Health Economics and Epidemiology Research Office

HE²RO

Wits Health Consortium
University of the Witwatersrand

HEALTHCARE COSTS AND OUTCOMES MODEL
USER GUIDE

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Health Economics and Epidemiology Research Office
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Contents

1. INTRODUCTION

The Healthcare Cost and Outcomes Model (HCOM) provides a simple tool for analysts and decision-makers to determine the cost-effectiveness of a healthcare intervention in which resources are consumed to produce certain healthcare outcomes. Using patient-level medical record or case report form data, it estimates the quantity of resources consumed by a sample of patients and then multiplies these resources by their local unit costs, with stratification by patient outcome. The result is an average cost per patient per outcome, which can then be compared to other interventions or used for budget estimates or program monitoring.

For many developing countries the decision to offer HIV care and treatment, at what level and through which delivery model is influenced by the associated costs and effectiveness. This tool can assist policy makers in answering questions that are relevant for improving the efficiency of programme implementation. For example:

- The cost effectiveness of ART provision through various delivery models
- The cost effectiveness of nurse initiated and managed ART
- The cost effectiveness of rapid scale-up of Test & Start strategies
- The cost of viral load scale-up
- The cost effectiveness of rapid ART initiation
- The cost effectiveness of self-testing
- The cost effectiveness of using electronic patient adherence monitoring
- The cost effectiveness of adherence clubs
- The cost effectiveness of central chronic medicine dispensing and distribution programmes
- The cost and outcomes of multi-month scripting and dispensing
- The cost effectiveness of community-based ART delivery
- The cost effectiveness of offering second line treatment
- The cost effectiveness of down referring stable patients
- The cost effectiveness of resistance testing prior to changing to second line treatment

Although the model was designed to estimate the costs and cost-effectiveness of delivering antiretroviral therapy, it can be used to evaluate any outpatient healthcare programme. This user guide is designed to introduce participants to the basics of the model - how to set it up, collect and enter data, and interpret the results.

Data collection

The model relies on data collection for data inputs from two different sources: (1) the site (using a Site Data Collection Tool); and, (2) the subjects or patients (using a tool designed for the purposes of the study).

The **Site Data Collection Tool** collects data on indirect and direct costs: staff employed at the site, equipment and vehicles used, supplies, building usage, the number of programme-specific healthcare visits etc. This information is used for calculating monthly costs. An example of this tool is supplied with this model (*Site Data Collection Tool.v1*). Data collected in the site data collection tool is used to populate the indirect and direct cost tabs in this tool.

Data on **utilisation and outcome needs to be collected for a sample of subjects** identified for the project. An example of this tool is not provided as part of this model as the data collected is dependent on the specific healthcare programme being evaluated. Applications, such as

REDCAP, can be utilised to capture the relevant data and statistical software (for example, STATA and SAS) can be used to analyse and format the data. Data collected needs to be inputted into the *Subject Data* matrix sheets (more below).

The box in Section 2.2 describes how to convert a Case Report Form (CRF) (or other data extraction method) to the data format required by the Subject Data matrix.

Other notes

Project. The healthcare programme under evaluation is referred to as a "*project*" in this user guide.

Number of subjects. The model is currently set up to draw on data from up to **600** subjects (or patients). This should be more than sufficient. However, the model can be easily adjusted to accommodate up to 10,000 subjects by inserting more rows in the *Subject Data* sheets and by dragging down formulas in the *Sample Costs* and *Subject cost category* sheets.

Number of sites. It is possible to include more than one site. This is often the case when a RCT type design is used and one site acts as the intervention and another site as the control (see *Subject data variables* on ways to handle a trial design). Where there is more than one site, the model can be run twice – i.e. the entire workbook needs to be duplicated for the second site and the results aggregated separately. However, it is also possible to aggregate the sites and use one workbook. This decision would need to be made by the analyst, taking into account how important or different the other site's costs are and whether the study design requires separation of site costs or not.

Period of study. This model collects cost, utilisation and outcome data over the period of study which may vary from project to project. Cost per outcome and effectiveness can be reported for the period of study or for a 12 month period which will inflate/deflate the costs depending on whether the study period is more or less than 12 months.

Data Input Cells. When using the worksheets, note that the cells highlighted in light blue are the **only** cells that should be populated using the Subject Data and Site Data Collection Tools. White cells are calculated cells, and grey cells are prepopulated.

HIV cost and outcomes example. Two models are provided with the user guide (1) *HCOM_blank_v1* and *HCOM_example_v1*. The *HCOM_example_v1* model has been populated with a HIV evaluation example. This is to assist with understanding and the example is referred to in this user guide. However, once the user is ready to start populating their own model, the blank model should be used: *HCOM_blank_v1*.

Appendices. There are 8 Appendices in the example model - *HCOM_example_v1*. These are primarily used to illustrate how costs were calculated for the HIV example. The appendices draw on information collected in the Site Data Collection Tool as well as on external resources and are used as a reference for any sources and calculations required to determine costs.

