Resource Needs for HIV/AIDS:

Model for Estimating Resource Needs for Prevention, Care, and Mitigation

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The conceptual framework that is utilized here is based on a model initially developed by Lilani Kumaranayake and Charlotte Watts of the London School of Hygiene and Tropical Medicine, in a project financed by the World Bank, as well as on a model estimating the cost of care developed by Bernhard Schwartlander, now of the World Health Organization. The initial framework was further modified and described in a report by Rene Bonnel for the AIDS Campaign Team for Africa, World Bank. These initial models were developed further as part of a team that estimated the global funding requirements for HIV/AIDS for the United Nations General Assembly Special Session on HIV/AIDS in June, 2001, as summarized in a paper by Schwartlander et al. (2001). References in the manual to various assumptions or data used in 'earlier work' refer to these three pieces of analysis.

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I. Introduction

What is the Resource Needs Model?

The Resource Needs Model (RNM) calculates the total resources needed for prevention, care, and orphan support for HIV/AIDS on a national level. The RNM can assist national-level strategic planning efforts by providing a tool and methodology to examine the financial resources needed to implement a variety of prevention interventions, care and treatment programs, and orphan support.

In 1999, the United Nations set ambitious goals for reducing incidence through the expansion of prevention efforts and increasing access to care and support for all people living with HIV/AIDS, first at the 21st special Session of the General Assembly, then at the special meeting of the Security Council on HIV/AIDS. In June 2001, a Special Session of the General Assembly was held to discuss further these important issues. The Resource Needs Model was utilized to estimate the costs of reaching the goals stated at the UNGASS on HIV/AIDS.[1]

The model contains three sub-models:

- The ***prevention model***, which calculates the cost of fourteen prevention specific prevention interventions and allows the user to specify up to five additional priority populations such as prisoners, migrant, or truck drivers. The specific interventions are:
    - Priority populations
        - Youth focused interventions
        - Interventions focused on sex workers and their clients
        - Worklplace programs
        - Harm reduction for injecting drug users
        - Interventions focused on men who have sex with men
    - Service delivery
        - Condom provision
        - Improving STI management
        - Voluntary Counseling and Testing
        - Prevention of mother-to-child transmission
        - Mass media
    - Health care
        - Blood safety
        - Post exposure prophylaxis
        - Safe injection
        - Universal precautions

[1] Schwartlander et al. (2001) "Resource Needs for HIV/AIDS," *Science* 292:2434-2436, 29 June 2001.

- The ***care and treatment model***, which estimates the cost of ten care and treatment programs, including:

    - Home-based care
    - Palliative care
    - Treatment of opportunistic infections (OIs)
    - Diagnostic HIV testing
    - OI prophylaxis in symptomatic patients
    - Laboratory tests for monitoring anti-retroviral therapy
    - Anti-retroviral therapy (ART)
    - Training
    - Nutritional support
    - Tuberculosis treatment

- The ***orphan support model***, which calculates the cost of five interventions to support orphans and vulnerable children:

    - Primary schooling
    - Secondary schooling
    - Skills training
    - Food
    - Child care

There are three main elements in the methodology of each sub-model:

- *Population target groups*
- *Unit costs*
- *Coverage or access targets*

The final expenditure on any program is a combination of these three elements.

Steps in Using the Resource Needs Model

There are five major steps involved in using the RNM:

1. **Form a national team to implement the model.** The model needs to be implemented by a national team that can be trained in the use of the model. This team will generally receive some initial training in the use of the model and then extensive training as the model is set up and used. Ideally the model will be implemented by a multi-disciplinary team composed of participants with various areas of expertise (demography, epidemiology, health finance, planning) representing different aspects of society (government, civil society, private sector, donors).

2. **Collect data on socio-demographic variables, health systems, HIV prevalence and condom use, and the costs of prevention and care programs.** The RNM contains default values for many of the variables used by the model. These values are derived from information obtained from published studies on the cost of prevention and care programs. This information can be used or replaced with locally available data. It also requires national data on the population size and distribution, adult HIV and STI prevalence and sexual behavior (e.g., condom use).

3. **Enter data specific to RNM.** Once the data described in step 2 are collected for the relevant year, the data are entered into the RNM model.

4. **Conduct workshops on resource needs.** In most applications the model will be used in a workshop with decision makers. The workshop will be an interactive session where participants will validate the assumptions that are important in the model, such as coverage targets and certain unit costs.

5. **Follow-up on workshop outcomes.** A variety of workshop outcomes are possible. Ideally the model is applied as part of the overall strategic planning process. In this case the model may continue to be used as goals are revised and funding plans are developed. The workshop may result in a new budget for the plan, or a commitment to raise additional funds to pay for essential programs. Reports and presentations may need to be prepared in order to disseminate the results to national decision makers, donors and program partners.

II. Using the Resource Needs Model

The Resource Needs Model is implemented in an Excel Spreadsheet. The model uses a number of tabbed worksheets. You can switch from one tab to the next by clicking on the tab with the mouse. The main worksheets are:

- Title. Shows the title screen
- Menu. Shows the menu for prevention, care and treatment, mitigation and program support.
- Set-up. Contains the basic set-up information such as country name, national currency, exchange rate, first and last years of the analysis.
- Prevention. Contains the inputs and calculations for all the prevention interventions.
- Care and treatment. Contains the inputs and calculations for all the care and treatment interventions.
- Mitigation. Contains the inputs and outputs for the interventions to support orphans and vulnerable children.
- Program support. Contains the inputs and outputs for to estimate the resources needed for policy, administration, research and monitoring and evaluation.
- Summary. Displays a table with all the results by intervention and year.
- Funding chart. Shows a stacked bar chart showing resources needed by intervention and year.
- Prevention funding chart. Similar to the Funding Chart but for prevention only.
- Care funding chart. Similar to the Funding Chart but for care and treatment only.
- Distribution chart. Displays a stacked bar chart showing the percent distribution of resources needed by component.
- Demography summary. Contains the demographic input data.
- Adult HIV summary. Contains the epidemiological input data for adults.
- Child HIV summary. Contains the epidemiological input data for children.
- OVC summary. Contains the OVC input data.
- Impacts summary. Contains the input data for tuberculosis.

Any of these pages can be accessed directly by clicking the appropriate tab at the bottom of the Excel display or by clicking the "Menu" button and selecting the appropriate menu item.

Starting the program

To star the Resource Needs Model you should first start Excel and then select "File", "Open" and pick the Resource Needs Model file.

You may get a message similar to the following:

"Macros in this workbook are disabled because the security level is high…"

This means that the menu will not work because macros have been disabled. You can still use the program 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 you 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.

Specifying the model configuration

The application of the Resource Needs Model can be customized for you application by setting the appropriate values in the "Setup" tab. Once you select this tab you will see a screen like the following:

Country	**Cambodia**
Language	**English**
Start year	2004
Scale for currency	Millions
National currency	Riel
Currency to display	Riel
National currency per US$	4121

You should fill in each of the boxes with the appropriate data. A description of each item follows:

- Country. The name of the country or region of the application.
- Language. Select the language you want to use with the program by clicking in the blue cell next to the "Language" label, clicking on the down arrow and selecting the language.
- Start year. This is the first year of the estimates.
- Scale for currency. This sets the scale for the displays of resources needed. Click on the blue cell, click the down arrow and select from the list box.
- National currency. The name of the national currency.
- Currency to display. Select which currency you want to use for the output.
- National currency per US$. Enter the exchange rate per US dollar.

Entering demographic and epidemiological data

The Resource Needs Model uses demographic data on the size and composition of the population and epidemiological data on the number of people infected with HIV and those progressing to late stage infection each year. It also uses estimates of orphans and TB patients.

These estimates are all available from Spectrum projections. Spectrum is a computer program developed by the Futures Group in cooperation with USAID, UNAIDS, WHO, UNICEF, United Nations Population Division and other organizations[2]. It produces estimates and projections that include key demographic and HIV/AIDS indicators. More details on how the use the Spectrum model to prepare these projections is available from the Spectrum manuals, particularly the DemProj[3] and AIM[4] manuals. These manuals and the

[2] John Stover. Projecting the demographic consequences of adult HIV prevalence trends: the Spectrum Projection Package. Sexually Transmitted Infections Volume 80, Supplement 1. August 2004, pps. i14-i18.

