Overview

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First of all, what does PANCEA stand for?

PANCEA stands for Prevent AIDS: Network for Cost-Effectiveness Analysis.

The Issue
With growing international funds for AIDS, there is an urgent need for data to guide the efficient scaling up of HIV prevention spending in developing countries. In other words, how can we maximize prevention services and their impact with available funds?

The Goal
PANCEA’s over-arching goal is to describe the relationship between spending on HIV prevention programs and desired prevention outputs, such as condoms distributed, counseling sessions conducted, and behavior change achieved. In combination with computer models of the impact of behavior change on the HIV epidemic, this information will support policy-relevant epidemiologic and cost-effectiveness analysis that will help spend HIV prevention funds in the developing world most effectively. The graphic on page 4 represents the analysis structure.

The Scope
PANCEA has a broad scope. We will collect information about 8 different types of HIV prevention interventions from about 200 different sites in 5 countries (Uganda, South Africa, Mexico, India, and Russia).

HIV Prevention Interventions
Data collection will occur at programs that conduct one or more of the following eight types of HIV prevention interventions:

- Voluntary Counseling and Testing (VCT)
- Programs for Sex Workers (SW)
- Preventing Mother-to-Child-Transmission (MTCT)
- Sexually Transmitted Infections (STI) treatment
- Information, Education and Communication (IEC)
- Condom Social Marketing (CSM)
- Risk Reduction for IDUs – Needle Exchange
- School curriculum programs
What is a site team’s role in this process?
We are relying on you to take on the challenging task of documenting interventions’ expenditures, the number and types of services delivered, and the change in expenditures and in services over time. With the data you collect, we will be able to assess the cost of these HIV-prevention interventions and their impact on the HIV epidemic.

Data Collection Approach
PANCEA employs several data collection methods to provide information for our analyses of prevention efficiency and its determinants.

From all 200 programs we will collect limited cost and output information, using an "abbreviated" data collection protocol. These data will be used to generate simple point estimates of efficiency (cost per prevention service delivered) and cost-effectiveness (cost per HIV infection averted, in conjunction with epidemic modeling). We will also collect data on potential determinants of efficiency. This will be used with cost and output data to construct an econometric model that assesses variation in program efficiency. This data collection relies mainly on the ARQ or the “Acronym-Resistant Questionnaire”—we couldn’t come up with a satisfactory acronym for this one. Perhaps you can invent one as you collect data with it!

Second, we will collect intensive data on costs and outputs from approximately 55 prevention intervention programs across five countries. This portion of the data collection relies on the ADC (from “Accounting Data Costing”) worksheet for cost and output data over time. It uses the HIPPI, or the “HIV intervention prevention program interview” for the program’s interpretation of the causes of high or low efficiency and fluctuations in costs or outputs over time. Data collected using these techniques will be used for intensive single program analyses for a subset of programs. Findings will help guide the econometric analyses.

We are also conducting selected “case studies” of interventions and the policy environment. These are being designed and implemented separate from the primary data collection effort, and thus are not addressed in this manual.

PANCEA Project Team

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Conceptual Approach

Overall Purpose of PANCEA
PANCEA will generate new and policy-relevant information on the efficiency of HIV prevention programs in developing countries. The overall goal is to provide data on costs and outputs that can be used with existing epidemiologic models. With the addition of these data, these models can then predict the effect of prevention on the HIV epidemic. PANCEA will also identify the conditions that best predict efficiency. Particular attention will be devoted to the effect of program scale and to possible synergies generated by combinations of programs and between programs and their enabling environment.

PANCEA Uses Two Different Major Analytic Methods
PANCEA employ two distinct and complementary methods for estimating efficiency:

*Single program cost-effectiveness analysis, both simple and intensive.* We will calculate simple cost-efficiency ratios from the data from approximately 200 abbreviated sites in five countries, Mexico, Uganda, South Africa, India (Andhra Pradesh) and Russia. This will allow us to describe both the cost function that relates program costs per unit time with output per unit time, and the underlying production function that describes the particular mix of inputs the program used. It will provide a range of cost-efficiency ratios, with limited hints of what explains the differences, from our observations of the data and from a few open-ended questions to respondents.

