Testing Platform Cost Model (TPCM) User Guide

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Contents

Acknowledgements

This model is based on work published by Larson et al in PLoS Medicine 2012.
Larson, B. Schnippel K, Ndibongo B, Long L, Fox MP, et al. (2012) *How to Estimate the Cost of Point-of-Care CD4 Testing in Program Settings: An Example Using the Alere PimaTM Analyzer in South Africa*. PLoS ONE 7(4)

Introduction

This cost model provides a simple tool for analysts and decision-makers to determine the **cost per test** for a testing platform from a provider's perspective.

For many developing countries, the decision to introduce or scale-up certain laboratory tests is influenced by the associated costs and effectiveness. For example, introducing point-of-care (POC) testing, or low-volume testing technologies, into healthcare programmes may improve access, linkage to care and treatment. This tool can assist policy makers in answering questions related to the cost per test for different test technologies, for example CD4, viral load, Gene-Xpert etc., and ultimately improve programme efficiency.

This guide is designed to introduce users to the basics of the model - how to set it up, collect and enter data, and interpret the results. The model has been set up to be as flexible as possible so that users can adjust it to accurately cost the cost components, settings and platforms that are of interest to the user.

The model is set up to evaluate the costs of the testing platform in:

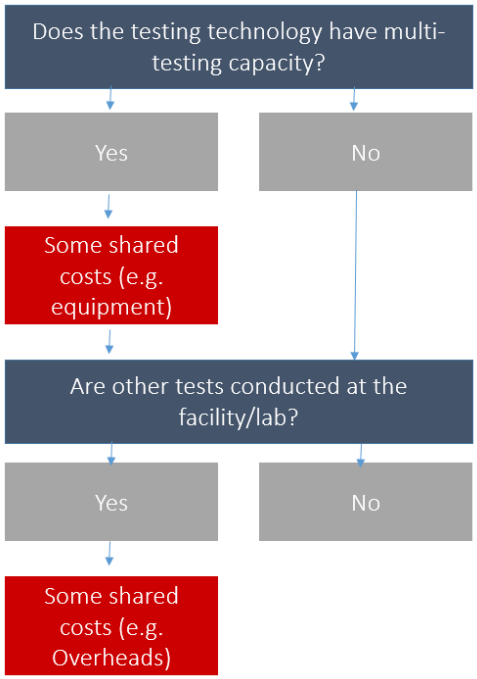
(1) Either a facility or a laboratory setting, where facility-based testing technology includes both **POC** and **low-volume test technologies**;

(2) For **polyvalent testing platforms** that have multi-test capabilities (e.g. Gene-Xpert IV); and

(3) For settings where **other tests** and testing technologies are conducted on-site.

An evaluation might include a specific test across a range of **settings and platforms**, for example facility-based POC viral load technology versus large-referral laboratory viral load testing platforms. Alternatively, an evaluation might be limited to a certain setting, for example, POC at a facility where no other tests are conducted on-site. The difference in the approach to costing amongst the different scenarios, is the element of **'shared'** costs between the specific test under evaluation and the other tests conducted at the facility and laboratory, or on the testing platform (in the case of polyvalent platforms). This is illustrated in the diagram below. Shared costs include services, materials and activities that are used or conducted at the facility or laboratory level that are not directly attributable to the test under consideration but rather are incurred by the laboratory or facility as a whole and therefore need to be shared by all tests conducted at the site (typically referred to as "overhead").