Structure of the model

The excel model is structured as follows:

	Start	Start and cost menus, and copyright
	Data Entry	Parameters that set up the model
		Subject data on utilisation and outcomes
		Indirect costs (staff, buildings etc.)
		Direct costs (lab, drugs costs etc.)
	Calculations	Calculations using data inputted into the model
	Results	Results of the model: cost per outcome and effectiveness
	Appendices	Appendices detailing sources and extra calculations

INTRODUCTION TO THE HEALTHCARE COSTS AND OUTCOMES MODEL

Data entry by you

Purple tab (1 worksheet)

Parameters: Basic information about your site, intervention, data set, and resources.

Gather the information requested and make a list of all variable resources used, including each drug, laboratory test, and type of clinic visit.

Yellow tabs (2 worksheets)

Subject data: Quantities of each type of resource used per individual client or patient and outcomes for each individual.

Use a data management program (e.g. SAS or STATA) to create table with one row per patient or client and a column for each type of outcome and resource, as shown in the subject data pages.

Green tabs (7 worksheets)

Cost data (indirect): Unit costs for all the fixed resources used, such as staff and clinic space.

Refer to invoices, price lists, salary schedules, and other source documents and interview site or program staff to estimate the actual quantity and cost of each item in the green costing pages.

Blue tabs (5 worksheets)

Cost data (direct): Unit costs for all the variable resources that are used by individual patients (e.g. drugs, clinic visits).

Refer to invoices, price lists, salary schedules, and other source documents to estimate the actual cost of each item in the blue costing pages.

Calculations –no action needed

Gray tabs (5 worksheets)

Model calculations: The model will use the data you have entered to calculate the outcomes and costs and produce the results in the next section.

You do not need to make any changes to these worksheets.

Results—here are your findings

Orange tabs (4 worksheets)

Results: These sheets provide the detailed results of the analysis.

Refer to the User Guide for further explanation of how to interpret the results.

Red tabs (8 worksheets)

Appendices: These worksheets are set up to help calculate specific types of costs.

Use the appendices as needed for cost calculation data.

Starting the model

To start the HCOM Model, open Excel and then select "File", "Open", and "HCOM Model".
A message similar to the following might appear: "Macros in this workbook are disabled because the security level is high"…"
This means the menu will not work because macros have been disabled. The programme can still be used without the menu. However, it is better to allow the menu to operate. To do this, follow these steps:

1. Select "Tools" from the Excel menu.
2. Select "Macros" from the "Tools" menu.
3. Select "Security" from the "Macros" menu.
4. In the tab "Security level," select "Medium."
5. Press "Ok." This will change the security level to allow Excel to run macros that are embedded within Excel spreadsheets.
6. Close the model by selecting "File" and "Close."
7. Open the model again by selecting "File" and "Open."

The menu should now run correctly. Note that use of the model implies having read and agreed to the copyright statement.

2. DATA ENTRY

This section of the manual covers the inputs necessary to estimate the total cost, cost per outcome and cost effectiveness. The following inputs will need to be entered:

- **Parameters.** These set up the structure for the cost model and identify key assumptions. Data for parameters can be sourced from the study protocol and publicly available financial data.
- **Subject Data**. This includes all utilisation data and outcome data on the sample of patients identified for the project.
- **Indirect Costs**. These are costs that are not directly attributable to the patient. These costs are estimated using the *Site Data Collection Tool* and external sources.
- **Direct Costs**. These are costs that are collected with each patient interaction. These costs are estimated using the *Site Data Collection Tool* and external sources.

Note on indirect versus direct costs and allocation:

The data entry for costs are split between what are termed "direct" costs and "indirect" costs. Direct costs are those costs which are collected at the level of the patient or where data is collected and recorded at each patient interaction. These direct costs include, for example, the type and quantity of drugs dispensed, the lab tests taken and the number of doctor consultations. They are generally variable costs that vary directly with the volume of patients.

Indirect costs, on the other hand, are those costs that are not collected by the site at the level of the patient. They are generally fixed costs that do not vary directly with the volume of patients. They include, for example, staff salary costs which are paid regardless of the number of patients seen, building rental costs and other overheads. In general, an assumption has to be made in order to allocate a proportion of these costs to the project. This is discussed in the Note on **allocation assumptions**.

2.1 Parameters

This sheet lists all the important parameters that provide the assumptions and structure for the cost model and will inform the ultimate cost and outcomes of the study. This needs to be filled in prior to populating further sheets. It will be informed by the study protocol and the data collected on subjects. Only fill in the blue shaded cells.

Site parameters

- <u>Full name of site:</u> Provide the full name of the site

- Description of site: Provide a text description of the site. Although this information is not used in the model, it is important to document the location, setting (rural/urban), sector (private/public) and type of site (for example, hospital, clinic, out-patient clinic, mobile etc.).