In addition, we will collect and analyze intensive data from approximately 55 prevention programs in these countries. The intensive analyses will allow us to describe and understand the cost and production functions over time. To do this, we will gather information on both costs and outputs from the very start of the program up to a very recent time. We will also ask a large set of open-ended questions to explore the reasons for variations in efficiency across programs and over time.

*Econometric techniques.* A second, econometrics-based method will be used to analyze the abbreviated data from approximately 200 programs. We will construct a model that describes the determinants of variation in program efficiency. This model will use the statistical technique of regression analysis to understand the relationship between program efficiency (cost per unit output) and factor prices, other selected cost items (e.g., outreach and publicity), demand constraints (e.g., population density, percent of population estimated to be at risk), and other variables that may affect efficiency. Among the expected results of this analysis are identification of the variables that most strongly predict efficiency for each of the eight types of prevention interventions investigated by PANCEA. Prior hypotheses will be generated based on findings from the single program analyses.

*Modeling HIV Prevention Production functions*
Based on the single program and econometric findings, we will develop computer simulation models that estimate program outputs based on key predictors of efficiency. These models will present results in graphic formats useful for policy and program design. We will use these models to portray important prevention cost-effectiveness issues, such as comparing cost functions across prevention strategies and across countries.
Calculating Cost-effectiveness
In order to generate estimates of cost-effectiveness (cost per HIV infection averted), PANCEA will translate program outputs into behavior change estimates than can be used as inputs for epidemic models. To accomplish this, we will specify the translation from program outputs into behavior change estimates based on existing studies and theory. PANCEA will then adapt an existing epidemic model to two specific study settings, and run simulations using the behavioral outputs to generate estimates of change in HIV incidence and cost-effectiveness.

Disseminating PANCEA Findings
We will disseminate study products through several mechanisms intended to facilitate rapid availability to policy makers. We will establish a web site for ongoing posting of study activities, findings, and simulation tools. We will publish in peer-reviewed publications and scientific conferences. We will also use two face-to-face mechanisms: liaison with in-country HIV policy makers, and two workshops including prevention and modeling experts and policy makers. All of PANCEA’s publications and other products will be designed to be as policy-relevant as possible. The ultimate aim of the PANCEA team is for decision-makers to use this work to improve the way money is spent on HIV prevention.
INTRODUCTION: Outputs, Costs, Efficiency and the Determinants of Efficiency

As discussed in the overview, PANCEA aims to estimate the efficiency of HIV prevention programs, and the predictors of efficiency, using both single program and econometric methods. The project will also estimate cost-effectiveness, as cost per HIV infection averted, using HIV epidemic modeling.1

This section summarizes four major elements of estimating efficiency and its determinants – program outputs, program costs, program efficiency itself, the underlying story of the program’s development, and the particular circumstances it faces. This section complements the overview, by providing another way of thinking about the project’s data needs and basic analytic approach.

First, some basic definitions: Outputs are the services that the program produces. Costs represent the cost of the program. Efficiency is the cost per output. Determinants of efficiency are the factors that influence costs and outputs to be at the levels they are, and therefore determine the overall efficiency of the intervention.

Outputs

Outputs are the services that the intervention programs deliver. We are most interested in those outputs that may be related to reducing HIV risk. Two examples are counseling to reduce risk behaviors, and condoms. Outputs are measured in the ARQ and ADC intervention instruments.

Each intervention has a set of outputs that we have identified through discussion with intervention experts. The number of outputs ranges from several to more than twenty. For example, outputs for VCT programs may include: several types of publicity; pre-test counseling, HIV testing, post-test counseling for HIV+ and HIV-, and condom distribution.

Some outputs are unique to an intervention. For example, STI programs evaluate and treat for sexually transmitted infections. Outputs include the number of individuals assessed and the number of STIs diagnosed and treated. Other programs do not provide this range of STI services; if they do, we’d say they have an STI program!

Other outputs are similar across interventions. For example, most interventions distribute condoms, and many do publicity intended to increase awareness of risk reduction opportunities for the population.

Each intervention has one or two outputs designated as “essential”. These are the outputs that we think best capture the mix of outputs provided, and/or are most closely related to HIV risk reduction. For VCT, this is the number of HIV+ individuals receiving post-test counseling. For STI, this is the number of STI diagnosed. These essential outputs are the ones most intensively measured over time.

