some data, but they are unlikely to be detailed enough. For a piece of electrically operated equipment you will need to know its power requirements (the number of kilowatt-hours), the length of time it is operated over the year, and the cost per unit of electricity. You will probably need to ask the people directly responsible for the equipment about the kind of maintenance and repairs that were necessary and what spare parts were needed. There are a variety of "rules of thumb" to estimate the likely operating and maintenance costs of equipment used in health programmes." (Creese and Parker, 1994, p. 40-41).

For most syphilis prevention strategies this cost category will be relatively insignificant. Only minor effort should be made to cost these inputs where they are likely to be negligible in the overall profile of costs.

Financial cost

If available, cost information should be taken from expenditure records. If unavailable, rough estimates of costs should be made from quantities of inputs consumed and prices.

Economic cost

If any of the financial prices clearly do not reflect opportunity costs, a shadow price should be substituted in *Annual cost_econ* but effort in doing this should be proportional to the contribution of cost in total costs.

Allocation

Shared costs should be apportioned in a manner logical to the way that they are incurred. The percentage allocation of costs and the resulting cost to the strategy should be entered in the appropriated column.

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5.6 Private costs (Form PC)

Form PC seeks information on patient costs. As this costing is being done from the provider's perspective it is not directly relevant. Form PC provides a separate record of the cash fees that are raised from individual clients. The form is very general, allowing collection by month for a number of types of fees and will, therefore, need to be adapted to particular circumstances. The preferred method of obtaining the data is from fee collection registers or income records. If these are not available, estimates of fees raised should be made from volume of clients and average official fee rates although these estimates will clearly miss over and under charging and any leakage of funds. Data on fees paid should be kept separate and not added to total costs (otherwise there will be double counting).

To set the data in context, more qualitative information should also be recorded on how the fees are administered and managed; for example whether they can be kept at the level at which they are collected and what they can legitimately be used for.

However, to answer the question of low uptake of services that are being offered, broader patient costs, including travel costs and the opportunity cost of their time, would need to be analysed.

5.7 Collection of outcome data –Project Outputs form

During the process of collecting data on costs, data on the outputs and outcomes of the programme should also be collected. These outcomes will differ according to the syphilis prevention strategies used. Even if a number of strategies, which are being used together, are being assessed, the use of process or intermediate outcomes means that the measures will be relatively-specific to each strategy.

In order to decide on which outcome measures to collect data for, it is useful to ask the following questions:

- What are the main objectives of the project or strategy?
- What are the main activities in the project or strategy?
- What are the outputs of the project or strategy? Are they related to particular activities?
- What are the main intermediate outcomes?

The answers to the questions will clarify the nature of the outcome measures for the entire project, but also by activity. These will help to clarify the type of data that needs to be collected both for process and intermediate outcomes. In practice, data availability will influence the actual measures that can be used in the cost effectiveness analysis.

Likely outcome measures that are needed to estimate the impact of the intervention and model the costs of scaling-up are:

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Process outcomes:

- Size of community (catchment area)
- Number of men, pregnant and non-pregnant women *screened*
- Number of men, pregnant and non-pregnant women with *reactive test results*
- Number of men, pregnant and non-pregnant women *treated*
- Number of high-risk people *treated* (e.g. FSWs).

Intermediate outcomes:

- True cases treated

  True cases treated is a critical outcome between project outcomes and the primary effectiveness measures. As the tests are not perfect, not all reactive tests will be active syphilis cases. The other infections can trigger a reactive RPR test, and past infections will lead to reactive RSTs. In either case, there will be some overtreatment. To obtain an estimate of true cases treated, specificity is needed. This will vary by local epidemiology and depend on access to treatment. Where testing is new, most reactive test results will indicate active syphilis cases. Therefore more of those treated will avert adverse outcomes. However, over time as treatment is more accessible, reactive test results are more likely to indicate past infections. With RPR, it can depend on a range of local factors such as the presence of malaria. The gold standard to obtain specificity is to test with both RPR and TPPA to know the reactive results are truly syphilis (confirmed by TPPA) and current and active (confirmed by RPR). This indicator is very important for estimating cost effectiveness. If local data is not available, then lab specificity can be used, but it must be acknowledged that this is quite a rough approximation.

Primary outcomes:

- Infant outcomes averted
  - *stillbirth*
  - *miscarriage*
  - *neo-natal death*
  - *non neo-natal death*
  - *low birth weight*
  - *congenital syphilis*
  - *any adverse outcome*

- Adult infections averted
  - *neurological syphilis cases averted*

- DALYs averted

  This is a composite measure of lost health that incorporates health outcomes due to neo-natal death, non-neonatal death, low birth weight, congenital syphilis and neurological syphilis. Stillbirth is sometimes also included. The next section describes DALYs and their estimation in detail.

A preliminary project output form has been developed; this also feeds into the DALY form.

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5.8 Calculation of DALYs

To allow the impact of introducing rapid syphilis testing to be compared with other health interventions beyond antenatal syphilis screening, it is common practice to translate the disease specific indicators (i.e. stillbirth, neonatal death, low birth weight, and congenital syphilis) to more generic health outcomes. DALYs is one such outcome widely used. DALYs were developed as health outcome measures that could represent burden of disease and intervention impact on the dimensions of quality and quantity of life. They were developed as part of the World Health Report 1993 and further revised in the Global Burden of Disease study to estimate the impact of diseases around the world and facilitate comparison of cost effectiveness and impact across different types of health interventions globally (World Bank, 1993, Lopez et al., 2006). This section summarises the inputs needed for calculating DALYs for syphilis screening and treatment strategies based on Fox-Rushby's 2001 paper on calculating and presenting DALYs (Fox-Rushby and Hanson, 2001).