Study parameters

- Period of study: The period over which the subject data (utilisation and outcomes) is collected. Provide the start and end dates.
- Study period (in months): Convert the above period into the total number of months for which data on utilisation and outcomes will be collected. This will generally be captured in the tool that is being used to collect subject data. This is an important variable for the *Summary Sheet* where both a 12 month reporting period and the study period can be used to summarise cost and outcome data. As the study period might be more or less than 12 months we need to multiply the costs by a factor to convert them to a 12 month period. This factor depends on this variable.
- Reporting cost year: This is the cost year in which the results from the model will be reported – in policy documents, journal articles etc.
- Unit cost year: The year which reflects the unit costs entered in the model. All unit cost data must be entered into the model for the same year. If some unit costs are for previous years, they need to be inflated to reflect unit costs for the year indicated here.
- Number of patients (px) in the sample: This data can be sourced from the study protocol.

> **Note on inflation for unit costs:**
> Commonly, resource use and outcome data is collected over an extended period of time (the study period), whilst unit cost data is only collected towards the end of the study. If these unit costs are collected over an extended period of time, or are sourced from previous years, then it is very important to ensure that all unit costs entered in the model reflect the same year.
>
> For example, if data for costs is being entered in 2014, then 2014 unit costs should be reflected in the model. However, if there are only 2013 price lists available for, for example, some medical supplies, then these medical supplies will need to be inflated to 2014 prices using the inflation rate for 2014. These calculations can be conducted in an Appendix.

Financial parameters

- Local currency: The currency that the costs are originally recorded in.
- Foreign currency: The currency used for international comparison, usually the US$.
- Exchange rate: The exchange rate between the local and foreign currency. More information on the source and calculation can be provided in an *Appendix*.
- Entry currency: This is the currency that you are going to use to enter cost data. Pick either "Local" or "Foreign" from the drop-down box
- Inflation rate: Average percentage increase between the *reporting cost year* and the *unit cost year* to apply to the results to adjust them to the year in which the results will be reported. More information on the source and calculation can be provided in an *Appendix*. The type of inflation rate to be used is at the discretion of the analyst but is likely to be the CPI. [Note: this may need to be inputted once the study is complete and the inflation rate is known.]
- Discount rate: This is the effective cost of capital and is the rate used to discount equipment and vehicle 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].

Note on inflation for results

Once the model is complete, it might be desirable to report the results using current prices (i.e. in the prices of the reporting year). For example, the cost data might reflect 2014 prices, but it is necessary to report the results for 2015. This option can be selected in the Summary Sheet. The results will then be adjusted to reflect this. The average inflation rate for the period between the unit cost year and the reporting cost year is used to inflate the results.

Patient outcome parameters

- Outcome definition: There are 10 possible patient outcomes that this model can measure. The outcomes to be measured are determined by the study protocol and need to be described here.
- Outcome category: It is important, where possible, to categorize and aggregate the different outcomes into groups. This model summarises outcomes and cost effectiveness by the major outcome categories. For example, the 8 outcomes illustrated in the example are categorized into three main patient outcome categories.
  1) In Care and Responding
  2) In Care and Not Responding
  3) Not in Care)
  There are a total of 6 possible categories. If the outcomes are already mutually exclusive and cannot be categorized further, then a category number of "1" should be assigned to each outcome separately.
- Success: When the results are presented, the average cost for each of the outcomes and outcome categories is calculated. In addition, an average cost per patient is calculated as well as the average cost per successful outcome. In this example, a successful outcome is if the patient is in care and responding. The cost of producing this result is the total cost for the sample divided the number of patients who achieved a successful outcome. This ''production cost" is reported in the results summary sheet. As the definition of a successful outcome will change from project to project, the analyst needs to indicate what is considered a successful outcome with a "1".

Subject data variables

- Subject data on utilisation data and outcome data must be collected for a sample of patients identified for the project.
- The headings for the data collected need to be entered here under the relevant category. These headings will then populate the *Subject data* matrix.
- The variables are grouped into the following headings
  1) **Standard**: This includes study identification variables, time and outcome variables. There is a maximum of **20** standard headings. The Study ID variable (Row 1), months in care (Row 10), *outcome_code* (Row 11) which indicates the outcome number (1-10), *finaloutome* (Row 12) which provides the outcome definition, are all compulsory. If the

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

study is related to HIV, the baseline CD4 value and date is required in Row 4 and 5. If this study is not related to HIV (or CD4 values are not deemed relevant), Row 4 and Row 5 should be left empty as Standard4 and Standard5. The prescriptive nature of these standard variables are necessary as calculations are linked to these cells.

2) **Events**: These are defined as distinct events that involve a staff member interacting with a patient. For example: a staff nurse drawing blood; a counsellor performing a wellness session, a patient follow-up medical visit with a doctor, a patient collecting medication from a pharmacy assistant. There is a maximum of **30** possible events.

3) **Labs**: All test related utilisation information. There is a maximum of **50** possible lab tests.