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1 Cost-effectiveness (cost per HIV infection averted) is not discussed in this section, which is about how data collected in the instruments will be directly used. Briefly, cost-effectiveness will be calculated by translating program outputs into reductions in risk of HIV transmission. These reductions in risk will in turn be used as inputs for HIV epidemic models that will predict infections with different configurations of HIV prevention programs.
Output data are used in two major ways. They are used in calculations of efficiency (see below). They are also used to estimate the reduction in HIV risks (behaviors and biological co-factors); this is essential for estimating epidemic impact.

**Costs**

Costs represent the use of program resources used to deliver the outputs. These include personnel, other recurrent costs (like supplies), equipment, and buildings. These are measured in the ARQ and ADC cost instruments, also known as “non-intervention”, or “ni”. They have this “ni” designation because they are not tailored specifically to any particular intervention type.

Each intervention has costs in all four categories, but of course in different amounts. We have found so far that the largest costs are either personnel or other recurrent costs, especially trainings and contracted services.

We are interested in economic costs, (i.e., what it would ordinarily cost to provide a good or service if there were no donations, subsides or extra charges) not just financial costs (i.e., what the program paid). Economic costs are usually a better measure of what it would cost to replicate or expand programs. Thus, for donated services and items, with few exceptions, we have specific plans to determine reasonable market values.

In order to help with efficiency calculations using accounting methods, we ask for the allocation of each cost across interventions at that facility. Thus, for example, an individual staff person might spend 60% time on VCT, 20% on STI, and 20% on non-intervention activities. HIV test kits will be allocated exclusively to VCT. Some items (e.g., general supplies) will be allocated in proportion to staff effort.

**Efficiency**

Efficiency is the cost per output. The output used in this calculation for each intervention is the “essential” output described above. Thus, efficiency might be $50 per STI diagnosed and treated.

Because programs and interventions have multiple outputs, we will often need to allocate costs to specific interventions. (This is a “joint product” problem.) In the single program cost-effectiveness analyses, we will allocate based on the allocations reported in the instruments. Hence the importance of allocations across interventions. In the econometric method, the links between outputs and costs will be derived analytically.

**Determinants of Efficiency**

The determinants of efficiency are the result of strategic and tactical decisions made by the intervention; the quality of management; and external events and situations. These are assessed in the HIPPI interview, referring to cost and output information collected in the other instruments.

Each intervention has a unique history, from conceptualization, to implementation, stabilization, and expansion, (or possibly contraction). These events represent program “start-up” and “scale-up”, and can have profound effects on costs, outputs, and efficiency. For example, a program may initially have more staff than it needs, or trouble recruiting clients. Or, it may quickly reach
an initial set of clients, but then have to invest heavily in outreach. Or, periodic trainings may lead to occasional spikes in costs. Or, police enforcement of sex work rules may scare away clients.

By linking output and cost data over time to an understanding of the events, decisions and circumstances in the program history, we hope to attain a deep understanding of how these internal and external factors affect efficiency of operations over time.

By so doing, we believe that the intervention stories will reveal much about the economics of starting, maintaining, and building programs. We expect to identify important common themes and similar experiences across programs. Identifying these common themes will help us describe the conditions that could lead to more efficient use of HIV prevention resources. That, ultimately, is the goal of PANCEA.
**Forest and Trees**

In the USA we sometimes say: *You are missing the forest for the trees*. This means we can get so involved in the details, that we stop seeing the important bigger picture. This section is about remembering to see the forest.

The entire PANCEA team has devoted much effort to developing, testing and revising data collection instruments and data collection procedures. Because of the challenges entailed in doing this well, it is easy to forget that instrument development, and even the data themselves are only a means to an end. They are not useful themselves. All of these efforts are valuable only if they help estimate the efficiency of programs – cost per output – and the determinants of efficiency. The ultimate goal is to derive lessons from these analyses that can help inform resource allocation decisions.

How we use the instruments should be determined by how we can best achieve the purposes of the project. The “Forests and Trees” discussion operationalizes this guiding principle.