Figure 1: Implications for shared costs

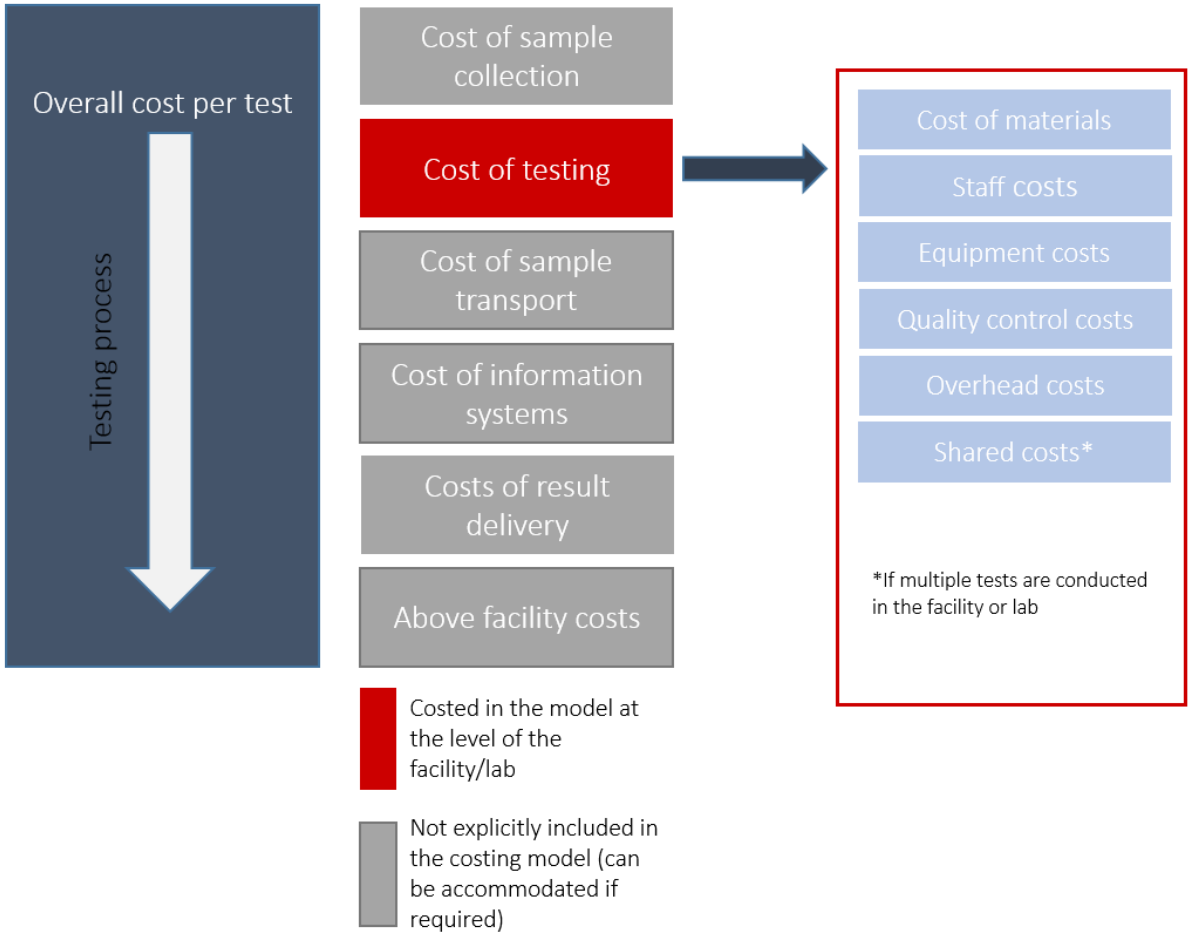


The TPCM model will need to be repeated for each testing platform under evaluation, and for each setting. For example, if the evaluation involved determining the cost of a POC viral load platform relative to a viral load technology used in a community laboratory setting, then the TPCM model would be repeated twice: once for a POC viral load platform in a facility, and again for a viral load platform at a community laboratory setting.

Whilst this model is set up to accommodate high-volume testing platforms (which are primarily based at large centralised laboratories which conduct a multitude of tests), there are a number of further intricacies that need to be taken into account. This model does not explicitly account for these (for example, additional overhead costs), and the inclusion of these would involve additional information and calculations.

This user guide addresses the cost of conducting a test at the facility or laboratory (i.e. material, staff, quality control, equipment, overheads and other shared costs). Costs incurred outside the facility or laboratory are not *explicitly* included. The diagram below summarises the cost categories that can be included when calculating the full cost of a test. These include the cost of sample collection, sample transportation costs (e.g. sample courier costs), sample delivery costs, and the cost of information systems, as well as any other above-facility costs. These might include any above facility district and management costs, and overall information system level costs. These other cost categories are not explicitly included but can be calculated and included if required. It is up to the user to decide which costs to include or exclude and to state these clearly.

Figure 2: Cost components included and excluded in the model



Deciding on which category of costs to include in an analysis, depends on the design of the evaluation. For example, if the analysis concerns assessing costs across numerous testing platforms where the sample collection or result delivery mechanism is the same across all the testing platforms, then it would be reasonable to exclude the sample collection cost category. However, if they are different, for example in the case of POC versus large laboratory testing platforms, then it is necessary to include them as they would affect the overall cost per test and influence the decision as to which platform and setting to choose. There might also be a case for excluding overhead costs if the analysis involves costing a testing platform that will be used in similar settings – e.g. in primary health clinics that have the same overhead costs.

The TPCM model has been set up with the primary aim of providing the cost per test including all components listed in the red box in the figure above. However, an analyst might decide that, for a specific analysis, an incremental cost is more appropriate: i.e. the *additional* costs incurred by introducing the new testing platform. For example, if the decision was whether to place an Xpert platform in an already functioning lab, and there was some open bench space in the lab, it could be argued that it is possible to ignore shared and overhead costs (or costs that have already been incurred) and explain that the cost analysis was conducted in an already operational lab and only incremental Xpert costs were considered.