[3] John Stover and Sharon Kirmeyer. DemProj. Version 4. A Computer Program for Making Population Projections. Washington, DC: POLICY Project, 2005.

Spectrum program can be downloaded from the web site of the Futures Group at:

www.FuturesGroup.com

Once you have a Spectrum projection you can transfer the projection to the Resource Needs Model by following these steps:

1. Start Spectrum and open the projection file by selecting "File" and "Open".
2. In Spectrum, display the Demographic Summary table by selecting "Display", "Demography", "Summary", "Demographic Summary Table". Click the box "Scale table values" to remove the check mark. Then press "OK".
3. Select "Edit" and "Copy all" to copy the contents of the table to the Windows clipboard.
4. Switch to Resource Needs Model in Excel and select the tab "Demographic summary"
5. Put the cursor on cell A1 (the top, left cell). Then click "Edit" and "Paste" to paste the data in to the model.
6. Return to Spectrum and select "Display", "AIDS", "Adults 15-49" and "Adults 15-49 summary". Copy the table to the clip board with "Edit" and "Copy all". Return to the Resource Needs Model and select tab "Adult HIV summary". Select cell A1 and paste the data.
7. Return to Spectrum and select "Display", "AIDS", "Children" and "Child 0-14 summary". Copy the table to the clip board with "Edit" and "Copy all". Return to the Resource Needs Model and select tab "Child HIV summary". Select cell A1 and paste the data.
8. Return to Spectrum and select "Display", "AIDS", "Orphans" and "Summary by age". Be sure to remove the check mark next to "Scale table values" if it is displayed. Copy the table to the clip board with "Edit" and "Copy all". Return to the Resource Needs Model and select tab "OVC summary". Select cell A1 and paste the data.
9. Return to Spectrum and select "Display", "AIDS", "AIDS Impacts" and "Impacts summary". Be sure to remove the check mark next to "Scale table values" if it is displayed. Copy the table to the clip board with "Edit" and "Copy all". Return to the Resource Needs Model and select tab "Impacts summary". Select cell A1 and paste the data.

Once these steps are completed you are ready to use the model. To select any intervention for input just click the "Menu" button and select the appropriate menu item. The displays for most of the interventions are similar. Below is an example of part of the screen for peer education for sex workers.

[4] John Stover. AIM Version 4. A Computer Program for Making HIV/AIDS Projections and Examining the Social and Economic Impacts of AIDS. Washington, DC: POLICY Project. 2005.

Sex workers				2004	2005
Population size					
Number of sex workers	#	20,145			
Annual growth rate in SWs	%	3.0			
Number of sex workers				20,145	20,751
Coverage					
% sex workers reached by intervention per year				12	23
% using condoms among those reached by intervention				16	27
% using condoms among those not reached by intervention				5	8
% of all condoms that are female condoms				2	3
Unit costs		**Riel**		**US$**	
Cost per sex worker targeted		321,438	$	78.00	
Cost per male condom distributed		824		0.2	
Cost per female condom distributed		4,121		1.00	
Results					
Sex workers reached				2,417	4,842
Resources required				845.9	1,791.6

The light blue cells indicate inputs that are required. The dark blue cells are figures that will be estimated by the model but you can replace the numbers with your own estimates if you prefer. The last line of each section shows the resources required for that intervention, by year.

The details of the inputs and calculations along with guidance on appropriate input values are given in chapters 3, 4, 5 and 6.

III. Prevention Interventions

General Principles

The aim of the RNM is to estimate the cost of HIV/AIDS prevention, care, and orphan support needs in a particular country. The basic approach is to first estimate the number of people receiving each service by multiplying the number of people needing the service by the coverage (the percent of those needing the service that actually use it). The resources needed are estimated by multiplying the number of people getting the service by the unit cost.

This approach can be illustrated by examining the calculations for a single intervention, peer outreach to sex workers.

First we need to know the *population size*. That is the estimated number of sex workers in the country or region. Generally the model will ask for the best estimate of the current number of sex workers and the rate at which this number is changing.

The next input is the *coverage*, or percent of workers that are currently reach by the outreach intervention. The future coverage goal can also be entered so that the model can calculate the resources needed to scale-up to the goal.

The final input needed is the *unit cost*, the cost to provide outreach services to one sex worker during one year. The unit cost is assumed to remain constant over the projection period.

With this information the model can estimate the resources required in the base year as:

Resources needed = number of sex workers x coverage x unit cost

The same equation applies to any future year as well:

Resourced needed$_t$ = number of sex workers$_t$ x coverage$_t$ x unit cost

A similar approach is followed for each intervention. Estimates of the population size may refer to actual numbers of people, (such as sex workers, students, or people with sexually transmitted infections), the number of commodities needed (such as units of safe blood, condoms, or post-exposure prophylaxis kits), or to the number of services needed (such as VCT visits).

The calculations for the prevention interventions all follow the model described above: population size x coverage x unit costs. For some interventions the **population sizes** can be estimated from social and economic statistics and

demographic data. For example, the number of primary school students can be estimated from the population aged 6-13 and the gross enrollment rate. In other cases direct estimates must be provided, for example the number of sex workers or number of cases of sexually transmitted infections. There are several methods that have been used for estimating the size of populations at higher risk, such as sex workers, MSM and IDU. These include census and enumeration, capture-recapture, multiplier methods, nomination methods, and population surveys. A good source of information on how to estimate population sizes is available from UNAIDS[5].

Information on **coverage** should be available from service statistics. Another course containing data from about 80 countries is the HIV/AIDS Coverage Survey report[6]. The information may be available as the number of people receiving the service, such as the number of VCT clients, rather than as a percentage. The model will display the number of people receiving the service whenever you enter a coverage estimate. So you can adjust the estimated coverage until you get the correct number of people served.

The future coverage targets can be whatever the program wishes to achieve. Generally these are set in terms of comprehensive coverage that provides equitable access to prevention services and has a significant impact on the epidemic. For some interventions the obvious target coverage may be 100%, such as safe blood or school-based AIDS education. For others it may be unrealistic to expect to reach 100% of the population in need and a target of 80% may be more feasible. For example, the UNGASS target for PMTCT is the reach 80% of women accessing antenatal care. For others the target should be set to have an impact on transmission. Studies have shown that in order to have a significant impact on transmission interventions for sex workers, men who have sex with men, injecting drug users and other populations at higher risk need to reach coverage of 60-80%. Table 1 below gives a recommended target levels for the prevention interventions:

[5] Estimating the Size of Populations at Risk for HIV: Issues and Methods. UNAIDS/FHI. Available at www.UNAIDS.org.

[6] Coverage of selected services for HIV/AIDS prevention, care and support in low and middle income countries in 2003, POLICY Project, June 2004. Available from www.FuturesGroup.com.

Table 1. Target Coverage Levels by Intervention

Intervention	Target Coverage
AIDS education for students	100%
Blood safety	100%
Post-exposure prophylaxis	100%
Safe injection	100%
Universal precautions	100%
Mass media	100%
Interventions for priority populations (sex workers, MSM, IDU)	60-80%
Service delivery interventions (condoms, STI treatment, VCT, PMTCT)	60-80%
Workplace interventions	5-50% depending on severity of the epidemic

Unit cost estimates should be program costs, that is the expenditure required by the program to implement the intervention. This is different from the economic costs which would include more costs, such as the value of donated commodities and volunteer labor. Information on unit costs may be available from the organizations implementing the interventions. A manual and model for estimating unit costs is available from UNAIDS[7]. A number of countries have provided unit cost estimates at a series of resource needs workshops. Where these are available they are provided below in the discussion of each intervention.

Sex workers

The population size is the estimated number of sex workers in the base year. This population may grow or decline according to the assumed growth rate. The default assumption is that the number of sex workers grows at the same rate as the population of men aged 15-49.

There are four coverage indicators required.

1. % sex workers reached by intervention. The percentage of sex workers that are reached by the intervention.

[7] Costing Guidelines for HIV/AIDS Intervention Strategies, ABD-UNAIDS Study Series: Tool 1. February 2004.