4) **Drugs**: All drug related utilisation information. There is a maximum of **250** different possible drugs. (Note: drugs prescribed in more than one formulation, e.g. d4T 30 mg and d4T 40 mg, should be listed separately.)

5) **Support Service**: Other services that are received. There is a maximum of 10 possible services.

6) **Other**: Anything else that is not captured by the above headings. There is a maximum of **10** other possible variables.

- Note that there can be no blanks in the blue cells i.e. if you only enter 3 Events then keep Event 4, Event 5, - Event 10 listed. The blanks row will be highlighted red indicating blank cells.

Note on clinical trials

It is possible to use outcome categories to denote different clinical trial arms. For example, in a two-armed clinical trial there might be five possible outcomes. These can be listed twice using a suffix of 1 or 2 to denote the different arm. These 10 outcomes can be grouped using the outcome category variable as belonging either to arm1 or arm2. The costs associated with these two arms will then be presented separately in the final results.

2.2 Subject data

As discussed above, subject data on utilisation and outcomes needs to be collected on the sample of patients identified for the project. This data then needs to be inputted into the *Subject Data* matrix sheets. The box below describes how to convert a Case Report Form (CRF) (or other data extraction method) to the data format required by the Subject Data matrix.

- The headings for the data collected are entered in the *Parameters Sheet* which then populate the *Subject data* matrix. All data collected needs to be inputted into this *Subject data* matrix.
- Only fill in blue shaded cells. Do not add further variables in this sheet: first update the *Parameters Sheet* with the additional data header and then populate the subject data under that data header in the matrix.
- Note: there are two sheets dedicated to subject data. This is due to the large number of variables that are collected. *Subject data 2* contains all subject data relating to the drug category.

Patient data extraction and manipulation

The CRF is the tool commonly used to collect data on each participating patient – whether this be retrospective (from medical records) or prospective. The CRF might need to be supplemented by other sources (for example, in South Africa there is Tier.Net, and Right to Care's Therapy Edge). Below are the steps to extract data, export it, and manipulate it into the form required by the subject data matrix.

1. Extract the information from the CRFs, and other sources, and enter it into a database
    - There are a number of databases that can be used for the purpose of data entry and storage, for example: Microsoft Access, CSPro, EpiInfo, RedCAP
    - One row of information must be entered for each CRF or visit date (for each patient)
    - Ensure that the data extracted falls between the study start- and end-dates.
    - Ensure that the data extracted is correctly categorized according to the subject data variables as described in the protocol (and then inputted in the parameters) - e.g.
    - Clean the data and ensure duplicates are removed

2. Export this primary patient dataset out of the database to other analysis software
    - For example: SAS, Stata, SPSS, Excel, others.

3. Aggregate the data by patient
    - From the primary data set (with many rows for each patient), create a new data set that has one row for each patient summing up quantities of each type of resource used. For example:
        - Total months in care
        - Number of CD4 counts
        - Number of Full Blood Counts
        - Number of medical visits

2.3 Indirect costs

- Only fill in the blue shaded cells.
- Ensure all unit cost data corresponds to the same year – the 'unit cost year' as identified in the parameters sheet.

Note on allocation assumptions:
In general, an assumption has to be made in order to allocate a proportion of indirect costs to the project as, for example, the equipment and staff used in an ARV clinic are only a subset of the resources used in the clinic as a whole. This assumption is referred to as the **project share** in the indirect cost sheets. It is up to the analyst to determine the best assumption to make for each of the indirect cost categories. The general attribution assumption used in this model is the proportion of project patient visits as a subset of all patients seen at the site. This is a proxy for the amount of resources that is consumed by the project. Other assumptions are:
- Staff: estimated staff time spent on the project as a proportion of total time available.
- Buildings: the m^2 of a space that is used by the project as a proportion of total size.
- Vehicles: the number of km driven for project related activities as a proportion of all km.
- Equipment: the number of tests conducted for project purposes as a proportion of all tests.

Note on treatment of capital costs:

To measure and value capital costs (buildings, vehicles, equipment) in an economic evaluation, we use one of two methods to compute the equivalent monthly cost: (1) If we know the purchase price and the useful life (or working life) of the asset, we annualise the initial capital outlay over the useful life of the asset; (2) Where market rates exist for the rental of buildings or lease of equipment, these are used instead.

Note on working life: There are a number of ways in which to determine the working life of an asset. (1) Government guidelines, for example, the South African Revenue Service has published a list of acceptable write-off periods[2]; (2) determine the expected life of the asset which can be based on past experience and other information[3]; (3) the site or organisation might use a specific value based on policy or experience.

Staff

This sheet lists *all* staff that work at the site. These staff might be either directly or indirectly involved with the project. In the HIV costing example, it includes all staff who service the ART clinic either as medical staff, or non-medical support staff (security, managers and administration staff).