DALYs are a measure of lost health. In contrast to quality adjusted life years (QALYs) which are most often applied in developed countries and require elicitation of quality of life weights in the population or target group, DALYs are calculated based on predetermined disability weights and a limited amount of setting-specific inputs. The impact of an intervention represented by DALYs is estimated by the difference between DALYs averted without the intervention (or with a different intervention) and DALYs averted with an intervention.

DALYs lost are the sum of years lived with disability (YLD) and years of life lost (YLL), relative to a standard life expectancy (World Health Organisation, 2011). The DALY equation contains weights for age, and time to account for effects occurring in the future. It further calculates the present value of YLL and YLD. The present value calculation is based on the assumption that YLL and YLD averted sooner are of greater value than those averted later, and therefore applies a discount rate to future effects (similar to what we do with future costs). The equation also contains an age weighting modulation factor, that imposes higher values to DALYs averted among the adult 'productive' population than among the very young or very old.

The DALY sheets provided in the accompanying workbook contain some assumptions, which are presented below.

5.8.1 Disease specific assumptions

Following Newman et al. (Newman et al., 2011), we assume six birth outcomes for syphilis in pregnancy: stillbirth, neonatal death, prematurity or low birth weight, an infant with clinical evidence of syphilis, non-neonatal infant death and a healthy uninfected infant[1]. The values for estimated probabilities of outcomes in untreated women were obtained from a review of the literature conducted by WHO/CHERG **(Table 2.1).**

[1] Newman et al (2011) also estimate the impact of syphilis on miscarriage. However, as miscarriage is not traditionally an outcome for which DALYs are estimated, and it is not clear which values to assume, these are ignored in the estimation of DALYs averted due to syphilis screening and treatment.

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5.8.2 The DALY equation

The equation used for calculation of YLLs is listed below, as outlined by Fox-Rushby and Hanson (Fox-Rushby and Hanson 2001):

$$YLLs = (KCe^{ra})/(r+ß)^2\{e^{-(r+ß)(L+a)}[-(r+ß)(L+a)-1]-e^{-(r+ß)a}[-r+ß)a-1]\}+(1-K)/r(1-e^{-rL})$$

Where *K* is the age weighting modulation factor (standard value is 1); *C* is the age-weighting correction constant (standard value is 0.1658); *ß* is the parameter from the age-weighting function (standard value is 0.04); a is the age of death, and *L* is the standard expectation of life at age *a. (Fox-Rushby and Hanson, 2001, Murray, 1996).*

The equation used for calculation of years of YLDs is similar to that for YLLs, with the addition of a disability weight (*D*):

$$YLDs = D\{(KCe^{ra})/(r+ß)^2\{e^{-(r+ß)(L+a)}[-(r+ß)(L+a)-1]-e^{-(r+ß)a}[-r+ß)a-1]\}f+(1-K)/r(1-e^{-rL})\}$$

The values for *a* and *D* and the proportion of deceased and disabled are outcome-specific, and are derived from the literature. We assume 50% of infants with congenital syphilis and 13% of premature/low birth weight infants die before age 1, while 50% of infants with congenital syphilis and 6% of premature/low birth weight infants are disabled (Murray et al. 1996). Disability weights were set by a panel of experts and can be found on WHOs website: **www.who.int/healthinfo/global_burden_disease/daly_disability_weight/en/index.html**

Syphilis is unlikely to have led to significant changes in average life expectancies; however HIV has significantly reduced life expectancy in some high prevalence countries. If estimating DALYs averted due to an HIV prevention intervention (e.g. a joint antenatal syphilis and HIV screening programme), it is the pre-HIV epidemic life expectancy that is the appropriate one (See Creese, Alban and Guinness's literature review of the cost effectiveness of different HIV interventions 2002, Creese et al., 2002).

Traditionally, DALYs can only be lost after a live birth occurred, however, this would neglect any impact in terms of stillbirths averted. In the more recent applications the impact of this assumption is explored by attributing to each stillbirth the same value as a death at age 0 (Schackman et al., 2007, Terris-Prestholt et al., 2003).

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5.8.3 The DALYs form

The outputs need to be entered only into the project outputs form, and DALYs will be calculated automatically. In order to estimate DALYs from the project outcomes, some country/project specific inputs will need to be entered into the *project outputs DALY inputs* sheet where the cells are highlighted in blue, green, and orange.

Country-specific inputs

The **standard expectation of life at birth** (highlighted in blue) is country-specific. Life expectancy at birth can be obtained from the 'ex' column in the lifetables: www.who.int/healthinfo/statistics/mortality_life_tables/en/.[2] To ensure comparability, we also calculate DALYs using the longest possible life expectancy known (Japan) which is a constant (81.25 years). This is used as a generic measure to compare across countries.

The **number of pregnant women treated, and total number of people treated** (highlighted in green) are derived from the country outputs. The number of 'true cases treated' can be estimated using the **test's specificity** (highlighted in orange). The specificity will change depending on the type of test used. The specificity values of five rapid tests in field and lab settings are reproduced from Mabey, et al. (2006) (Mabey et al., 2006) below. Specificity estimates can also be obtained from the test insert, or from field-based evaluations using a gold standard. **Table 5.1** shows the specificity of four RSTs.