2. % using condoms among those reached by the intervention. The rate of condom use among those sex workers exposed to the intervention.
3. % using condoms among those not reached by the intervention. The rate of condom use among sex workers that are not exposed to the intervention.
4. % of condoms that are female condoms. The percentage of all condoms used by sex workers that are female condoms.

There are also three inputs required for unit costs.

1. Cost per sex worker targeted. The annual cost per sex worker of peer outreach programs. Unit costs estimates range from $3 - $120, with a median of $25, and inner quartile range of $15 - $60.
2. Cost per male condom distributed. This refers to the full costs of condom distribution not just the commodity costs. Unit costs estimates range from $0.01 (lower quartile) to $0.29 (upper quartile) with a median of $0.15. This should be the cost to outreach program. If the condoms are provided free of charge from another source, then the cost should be zero.
3. Cost per female condom distributed. This refers to the full costs of condom distribution not just the commodity costs. Unit costs estimates range from $0.85 (lower quartile) to $1.75 (upper quartile) with a median of $1.00. This should be the cost to outreach program. If the condoms are provided free of charge from another source, then the cost should be zero.

The calculations are as follows:

$$\text{Number of sex workers}_t = \text{Sex workers}_1 * (1 + \text{annual growth rate}/100)^{(t-1)}$$

$$\text{Sex workers reached}_t = \text{Sex workers}_t * \%\ \text{sex workers reached by intervention}_t / 100$$

The resources required are estimated as the number of sex workers reached times the cost of outreach plus the cost for male and female condoms.

$$\text{Resources required}_t = \text{Sex workers reached}_t \times \text{Cost per sex worker reached} + \text{Sex workers reached}_t \times \text{Sex worker acts per year} \times \%\ \text{using condoms among those reached by intervention}_t/100 \times (\text{Cost per male condom distributed} \times (1 - \%\ \text{of all condoms that are female}) + \text{Cost per female condom distributed} \times \%\ \text{of all condoms that are female})$$

Men who have sex with men (MSM)

The population size is the estimated number of MSM in the base year. This population may grow or decline according to the assumed growth rate. The default assumption is that the number of sex workers grows at the same rate as

the population of men aged 15-49. The model also asks for an estimate of the number of sex acts per year per MSM. This figure from country to country with a range of about 50 to 110.

There are four coverage indicators required.

1. % MSM reached by intervention. The percentage of MSM that are reached by the intervention.
2. % MSM condoms among those reached by the intervention. The rate of condom use among those MSM exposed to the intervention.
3. % using condoms among those not reached by the intervention. The rate of condom use among MSM that are not exposed to the intervention.

There are two inputs required for unit costs.

1. Cost per MSM targeted. The annual cost per MSM of peer outreach programs. Unit costs estimates range from $14 (lower quartile) to $45 (upper quartile) with a median of $20.
2. Cost per male condom distributed. This refers to the full costs of condom distribution not just the commodity costs. Unit costs estimates range from $0.01 (lower quartile) to $0.29 (upper quartile) with a median of $0.15. This should be the cost to outreach program. If the condoms are provided free of charge from another source, then the cost should be zero.

The calculations are as follows:

Number of MSM_t = MSM_1 * (1 + annual growth rate/100)$^{(t-1)}$

$MSM\ reached_t$ = MSM_t * % $MSM\ reached_t$ / 100

The resources required are estimated as the number of MSM workers reached times the cost of outreach plus the cost for male.

$Resources\ required_t$ = $MSM\ reached_t$ x Cost per MSM reached + $MSM\ reached_t$ x MSM acts per year x % using condoms among those reached by $intervention_t$/100 x Cost per male condom distributed

Injecting drug users (IDU)

The population size is the estimated number of IDU in the base year. This population may grow or decline according to the assumed growth rate. The default assumption is that the number of IDU grows at the same rate as the population of men aged 15-49.

There are several of inputs required in order to estimate the need for different interventions targeted to IDU. These are:

Number of IDU reached per counselor: This is the number of IDU that one counselor can support during a year. It typically ranges from 20 to 40.

Number of sex acts per IDU per year. The number of times a typical IDU has sex during a year. This is used to estimate condom requirements.

Number of IDU injections per year. The number of times the average IDU injects per year.

There are six coverage indicators required to describe the different IDU interventions. Coverage may be set to zero if any of these interventions are not part of the prevention program in your country.

1. % IDU receiving harm reduction interventions. The percentage of IDU that are reached by general harm reduction programs. You may use this intervention if you do not have information on the specific type of interventions listed below. However, it will be better to se the coverage for this intervention to 0 and specify the coverage of specific interventions in the following rows.
2. % IDU receiving counseling and testing.
3. % IDU receiving community outreach and peer education.
4. % IDU receiving syringe and needle exchange.
5. % IDU receiving drug substitution
6. % IDU reached by condom promotion interventions
7. % using condoms among those not reached by the intervention. The rate of condom use among MSM that are not exposed to the intervention.

There are also seven unit costs required, one for each intervention. Unit costs may vary from $10 - $60.

1. Cost of harm reduction programs per IDU reached
2. Cost of counseling and testing per IDU reached
3. Cost of community outreach and peer education per IDU reached
4. Cost per needle distributed and destroyed
5. Cost of drug substitution per IDU reached
6. Cost per condom. This should be the cost to outreach program. If the condoms are provided free of charge from another source, then the cost should be zero.
7. Cost to train one counselor

The calculations are as follows:

Number of IDU_t = Number of IDU_1 x (1 + annual growth rate/100)

Number of needles and syringes required$_t$ = Number of IDU_t x Number of injections per IDU per year

Number of condoms required$_t$ = Number of IDU_t x Number of sex acts per IDU per year

IDU reached$_t$ = Number of IDU x % IDU receiving harm reduction programs$_t$ / 100

Counselors trained$_t$ = IDU reached$_t$ / Number of IDU reached per counselor

IDUs receiving counseling and testing$_t$ = Number of IDU x % receiving counseling and testing/100

IDUs receiving community outreach and peer education$_t$ = Number of IDU$_t$ x % receiving community outreach and peer education$_t$ / 100

IDUs receiving needle and syringe exchange programs$_t$ = Number of IDU x % receiving NSEP$_t$ / 100

IDUs receiving drug substitution$_t$ = Number of IDU$_t$ x % receiving drug substitution$_t$ / 100

Number of needles and syringes provided$_t$ = Number of needles and syringes required$_t$ x % of IDU receiving needles and syringes$_t$ / 100

Number of condoms required$_t$ = Number of condoms required$_t$ x % of IDU reached by condom interventions$_t$ / 100 x (1 + condom wastage/100)

Resources required for counseling and testing$_t$ = IDUs`receiving counseling and testing$_t$ x Cost of counseling and testing per IDU reached

Resources required for community outreach and peer education$_t$ = IDUs receiving community outreach and peer education$_t$ x Cost of community outreach and peer education

Resources required for needles and syringes$_t$ = Number of needles and syringes provided$_t$ x Cost per needle and syringe provided and destroyed

Resources required for drug substitution$_t$ = IDUs receiving drug substitution$_t$ x Cost of drug substitution per IDU targeted

Resources required for condoms$_t$ = Number of condoms providedt$_t$ x Cost per condom

Resources required for counselor training$_t$ = Counselors trained$_t$ x Cost to train one counselor

Resources required$_t$ = sum of resources required for each intervention$_t$

User-defined interventions

You may define up to five additional specific interventions for priority populations such as truck driver and prisoners. The population size is the estimated number of people in the population in the base year. This population may grow or decline according to the assumed growth rate. The default assumption is that the population grows at the same rate as the population of all adults 15-49.

There is one coverage indicator required.

1. % reached by intervention

There is one input required for unit costs.

1. Cost per person reached

The calculations are as follows:

$Population_t = Population_1 * (1 + annual\ growth\ rate/100)^{(t-1)}$

$Population\ reached_t = Population_t * \%\ reached\ by\ intervention_t / 100$

The resources required are estimated as the number of people reached times the cost per person reached.