### 1. The Forest and Tree concept

**What detail is just a tree? What detail tells us about the forest?**

It is critical to understand the distinction between the “trees” and the “forests”. By trees we mean details that don’t contribute much to our understanding of prevention efficiency or its determinants. By forest we mean data that largely determine these estimates of efficiency or its determinants. Central to any discussion of efficiency is the efficiency ratio.

**The efficiency ratio**

Efficiency is the cost per prevention output. Cost-effectiveness is the cost per HIV infection prevented. These ratios are the core output of PANCEA.

Here are some examples of *trees* -- details that don’t contribute much to our understanding of prevention cost-effectiveness:

- Two staff out of 50 for whom salary data are estimates only.
- Costs of once-monthly meals for 3 volunteers.
- Number of counseled individuals may be low because a few clients arrive late and are excluded from the count.

Corresponding examples that are more *forest* than tree are those where the information in question is enough to have a major effect on overall costs or outputs, and hence on cost per output. For example:

- 40 staff out of 50 for whom salary data are crude estimates only.
- Costs of 3-times daily meals and per diems for 30 volunteers.
2. Outputs!

Individual outputs are more likely to be “forest” issues than are individual costs. This is because outputs are relatively few (e.g., the number of HIV+ individuals identified and counseled captures the main effects of VCT), whereas costs are relatively many (e.g., 20 staff, 10 pieces of equipment, 40 recurrent expense categories).

For example, 50% uncertainty in the number of women given nevirapine (to prevent mother to child transmission of HIV) means 50% uncertainty in cost per HIV infection averted for MTCT. Specifically, if the denominator of the efficiency ratio (i.e., the outputs) drops by half, the value of the overall ratio doubles. Thus, there is an equivalence between uncertainty in a single data point and uncertainty in the ultimate cost-effectiveness ratio.

In contrast, 50% uncertainty in the year-end bonus amounts for staff may mean only a 2% uncertainty in the cost, and hence only 2% uncertainty in the cost per HIV infection averted. Specifically, if one component of the numerator of the efficiency ratio (i.e., the costs) increases by 50%, but the overall numerator increases by only 2%, the value of the overall ratio increases by only 2%.

Thus, precision for the number treated is far more important than for a few bonus amounts.

Because outputs are so important, we prefer that the ARQ intervention sheets be administered prior to the ARQ expenditure portions, at least if the respondent is the same. This way we’ll ask the most key questions when the respondent is freshest. See the “Data Collection” chapter.

3. Matching Inputs to Outputs

A valid cost-effectiveness ratio requires that the numerator (cost) and denominator (outputs) refer to the same services.

Thus, if VCT is the output, it’s important that only VCT costs are counted. For example, if there are 20 staff in a program, and 10 work on VCT average 50% time, that’s 5 FTEs. Using 20 FTEs would overestimate the CE ratio 4-fold. Likewise, all important VCT costs should be counted. For example, omitting the costs of HIV test kits would underestimate the CE ratio, by an amount determined by the economic cost of those test kits compared with other costs of delivering VCT.

A useful technical formulation is that the input domain and output domain must correspond; that is, they must cover the same set of activities.

The operational definition of “domain” is based on identifying what activities are outside of the intervention. Ask the question: “Would the program be doing the activity if the intervention of interest were not in place?” For example, for a VCT program linked to an HIV home care program:
o Providing HIV care is not part of VCT, because it would be done even without the VCT program. Its costs and outputs should not be counted in our assessment of VCT.

o Time spent encouraging individuals to get tested is part of VCT, because it’s done only because the VCT program is in place.

o HIV test kits are part of VCT. (This is a little subtle, because it is possible that without a full VCT program, some HIV testing could still go on. However, current standard of practice is that testing should not occur without counseling.)

PANCEA uses two analytic methods to match outputs and inputs.

The first method depends on explicitly matching outputs and inputs. This approach relies heavily on the intervention-related costs being accurately identified and measured, as discussed above. This is used for the simple cost-effectiveness analyses (done for abbreviated sites) and for the Intensive single program analyses (done for full sites).

The second method analytically matches outputs and inputs. This is the econometric regression approach: all facility outputs and costs are measured, and intervention costs are calculated by statistically separating costs for non-intervention outputs (e.g., outpatient visits). This approach is designed to work with a large sample of facility-level (rather than intervention-level) data. We hope the PANCEA sample will provide adequate data for this approach.