Table 5.1 Rapid test specificity

	Clinic Setting Whole Blood	Lab Setting Whole Blood	Lab Setting Serum
Abbott Determine	98.80%	98.37%	97.60%
Omega Visitect	99.28%	99.43%	98.58%
Qualpro Syphicheck	99.05%	99.13%	98.93%
Standard Bioline	98.80%	98.00%	97.83%

(Mabey et al., 2006)

The above inputs will give an estimate of the total number of DALYs averted by condition. The total number (cost per DALY averted) is found by dividing the total project cost by the sum of DALYs averted across all conditions. The number of DALYs averted by antenatal syphilis screening is often presented both including and excluding stillbirth.

[2] Note: Website may change: search for 'WHO' and 'Lifetables' for latest tables.

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6. Cost Analysis

6.1 Total costs and an example cost structure

When all the component costs have been collected, then the data need to be aggregated or collated. Once the summary is completed, a cost profile of the project or programme has been derived. It will look like the table below.

Table 6.1 Cost profile example: Antenatal syphilis screening in Geita, Tanzania

Cost Category	Financial Costs			Economic Costs		
	Currency	$	%	Currency	$	%
Start-up						
Training (Syphilis)	310,206	$221	9.6%	360,474	$257	10.4%
Other start-up	77,055	$55	2.4%	82,462	$59	2.4%
Total Start-up Costs	*387,261*	*$276*	*12.0%*	*442,936*	*$316*	*12.8%*
Capital						
Buildings and Storage	0	$0	0.0%	27,225	$19	0.8%
Equipment	0	$0	0.0%	0	$0	0.0%
Vehicles	0	$0	0.0%	42,054	$30	1.2%
Other Capital Costs	0	$0	0.0%	0	$0	0.0%
Total Capital Costs	*0*	*$0*	*0.0%*	*69,279*	*$49*	*2.0%*
Recurrent						
Personnel	384,727	$274	11.9%	384,727	$274	11.1%
Supplies	2,108,521	$1,502	65.3%	2,133,677	$1,520	61.5%
Vehicle Operation & Maintenance	38,191	$27	1.2%	43,108	$31	1.2%
Building Operation & Maintenance		$0	0.0%		$0	0.0%
Recurrent Training		$0	0.0%		$0	0.0%
Waste Management	7,432	$5	0.2%	7,432	$5	0.2%
Quality Assurance	300,453	$214	9.3%	386,164	$275	11.1%
Other	0	$0	0.0%	0	$0	0.0%
Total Recurrent Costs	*2,839,324*	*$2,023*	*88.0%*	*2,955,109*	*$2,105*	*85.2%*
TOTAL ANNUAL COSTS	3,226,585	$2,299	100%	3,467,324	$2,470	100%

Alternatively, a cost profile in terms of activities rather than inputs can be obtained. These profiles are useful in highlighting major cost components (and thus identifying potential areas where improvements in efficiency may have significant impact on costs). For example, high drug costs could indicate wastage. These cost profiles can be compared across different projects and programmes, as well as within programmes. Within programmes the profiles can be presented by different clinics, and a comparison can be made between them. "If there are significant differences in cost profiles, then this may mean that there may be ways to re-structure and improve efficiency" (Creese and Parker, 1994, p. 13).

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However, comparison of cost profiles across countries or regions is problematic due to different price structures. Comparison of cost profiles over time might be more useful than the comparison across different projects. Thus, one must be careful to only generalise from cost profiles when appropriate.

6.2 Unit costs

Once total costs of a programme or project have been calculated, then unit costs can be derived. These can be calculated in terms of the intermediate outcome indicators collected in the project outcomes sheet. They are simply calculated as total costs divided by the outcome measure.

Unit costs can be used to compare costs between similar projects, and consider issues of project efficiency. There are a number of factors affecting unit costs. These include:

- Different prices paid for inputs by projects in different locations;
- Different mix of inputs used by different projects (e.g. more staff or more supplies);
- Different levels of staff productivity;
- Efficiencies gained due to the size or scale of the project (economies of scale);
- Efficiencies gained due to having a number of services or projects undertaken together (economies of scope) (e.g. PMTCT with antenatal syphilis screening).

However, not all differences in unit costs should be attributed to differences in efficiency. A higher unit cost may not indicate a less efficient programme. There may be other factors driving these differences, for example:

- Differences in unit costs may indicate differences in ease of delivery of services. For example, a project that is based in rural areas with a more dispersed population or projects reaching more marginalised groups might engender higher costs. Thus there may be equity reasons why more resources are allocated to this project.
- The duration of a project or programme may affect unit costs. Thus comparing an established programme with a relatively new programme should take this into account.
- The prevalence of syphilis in the population may have an impact on unit costs. There is a direct relationship between the cost effectiveness of any screening programme and the prevalence. As prevalence decreases, the number of people that need to be screened to identify a case, treat it and thus avert an outcome will increase, thus increasing the unit cost per adverse outcome averted.

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In addition, unit costs by activity can be estimated. These can assist analysis of efficiency of particular activities within a project.