$Resources\ required_t = Population\ reached_t$ x Cost per person reached

Youth

There are seven inputs required to define the target population for youth interventions. These are:

2. Primary school gross enrollment rate-males. The gross enrollment rate is the number of students divided by the population of school age. It may be above 100% if many children younger or older than the typical age group are enrolled. Information should be available from the Ministry of Education.
3. Primary school gross enrollment rate-females.
4. Primary pupil-teacher ratio. This is the average number of primary students per teacher.
5. Secondary school gross enrollment rate-males.
6. Secondary school gross enrollment rate-females.
7. Secondary pupil-teacher ratio.

There are three coverage indicators required.

1. % primary students with teachers trained in AIDS.
2. % secondary students with teachers trained in AIDS.
3. % out-of school reached

There are also three unit cost estimates required.

1. Cost per teacher trained in primary education. This is the cost to train a primary school teacher in AIDS education. The median unit cost across countries with information is $75 with an inter-quartile range of $32 - $150.
2. Cost per teacher trained in secondary education. This is the cost to train a secondary school teacher in AIDS education. The median unit cost across countries with information is $75 with an inter-quartile range of $32 - $150.
3. Cost of peer outreach for out-of-school youth. The median unit cost across countries with information is $12 with an inter-quartile range of $8 - $21.

The calculations are as follows:

$Number\ of\ primary\ teachers_t$ = Population aged $6\text{-}13_t$ x (Primary school enrollment rate-males + Primary school enrollment rate-females) / 2 /100 / Primary pupils per teacher

Number of secondary teachers$_t$ = Population aged 14-17$_t$ x (Secondary school enrollment rate-males + Secondary school enrollment rate-females) / 2 / 100 / Secondary pupils per teacher

Number of youth not in school$_t$ = Population aged 6-13$_t$ x (1 – {primary school gross enrollment rate-males + primary school enrollment rate-females}/2/100) + Population aged 14-17 x (1 – {secondary school gross enrollment rate-males + secondary gross enrollment-females}) / 2 / 100

Workplace programs

Workplace programs are prevention interventions provided to employees in the work place. We assume that these interventions are target to employees in the formal sector. There are four inputs required to estimate the number of formal sector employees. They are:

1. Labor force participation rate – male. The percentage of men 15-64 who are in the labor force.
2. Labor force participation rate – female. The percentage of women 15-64 who are in the labor force.
3. Percent of labor force in services and industry. The percentage of the total labor force that is employed in the services and industry sector. These employees are assumed to be in the formal sector.
4. Percent of labor force in wage employment in agriculture. The percentage of the labor force that is engaged in agriculture for a wage.

There are three coverage indicators which refer to the interventions provided in the workplace. They are:

1. % workforce receiving peer education
2. % workforce receiving STI treatment
3. % workforce receiving condoms

In all three cases these percentages refer to the percentage of the formal workforce that receives the intervention in the workplace.

There are three unit cost inputs that describe the three workplace interventions.

1. Cost per employee reached with peer education. For countries with data available the median cost is $5 with an inter-quartile rate of $3 - $10.
2. Cost per STI case treated. For countries with data available the median cost is $11 with an inter-quartile range of $9 - $15.
3. Cost per condom distributed. For countries with data available the median cost is $0.15 with an inter-quartile range of $0.12 - $0.27.

The calculations are as follows:

Number of formal sector employees$_t$ = (Male population 15-64$_t$ x Labor force participation rate-male/100 + Female population 15-64$_t$ x Labor force participation rate-female/100) x (Percent labor force in services and industry + Percent labor force in wage employment in agriculture)/100

Workers reached with peer education$_t$ = Number of formal sector employees$_t$ x % workforce receiving peer education$_t$

STI cases treated$_t$ = Number of formal sector employees$_t$ / (Male population 15-49 + Female population 15-49) x (Male STI cases + Female STI cases) x % workforce receiving STI treatment / 100

(This equation first estimates the percentage of the adult population that is in the formal sector workforce, then multiplies that percentage by the total annual number of STI cases to estimate the number of STI cases per year among formal sector employees. This is then multiplied by the coverage rate to estimate the number of cases treated in the workplace.)

Condoms provided$_t$ = Number of formal sector employees$_t$ x Sex acts with regular partners x % workforce receiving condoms / 100 x (1 + condom wastage/100)

Resources required$_t$ = Workers reached with peer education$_t$ x cost per employee reached with peer education + STI cases treated$_t$ x cost per STI case treated + Condoms provided$_t$ x Cost per condom distributed

Condom provision

There are eight inputs required to calculate the number of condoms required. They are:

1. Percent of population 15-49 that is sexually active.
2. Percent of males 15-49 in regular partnerships. 'Regular partnerships' refers to marriage or living together on a permanent basis.
3. Percent of males 15-49 reporting non-regular partners.
4. Number of sex acts with casual partners per year. Casual partner are non-regular partners that are not sex workers.
5. Number of sex acts with regular partner per year. Surveys have found that this figure varies from about 50 – 110 with a median of about 66.
6. Number of commercial sex acts per sex worker per year.
7. Percent of condoms wasted during storage and distribution. The default value is 10%
8. Percent of condoms distributed through social marketing programs.

There are two measures of coverage.

1. % of casual acts covered by condom use. This is the percentage of casual sex contacts that involve condom use. This may range from 5% to as high as 60-70%.
2. % marrieds with casual partners using condoms in marital sex. This refers to condom use with marital sex among those couples where at least one partner has outside partner. This rate is usually quite low, less than 10%.

There are two unit cost estimates required:

1. Cost per male condom distributed by the public sector. This should generally include the full costs of distribution, not just the cost of the condom itself. For countries with data available the median cost is $0.14 with an inter-quartile range of $0.10 - $0.30.
2. Cost per condom distributed by social marketing. For countries with data available the median cost is $0.14 with an inter-quartile range of $0.10 - $0.30.

The cost of a distributed condom should reflect the cost to the government or to the social marketing program. Sometimes this cost will be the commodity cost alone, while other times the cost will include the distribution costs associated with it, including operational and management costs. Stallworthy[9] presents information on the cost of distributing condoms through social marketing programs. These unit costs include costs such as cost of the condom, operations, management, technical assistance and other indirect costs. Although the cost per condom sold varied between US$0.08-US$0.13 for several large countries with long-running programs, the average unit cost per condom sold for 13 other countries ranged between US$0.17-US$0.34. In addition, there were a few outliers where costs were greater than US$0.40 per condom.

The number of condoms needed and the resources required are calculated as follows:

We assume that risky acts requiring condom use are all acts with a sex worker, all acts of MSM and IDU, all casual sex contacts and all marital contact when at least one partner has outside partners. If the cost of condoms is included in interventions for sex workers, MSM and IDU then no additional cost for condoms for those population is included here, but if the cost per condom for any of those interventions is set to 0, then the condoms costs are included here.

$$\text{Number of condoms required}_t = \text{Number of sex workers}_t \times \text{sex worker acts per year} + \text{Number of MSM}_t \times \text{MSM acts per year} +$$

[9] Stallworthy G, Meekers D. 1998. An analysis of unit costs in selected condom social marketing programs, 1990-1996. Presentation at the XII World AIDS Conference, Geneva, June 28-July 3, 1998.

Condoms for IDUs + Male population 15-49$_t$ x % men with casual partners/100 x sex acts per year with casual partners + Male population 15-49$_t$ x % men with regular partners/100 x % males with casual partners x contacts per year with regular partners

Condoms provided for sex work$_t$ = (Sex workers reached$_t$ x % condom use among sex workers reached by intervention$_t$ /100 + (Sex workers$_t$ – Sex workers reached$_t$) x % condom use among sex workers not reached by intervention/100) x sex worker acts per year x (1 + condom wastage/100)

Condoms for MSM$_t$ = MSM reached$_t$ x % condoms use among those reached by the intervention/100 x MSM sex acts per year x (1 + condom wastage/100)

Condoms provided for casual sex$_t$ = (Male population 15-49 x % male with non-regular partners/100 x Sex acts with non-regular partners x % casual acts covered with condoms) x (1 + condom wastage/100)

Condoms provided for marital sex$_t$ = (Male population 15-49$_t$ x % males with regular partners/100 x % males with non-regular partners/100 x sex acts with regular partner x % marrieds with casual partners using condoms in marital sex/100) x (1 + condom wastage/100)

Condoms provided$_t$ = Condoms for sex work$_t$ + Condoms for MSM$_t$ + Condoms for IDU$_t$ + Condoms for casual sex$_t$ + Condoms for marital sex$_t$

Resources required$_t$ = Condoms provided$_t$ x {cost per male condom distributed by public sector x (1 - % condoms provided by social marketing/100) + cost per male condom distributed through social marketing x % condoms provided by social marketing/100}

STI management

There six inputs required to estimate the need for management of sexually transmitted infections.