- Position or title: Enter a brief description of the position and title of each type of staff member within that category: E.g. Doctor, Pharmacist.
- Fixed or per patient event: If the staff member interacts with patients directly, and a record of the number of these events that occurs per patient is available or can be estimated, then select "*Event*", otherwise "*Fixed*". For example, in general, clerks and security guards do not interact with patients directly and there is no data collected on their interaction. Therefore they would be regarded as "Fixed". In comparison, a nurse who draws the blood of a patient has an identifiable period with a patient and this period can be measured. As such, nurses would be classified as "Event".
- Number of individuals: Enter the number of that type of employee working at the site.
- Project share: Enter the average percentage of these employees' time that is spent on the project. This is important as it is used to attribute the proportion of the staff cost that the project is responsible for. For example a doctor might only work one day a week in the HIV clinic. As such, only 20% of the cost of that doctor should be allocated to the project. Similarly, an operational manager does not spend all they time managing the HIV clinic. An assumption is necessary to determine what proportion of the operational manager's salary can be allocated to the project. In the illustrated example, an estimate of 16% is used which is calculated by determining the number of patients visiting the HIV clinic as a proportion of all patients visiting the clinic.
- Effective Level of Effort (hidden): This is a calculated hidden field which shows the effective number of employees working on the project within each employee type. It multiples the number of individuals by the proportion of time they dedicate to the project.

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[2]See the Schedule of Write-Off Periods Acceptable to SARS – as per Schedule A of interpretative note 47. http://www.sars.gov.za/AllDocs/LegalDoclib/Notes/LAPD-IntR-IN-2012-47%20-%20Wear%20And%20Tear%20Depreciation%20Allowance.pdf

[3] Information to take into account in determining the expected life of an asset might include manufacturer's specifications, accounting write-off period, past experience of users of similar assets etc.

- Total Cost p/m: This is total cost per month for each employee of that type, including salary, allowances, benefits, etc. The staff cost for the cell can link to calculations conducted in an *Appendix*.
- Effective Total cost (hidden): This calculated hidden field provides the total effective staff cost per month to the project as it multiplies the staff cost by the effective time spent on the project.
- Fixed Cost: If the employees were categorized as "Fixed", then the effective staff cost is allocated to this column.
- Event Cost: If the employees were categorized as "Event", then the effective staff cost is allocated to this column.
- Notes and Sources: All appendices and notes can be recorded here.

Building costs

Buildings:
- Description: Enter a brief description of each building. A building is an aggregation of a number of spaces: e.g. consulting rooms, storage rooms, waiting and pharmacy rooms etc. If necessary, different rooms and spaces can be aggregated in an *Appendix.*
- Bought /Rented: Was the building bought or is it being rented? Indicate this by using the drop down box.
- Bought: If the building was bought, indicate the price of the building and the year in which it was bought.
- Rental/ Effective Rental: The actual rent (if rented) and, if the building was bought, then the estimated rent. This can be calculated by using 1% of the purchase price, a bond payment, or a market-related rental (per m^2). (Calculations for this must be conducted in an *Appendix*).
- Project Share: Enter the percentage of the building that is utilised by this project (m^2 used / total floor space). If the project utilises the entire building, the project share would be 100%. This is particularly relevant for projects that only utilise a small space within a building (e.g. a couple of rooms). (Calculations for this must be conducted in an *Appendix*).
- Effective monthly costs: This is a calculated field which multiplies the calculated rental by the project share.
- Notes and Source: All appendices and notes can be recorded here.

Operations and Maintenance or shared facility costs:
- Description: Enter a brief description of the operation and maintenance cost. Include all other costs associated with the operation and maintenance of the facility: e.g.: water and electricity, telephone, insurance, repairs, internet connection, etc.
- Average cost p/m: This is the average monthly cost. (Calculations for this must be conducted in an *Appendix*).
- Project Share: Enter the percentage of the cost that is utilised by this project. This is generally m^2 used/ total floor space. If the maintenance cost can be entirely attributed to the project, the project share would be 100%.
- Effective monthly costs: This is a calculated field which multiplies the average monthly cost by the project share.
- Notes and Sources: All appendices and notes can be recorded here.

Vehicle costs

Vehicles:
- Description: Enter a brief description of each vehicle (e.g. model and make).
- Bought / Rented: Was the vehicle bought or is it being rented? Indicate this from the drop down box.
- Bought: The price of the vehicle and the year in which it was bought as well as the working life of the vehicle – the number of years that the vehicle can be used.
- Rent: The actual rent (if rented) or the estimated rent (e.g. if the vehicle is donated contact a local rental agent for an estimated cost).
- Average monthly cost: This is a calculated field which determines the average monthly cost if the vehicle is bought (taking into account the discount rate and working life of the vehicle), or uses the monthly rental if rented.
- Project Share: Enter the percentage of the vehicles use that is attributed to this project (km per month for project / total km per month or estimate it using project visits as a proportion of total visits).
- Effective monthly costs: This is a calculated field which multiplies the average monthly cost by the project share.
- Notes and Sources: All appendices and notes can be recorded here.