### 4. Unexpected Cost-Efficiency Ratios

We know enough about currently accepted values for intervention efficiency for a few interventions to be able to identify unexpectedly high or low efficiency ratios. Values outside of published ranges (which we list below, and will refine as PANCEA gains more data) should lead to especially careful verification of costs and, especially, outputs.

- **VCT:** $10 - $50 per person obtaining test result.
- **MTCT nevirapine:** $75 - $150 per woman receiving NVP.
- **STI:** $2 - $20 per STI diagnosed and treated.

The data collection teams should, of course, try to collect all data accurately. But given the substantial difference in importance of some data points versus others, and the limited time we have to collect data, prioritizing of efforts is critical: **Refine data that will be most important in understanding the cost per output ratio.** If in doubt on what warrants priority attention, discuss with the UCSF team. We’re always happy to address this and will provide feedback as quickly as needed.

### 5. Determinants of efficiency

Another, more subtle, “forest” issue is the data that reveal how efficiency is affected by program characteristics. This includes understanding patterns over time within programs, the components of costs, and variation across programs.
Listed below are examples of the kinds of questions you might ask yourself as you collect, review, and clean PANCEA data. Asking these questions will help you accomplish two important tasks: correct data errors, and understand how the program was operated and financed.

A. Why did personnel costs remain low for the first year of program operations, and then nearly double during the second year?

B. Why are personnel expenses such a small part, 20%, of total cost? In particular, why are other recurring costs as large as personnel? (Our prior expectation was that up to 80% of program costs might be personnel, but it turns out this is often not true.)

C. Why did capital expenditures spike so high in June of 2000, three years after program initiation?

D. VCT supply costs rose by 50% yet total recurrent costs fell by 15%. What recurrent cost item(s) fell so dramatically as to cause this net decline?

E. Utilities, driven particularly by electricity, are 30% of all non-personnel recurring costs. Why are they so high?

F. Why does the number of condoms distributed vary by 300% from one season to the next?

Some of these phenomena may be peculiar to the circumstances of this particular program and therefore support no general conclusions. Others may suggest a pattern that could repeat itself in other programs. In the latter event, we would advance a specific, testable hypothesis to see if the phenomenon observed is indeed repeated elsewhere.

The process to assess these questions involves the following components: collecting and verifying data; establishing and explaining facts; generating hypotheses; and showing how these processes are linked. These are described below and illustrated in the Figure.

**Collecting and verifying data**

One type of answer to these questions is important but probably uninteresting, namely that the premise is wrong. That is, personnel expenses aren’t such a small part of the total, and capital expenditures didn’t spike so high in June of 2000. Rather, there were errors in the source data; in our data collection procedures, or in our instruments. In that case, we have not yet established the basic facts about our prevention site.

Sometimes errors become apparent only after data collection. For example, recurrent spending may include no medication costs, even though clients are provided medications for free. Or, reviewing an odd pattern on a graph of spending or outputs over times indicates that data may have been entered in the wrong time periods. Or, respondents may have given inconsistent responses to different questions (e.g., ARQ vs. ADC).

The remedy for suspected errors is to check the numbers with the appropriate interview respondent or expenditure documents. This process is indicated by the feedback arrows between data verification and establishment of fact as shown in the Figure below.
**Establishing facts**
The facts we are referring to here are the interesting findings, such as those in the questions above. For example, personnel is only 20% of costs, and recurrent expenditures are 70%.

**Explaining the facts**
Once the facts have been established, we seek an explanation for any unusual or unexpected facts that have been noted. We believe that in most cases this explanation will be embedded in the information collected through the other instruments. *This is an important point.* The instruments are intended to work together, and only by looking at the total set of information available can we hope to understand the “forest”. In many cases explanations can be derived from the detailed itemization of costs by category and line-item provided by ARQ and ADC; or by the description of the various service components provided by the intervention-specific portions of ARQ. In other cases, explanations and insights can be obtained by reviewing the qualitative information portrayed by the HIPPI data.

For example, the explanation for low personnel costs and high recurrent costs may be that many services are contracted to another organization.