1. Number of new cases of treatable STIs-male. The annual number of new cases of sexually transmitted infections in males.
2. Growth rate of new cases of treatable STIs-male. The annual rate of increase in new cases of treatable STIs in males. The default value is the growth rate of the adult male population.

3. Number of new cases of treatable STIs-female. The annual number of new cases of sexually transmitted infections in females.
4. Growth rate of new cases of treatable STIs-female. The annual rate of increase in new cases of treatable STIs in females. The default value is the growth rate of the adult female population.
5. Percent of STIs that are symptomatic-males. The percent of treatable STIs in males that are symptomatic and, therefore, likely to be identified for treatment.
6. Percent of STIs that are symptomatic-females. The percent of treatable STIs in females that are symptomatic and, therefore, likely to be identified for treatment.

There are two inputs describing the coverage of STI treatment.

1. % males with STIs receiving treatment
2. % females with STIs receiving treatment

There is only one unit cost input required.

1. Cost per STI case treated. For countries with data available the median unit cost is $12 with a range of $9 (lower quartile) to $25 (upper quartile).

The calculations are as follows:

Number of symptomatic STI cases-males$_t$ = Number of new cases of treatable STIs-males$_1$ x (1 + annual growth rate-males/100) x Percent of STIs that are symptomatic-males / 100

Number of symptomatic STI cases-females$_t$ = Number of new cases of treatable STIs-females x (1 + annual growth rate-females/100) x Percent of STIs that are symptomatic-females / 100

STI cases treated$_t$ = Number of symptomatic STI cases-males$_t$ x % males with STIs receiving treatment + Number of symptomatic STI cases-females$_t$ x % females with STIs receiving treatment

Resources required$_t$ = STI cases treated$_t$ x Cost per STI case treated

Voluntary counseling and testing

There is only one input required to estimate the need for VCT.

1. Percent of adult population requiring VCT annually.

There are two coverage indicators.

1. % of adult population receiving VCT annually
2. Number of VCT sites

There are two unit cost measures required.

1. Cost per VCT client. For countries with data available the median is $15 and the range is $11 (lower quartile) to $25 (upper quartile).

2. Cost to establish a new VCT site. This is the cost of building or renting space and equipping a site to provide VCT services.

The calculations are as follows:

Number of people needing VCT services$_t$ = Population 15-49$_t$ x % of adult population needing VCT annually

Number of VCT clients$_t$ = Population 15-49$_t$ x % of adult population receiving VCT annually$_t$ / 100

Resources needed$_t$ = Number of VCT clients$_t$ x Cost per VCT client + (Number of VCT sites$_t$ – Number of VCT sites$_{t-}$) x Cost to establish a new VCT site

Prevention of mother-to-child transmission

There is just one input required to estimate the need for PMTCT.

1. Percent of pregnant women who had some antenatal care. The calculations assume that only women receiving some antenatal care can be reached by PMTCT interventions.

There are three coverage indicators for PMTCT.

1. % of pregnant women attending ANC tested for HIV. The percentage of all pregnant women who attend antenatal clinics that are tested for HIV. This indicator combines the availability of PMTCT at antenatal clinics and the percent of women who accept to be tested if the service is available.
2. % HIV-positive pregnant women treated with ARV. This is the percent of women who are tested and found to be HIV-positive who receive treatment to prevent mother-to-child transmission.
3. % HIV-positive women who receive infant formula. The percent of HIV-positive women who are provided with infant formula in order to avoid transmission through breastfeeding.

There are also three unit costs required.

1. Cost per women screened. The cost per woman who is counseled and tested. For countries with data available the median cost is $8 with a range of $4 (lower quartile) to $10 (upper quartile).
2. Cost per woman testing HIV-positive and receiving treatment. This includes the additional counseling costs for a woman who is found to be HIV+ and the cost of treatment to prevent transmission of HIV to the baby. For countries with data available the median cost is $40 with a range of $10 (lower quartile) to $165 (upper quartile).
3. Cost per woman of infant formula. If infant formula is provided, this is the cost of six months of formula. For countries with data available the median cost is $24 with a range of $14 (lower quartile) to $47 (upper quartile).

The calculations are as follows:

Number of women attending ANC services$_t$ = Population$_t$ / 1000 x Crude birth rate$_t$ x Percent of women who had some antenatal care / 100

Number of women receiving counseling and testing$_t$ = Number of women attending ANC services$_t$ x % of pregnant women attending ANC tested for HIV / 100

Number of HIV+ women receiving ART prophylaxis$_t$ = Number of women receiving counseling and testing$_t$ x HIV prevalence among pregnant women$_t$ /100 x % HIV positive women treated with ART/100

Number of HIV+ women receiving formula$_t$ = Number of women receiving counseling and testing$_t$ x HIV prevalence among pregnant women$_t$ /100 x % HIV positive women receiving formula/100

Resources required$_t$ = Number of women receiving counseling and testing$_t$ x Cost per women receiving counseling and testing + Number of HIV+ women receiving ART prophylaxis$_t$ x Cost per women testing HIV+ and receiving ART + Number of HIV+ women receiving formula$_t$ x Cost per woman of six months of formula

HIV prevalence among pregnant women is assumed to be equal to adult HIV prevalence for generalized epidemics and equal to HIV prevalence among females 15-49 in concentrated and low level epidemics. Countries are classified as having generalized epidemics if adult HIV prevalence is greater than one percent.

Mass media

The population in need of mass media is assumed to be the entire adult population. There is a single coverage indicator which is the number of mass media campaigns per year. The only unit cost input required is the cost per campaign. For countries with data available the median cost is $150,000 with a range of $70,000 to $390,000. The resources required are estimated as:

Resources required$_t$ = Number of mass media campaigns per year$_t$ x cost per campaign

Blood safety

The only input required to estimate the need for safe blood is the number of units of blood required per 1000 people. This figure should be available from the national blood transfusion service.

The only coverage input needed is the percentage of blood tested before transfusion.

The only unit cost required is the cost of screening blood for HIV. This is the cost of screening not the cost of blood collection, since only the screening cost is usually considered an AIDS-related cost. For countries with data available the median cost is $10 with a range of $4 (lower quartile) to $15 (upper quartile).

Resources required for safe blood are estimated as follows:

Units of safe blood required$_t$ = Population$_t$ / 1000 x Units of blood per 1000 population

Units of safe blood produced$_t$ = Units of safe blood required$_t$ x percent of units of blood tested before transfusion

Resources required$_t$ = Unites of safe blood produced$_t$ x cost per screening a unit of blood

Post-exposure prophylaxis

Post-exposure prophylaxis (PEP) refers to anti-retroviral treatment provided, usually for one month, to a person who may have been newly exposed to HIV. This is typically provided for health care personnel who may have come in contact with infected blood through a needle stick or other accident and for rape victims.

The estimate of need is based on the estimated number of PEP kits per million population. The default assumption is one kit per million population. For countries with data available the median unit cost is $184 with a range of $125 (lower quartile) to $243 (upper quartile).

Resources needed are estimated as follows:

Number PEP kits required$_t$ = Population$_t$ / 1,000,000 x PEP kits per million population

PEP kits provided$_t$ = PEP kits required$_t$ x Percent of need that is met

Resources required$_t$ = PEP kits provided$_t$ x Cost per PEP kit

Safe medical injection

HIV can be spread through injection with contaminated needles and syringes. Interventions to prevent contaminated injections promote the use of needles and syringes that can only be used once (auto-destruct needles) and the reduction of unnecessary injections. The number of unsafe injections is estimated from three inputs.