Overview of model

As outlined in figure 2, the cost to a provider of a test depends on many individual components. These include the material costs per test, the salaries of staff who conduct start-up and daily quality control activities on the machine, the salaries of staff who perform the test, how the technology is integrated into patient flow and management, equipment and other related costs (e.g. insurance, replacement parts), the expected working life of the platform itself, and the opportunity cost of funds used to acquire the platform (i.e. the discount rate).

The model uses 9 main data input sheets, to capture all the relevant data on costs and activities, as well as test volumes. Data for these 9 input sheets needs to be captured at the facility or laboratory at which the testing platform is being introduced or used. These yellow sheets include:

i. Staff time and cost per hour to perform activities related to the test
ii. Materials required to conduct the test
iii. Activities required to conduct the test (3 sheets)
iv. Test volumes per day (2 sheets)
v. Daily start-up and quality control(QC) activities and cost
vi. Equipment costs
vii. Other costs incurred to conduct the test
viii. Overhead costs
ix. Shared costs

Information on inflation and exchange rates also need to be sourced.

Data from these **input sheets (yellow)** is then transferred into the **model calculation sheets (grey)** and ultimately summarised in the result ***Summary* sheet (red)**. This sheet provides a summary of the cost per test for the testing platform under evaluation. It breaks this cost down into the different cost categories (e.g. materials, staff, equipment, overhead etc.) for different cases – best, worst and expected. These three cases are summarised in the table below. The cases are structured based on activity time and test volume scenarios. This is important as it provides some sensitivity of the cost per test to different volumes and time scenarios. Scenarios for the working life of the equipment, are also included in the cases.

Table 1: Cost per test cases

Case	Definition
Best Case	The time per activity is assumed to be the 25th percentile (/shortest), resulting in lower associated salary costs. The number of tests performed per working day is assumed to be the 75th percentile (/highest), resulting in a lower QC and equipment cost per test. Equipment is assumed to have the best case working life scenario. The material cost is its lowest.
Expected Case	The time per activity is assumed to be average (/as expected), resulting in mid-range associated salary costs. The number of tests performed per working day is assumed to be average (/as expected), resulting in a midrange QC and equipment cost per test. Equipment is assumed to have the expected case working life scenario. The material cost is its calculated value.
Worst Case	The time per activity is assumed to be the 75th percentile (/highest), resulting in higher associated salary costs. The number of tests performed per working day is assumed to be the 25th percentile (/lowest), resulting in a higher QC and equipment cost per test. Equipment is assumed to have the worst case working life scenario. The material cost is its highest.

In addition, it is also possible to vary the type of estimates on which the data is based – e.g. either actual data collected or on expert opinion for both activity time and test volumes. It is also possible to vary the discount rate (for discounting the initial capital outlay of equipment costs) and the cost range for material costs. Although material costs are fixed per test, it is possible to provide a cost range between the best and worst cases. The default is 0%. These scenarios are all included in the *Summary Sheet.* Finally, the cost per test is adjusted to take into account the failure rate of the testing equipment to derive a *cost per successful test.*

Start

Before data collection, the key parameters and a description of the evaluation need to be entered in the *Start Sheet.*

Description of evaluation

None of these descriptions of the evaluation are essential to the workings of the model. However, they provide a useful summary of the evaluation for a user to refer to. This is especially useful when multiple settings and platforms are being evaluated.

Type of evaluation

The selection of the type of evaluation will assist in determining which testing volumes are required for allocating shared costs and ensure only relevant items are highlighted for input in the model. The four options include:

1. Only the specific test is conducted on-site, no other tests are conducted.
2. The specific test under evaluation is performed on a polyvalent platform (no other tests are performed onsite)
3. The specific test under evaluation is performed on a polyvalent platform. Other tests are also performed onsite.
4. The specific test under evaluation (polyvalent platform or not) and other tests are performed onsite.

Volumes in the *'Test' sheet* will be updated depending on the volume scenario identified here.

Setup

Key parameters to be used in the model are to be entered here.

- **Exchange rate**: The user is required to enter both the input currency (of all cost data in the model), and the desired reporting currency (usually the US dollar), and the average exchange rate between these two currencies for the study period. This cell can link to calculations conducted in the **green** '*Exchange rate' sheet.*

  NOTE: If the currency in which the cost data is being inputted does not match the input currency identified in the *Start* sheet, then it is necessary to manually update the input such that it reflects the input currency. For example, if the cost data is sometimes provided in the reporting currency, then, the user can use the exchange rate displayed in the *Start* sheet.