6.3 Sensitivity analysis

As not all data is available precisely, it is usually necessary to make a number of assumptions throughout the data collection and analysis. To understand the impact of these assumptions on the cost results, one can use a sensitivity analysis. A sensitivity analysis indicates how the estimates would react to percentage changes in the value of the parameters (i.e. assumptions) of the model. It can help the reviewer to determine which parameters are the key drivers of a model's results. This helps to check the robustness of the assumptions given a range of scenarios (Gold et al., 1996).

When only one parameter is changed - if for instance the researcher would like to test the effect of personnel cost on the estimated cost of the syphilis rapid test and check if the intervention is still cost effective, then one can change only this parameter (personnel) - let's say from the original 20% staff input to 30% - and see what happens with the total costs and cost effectiveness. This type of analysis is called **one-way sensitivity analysis** because one parameter is changed at each time. A **multi-way sensitivity analysis** refers to two or more parameters changing simultaneously and a **probabilistic sensitivity analysis** characterises uncertain parameters as probability distributions and propagates uncertainty through a model using Monte Carlo simulation (Claxton, K. et al., 2005).

The decision on what type of sensitivity analysis to use will depend on two main points: how many parameters are being changed; and the level of uncertainty involved in the estimation. When there are several parameters in the analysis that are based on assumptions and that contain a high level of uncertainty, the best approach is a probabilistic sensitivity analysis. When few parameters contain uncertainty, one way and multi-way sensitivity analyses are the most common methods used to deal with these uncertainties, although probabilistic sensitivity analysis can also be used. These analyses may or may not be based on confidence intervals, which tells us the range of values in an interval that is used to indicate the reliability of an estimate.

To identify parameters to include in the sensitivity analysis, consider the level of uncertainty contained in each. Parameters that were impossible to collect directly, such as those collected from a secondary source and of which the quality may be questionable, might be included in a sensitivity analysis. Other parameters might be those modelled from the outset (such as effectiveness or efficacy estimates, life expectancy of the project, prevalence and incidence rates, etc.), parameters originated from official data (NGOs, MoH), but that also have a market reference (drugs and tests prices, quality, etc.), and those based on general convention for specific countries or regions (discount rates). The common sense for decision about which data should be included in a sensitivity analysis is: if you are uncertain about the parameter, test it!

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Calculating a confidence interval (CI) is a straightforward job.
The data needed are:

- The average value (cost) of the parameter to be evaluated
- The standard deviation
- The number of items in the sample (or the population)

In Excel, an average cost can be calculated as (write down the command):

=AVERAGE(select the range of the sample observations or estimates); for example, in the Excel spreadsheet it would look like: =AVERAGE(A1:A12). Do not forget to put the equal sign in the front of the formula.

The standard deviation is calculated as:
=STDEV(select the range); this is the same range over which the average was calculated, so from the example above, the standard deviation is calculated using =STDEV(A1:A12).

And finally, the confidence interval is calculated as:
=CONFIDENCE(alpha, s, n)

- *alpha:* is the significance level. It equals 1 minus the confidence level (expressed as a decimal). So, for 95% CI will be 1-0.95=**0.05**. For 90% CI, alpha will be 1-0.90=**0.10**. For 99% CI, alpha will be 1-0.99=**0.01.** Greater confidence would require more data to generate intervals of usable lengths. This can be varied but common practice is to use a value of 0.05 to start off the analysis.
- *s*: standard deviation
- *n*: the number of items in the sample ("population"). For the example above this would be 12.

If, for example, the average cost of a nurse was $448 in 12 clinics, and a CI was calculated as $199-$695, we could investigate how variations of –50%, -20%, -10%, +10%, +20%, +50% would affect the best estimate ($448). In this case, we have:

- -50% of $448 would be **$224**
- -20% of $448 would be **$358**
- -10% of $448 would be **$403**
- +10% of $448 would be **$493**
- +20% of $448 would be **$538**
- +50% of $448 would be **$672**

For this example we could state that even a reduction of 50% or an increase of 50% of the costs of the nurse would continue generating a cost effective intervention. It is because for all scenarios the estimated costs fell inside the CI of $199-$695.

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6.4 Using the cost analysis in planning and budgeting

Once the basic cost analysis is done, the information can be used in a variety of ways to aid planning and budgeting for the future. In general, current cost data can serve as a baseline for extrapolating information for the future and for other projects. What is clearly important is to consider to what extent the project, from which cost information was collected, is similar to the activities that are being planned.

The financial cost analysis can contribute to an understanding of budgeting requirements of a specified project. The financial cost analysis will give an idea of the total volume or resources that have been spent. The financial analyses will also serve as a basis for future budgeting.

- An ingredients approach would mean that all of the possible inputs are listed and then considered to what degree they will be used in the future project for the expected level of output (e.g. number of persons counselled) that aims to be achieved. Once the "quantity" has been determined, then the price and the cost can be considered. For example if you think that you will need 1.25 nurses, you can think about whether to hire 1 full-time nurse and 1 part-time nurse, or you can consider whether it is feasible to hire one nurse and pay for extended hours. This approach requires a lot of detailed cost information and is appropriate if programme conditions are changing quickly.

- A less detailed approach to budgeting would be to take the current costs of a project and extrapolate to the replication scenario and then do a rough adjustment depending on how similar the projects are deemed to be. An important thing to consider is whether the project from which the costs are taken is actually running efficiently. Alternatively a mark-up can be applied to the costs (e.g. 20%) in order to give some margin of error.