1. Average number of immunizations per child aged 0-23 months. This should be the actual number of injections per child, not the recommended number.
2. Number of adult injections per person per year.
3. Percent of injections that are unsafe.

WHO has estimated the number of adult injections per person per year and the percent of injections that are unsafe by region, as shown in the table below.

Region	Injections per person per year	Percent of injections that are potentially unsafe
Afr D: Algeria, Angola, Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Comoros, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania, Mauritius, Niger, Nigeria, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Togo.	2.2	19%
Afr E: Botswana, Burundi, Central African Republic, Congo, Co€te d'Ivoire, Democratic Republic of the Congo, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.	2.0	17%
Amr B: Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, El Salvador, Grenada, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela.	1.7	1%
Amr D: Bolivia, Ecuador, Guatemala, Haiti, Nicaragua, Peru.	1.9	11%
Emr D: Afghanistan, Djibouti, Egypt, Iraq, Morocco, Pakistan, Somalia, Sudan, Yemen.	4.3	70%
Eur B: Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Georgia, Kyrgyzstan, Poland, Romania, Slovakia, Tajikistan, The Former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Uzbekistan, Yugoslavia.	2.5	1%
Eur C: Belarus, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Ukraine.	3.5	11%
Sear B: Indonesia, Sri Lanka, Thailand.	2.1	30%
Sear D: Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Maldives, Myanmar, Nepal.	4.0	75%
Wpr B: Cambodia, China, Cook Islands, Fiji, Kiribati, Lao People's Democratic Republic,	2.3	30%

Region	Injections per person per year	Percent of injections that are potentially unsafe
Malaysia, Marshall Islands, Micronesia (Federated States of), Mongolia, Nauru, Niue, Palau, Papua New Guinea, Philippines, Republic of Korea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, Viet Nam		
World	3.4	40%

Source: AM Hauri, GL Armstrong, YJF Hutin. "The global burden of disease attributable to contamined injections given in health care settings" *International Journal of STDs & AIDS*, 2004; 15: 7-16.

There are two coverage indicators.

1. Percent of unsafe injections replaced with auto-destruct (AD) syringes
2. Percent reduction in number of injections. This is the percent reduction in injections that would results from efforts to reduce unnecessary injections.

The only unit cost input is the additional cost per auto-destruct syringe provided. This is the difference between the cost of AD syringes and re-usable syringes. The additional cost is generally about $0.03 per syringe.

The calculations are as follows:

Number of unsafe immunizations$_t$ = Population$_t$ /1000 x crude birth rate x average number of immunizations per child 0-23 months x percent of injections that are unsafe / 1000

Number of other unsafe injections$_t$ = Population 15-49$_t$ x injections per capita x percent of injections that are unsafe / 100

Number of AD syringes provided$_t$ = (Number of unsafe immunizations$_t$ + Number of other unsafe injections$_t$ x (1 – percent reduction in other injections / 100) x percent of unsafe injections replaced with AD syringes

Resources required$_t$ = Number of AD syringes provided$_t$ x additional cost per AD syringe

Universal precautions

"Universal precautions" refers to the use of gloves, masks and gowns by health care personnel to avoid infection through contaminated blood. The need for universal precautions is estimated from the number of hospital beds. For countries with data available the median annual cost is $150 with a range of $60 (lower quartile) to $380 (upper quartile). The calculations are as follows.

Number of hospital beds$_t$ = Population$_t$ / 1000 x hospital beds per 1000 population

Number of hospital beds covered$_t$ = Number of hospital beds$_t$ x Percent of health workers covered$_t$ / 100

Resources needed$_t$ = Number of hospital beds covered$_t$ x annual cost per hospital bed

IV. Care and Treatment

The care and treatment section of the RNM utilizes a similar methodology as the prevention section in that it combines estimates of population target groups, unit costs, and coverage targets, based on access to care and treatment. There are some differences, however, that are explained in detail below.

The model estimates resource needs for 10 types of care and treatment.

(1) Home-based care
(2) Palliative care
(3) Treatment of opportunistic infections (OIs)
(4) Diagnostic HIV testing
(5) Prophylaxis for opportunistic infections in symptomatic patients
(6) Laboratory monitoring for patients on anti-retroviral therapy
(7) Anti-retroviral therapy (ART)
(8) Training
(9) Nutritional support
(10) Tuberculosis

The population newly requiring treatment in a particular year is assumed to be equal to the number of people living with HIV who are newly symptomatic during that year. Symptoms are assumed to occur about two years before death from AIDS would occur in the absence of ART. In the absence of ART care and treatment is needed for two years until death. Patients receiving ART survive longer and have reduced need for palliative care and OI treatment. The number of people needing ART is all those newly symptomatic plus patients on ART in the previous year who survive to the current year. The details of these calculations are given below.

Home-based care

Home-based care is external support to chronically ill individuals and their families. It may include counseling, medical care, supplies for medical care, clothing, extra food, help with household work, companionship, financial support, legal services, training for care-givers, school fees, shelter or other medical or social services.

The population in need of home-based care is the number of people newly needing care multiplied by 2, since we assume that the need for care lasts for 2 years.

The single coverage indicator is the percentage of those in need of care who received home-based care.

The single unit cost input is the cost per person per year of home-based care.

The calculations are as follows:

Number receiving home-based care$_t$ = Number newly needing home-based care$_t$ x 2 x coverage$_t$

Resources needed$_t$ = Number receiving home-based care x unit cost

Palliative care

Palliative care refers to care that addresses pain and discomfort associated with HIV. When delivered through home-based care it should be considered as part of that intervention. When delivered through another setting, such as a health post, clinic or hospital, it is considered here.

The population potentially in need of palliative care is the number of adults and children newly needing care minus those who start receiving ART plus those failing on ART this year. ART failure is assumed to occur according to a poisson distribution of the number of years a person has been on ART. The costs of caring for children are expressed as a ratio of the adult costs. The default value is 100%.

Pop in need of palliative care$_t$ = Adults newly needing care$_t$ + Children newly needing care x Ratio of child care costs to adult care costs) x (1 - % on ART) + ART failures$_t$

Pop receiving palliative care$_t$ = Pop in need of palliative care$_t$ x coverage$_t$

Resources needed$_t$ = Pop receiving palliative care$_t$ x unit cost

Diagnostic testing and routine offer of testing

Diagnostic testing refers to tests ordered by health care providers who suspect on the basis of symptoms that a person is infected with HIV or the routine offer of testing to all patients who conditions might suggest an elevated risk, such as STI patients or TB patients. The target population is generally set as all hospital patients, but some other indicator of the number of people in contact with the health care system could be used as well. Tuberculosis patients are considered separately as a population group in need of testing.

There are two coverage indicators:

1. Percent of medical patients tested
2. Percent of TB patients tested

The unit cost is the cost of the HIV test.

The calculations are as follows:

Number of medical patients tested$_t$ = Number of medical patients$_t$ x % medical patients tested

Number of TB patients tested$_t$ = Number of TB patients$_t$ x % TB patients tested

Resources required$_t$ = (Number of medical patients tested$_t$ + Number of TB patients tested$_t$) x cost per test

OI treatment

The population in need of treatment for opportunistic infections is estimated separately for adults and children as the number newly needing care that are not started on ART plus those failing on ART.

Pop needing OI Tx$_t$ = (Adults newly needing care$_t$ + Children newly needing care$_t$ x Ratio of child care costs to adult care costs) + ART failures$_t$

Prophylaxis for adults for opportunistic infections

HIV infection weakens the immune system and makes people susceptible to infections that can normally be controlled when the immune system is healthy. For example, many people are infected with latent tuberculosis, but the immune system keeps this infection from developing into active tuberculosis. However, in people with advanced HIV infection, this protection is weakened and active tuberculosis occurs more frequently. Drugs can prevent some common HIV-related diseases. Cotrimoxazole can protect against many of the causes of pneumonia and diarrhoea. Isoniazid can prevent active tuberculosis. These drugs are inexpensive and effective in HIV-positive individuals.

Prophylaxis against these common infections can extend life and improve the quality of life for many individuals. Prophylaxis is also cost-effective, since preventing these infections costs less than treating them.