- **Real discount rate**: This is the effective cost of capital and is the rate used to discount equipment purchases. The rate of return on long-term government bonds adjusted for inflation is generally used. Some governments announce an advised rate which can be used as a discount rate, alternatively, the convention has been to use a rate consistent with the existing literature. A rate of 5% is commonly used in the literature[1]. The model allows for three scenarios of different discount rates. It is also a scenario that is adjusted in the *'**Summary**' sheet.*

- **Operating days per month**: This is an estimate of the average number of days that the testing unit is used a month. If it is used every day of the week, it would be used for 20 working days on average a month. It is possible to account for downtime, stock outs, electricity outages etc., by assuming less than 20 days per month. This variable directly affects the cost of equipment - fewer

[1] *See Drummond et al. (2005) Methods of Economic Evaluation in Healthcare Programmes. Third edition. Oxford University Press, New York*

operational days a month increases the cost of equipment per working day. It might be useful to make a note here, or up front in the description of the evaluation, whether the lab or facility is open for more than 8 hours a day. This however does not affect the model as the unit of analysis is working days and tests per working day.

- **Cost year**: This is the year that all costs in the model will reflect. Costs from earlier years will automatically be inflated in the model calculation sheets (grey). The inflation rate index data is collected in the **green** '*Inflation rate' sheet.*

Data inputs

The **data input sheets (yellow)** are linked to the **data calculation sheets (grey)**. This user guide primarily discusses what data needs to be collected, and then inputted in the data input sheets. We have chosen to separate data to be collected and calculations in order to facilitate seamless data collection in the field. If these data are collected and inputted in the right format, the data will be pulled through into the data calculation sheets. No cells are locked. As such, should the user require greater flexibility with data input, attention should be paid to the final calculation of interest in the calculation sheets, for example, either the cost per working day, or cost per test. The user can then collect and calculate inputs in any form or manner such that the final calculations draw the correct data. Throughout the discussion below, reference will be made to the calculation or inputs of interest that are required for the model to calculate the results.

In the yellow data collection sheets, all blue cells need to be inputted, according to the instructions provided in the cell comments. No data should be entered into white or grey cells.

NOTE: If there are figures/input in the blue shaded cells, this is just for illustrative purposes and should be deleted prior to entering the evaluation's data.

Staff salaries

In order to calculate a staff cost per test, it is necessary to first collect staff salary costs. This sheet is a comprehensive list of **all** staff who work at the facility or laboratory who might be directly or indirectly involved with conducting tests and their associated salaries and all benefits. Salary costs can generally be sourced from published government salary scales and should include all benefits that staff members are allowed (including pension, housing, medical, and a 13th cheque). The cost year that the salary source corresponds to needs to be inputted.

Where necessary, edits can be made to the average monthly cost should there be a need to adjust monthly salaries. It should be noted that this monthly cost is in current prices for the cost year inputted in the *Start* sheet (i.e. it is adjusted for inflation).

Staff costs – working days
In order to determine a staff cost per hour, it is necessary to determine how many actual days (and hours) are available for work, in an average year. For example, there might be 260 potential working days in a year (52 weeks multiplied by 5 working days a year), but it is also necessary to subtract all allowable leave (annual and sick leave) and public holidays in order to approximate the actual number of working days.

Working days are usually officially 8 hours per day. However due to breaks and other administrative duties that are not client facing, it can be assumed that at least another 2 hours per day are used for non-productive purposes. However, it is up to the user to decide what would be a reasonable amount of time to assume and adjusted.

The total monthly salary cost is then used in conjunction with the number of working days (less allowable leave and public holidays) to determine the salary cost per hour.

Material costs

All materials, consumables and reagents, required to run the specific test under evaluation need to be listed and costed in this sheet. These materials would differ depending on the type of testing platform used but might include, for example, a pair of gloves, sample collection kit, test cartridges, reagent, and paper for printing results.

If sample collection costs are to be included, materials used for sample collection (e.g. sample collection kits, needles, tubes) can be included in this sheet. Furthermore, if blood sample collection is shared among a number of tests, this needs to be taken into account using the *units/test* column. For example, if the blood sample collection is generally shared between four tests, then 25% (1/4) will be used to allocate the costs to this test.

The "***Summary*** *Sheet"* includes a scenario for material costs. It is possible to specify a cost range between the worst case and best case for material costs. This takes into account any possible uncertainty in any of the material costs. However, if there is one specific material cost that is likely to impact the fixed material cost per test dramatically (e.g. reagents which can contribute a significant amount to material costs), then it would be necessary to re-run the model by changing this cost of the specific input and assessing the impact.