Regardless of the method used, if budgeting for the future, the price or cost information for inflation needs to be adjusted for each year in the future. This can be done either in the local currency or in US dollars. In a country with a relatively stable level of inflation of 8%, 10% could be chosen as the proportion by which prices are expected to increase each year. However, if the programme is operating in an environment with rapid inflation, it may be wiser to convert your costs to a more stable currency such as the US $ and then do the budget calculations (Kumaranayake, 2000).

Financial cost analyses will also help to consider the affordability of projects, as it provides information on the amount of money required to run a project. This information can be used to consider the range of sources and amount of money that is available to finance the project.

However, financial cost analyses only reflect the actual expenditure on a project.

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If a project had substantial donated components, then relying on financial cost analyses will give a distorted view of the actual resources being used. Thus when considering issues such as replication of projects to different settings or scaling up projects in size, it is critical to consider what basic infrastructure may have been in place which was not accounted for in a financial cost analysis. For example, many NGO-based projects often receive assistance in the start-up phase of projects (e.g. exchange of goods in kind or subsidised printing). It is here that economic analyses are useful.

6.5 Using the cost analysis to model the costs of replication or scaling up

6.5.1 Scale up

Projects may wish to estimate the costs of 'scaling up' by increasing the coverage or geographical reach. Before modelling scale up, it is important to understand the plans for expansion of the project, and how increased scale will affect the project model. In their paper on scaling up HIV and TB interventions, Vassall and Compernolle (2006) have highlighted three dimensions to be considered when planning for project scale up (Vassall and Compernolle, 2006):

1) The definition of interventions: as in cost effectiveness analysis, estimating the cost of scaling up an intervention will rely on what components are included: is it the whole of the pilot project or will some components be prioritised? Some start-up activities will not need to be repeated in the scale up process. The model of scale up will also consider if the entire package of intervention will be scaled up at a slower pace or a reduced package at a faster rate.
2) Estimating the population in need: the ideal situation is when epidemiological data and estimates of changes in incidence in the medium or long term are available, to reflect the reality of domestic resource use. However, the availability of epidemiological data is not a reality in many countries. In this case, the authors suggest assuming a fixed progression of incidence over time adjusted for population growth. Estimates should also allow for improvement in health outcomes associated with general socioeconomic progress, unrelated to the intervention in question.
3) Establishing baseline levels and target coverage of services: after defining the population in need it is necessary to determine the target level of population to be covered. This is strongly related to the existing and future capacity to scale up interventions. This is also related to the existence of other programmes which may be scaling up at the same time. This would mean that the resources are not only used for one intervention, and the allocation of such shared costs needs careful consideration.

Finally, it is important to consider the impact of any existing programmes or infrastructure. There may be parallel health programmes already operating in other districts. As acknowledged by Victora, et al., different development partners tend to support interventions in different areas (Victora et al., 2011). Scale up may therefore result in the programme replacing or displacing a programme run by a different organization which is just as (or more) effective. Alternatively, there may be potential for economies of scope through exploitation of underutilized capacity when scaling up the new intervention.

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Once the planned expansion model has been defined, it is possible to think about estimating costs for scale up. There is currently no standardised method to estimate the resources needed for scaling up. The most basic approach to modelling scale up is a linear projection. A linear projection assumes the average cost remains constant as scale increases – for example, if the unit cost for reaching 100 people is $5 per person, the cost of treating an additional 50 people would be $5 x 50 or $250.

It has been shown, however, that increases in scale and geographical variation can have significant impacts on cost. Where possible, average costs should therefore be adjusted to reflect potential variations in cost as the programme is expanded. Johns and Tan Torres highlight four general trends in the literature which can serve as guidelines to those wishing to estimate the costs of scaling up an intervention (Johns and Torres, 2005):

1) Average costs should be calculated for different areas. There is evidence that average costs tend to be higher in rural areas than in urban areas, due to higher transportation costs, less infrastructure, or less highly trained personnel.
2) Fixed, semi-fixed, and variable costs should be identified and when possible, dis/economies of scale should be acknowledged. Projections should incorporate possible variations in average costs at different levels of health care – for example larger health centres tend to have lower average costs, because fixed costs are spread over a greater number of people. Alternatively, some programmes might have high costs at a central level, which will diminish as the scale of the project increases.
3) The availability and capacity of human resources should be assessed. Especially in low- and middle-income settings, a lack of human resources represents one of the biggest constraints in expanding health services. Depending on the type of intervention and the current HR situation in the country, there may be unused capacity in human resources or there may be additional costs to recruit, select, and train medical staff.
4) Projection estimates should include the costs of managing the scale up process itself. These additional costs can include winning political support within the Ministry of Health for scale up, educational outreach or mass media to create demand for the intervention, or building administrative infrastructure to manage and supervise the intervention.

Finally, because the price of drugs, level of coverage, and cost of the intervention can vary over the time, estimates need to be tested to see how sensitive they are to changes in key variables. Resources can then be evaluated based on a range of possible scenarios (Vassall and Compernolle, 2006).

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6.5.2 Replication

The objective of a costing exercise is not likely to be that of collating information on the on-going costs of the project for management purposes, but rather that of assessing the costs of this strategy relative to the other main strategies or providing information on costs of replication of the project elsewhere. If the objective is to provide information on the total costs of the strategy in view of replication, both on-going and start-up costs should be collected. Start-up costs include any development and production of information, education and communication (IEC) materials as well as dissemination of diagnostic and treatment protocols, IEC, and recruitment of workers.