The number of adults in need of prophylaxis for OIs is the number of adults newly needing care plus those adults continuing on ART from previous years who need prophylaxis. The default is that 50% of those on ART have a continuing need for prophylaxis, but this may vary according to local protocols.

The number of people receiving prophylaxis is the number newly needing care plus those continuing on ART from the previous year multiplied by the percent needing prophylaxis multiplied by the coverage.

Pop receiving prophylaxis$_t$ = (Newly needing care$_t$ + (ART$_t$ – Newly needing care$_t$ x ART coverage) x Percent on ART needing prophylaxis) x coverage$_t$

Resources needed$_t$ = Pop receiving prophylaxis$_t$ x unit cost

Anti-retroviral therapy (ART)

There are five inputs required to define the population in need of ART.

1. Population in need receiving ART: the population in need of ART that receives it
2. Years of expected life with ART: the number of years a person on ART is expected to survive
3. Non ART survival: the number of years a person eligible for ART but not receiving it is expected to survive
4. Adults currently on ART: the number of adults already on ART in the base year
5. Average time on ART: the average number of years that adults on ART in the base year have been on ART

There are five different unit cost figures required:

1. Cost of ART: the cost per patient on first line ART
2. ART, male TB annual: the annual cost per male patient on ART if that patient is also being treated for TB
3. ART, female TB annual: the annual cost per female patient on ART if that patient is also being treated for TB
4. Cost of toxicity therapy: the annual cost per patient of therapy to treat toxic side effects
5. Cost of second line therapy: the annual cost per patient of second line ART

Five additional parameters are required to estimate the resources needed for ART:

1. Percent of total ART with TB therapy: the percent of all patients on ART that are also being treated for TB
2. % toxicity due to OI, pregnancy, etc.: the percent of all patients on ART that need toxicity therapy due to opportunistic infections, pregnancy or other conditions
3. Failure rate in first year on ART: the percent of ART patients who fail therapy in the first year
4. Annual increase in failure rate of first line therapy: the annual increase in the number of patients failing on ART. This is used to calculate the percent of ART patients who fail after 2, 3, 4, etc. years on therapy
5. % women TB: the percent of all ART patients also being treated for TB that are women

The calculations are as follows:

ART_t = Adults newly needing $treatment_t$ x $ART\ coverage_t$

ART_t = Children newly needing $treatment_t$ x $ART\ coverage_t$

ART_t = Adults starting on ART_t + Children starting on ART_t * Cost of care for children as % of adult cost of care

Adult equivalents on ART_t = Adult equivalents starting on ART_t + $\Sigma_{(y=1 \text{ to } t)}$ Adult equivalents starting on ART_y x Survival on ART_{t-y}

(where Survival on ART_{t-y} is a poisson distribution describing the percent of patients surviving on ART t-y years after starting therapy. The mean of the poisson distribution is the expected years of life for those on ART).

Male adult equivalents on ART-TB_t = Adult equivalents on ART_t x Percent of ART patients receiving TB treatment x (1 – % women TB)

Female adult equivalents on ART-TB_t = Adult equivalents on ART_t x Percent of ART patients receiving TB treatment x % women TB

Adult equivalents on toxicity $therapy_t$ = Adult equivalents on ART_t x % toxicity due to OI, pregnancy, etc.

Adult equivalents on second line $therapy_t$ = $\Sigma_{(y=1 \text{ to } t)}$ Adult equivalents starting on ART_y x (1-Survival on ART_{t-y})

Resources $required_t$ = Male adult equivalents on ART-TB_t x Cost of ART for male with TB + Female adult equivalents on ART-TB_t x Cost of ART for female with TB + Adult equivalents on second line $therapy_t$ x cost of second line therapy + Adult equivalents on toxicity $therapy_t$ x cost of toxicity therapy + (Adult equivalents on ART_t - Male adult equivalents on ART-TB_t - Female adult equivalents on ART-TB_t - Adult equivalents on toxicity $therapy_t$ - Adult equivalents on second line $therapy_t$) x Cost of ART

Laboratory monitoring for ART

The number of tests required is estimated as the number of people on ART multiplied by the number of test per year per patient. The resources required are simply the number of tests required multiplied by the cost per test.

Training

Training may be required to prepare physicians and clinical mangers to treat patients on ART. To estimate the need for training there are 10 inputs required. The first six refer to the number of facilities where ART could be provided. These include: referral hospitals, general hospitals, primary hospitals, maternity clinics, other clinics and health posts with nurses. Four other inputs are also required:

1. Maximum patients served by FTE: the maximum number of patients that can be served by a health worker working full time on ART.
2. Percent of time physician spends on caring for AIDS patients. The percent of time that the average physician who care for AIDS patients spends on AIDS care.

3. Clinic manager per health center. The average number of clinics managers per health center. Typically this would be one.
4. Length of training. The number of days a typical training session lasts to train health workers to care for ART patients.

The calculations are as follows:

Number of physicians required$_t$ = Adult equivalents on ART$_{t+}$ / Maximim patients served by FTE / Percent of time physician spends on caring for AIDS patients

Number of training days required$_t$ = Number of physicians required$_t$ x length of training + Training days in clinical management$_t$

Training days in clinical management$_t$ = minimum(Number of hospitals and clinics$_t$ x length of training OR Number of physicians required$_t$ x length of training)

(If the number of physicians trained is smaller than the number of facilities then those physicians will also be trained in clinic management, if it is larger than the number of facilities then one physician or clinic manager will be trained per facility.)

Resource needed$_t$ = Number of training days$_t$ x cost per day of training

Nutritional support

Patients receiving ART may also need nutritional support to restore their health and allow them to benefit fully from ART. Two inputs are required to estimate the population receiving nutritional support:

1. Percentage of children that are undernourished: The percentage of children under the age of 5 that are undernourished.
2. Ratio undernourished < 5 : undernourished HIV+. The is the ratio of the percentage of children under the age of 5 that are undernourished to the percentage of all HIV+ eligible for ART that are undernourished. The default values are 0.44 for low income countries and 0.10 for middle income countries.

The percentage of all HIV+ patients eligible for ART that are undernourished is estimated by multiplying the percentage of children under 5 that are undernourished by the ratio of undernourishment among children under 5 to HIV+ patients:

Percent of HIV+ undernourished$_t$ = Percent of children under five that are undernourished x ratio undernourished < 5 : undernourished HIV+

We assume that nutritional support is provided in the first year to patients starting ART.

Number receiving nutrition support$_t$ = Adult equivalents starting on ART$_t$ x Percent of HIV+ undernourshed$_t$

Resources required$_t$ = Number receiving nutrition support$_t$ x unit costs

The unit costs typically range between $100 and $200.

Tuberculosis

The resources needed for tuberculosis treatment are simply the number of people with TB multiplied by the percent receiving treatment multiplied by the annual costs of treatment.

Resources needed$_t$ = Number with TB$_t$ x coverage$_t$ x unit cost of treatment

V. Support for Orphans and Vulnerable Children

Orphans are defined as children under the age of 18 that have lost one or both parents. An AIDS orphan is a child under 18 who has lost one or both parents to AIDS. Programming for orphan support general should not distinguish between AIDS and non-AIDS orphans. Both need education, food, clothing, etc. Many other children may be vulnerable and in need of support. Definitions of vulnerability vary from country to country, so the number of orphans and vulnerable children potentially in need of support will depend on national definitions.

In countries with generalized AIDS epidemics a significant proportion of orphans are due to AIDS. As a result orphan support is often included as part of the AIDS budget. In other countries, AIDS may be responsible for only a small percentage of all orphans. In those cases, orphan support may not be considered part of the AIDS budget and this section can be skipped.

Estimates of the number of orphans by age are the starting point for this analysis. But not all orphans are in need of public support. Some may be living with one surviving parent who can afford to care for them. We estimate the proportion of orphans in need of public support as the proportion of households living below the poverty line.

Orphans and vulnerable children need many types of support including education, food, health care, shelter, clothing, economic support and psychosocial support. Some services, such as education and health care, may be provided free by the government or may require fees.