Operation and Maintenance:
- Description: Other costs associated with the operation and maintenance of the vehicles should be accounted for (e.g. petrol, repairs, maintenance, insurance and registration).
- Average monthly cost: This is the average monthly cost. (Calculations for this can be conducted in an *Appendix*).
- Project Share: Enter the percentage of the vehicles use that is attributed to this project (km per month for project / total km per month or estimate it using project visits as a proportion of total visits).
- Effective monthly costs: This is a calculated field which multiplies the average monthly cost by the project share.
- Notes and Sources: All appendices and notes can be recorded here.

Equipment costs

All equipment (i.e. not a fixture and lasts > 1 year) should be listed and assigned a cost, which would be shared across the life time of the project. Equipment is used in providing treatment and services therefore needs to be included. The working life of equipment is dependent on the type of equipment. Equipment includes furniture (examination beds, chairs, desks, cabinets etc.), computers, phones, and medical equipment such as stethoscopes etc.
- Description: Enter a brief description of each piece of equipment e.g. computer system, diagnostic equipment, furniture etc. Where necessary, the number of equipment items can be increased by dragging the rows down to accommodate all equipment as long as the total row remains at the bottom and the calculated columns are extended.
- Quantity: Indicate the number of items for the equipment that is described.
- Bought / Rented: Was the equipment bought or is it being rented? Indicate this by using the drop down box.
- Bought: The price of the equipment and the year in which it was bought, as well as the working life of the equipment – i.e. the number of years that the equipment can be used for. This is determined from the year that the equipment was bought.

- Cost per month: This is a calculated column that determines the cost per month of the equipment taking into account the discount rate and working life of the piece of equipment.
- Rent: The actual rent (if rented) or the estimated rent (if the equipment is donated contact a supplier for an estimated cost).
- Project Share: Enter the percentage of time that the equipment is utilised for the purposes of this project. For example, for a diagnostic piece of equipment this could be estimated using the number of tests conducted for the project per month/total tests per month.
- Effective monthly costs: This is a calculated field which multiplies the average monthly cost by the project share.
- Notes and Sources: All appendices and notes can be recorded here.

Operation and Maintenance:
- Description: Other costs associated with the operation and maintenance of the equipment should be accounted for (e.g. registration, repairs, insurance, spare parts etc.)
- Average monthly cost: This is the average monthly cost. (Calculations for this can be conducted in an *Appendix*).
- Project Share: Enter the percentage of the time that the equipment is utilised for the purposes of the project. This should correlate to the project share entered for the equipment item.
- Effective monthly costs: This is a calculated field which multiplies the average monthly cost by the project share.
- Notes and Sources: All appendices and notes can be recorded here.

Supplies

While these costs often tend to be a small part of the overall cost of treatment they are essential to providing treatment. A supply is anything that is used up in less than a year and would range from stationery to medical supplies, such as gloves and swabs. These items are generally ordered centrally and cannot be directly attributed to a patient.
- Description: Enter a brief description of each supply category e.g. cleaning products, stationary, groceries, gloves and swabs.
- Average monthly cost: This is the average monthly cost. (Calculations for this can be conducted in an *Appendix*).
- Project Share: Enter the percentage of the supply cost that can be attributed to this project.
- Effective monthly costs: This is a calculated field which multiplies the average monthly cost by the project share.
- Notes and Sources: All appendices and notes can be recorded here.

Other fixed costs

- Description: Enter a brief description of each fixed cost – e.g. staff training costs.
- Average monthly cost: This is the average monthly cost. (Calculations for this must be conducted in an *Appendix*).
- Project Share: Enter the percentage of the fixed costs that can be attributed to this project.
- Effective monthly costs: This is a calculated field which multiplies the average monthly cost by the project share.
- Notes and Sources: All appendices and notes can be recorded here.

2.4 Direct costs

- Only fill in the blue shaded cells.
- Ensure all unit cost data corresponds to the same year – the 'unit cost year' as identified in the parameters sheet.

Drug costs

- Drug code: This is prepopulated using the drug information provided in the Parameters section and provides a unique code to identify the drug and its formulation.
- Drug name: This is the full name of the drug and is the most commonly used name for the drug in the study country.
- Drug description: Full description of the drug (including full name, unit strength, other names, generic or brand and any other useful information about this particular drug).
- Quantity utilised by sample: This is a calculated field that sums the total quantity used from the subject data.
- ARV: If the drug is used as part of ART (i.e. is an ARV) then select "1" from the drop-down box, alternatively select "0" for non-ARV medication. Only input data here if ARVs are relevant to the study.
- Unit Form: Type of medication (tablet, liquid). Use drop-down menu or fill in other form.
- Unit Strength: This is the strength of the medication being costed and is measured as the quantity of medication per unit, in mg/tablet or other quantity measure.
- Units/package: This is the number of units per package typically procured by the site. **This unit must be consistent with the unit used to measure utilisation of the drug in the Subject Data.**
- Package cost: This is the cost for a package of the medication.
- Cost/unit: This is a calculated field determining the unit cost.
- Notes/ Price source: Indicate the source for the Package cost in this cell. For example the Essential Medicines List (EML) Catalogue in South Africa.