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Annex 1. Costing worksheets

Background Data

Country:			
Site name:			
Data collected period		FROM	TO
	MONTH YEAR		
Programme year:		20..	
Local Currency:			
US dollars exchange rate:		per US$	Source:
Exchange rate date or time period (if average):		FROM	TO
	MONTH YEAR		
Discount rate chosen:		3%	

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Summary

Cost Category	Financial Costs			Economic Costs		
	Local Currency	$	% of costs	Local Currency	$	% of costs
Start-up						
S1. Training						
S2. Other start-up						
Total Start-up Costs						
Capital						
A. Buildings and Storage						
B. Equipment						
C. Vehicles						
D. Other Capital Costs						
Total Capital Costs						
Recurrent						
E. Personnel						
F. Supplies						
G. Vehicles /Transportation						
H. Building Operation and Maintenance						
I. Recurrent Training						
J. Waste Management						
K. Quality Assurance						
L. Other Recurrent Costs						
Total Recurrent Costs						
TOTAL ANNUAL COSTS						

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Summary

	Total achieved	Cost per:	
Outcome indicator	**N**	**USD (financial)**	**USD (economic)**
Pregnant women screened			
Reactive tests			
Treated women			

Effectiveness indicator	**N**	**USD (financial)**	**USD (economic)**
Neonatal Deaths Averted			
Non-Neonatal Deaths Averted			
Congenital Syphilis Cases Averted			
Stillbirths Averted			
Low Weight Births Averted			
Baby with any adverse birth outcome			
Total DALYs averted			

S1a.CENTRAL TRAINING *

Sources of data:_____ _____ _____ _____ _____

Central costs	Quantity	Days used	Fin. cost	Econ. cost (daily charge for equivalent space)	Total cost		% Allocation (# project participants /# participants)	Annual programme cost	
					Fin.	Econ.		Fin.	Econ.
Training Venue									
Training rooms									
Lab rooms									
Other space									
Equipment:									
Transport (e.g van use/hire plus fuel)									

Training supplies	Quantity	Unit price	Total cost		% Allocation	Annual programme cost	
			Fin.	Econ.		Fin.	Econ.
practice test kits							
gloves							
refreshments							
stationery							
Other costs							
communications							
TOTAL CENTRAL TRAINING COSTS							

*Please remember that though some of the inputs are generally considered recurrent, the activity as a whole should have a life of longer than a year, and is therefore annualised and treated in the same way as capital costs.

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S1b. TRAINING, PERSONNEL

Personnel costs	Quantity	Nr.ofdays	Per diems/ subsistence	Travel reimburse-ments	Accom-modation	Salary costs		% Allocation (# project staff/ # participants)	Annual programme cost	
						Fin.	Econ.		Fin.	Econ.
Project staff input										
manager										
Trainers						fees or salary costs				
Participants*										
TOTAL PERSONNEL COSTS FOR TRAINING										
TOTAL TRAINING COSTS (CENTRAL+PERSONNEL)										
Life of project (years)										
ANNUAL TRAINING COSTS										

*The economic cost of taking participants out of their daily duties should be included, use a daily salary estimate.

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S2a.OTHER START-UP

Definition of start-up period: month/year_____ to month/year____;Duration of start-up period: _____ months

Item	Quantity	Time used	Fin cost	Econ cost	Total cost		% Allocation	Annual programme cost	
					Fin.	Econ.		Fin.	Econ.
Building and storage costs									
Equipment:									
computers									
Vehicle costs (e.g. to go to stakeholder meetings)									
TOTAL (Building, Equip, Vehicles)									

S2b.OTHER START-UP, continued

Project staff input	% of annual time used	Annual gross salary	Total cost		% Allocation	Annual programme cost	
			Fin.	Econ.		Fin.	Econ.
Manager							
Supplies	**Quantity**	**Unit price**	**Fin.**	**Econ.**	**% Allocation**	**Fin.**	**Econ.**
stationery							
Other							
TOTAL (Staff, Supplies, Other)							
Sum Total (Buildings, Equip, Vehicles) + (Staff, Supplies, Other)							
Life of project (years)							
Annual other start-up costs							

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A) BUILDINGS AND STORAGE

Sources of data: _____ _____ _____ _____ _____

Buildings/storage spaces (list)	Annual rent/hire		Furnishing @ 10%	Annual costs		% Allocation cost	Annual programme cost	
	Fin.	Econ.		Fin.	Econ.		Fin.	Econ.
TOTAL								

B) EQUIPMENT

Sources of data: _____ _____ _____ _____ _____

Equipment (list)	Cost		Life expectancy or working life	Annual costs		% Allocation cost	Annual programme cost	
	Fin.	Econ.		Fin.	Econ.		Fin.	Econ.
TOTAL								

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C) VEHICLES

Sources of data: _____ _____ _____ _____ _____

Vehicles (list)	Cost		Life expectancy or working life	Annual costs		% Allocation cost	Annual programme cost	
	Fin.	Econ.		Fin.	Econ.		Fin.	Econ.
TOTAL								