Activity costs

A large component of test costs is staff costs, which is driven by the time staff take to perform the tests each day. It is important to collect this data and provide scenarios for different feasible activity times per test. Activity time per test can be calculated using one of two way: (1) **actual** data collected at the facility or laboratory using time and motion surveys; (2) **estimates** based on either expert opinion, experience or informed calculations. Each of these two cases has three time scenarios specified in the model:

Table 2: Scenarios

Scenario	Estimated data	Actual data
1	Likely	Expected case
2	Low	Worst case
3	High	Best care

Data collection:
First it is important to identify all the activities that are required when performing the specific test. For example, in the case of a POC test, there would first be the collection of the blood sample, then there would be the sample preparation, the running of the sample, and finally the interpretation of the result, recording of the result, and delivery of the result to the patient (if the analyst has decided to include this cost component). Each of these activities involve a staff member, and their time.

In the sheet, "*Activity data (1)*", all activities, and the corresponding staff member performing the activity, are listed. The corresponding staff member can be selected from the drop down box. This staff list references the staff list included in the '*Staff costs – salary'* sheet which is list of all staff working at the site and their respective salaries and benefits. It is important to first collect this information.

Note: Activities that exist in the absence of the test should not be included. Shared activities, between tests conducted on the same platform, or other tests conducted on-site, are included under the *'Shared data'*.

Where a test is part of a batch, the activity conducted on the batch is included (but the time allocated will need to take into account the time per test, as cost per test is the relevant parameter).

Note: It is also important to determine whether a staff member performing the activity is able to complete other tasks simultaneously. For example, if a nurse is able do other work whilst a test is running, then the time spent running that test by that staff member might be close to or equal to zero minutes.

(a) Actual activity time data

Actual activity time data per test can be collected using the sheet '*Activity data – Actual (2)'* on a specified sample of subjects. This records the number of minutes taken by each staff member to perform an identified activity for a test. The different activity time scenarios are based on the summary statistics of the activity time per test conducted over a sample of subjects: the median (expected case), the 25% IQR (worst case), and the 75% IQR (best case).

(b) Estimated activity time data

The '*Activity data - estimates (3)*' sheet needs to be completed if the activity time per test is estimated (and not actual data). Based on expert opinion or experience, include three scenarios for the amount of time (in minutes) that each staff member spends on the activity per test: a likely, a low estimate, and a high estimate.

Test volumes

The cost of a testing platform is very dependent on the number of tests the platform can perform per working day. It is important to collect this data and provide scenarios for different feasible volumes per working day. As with time per activity, test volumes per day can be calculated using one of two ways: (1) **actual** data collected at the facility or laboratory; (2) **estimates** based on either expert opinion or informed calculations. Each of these two cases has three volume scenarios, as specified in Table 2.

In addition to the above sources of data, it is possible to determine the **theoretical maximum** tests per platform for a 24 hours as this would inform the estimates above and provide an upper bound. The theoretical maximum is the highest throughput that the platform can manage if the only constraint was test time and is usually available from specification documents from the manufacturers. Whilst it is theoretically possible to achieve this, in practice it is seldom the case that the testing platform is run at maximum capacity due to a number of reasons: power outages, staffing issues, limited shifts, stock outs of reagents, low test demand etc. Whilst having much lower volumes (and resulting in higher costs), it is often more appropriate to use actual data from the field to approximate volumes or the experience of health workers working with the testing platform. However, this decision will need to be made by the user. Scenario cells for the specific test and platform tests will be highlighted in red if they are above the theoretical maximum.

In addition to test volumes per working day, the **failure rate** for the specific test is also collected. Tests results can fail or be inconclusive for a number of reasons. There is still a cost associated with these failed tests and they should be accounted for in the cost per test. This data might be collected from laboratories performing the test with historic data; alternatively, this information can be sourced externally from the technology manufacturers. This input informs the cost per *successful* test in the '*Summary Sheet'.*

Data collection:

The main data collection sheet, '*Test data (1)'*, draws data from '*Test data – Actual (2)'* for test volumes per working day for three volume scenarios. Three different volume categories are collected, depending on the evaluation type (as specified in the *Start*):

- Test volumes per working day for the specific test under evaluation (e.g. viral load)
- Test volumes per working day for all tests conducted on the same platform (e.g. viral load and MDR tests on the XPERT IV platform), if applicable.

- Test volumes per working day for all tests conducted at the site, whether a facility or a full-scale laboratory, if applicable. These test volumes are important to collect in order to assign shared costs.

(a) Actual data

Actual test data can be collected using the sheet '*Test data – Actual'*. This would collect data on the average number of tests performed for every working day across each volume category (regardless of the number of shifts conducted). It is very important to only include working days, and to record zero's when no tests are conducted. Ideally data should be collected each day, however, if data is collected over a period (e.g. the month of January), then the number of tests for January need to be recorded as well as the number of working days in January. The different volume scenarios are based on the summary statistics of the volume of tests conducted over the period of study: the median (expected case), the 25% IQR (worst case), and the 75% IQR (best case).