Lab Costs

- Lab Code: This is prepopulated from the Parameters tab. It uniquely identifies a test/procedure.
- Official Code: This is a unique code to identify the test/procedure from the national laboratory list (e.g. the NHLS code in South Africa).
- Test Name: This is the commonly used name of the test.
- Test Description: Provide a brief description of the test.
- Cost per test: Enter the cost per test at the study site.
- Quantity utilised by sample: This is a calculated field that draws on utilisation data for the test captured in the subject data.
- Notes/ Price Source: All sources for the price and cost per test data indicated in the "original cost" column are referenced here (including Appendices).

Event costs

Events are defined as distinct events that involve a staff member interacting with a patient and essentially cover a number of different types of **outpatient visits**. For example: a staff nurse drawing blood; a counsellor performing a wellness session; a patient follow-up medical visit with a doctor; a patient collecting medication from a pharmacy assistant. The event unit cost is calculated by either estimating the time spent by the relevant staff member with the patient (and

calculating the resultant cost as a proportion of the staff member's salary); or, using actual data on the number of events conducted by that staff and how much time the staff member allocates to the event. Ultimately, the user needs to determine a unit cost per event using the data available.

- Event Code: This is prepopulated from the *Parameters* sheet and denotes a unique letter code to identify the event.
- Event Name: This indicates the name of the event / occurrence, for example, blood draw.
- Event Description: This briefly describes the event or activity and which healthcare professional is involved in the activity: for example, staff nurse draws blood.
- Event Cost p/m: This provides the average total cost for conducting the event. It is measured using the monthly salaries of the relevant healthcare professional involved in the defined event. It can be calculated from the *Staff Sheet* and the staff sub-totals from the relevant staff category for the event. See the Table in the Appendix below for the two different methods for determining this.
- Events p/m: This figure is based on a calculated value (calculations and sources in *Appendix*) that provides the maximum number of these events that can occur in a month in the total population or the actual number of events. See the Table below for the two different methods for determining this.
- Cost per event: This is a calculated field that provides the Cost per event and is the event cost per month over the total number of possible events in that month.
- Notes and Sources: All sources for the events cost and the number of events per month indicated in the "events p/m" or "event cost p/m" column can be referenced here (including Appendices).

Note on methods for calculating the cost per event:
There are two ways of calculating the cost per event. The example illustrated in this user guide is Method A.

Method	Unit of time per patient	Quantity	Cost	Comments
Method A	Estimate and/or use actual data to determine the number of minutes the relevant staff member spends with the patient for that event.	Calculate the maximum number of events that are possible per month if that staff member devoted 100% of their time to conducting that event.	Use the **total monthly salary** of the staff member and divide it by the maximum number of events possible.	This method assumes that the staff member is working at maximum capacity. (This can be improved on by assuming some downtime in the number of hours worked).
Example A	The event involves a nurse drawing blood. A nurse spends on average 2.5 minutes per patient to draw blood.	A nurse works on average 6 hours per day for 18 days a month so they could therefore draw blood from a maximum of144 patients per day or 2592 patients per month given that its takes 2.5 minutes to draw blood.	A nurse's monthly salary is 19,000. Therefore the cost per event would be 19,000/2592 = 7.33	
Method B	N/A	The actual number of events conducted by each staff member is recorded.	Use the **total monthly salary for *Events*** as calculated in the Staff sheet. This provides the effective salary given the proportion of time the staff member dedicates to the project/activity.	This method relies on estimating the proportion of time the staff member dedicates to the event. Use this method when the time the staff member dedicates to the project as a whole is measurable and equal to the time allocated to the event.
Example B		Nurse B drew blood from 1000 patients on average per month.	Nurse B dedicates 50% of her time to drawing blood. Therefore the effective salary is 50%*R19,000 and divided by 1000 = R9.50	

Support costs

- Support Code: This is prepopulated from the *Parameters Sheet*. It uniquely identifies the support service.
- Support Services Name: This is the common name of the service– e.g. home-based care.
- Support Services Description: This is a description of the support service.
- Cost per unit: Input the cost per single use of the support service by a patient.
- Notes/Price source: All sources for the cost per unit of support service are referenced to here (including any Appendices).

Other variable costs

- Support Code: This is prepopulated from the Parameters sheet. It uniquely identifies the other variable cost item.
- Support Services Name: This is the common name of the other variable cost item.
- Support Services Description: This is a description of the other variable cost item.
- Cost per unit: Input the cost per single use of the other variable cost item by a patient.
- Notes/Price source: All sources for the cost per unit of the other variable cost are referenced to here (including any Appendices).