D) OTHER CAPITAL COSTS

Sources of data: _____ _____ _____ _____ _____

Item (list)	Cost		Life expectancy or working life	Annual costs		% Allocation cost	Annual programme cost	
	Fin.	Econ.		Fin.	Econ.		Fin.	Econ.
TOTAL								

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E) PERSONNEL

Sources of data: _____ _____ _____ _____ _____

Category of personnel (list with grade where appropriate)	Gross annual salary		Cost of annual allowance		Total annual cost		% Allocation cost	Annual programme cost	
	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
TOTAL									

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F) SUPPLIES

Sources of data: _____ _____ _____ _____ _____

Supplies (list)	Quantity consumed (including loss and wastage)	Unit cost		Cost		% Allocation Cost	Annual programme cost	
		Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
TOTAL								

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G) VEHICLE OPERATION AND MAINTENANCE AND/OR TRANSPORTATION

Sources of data: _____ _____ _____ _____ _____

Supplies (list)	Cost		% Allocation cost	Annual programme cost	
	Fin.	Econ.		Fin.	Econ.
Petrol/Diesel					
Oil					
Maintenance					
Insurance					
Registration					
Repairs					
Spare parts					
TOTAL					

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H) BUILDING OPERATION AND MAINTENANCE

Sources of data: _____ _____ _____ _____ _____

Utility	Telephone/fax	Water	Electricity*	Maintenance/repair	Insurance	Other (please describe)
Source of funds						
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Annual Cost						
Total annual cost						
(% allocation) cost						
Base year cost						

*Note: the presence of air conditioning in some rooms but not all, will affect the allocation of electricity costs by room.

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I) RECURRENT TRAINING

Sources of data: _____ _____ _____ _____ _____

Detail personnel involved in training	Fees	Travel	Subsistence + miscellaneous	Salary costs	Total cost		% Allocation	Annual programme cost	
					Fin.	Econ.	Fin.	Fin.	Econ.
TOTAL									

* if run in-house, the extended training forms from the start up section may be more useful, without annualisation

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J) WASTE MANAGEMENT

Sources of data: _____ _____ _____ _____ _____

Type of wastage (list)	Company responsible for waste collection*	Quantity	Unit cost		Total cost		% Allocation cost	Annual programme cost	
			Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
TOTAL									

* if applicable

Remember to annualise any equipment used, e.g. Incinerator, etc.

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K) QUALITY ASSURANCE AND SUPERVISION

K1. INCOMING INSPECTION

Supplies	Quantity	Unit price		Total cost		% Allocation to Clinic	QA Cost per sample set	
		Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
Pesonnel (Project Staff)		**Quantity**	**Nr. of days**	**Salary costs/day**		**% Allocation to Clinic**	**QA Cost per sample set**	
				Fin.	Econ.		Fin.	Econ.
TOTAL COSTS PER INSPECTION								
NUMBER OF INTERNAL INSPECTIONS IN COST PERIOD								
TOTAL								

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2. EXTERNAL QUALITY CONTROL

2.1 CENTRAL LEVEL COSTS

Building Space	Days used	Fin. cost	Econ. cost	Total cost		% Allocation to Clinic	QA Cost per sample set	
				Fin.	Econ.		Fin.	Econ.
MANUFACTURE:								

Equipment	Cost		Life expectancy	Annualized cost		% Allocation to Clinic	QA Cost per sample set	
	Fin.	Econ		Fin.	Econ.		Fin.	Econ.
MANUFACTURE:								

Supplies	Quantity	Unit price		Total cost		% Allocation to Clinic	Cost per sample set	
		Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
MANUFACTURE:								

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2.1 CENTRAL LEVEL COSTS - continued

Personnel (Project Staff)	Nr. of days	Per diems	Travel reimb-ursements	Salary cost/day		% Allocation to Clinic	% QA Allocation	QA Cost per sample set		% Supervision Allocation*	Supervision Cost per sample set	
				Fin.	Econ.			Fin.	Econ.		Fin.	Econ.
MANUFACTURE:												
DISTRIBUTION:												
TOTAL CENTRAL COSTS												

*Note: supervision allocation will only be relevant when there are joint visits made for supervision and distribution of QA samples

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2. EXTERNAL QUALITY CONTROL

2.2 CLINIC LEVEL COSTS

Transport	Number days	Gas	Hire	Maintenance	% Allocation to Clinic	% QA Allocation	QA Cost per sample set		%Supervision Allocation*	Supervision Cost per sample set	
							Fin.	Econ.		Fin.	Econ.

Equipment	Fin. cost	Econ. cost	Life expectancy	Total cost		% QA Allocation	QA Cost per sample set	
				Fin.	Econ.		Fin.	Econ.
MANUFACTURE:								

Supplies	Number Schemes	Quantity	Unit price		Total cost		% Allocation to Clinic	QA Cost per sample set	
			Fin.	Econ	Fin..	Econ.		Fin.	Econ.
TESTING:									

Personnel (Clinic Staff)	Gross Annual Salary		Cost of Annual Allowance		Total Annual cost		Staff Time Allocation	QA Cost per sample set	
	Fin.	Econ.	Fin.	Econ.	Fin.	Econ.		Fin	Econ.
TESTING:									

TOTAL CLINIC LEVEL COSTS		
TOTAL COSTS PER SCHEME (CENTRAL + CLINIC)		
NUMBER SCHEMES IN COST PERIOD		
TOTAL COSTS		

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K3. EXTERNAL QUALITY ASSURANCE