Note: Where tests are conducted in batches, it is important to translate this into the number of tests conducted as the unit of interest ultimately is the cost per test.

(b) Estimated data

In the main data collection sheet '*Test data (1)',* space is provided to enter daily test volumes for the three volume scenarios: likely, low and high estimates. These are normally based on expert opinion and experience.

Quality control costs

This sheet documents the activities or materials that are required to conduct quality control and daily start-up for the specific test under evaluation. An activity or material that is used/conducted for every single test must be put under the *Activity Sheet.* These are QC activities that are not conducted for every test, but might be conducted for a few tests (e.g. start up, cleaning etc.) or a batch or more, or conducted daily regardless of the number of tests. They are also not shared QC activities amongst all tests performed in the laboratory or facility, nor are they shared activities amongst other tests performed on the same platform (these will go under the '*Shared' sheet*).

The output of interest is the QC and start-up cost per **working day.** As such, it is important to convert the costs of the activity or materials to costs per working day.

Data collection:

First, it is necessary to identify whether the QC cost is related to a material that is used or an activity i.e. a staff member's time. It may be that an activity includes using materials in addition to a staff member's time and therefore the materials used should be listed as well as the activity.

Frequency: This column in the *'QC data' sheet* requires that the user determine the frequency with which the activity is conducted, and the useful- or working-life of the material. For example, how often does the material need to be replaced? Monthly? How often is the activity performed? Daily, weekly? This frequency then needs to be converted into the equivalent in working days. For example, if a material needs to be replaced monthly, then it can be used for 20 days and the cost of that material needs to be allocated across those 20 workings days. Alternatively, if an activity is conducted weekly, then the cost of conducting that activity needs to be allocated over the 5 working days in order to arrive at a cost per working day. The table summarises this conversion below.

Table 3: Frequency and equivalent working days

Frequency *How frequently is the activity conducted? How often does the material need to be replaced*	**Equivalent working days**
Daily	1
Every second day	2
Weekly	5

Bi-monthly	10
Monthly	20
Every six months	40
Annually	260

Since testing technologies are unlikely to be used every day of the month, due to holidays, staff meetings, stock outs etc., the user might want to build in some flexibility here by assuming 16 working days per month. This is however a decision for the user to make.

If the QC cost is an activity, then it is necessary to determine how long it takes to conduct that activity and which staff member performs that activity. If the activity is conducted more than once a day, the total time required per working day needs to be aggregated.

If the QC cost is a material, than the cost of the material needs to be inputted. This material cost must correspond to the unit that is replaced over the period specified.

All assumptions and sources should be referenced.

Equipment costs

All equipment (i.e. lasts > 1 year) should be listed and assigned a cost, which would be shared across the life time of the project. Equipment includes the testing platform used to perform the tests, as well as other equipment shared across all tests conducted in the laboratory or facility e.g. safety googles, a fan, a desk, as well as more general lab equipment.

To measure and value equipment costs in an economic evaluation, we use one of two methods to compute a monthly cost. First, if the equipment is to be/was purchased, then we need to know the purchase price and define a useful life (or working life) of the equipment. With this information, along with the discount rate, we can annualise the initial expense over the useful life of the equipment. And second, if the equipment can be or is likely to be leased for a period of time, then the monthly lease cost is used directly.

The working life of equipment is dependent on the type of equipment. There are a number of ways in which to determine the working life. (1) Government guidelines, for example, the South African Revenue Service has published a list of acceptable write-off periods; (2) determine the expected life of the asset which can be based on past experience and other information; (3) the manufacturer, site, laboratory or organisation might use a specific value based on policy or experience. For example, the standard assumption for the working life of laboratory equipment used by the national laboratory provider in South Africa (the NHLS) is 5 years.

Data collection
The "*Equipment data*" sheet is split into two sections.

(a) The first section requires that equipment directly related to conducting the specific test be identified. This includes the test platform, as well as other equipment that is used solely for the purpose of conducting the specific test. How the technology is acquired, and under what conditions, must be considered and the purchase price might include warranties, insurance and annual care plans. All costs related to this section will be borne by the specific test. If the platform is a polyvalent platform, then the costs will be shared by all tests conducted on the platform.
(b) The second section lists equipment that is not specific to any one test, but that is used for all tests (including the specific test) and as such these costs will be shared by all tests conducted in the laboratory or facility. The type of equipment included in this section is anything which is used across tests: desk chairs, waste baskets, desk fans, metal patient stool, etc.

In both cases, information on whether the equipment is rented or purchased, the rental or purchase price, and, if purchased, the working life of the equipment and working life scenarios, will need to be determined.