**Generating and testing hypotheses**
By establishing and explaining interesting and unexpected facts, we have come a long way toward generating useful knowledge, but have not yet arrived. If these findings are idiosyncratic to this particular project they will not help us achieve PANCEA’s larger objectives. These objectives include identifying the predictors of efficiency, and describing the patterns of cost and efficiency over time and scale. To achieve this we must instead be able to generate hypotheses that suggest more general relationships between the cost structure and other characteristics of a program, and its observed efficiency. These hypotheses may then be testable through PANCEA’s econometric analyses, and through the querying of both quantitative and qualitative PANCEA data.

Here are hypothetical examples of the explanations, hypotheses, and testing strategies that might be obtained from closer examination of the data collected on site.

**A. Fact: Personnel costs doubled per unit of output during second year.**

*Explanation-elaboration:* Personnel costs doubled because new government regulations required the job reclassification of all counselors as part of an initiative to integrate them into the MoH personnel structure. This was accompanied by large concomitant salary increases (*HIPPI*).

*Hypothesis:* Personnel costs per unit output rise as programs begin to reach full capacity. This may be due to the normal transition from a more charismatic to a more bureaucratic organization.

*Testing strategy:* Tabulate frequency of this occurrence in PANCEA sites.

**B. Fact: Personnel expenses constitute only 20% of total cost.**

*Explanation-elaboration:* This program uses large groups for both pre and post-test counseling (*ARQ_intervention*) and so required far fewer counselors than programs providing small-group and individual counseling.
Hypothesis: Large-group counseling is less effective, especially for post-test counseling. This may be a false economy.

Testing strategy: Definitive tests are outside PANCEA’s scope. However, we should be able to calculate the difference in effectiveness at which the small and large group counseling strategies yield the same behavior change per dollar. Some evidence on effectiveness might be available through client interviews, the efficiency-quality portions of HIPPI, and pre-existing surveys of clients behavior-change self-reports.

C. Fact: Spike in capital expenditures late in program development.

Explanation-elaboration: New equipment was required when the program expanded to a new site (ADC and HIPPI).

Hypothesis: Normal and expected part of program expansion.

Testing strategy: Would look for instances in which expansion was not accompanied by increased capital spending. These instances would require more explanation.

D. Fact: VCT supply costs rose by 50% yet total recurrent costs fell by 15%.

Explanation-elaboration: VCT supply costs rose because the project switched to more expensive rapid tests; yet total recurring costs declined because of the savings in laboratory and follow-up activities (ADC and HIPPI).

Hypothesis: The introduction of rapid tests is associated with a decline in recurring costs in VCT and pMTCT programs.

Testing strategy: Using HIPPI and ADC, look at the relationship between time of introduction of rapid tests and possible changes in lab and other test-related recurrent costs.

E. Fact: Utilities are 30% of all non-personnel recurring costs.

Explanation-elaboration: Electricity is extremely costly per kilowatt hour in this rural town as government policy taxes rural power in order to subsidize cheap electricity in the capital city (ARQ or ADC).

Hypothesis: None. Idiosyncratic to this country and does not pertain to HIV prevention per se.

Testing strategy: None.

F. Fact: Number of condoms distributed varies 300% from one season to another.

Explanation-elaboration: Vehicles can’t pass many key roads in the rainy season, and fewer people attend the events where condoms are sold.

Hypothesis: Seasonal weather patterns cause major changes in the ability to deliver services.

Testing strategy: Look for monthly patterns in outputs that correspond to local weather patterns.
Summary

Be confident in the data (especially outputs) that are most likely to have an effect on the efficiency ratio. If time is limited, make sure efforts focus on the trees that affect the forest. If in doubt on what warrants priority attention, discuss with the UCSF team.

Be alert to unusual, confusing or surprising patterns as you collect your data. For the quantitative information the graphs may be a particularly good way of detecting problems. If information appears to be inaccurate, and is likely to have a significant effect on total costs or outputs, do what it takes to arrive at a resolution that you believe in, including recontacting the site if necessary.

If the results are still unusual, think of explanations and hypotheses that could account for your observations. You may have discovered something important! Share your ideas with us!

(Figure on next page)
INTRODUCTION: Forest and Trees

Collect and Verify Data

Establish Facts

Explain facts
(Proximate causes)

Generate and test hypotheses
(Distal causes; generalize)