3. CALCULATIONS

The following sheets draw on the cost and utilisation data inputted into the model and calculate a fixed cost per event and total costs per subject. It also summarises the sample by outcome, and CD4 count data (if applicable).

The tabs are coloured grey and no data needs to be inputted, with the exception of cell F9 in the *Allocation* sheet.

3.1 Allocation

This sheet summarises all the indirect costs (staff, buildings, vehicles, equipment, supplies and other fixed costs), and calculates the indirect costs per patient visit. These indirect costs are for a 12 month period and have already been adjusted to only include costs related to the project. Therefore, the indirect cost per patient visit can be calculated by dividing the total costs by project visits over a 12 month period. In the example, indirect costs account for R251 per patient visit.

The total project visits over a 12 month period need to be assessed and inputted in cell F7. This will likely be calculated in the same Appendix (for example, *Visits)* that was used to determine staff project share in the *Staff* Sheet.

It is important that project visits are counted for the period over which indirect costs are typically aggregated – a 12 month period in this model. However, if this is not possible, monthly totals for the indirect costs can be used and multiplied by the number of months over which project visits were collected. In this example, these monthly costs are multiplied by 12.

The total number of study visits (in B19) is calculated from the *Subject Data* sheet and is the sum of all the events (for example, doctor consultations, pharmacy visits, counsellor visits etc.) for the identified sample (in the example, this is 20 patients) for the study period (in this example, 12 months).

3.2 Sample costs

This sheet is hidden.

This sheet determines the resource cost (by subject) by multiplying the individual resource usage data (from the *Subject Data* sheets) with the appropriate unit cost.

Sample Costs includes all information relating to the outcome, outpatient visits (events), indirect costs, labs, services and other variable costs. *Sample Costs 2* includes all drug-related costs. It is possible to expand the sheet in *Sample Costs 2* (in row 16) to assess the split in ARV versus non-ARV drugs. This will be blank if ARVs were not identified in the *Drug Sheet* or if ARVs are not relevant to the study.

3.3 Subject cost category

This sheet is hidden.

This sheet aggregates the individual resource costs from the *Sample Cost* sheets into meaningful categories: indirect, event, lab, drug, support, other and total costs. It essentially summarises the data from the *Sample Costs* sheets.

3.4 CD4s

This sheet is hidden.

This sheet summarises each patient's baseline CD4 count by outcome. The baseline CD4 count is a marker traditionally used to indicate the health status of a patient at initiation on ART. It is useful for stratifying patients and costs by disease severity.

However, if the project is not related to HIV treatment (or if CD4 values are irrelevant), this sheet may be ignored.

Note: This sheet will only capture the correct data if the variables are inputted correctly in Row 4 and Row 5 in the Subject Data parameters.

4. RESULTS

No data should be entered for any of the sheets. These sheets summarise all the data inputted and the calculations conducted on previous sheets.

4.1 Outcomes

This sheet summarises the number of patients that are allocated to each outcome and outcome category, as well as baseline CD4 count, mean and median CD4 count by outcome category (if applicable).

4.2 Cost per outcome

This provides the cost per patient per outcome, outcome category and successful outcome. The variables reported include:
- The number and proportion of patients
- Indirect costs
- Direct costs
    - Outpatient visit costs
    - Lab costs
    - Drug costs (including a split between ARV and non-ARV if relevant)
    - Support costs

- o Other costs
- The total cost per outcome is the average cost per patient achieving that outcome
- Average mean and median starting CD4

The Total Average Cost is the average cost of all patients in the sample having any of the outcomes. In this example, on average, it costs R9,994 per patient for a 12 month period regardless of outcome.

4.3 Cost-effectiveness

This sheet summarises the major cost categories for the entire sample. It also provides the total cost and average cost for each of the 6 outcome categories and the successful outcome. This is a summary of the *Cost per outcome* sheet.

4.4 Summary

The summary sheet summarises the key outputs of the analysis.

The upfront section, **Settings**, allows the user to specify the following:
- Reporting period (the study period or a 12 month period)
- Reporting currency (local or foreign).
- Whether the results should be inflated to the year in which the results will be reported.

It also allows the user to hide/unhide irrelevant rows - for example, additional outcome categories that were not used.

Section A provides a cost summary by outcome category and outcome.

Section B summarises the cost effectiveness ratios for all patients and for patients in each of the outcome categories. The production cost of a successful outcome provides the cost per successful outcome. The effective 'tax' on successful outcomes is also calculated.

Section C summarises the means and 95% confidence intervals by each outcome category.

Appendix

Contact

For further information about the model or any queries, please contact HCOM@heroza.org.

Model Appendix - Patient years in care

This sheet calculates the number of effective years in care per patient by outcome. This is calculated by summing the number of months in care (during the study period) from the Subject Data sheet, dividing this by 12 to determine the number of patient years, and then dividing this by the total number of patients in an outcome category.

This calculation may be useful for budgeting purposes when determining the effective sample to use when calculating a cost per patient for the period over which the patient was receiving care.