Other costs

This sheet documents any other costs that are incurred as a result of conducting the specific tests. This might include training costs (i.e. to train staff personnel on how to use the testing equipment), insurance costs for the equipment, service and maintenance costs (f not included in the purchase/rental agreement of the equipment), repairs and medical waste disposal. Include all assumptions in the 'Source' column. For example, for training, it might take 2 hours, and is repeated every 2 years to take into account staff turnover or retraining.

The user needs to distinguish between other costs that have a time and activity component (e.g. training for 2 hours by a laboratory technician) – "*other costs – activity based'*, and costs that are for a fixed period of time (service and maintenance contract for a year) – *"other costs"*.

Any of these other costs that are done for every single test must be put under the *Activity Sheet.* These are all other costs that are not conducted for every test, but might be conducted for a few tests (e.g. waste disposal) or a batch or more. They are also not shared costs amongst all tests performed in the laboratory or facility, nor are they shared activities amongst other tests performed on the same platform (these will go under the '*Share data' sheet*).

The output of interest is other costs per **working day.** As such, it is important to convert the costs to costs per working day.

Data collection
First, as for QC activities and materials it is necessary to identify whether the cost includes staff member's time – "*other costs – activity based'*, or is a cost that is fixed for a period of time "*other costs"*.

Frequency: The column requires that the user determine the frequency with which the cost is incurred. For example, training occurs once every two years, and insurance costs are paid annually. This frequency then needs to be converted into the equivalent in working days. For example, the training cost needs to be allocated over two years or 520 working days. See the table under QC costs for more.

In addition, if the other cost is activity-based, then it is necessary to determine how long it takes to conduct that activity and which staff member performs that activity. Salary costs will be sourced from the salary cost table. If the other cost is not activity-based, costs for the period specified need to be inputted.

All assumptions and sources should be referenced.

Overhead costs

Overhead costs include indirect costs that are not directly attributable to the specific test under evaluation but rather are incurred by the laboratory or facility as a whole and therefore need to be shared by all tests conducted at the site. These overhead cost include:

- The cost of the space that is used to conduct the tests, as well as space indirectly used to accommodate test taking – e.g. patient waiting rooms.
- Utilities (electricity, water)
- Other facility running costs (e.g. security, connectivity etc.)
- Support and managerial staff

Space
The table below summarises the spaces that need to be measured in order to determine the area and costs that should be attributed to the test. These includes the entire building, the space that this shared with other tests, the area used for testing the specific test, and shared patient and staff areas. The sheet

requires that the user includes an indication of **the proportion of the space that should be allocated to the specific test**. For example, the area used to test the specific test (e.g. the size of the area that the equipment takes up) should be allocated 100% to the cost per test (unless it is conducted on a polyvalent platform), and the shared staff spaces would be allocated according to the proportion of staff directly involved with testing over total staff at the facility. This is summarised in the below table.

	Space to measure	Examples	Allocation
A	Area used to conduct testing of the specific test.	Area of testing platform– typically the space the equipment takes up	100% - unless it is a polyvalent platform (then it would be specific tests/platform tests)
B	Shared space with other tests	The laboratory or area in facility that is dedicated to testing	Specific test/total tests
C	Shared patient spaces	All spaces that are used by all patients including hallways, waiting and storage areas which cannot be clearly allocated to a service	Test patients/total patients
D	Shared staff spaces	All space used by staff including staff toilets and kitchens	Staff directly involved with testing/total staff

The output of this table is the proportion of space (out of total space) that is both directly and indirectly used for testing the specific test, as well as the size of the space that can be attributable to the test. These outputs are used to allocate rental, utility, other facility and staff overhead costs to the specific test.

Note: The rent and utility bills must correspond to the building that is used to calculate the total size.

1. **Rental**

A rental cost for the allocated space is determined using an average cost per square meter determined either from facility or laboratory records or external sources (rentals in the area).

2. **Utilities**

The average monthly cost for utilities needs to be sourced and the total allocated monthly cost calculated based on standard commercial space usage per square meter.

3. **Other facility running costs**

All other facility running costs (that are not already included) should be identified in this section. The average monthly cost needs to be provided. Examples included security services, internet services, any repairs and maintenance costs, etc. The costs allocated to the test are calculated using the proportion of space used for testing.

4. **Staff overhead costs**

All managerial and support staff at the facility or laboratory, not directly involved with testing need to be included here as part of the costs to be allocated to the test's total cost. These include clerks, facility managers, cleaning staff etc. Staff overhead costs are allocated using the proportion of space used for testing.

The summary table at the bottom of the sheet summarises all information in order to be directly inputted into the *Shared sheet*.