Estimates of the number of orphans and vulnerable children should be provided by age. These may come from Spectrum projections or from other sources. Two other inputs are required to estimate the population in need:

1. Secondary school enrollment rate: This is the gross enrollment rate, which is the number of secondary school students divided by the number of children of secondary school age.
2. Percent living below the poverty line: The percent of households living below the national poverty line.

The number of orphans and vulnerable children needing support is estimated as follows:

Primary school$_t$ = $OVC_{5\text{-}12,t}$ x % below poverty line

Secondary school$_t$ = $OVC_{13\text{-}17,t}$ x secondary school enrollment rate x % below poverty line
Skills support$_t$ = $OVC_{13\text{-}17,t}$ x (1 – secondary school enrollment rate) x % below poverty line
Hot meals$_t$ = $OVC_{0\text{-}17,t}$ x % below poverty line
Health care$_t$ = $OVC_{0\text{-}17,t}$ x % below poverty line
Bedding$_t$ = $OVC_{0\text{-}17,t}$ x % below poverty line
Clothes$_t$ = $OVC_{0\text{-}17,t}$ x % below poverty line

The unit costs are required for each type of support. Median and quartile ranges are shown below for OVC support in sub-Saharan Africa.

Type of support	**Unit cost (US Dollars)**
Primary school (fees, uniforms, supplies, etc.)	$60 ($40 - $100)
Secondary school (fees, uniforms, supplies, assessments)	$180 ($130 - $300)
Skills training	$85 ($40 - $150)
Food	$1.00 ($0.30 - $1.30)
Health care	$180 ($30 - $110)
Clothes	$45 ($30 - $70)
Bedding	$16 ($9 - $30)

Source: J Stover, L Bollinger, N Walker, R Monash. Resource needs to support orphans and vulnerable children in sub-Saharan Africa, forthcoming.

Resources required$_t$ = $\sum_S$ Number needing support$_{s,t}$ x coverage$_{s,t}$ x unit cost$_s$

Where s = primary school, secondary school, skills support, hot meals, health care, bedding, clothing

VI. Program Support

Program support includes the policy, management and administration, research, and monitoring and evaluation activities necessary to support the implementation of a national program. Resources for these functions are estimated as a percent of total direct program resources. An often used rule-of-thumb states that 5% of program funding should be allocated to monitoring and evaluation. Similar percentages may be appropriate for the other functions. The calculated resources needed can be match to the estimated actual spending in the base year in order to calibrate the percentages to realistic levels.

Resource required for:

$\text{Enabling environment}_t = \text{Program resources}_t \times \%$ for enabling environment

$M\&A_t = \text{Program resources}_t \times \%$ for management and administration

$\text{Research}_t = \text{Program resources}_t \times \%$ for research

$M\&E_t = \text{Program resources}_t \times \%$ for M&E

VII. Outputs

The outputs from the Resource Needs Model are contained in individual worksheets within the workbook. Some of the outputs are in tabular form, while other outputs appear in graphs. The outputs that can be obtained are listed below according to the title of each individual worksheet:

- **Summary:** A summary of the expenditures on each of the prevention, care, and orphan support activities, for each of the years under analysis. Column B in this table is used to indicate whether this intervention is considered part of the AIDS program. If it is, then column B should contain a "Y". For low prevalence countries, some programs (such as orphan support or universal precautions) may not be considered part of the AIDS program budget. In that case, you can enter a "N" in column B and that intervention will be excluded from the total.
- **Funding chart:** A stacked bar chart that shows the distribution of expenditures for each of the prevention, care, and orphan support activities, for each of the years under analysis.
- **Prevention funding chart:** A stacked bar chart, as in the 'Funding chart' worksheet, except focusing on prevention activities only, for each of the years under analysis.
- **Care funding chart:** A stacked bar chart, as in the 'Funding chart' worksheet, except focusing on care and orphan support activities only, for each of the years under analysis.
- **Distribution chart**: A stacked bar chart showing the percentage contribution of each component to total resource needs by year.

VIII. Glossary of Terms

AIDS. The abbreviation for the acquired immune deficiency syndrome, a disabling and fatal disease caused by the human immunodeficiency virus (HIV).

Epidemiology. The study of the incidence, distribution, and determinants of an infection, disease, or other health-related event in a population. Epidemiology can be thought of in terms of who, where, when, what, and why. That is, who has the infection/disease, where are they located geographically and in relation to each other, when is the infection/disease occurring, what is the cause, and why did it occur?

EPP: Epidemic Projection Package. The computer package recently developed by the UNAIDS Reference Group on Estimates, Modelling and Projections to project HIV prevalence. The output from the model can feed directly into the Spectrum/AIM model (described below) to calculate various impacts. It can be found at http://www.futuresgroup.com, under software.

Harm reduction program. A prevention intervention designed to reach intravenous drug users. This program may contain a combination of different elements, including outreach programs, IEC campaigns, distributing disinfectants and clean syringes, and distributing condoms.

HIV. The human immunodeficiency virus is the virus that causes AIDS. Two types of HIV are currently known: HIV-1 and HIV-2. Worldwide, the predominant virus is HIV-1. Both types of virus are transmitted by sexual contact, through blood, and from mother to child, and they appear to cause clinically indistinguishable AIDS. However, HIV-2 is less easily transmitted, and the period between initial infection and illness is longer in the case of HIV-2.

HIV Infection. Infection with the human immunodeficiency virus (HIV). HIV infection is primarily a sexually transmitted infection, passed on through unprotected penetrative sex. The virus can also be transmitted through blood transfusions, through the use of unsterilized injection equipment or cutting instruments, and from an infected woman to her fetus or nursing infant.

Interpolation. Given two numbers that serve as boundary points, it is possible to estimate the values that lie at intervals between the two points. For example, if the HIV prevalence rate for a country or region was actually measured only in 1985 and in 1995, by assuming even increments from year to year, it is possible to interpolate a TFR for each intervening year. Spectrum uses a linear form of interpolation so that the difference between each annual value is the same. Other nonlinear forms of interpolation are also possible but are not used here.

Mass media campaign. An information, education, and communication campaign undertaken via different media to reach a large number of people. Media may include channels such as radio, television, and print.

Model. Computer system designed to demonstrate the probable effect of two or more variables that might be brought to bear on an outcome. Such models can reduce the effort required to manipulate these factors and present the results in an accessible format.

Module. Synonym for "model."

Orphan. In this manual, an orphan is defined as a maternal, paternal, or dual AIDS or non-AIDS orphan. This is the definition recently adopted by the US Census Bureau, UNAIDS, UNICEF, and USAID, after modelling work completed by the UN Reference Group on Estimates, Modelling and Projections.

Perinatal and Perinatal Transmission. Pertaining to or occurring during the periods before, during, or shortly after the time of birth; that is, before delivery from the 28th week of gestation through to the first seven days after delivery. The transmission of HIV from an infected woman to her fetus or newborn child is referred to as perinatal transmission.

Prevalence. The proportion of a defined population with the infection, disease, or other health-related event of interest at a given point or period of time.

Spectrum/AIM. A group of computer models that analyze existing information to determine the future consequences of today's reproductive health programs and policies. These models may be used to project the impact of HIV prevalence, calculated by the EPP model (see above), on various demographic and economic outcomes. The models and documentation are available for free download at http://www.futuresgroup.com, under Software.

IX. Acronyms and Abbreviations

AIDS	acquired immunodeficiency syndrome
ANC	antenatal clinics
ARV	anti-retroviral therapy
DHS	Demographic and Health Survey
DOTS	Directly Observed Therapy Short Course
FC	female condom
GDP	gross domestic product
GNP	gross national product
ARV	highly active anti-retroviral therapy
HIV	human immunodeficiency virus
IDU	injection drug user
IE&C	information, education, and communication
MSM	men who have sex with men
NEP	needle exchange programs
NGO	nongovernmental organization
OI	opportunistic infection
OVC	orphans and vulnerable children
PLHA	people living with HIV/AIDS
PMTCT	prevention of mother-to-child transmission
PY	person years
SW	sex worker
STI	sexually transmitted infection
UN	United Nations

UNFPA	United Nations Fund for Population Activities
UNGASS	United Nations General Assembly Special Session on HIV/AIDS
USAID	United States Agency for International Development
VCT	voluntary HIV counseling and testing
WHO	World Health Organization