3.1 CENTRAL LEVEL COSTS

Building Space	Days used	Fin. cost	Econ. cost	Total cost		% Allocation to Clinic	QA Cost per sample set	
				Fin.	Econ.		Fin.	Econ.
MANUFACTURE:								

Equipment	Cost		Life expectancy	Annualized cost		% Allocation to Clinic	QA Cost per sample set	
	Fin.	Econ.		Fin.	Econ.		Fin.	Econ.
MANUFACTURE:								

Supplies	Quantity	Unit price		Total cost		% Allocation to Clinic	QA Cost per sample set	
		Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
MANUFACTURE:								
DISTRIBUTION:								

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3.1 CENTRAL LEVEL COSTS - continued

Recurrent Costs

Personnel (Project Staff)	Nr. of days	Accommo-dation	Per diems	Travel reimb-ursements	Salary cost/day		% Allocation to Clinic	% QA Allocation	QA Cost per sample set		Supervision Allocation*	Supervision Cost per sample set	
					Fin.	Econ.			Fin.	Econ.		Fin.	Econ.
MANUFACTURE:													
DISTRIBUTION:													
TOTAL CENTRAL COSTS													

* Note: supervision allocation will only be relevant when there are joint visits made for supervision and distribution of QA samples

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3.2 CLINIC LEVEL COSTS

Transport (e.g. van use/hire plus fuel)	Days used	Fuel	Hire	Maintenance	% Allocation to Clinic	% QA Allocation	QA Cost per sample set		% Supervision Allocation	Supervision Cost per sample set	
							Fin.	Econ.		Fin.	Econ.

Supplies	Quantity	Unit price		Total cost		% Allocation to Clinic	QA Cost per sample set	
		Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
TESTING:								

Clinic Staff		Cost of Annual Allowance		Total Annual cost		Staff Time Allocation	QA Cost per sample set	
	Economic	Fin.	Econ.	Fin.	Econ.		Fin.	Econ.
TESTING:								

TOTAL CLINIC LEVEL COSTS		
TOTAL COSTS PER SCHEME (CENTRAL + CLINIC)		
NUMBER SCHEMES IN COST PERIOD		
TOTAL COSTS		

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4. CONFIRMATORY RETESTING

Supplies	Quantity	Unit price		Total cost		% Allocation to Clinic	QA Cost per sample set	
		Fin.	Econ.	Fin.	Econ.		Fin.	Econ.

Pesonnel (Project Staff)	Quantity	Nr. of days	Salary costs/day		% Allocation to Clinic	QA Cost per sample set	
			Fin.	Econ.		Fin.	Econ.
TOTAL CONFIRMATORY RETESTING COST							
NUMBER SCHEMES IN COST PERIOD							
TOTAL COSTS							

5. TOTAL QA/QC COSTS

Quality Assurance	Fin.	Econ.
INCOMING INSPECTION COSTS		
EXTERNAL QUALITY CONTROL		
EXTERNAL QUALITY ASSURANCE		
RETESTING		
TOTAL QUALITY ASSURANCE COSTS		

Supervision*	Fin.	Econ.
VEHICLE HIRE COSTS		
VEHICLE MAINTENANCE/OPERATION		
PERSONNEL COSTS		
TOTAL SUPERVISION COSTS		

* supervision costs should be fed back into personnel and transportation sheets

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M) OTHER RECURRENT COSTS

Sources of data: _____ _____ _____ _____ _____

Input detail	Annual cost		% Allocation cost	Annual programme cost	
	Fin.	Econ.		Fin.	Econ.
TOTAL					

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PC) PRIVATE COSTS: patient fees

Sources of data: _____ _____ _____ _____ _____

Fee type (specify)						
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Annual Total						
Strategy Total						

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DALY INPUTS

For infant impact

Note: Coloured cells are DALY inputs

Output indicator	Pregnant women	
People screened		Please complete with project outputs
Reactive tests		Please complete with project outputs
Treated		Please complete with project outputs
Local life expectancy at birth		Please complete with project outputs
Specificity of test in identifying active syphilis	95.00%	
Efficacy of treatment	100%	

For adult impact

Output indicator	Women	Men	Total	
People screened				Please complete with project outputs
Reactive tests				Please complete with project outputs
Treated				Please complete with project outputs
Local life expectancy at birth				(Country life tables, age 35)

see: http://www.who.int/healthinfo/statistics/mortality_life_tables/en/

(other assumptions, for your information)	
Average age of syphilis infection and treatment	25
Average duration of latent period	10
Average age of disease onset and death (neurological syphilis)	35
% experiencing symptoms of neurologic syphilis	9%
% of which with normal, disabled life expectancy	85%
% of which who die	15%
assume all are treated at age 25	

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DALY INPUTS - continued

DISEASE SPECIFIC ADVERSE OUTCOMES

Infant impact	Incidence assumption	Births affected
Neonatal Deaths Averted	9.3%	
Non-Neonatal Deaths Averted	3.4%	
Congenital Syphilis Cases Averted	19.4%	
Stillbirths Averted	13.3%	
Low Weight Births Averted	5.8%	
Baby with any adverse birth outcome	48.7%	

Adult impact

Neurological Syphilis Case Averted	

Total DALYs averted (excluding stillbirth)	
Total DALYs averted (including stillbirth)	
Adult DALYs averted	

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RECURRENT COSTS

Date	Assumption/Decision