Shared costs

Activities, materials and item costs that are shared amongst the different tests conducted at the facility or laboratory, or on the same platform are recorded in this sheet. Shared materials can include the ethanol used to disinfect equipment, and shared activities might include daily cleaning of the lab. The time frame over which the material lasts, the frequency of the activity, as well as whether the cost is shared amongst all tests, or for tests conducted on the same platform (e.g. the cleaning and start-up of the testing platform) needs to be determined.

The user must distinguish between the shared costs that have a time and activity component (e.g. stock taking every month for 2 hours by a nurse), and costs that are for a fixed period of time (e.g. a lab coat that needs to be replaced annually and gloves that are used each day).

The output of interest is shared costs per **working day.** As such, it is important to convert the costs to costs per working day.

Data collection
Frequency: The column requires that the user determine the frequency with which the cost is incurred. For example, stock take occurs every month, and insurance costs are paid annually. This frequency then needs to be converted into the equivalent in working days. For example, stock take cost needs to be allocated over a month or 20 working days. See the table under QC costs for more.

Shared volumes: It is important to identify whether the cost is shared with all tests conducted at the laboratory or facility, or with only those tests that share a platform. In the case that it is not a polyvalent platform, then all costs will be shared with all tests.

In addition, if the shared cost is activity-based, then it is necessary to determine how long it takes to conduct that activity and which staff member performs that activity. Salary costs will be sourced from the salary cost table. If the shared cost is not activity-based, costs for the period specified need to be inputted. For example, if 4 gloves are used for cleaning every day (i.e. the 4 gloves are used up daily), the cost should relate to 4 gloves (e.g. the unit price of a glove multiplied by 4 units.)

All assumptions and sources should be referenced.

Inflation and exchange rates

The inflation rate and exchange rate parameters that are used in the analysis, are sourced from the **green** input sheets. This data can generally be sourced from online financial data websites (e.g. from the International Monetary Fund's World Economic Outlook Database[2]). The inflation index rate, which shows cumulative information between various years, is easiest to work with rather than the inflation rate (a change between single time periods).

In the relevant data collection sheets, each time a price/cost is collected, the year for which the cost is in is collected. The model will then apply inflation to that cost depending on the year that is entered here. If the year of the cost is not known, this needs to be estimated with the best available information. If a cost is specified but the year of the cost is not specified, this will be highlighted in red. Salary costs, materials, QC costs, other, overhead, shared and equipment costs will all need to be inflated if the cost year differs from the unit cost data inputted.

Model calculations

No data input is required in the grey calculation tabs as data is pulled from the blue shaded cells in the data input sheets, and used to make the necessary calculations.

The estimate type for activity time and test volumes (estimate or actual data) is selected in the *Summary Sheet.* The discount rate for equipment costs is also selected in the *Summary Sheet*.

In each case below, costs are translated into a cost per test.

1. **Materials:** Based on the units per test and cost per unit entered during data collection, it is possible to determine a cost per test. This amount is fixed per test and therefore does not vary with test volumes.

[2] http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx

2. **Activity**: This sheet summarises the three activity time scenarios by estimation type: estimate and actual for each of the activities identified as required for performing the specific test under evaluation.

3. **Staff**: This sheet uses the salary and working hours of the staff required to perform test activities to determine a salary per hour. This is then applied to the activity time scenarios from the activity sheet.

4. **Test:** This sheet summarises the three test volume scenarios for each estimate type (actual data and estimate data), and volume category: the specific test, all platform tests, and all tests conducted at the facility or laboratory.

5. **QC**: The cost per working day is calculated. This is then converted to a cost per test using the number of tests for the specific test under evaluation that are completed per working day.

6. **Equipment:** This sheet determines the daily equivalent costs for the equipment based on three discount rate scenarios, as well as the three working life scenarios if the equipment: worst case, expected case and best case. The daily equivalent cost is determined by using the average days per month that the testing unit is used, as designated upfront in the *Start* sheet. If the equipment is rented, the daily equivalent cost for the use of the equipment is provided. For equipment that is solely used for the purposes of performing the specific test, the daily equivalent costs of both purchased and rented equipment, is divided by the total number of tests performed on the test platform. For equipment shared across all tests, the daily equivalent costs of both purchased and rented equipment is divided by the total number of tests performed at the laboratory or facility. The output is an equipment cost per test.

7. **Other:** The cost per working day is calculated. This is then converted to a cost per test using the number of tests for the specific test under evaluation that are completed per working day.

8. **Overhead:** The cost per working day is calculated using the 20 working days (as all overhead costs are monthly).The cost per test is calculated using the number of tests for the specific test under evaluation that are completed per working day.

9. **Shared:** The cost per working day is calculated for each of the shared cost categories. It is then converted to a cost per test using the number of tests specific in the sharing scenario (either all tests conducted at the lab or facility, or tests conducted on the same platform), for different test volume estimate types.