Cost and cost-effectiveness analyses of global HIV training programs

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Abstract

Background: The recent global response to the HIV epidemic required training large numbers of doctors, allied health professionals, and administrative support staff in HIV prevention, care and treatment. The evidence however, on the cost and cost-effectiveness of global training programs in general, and HIV training programs in specific is sparse. This article offers an introduction to cost analysis and cost-effectiveness analysis (CEA) of training programs for program managers who are not economists, but make decisions about how to deploy analytic resources.

Methods: A cost analysis is defined as the cost per unit of output and CEA is defined as the cost per unit of outcome. The scope of the CEA determines the common denominator to compare training programs. Three hypothetical examples of CEA are presented that progress from simple to more complex costs and from a narrow to broader scopes: 1) cost analysis to compare two approaches to training clinicians to assess patients on ART, 2) CEA of the cost per ART patient achieving 95% adherence that compares the performance of doctors and counselors who attended additional training, and 3) CEA of the cost per infant HIV infection averted for a Prevention of Mother to Child Transmission program that included training.

Results: The article demonstrates that cost analyses can be used to identify training programs with the lowest cost per trainee and to develop realistic budgets. They can be misleading however, when the effectiveness of the programs differ.

Conclusion: CEA with a narrow scope are feasible for many training programs, as are CEA based on intermediate outcomes or based on published estimates of program effectiveness. CEA can guide program managers to make the best investments in training and capacity-building.

Keywords: cost-analysis, cost-effectiveness analysis, training evaluation, training effectiveness, capacity development
Background

The global response to the HIV epidemic is one of the largest public investments in history to fight a single disease. This scaled-up response to the HIV epidemic required large numbers of doctors, allied health professionals and administrative support staff with new, HIV and management specific skills. Recognizing this need, governments, Non-Governmental Organizations (NGOs), and other international organizations invested in HIV training of health care providers in Africa, Asia and Latin America. For example, between 2004-2009, as part of the President’s Emergency Plan for AIDS Relief [1] a total of 213,200 health care providers were trained in Prevention of Maternal to Child Transmission (PMTCT) and a total of 213,200 were trained in anti-retroviral therapy (ART).

In 2012, global programs for HIV are moving from emergency response to address sustainability, task-shifting, and integrating HIV care and treatment into primary health care and chronic disease management. This transition will likely include continuing major investments in training [2, 3], and managers must know how to get good value for these investments. The evidence however, on the cost and cost-effectiveness of global training programs in general[4] and HIV training programs in specific is sparse.[5]

Schooling and training are investments, known as human capital. For schooling, there is a well-established model in which individuals invest in their own schooling in
return for higher life-time earnings.[6] For on-the-job training, organizations invest in their employees, but decisions are tied to competencies and skills that are of immediate value to the organization. Studies of the cost-effectiveness of global training to date has focused on how and who to train, as well as training as a component of a larger intervention. Analyses of how to train have addressed the most effective means of training a specific group of health care providers.[7-9] Analyses of who to train have addressed task-shifting or task-sharing in which training was extended to a group of health care providers who assumed new responsibilities for specific health services.[10-14] Finally, some analyses have estimated the cost-effectiveness of interventions that included training for health care providers who implemented them.[15, 16]

This article offers an introduction to cost analysis and cost-effectiveness analysis (CEA) of training programs for program managers who are not economists, but make decisions about how to deploy analytic resources. The article begins with definitions of cost analysis and CEA. Then three hypothetical examples of CEA are presented: 1) cost analysis to compare two approaches to training clinicians to assess patients on ART, 2) CEA of the cost per ART patient achieving 95% adherence that compares the performance of doctors to counselors who attend additional training, 3) CEA of the cost per infant HIV infection averted of a PMTCT program that included training. The structure of each analysis is outlined and the implications for program decisions are reviewed.
Methods

Cost analysis

A cost analysis estimates the cost per unit of output, based on all inputs or resources that a program uses and their costs. Cost analyses can be used for a variety of purposes. Program managers can determine what methods are least expensive, such as classroom versus distance learning. They can develop realistic budgets and plan for program expansion. Donors and multilateral organizations can track the efficiency of money spent.

For training activities, the resources consumed typically consist of personnel time for trainers, trainees, supervisors, and administrators, supplies, teaching materials, and possibly equipment, facility space and transportation. (See Appendix 1, “Inputs to Consider when Calculating Training Costs.”) These costs are divided by the outputs of the training such as the number of people trained. It is important to isolate and value only the extra or “incremental” costs. In deciding whether or not to include a particular cost, it is helpful to ask, “Absent the training activity, would this resource have been used?” For example, should a project vehicle that transports counselors to the hospital for training be included as a cost of the training? It depends. If the counselors were being transported to the hospital as an ongoing benefit of their employment, the answer is “No,” because no extra cost was imposed by the training. If transportation was arranged specifically for the training program, the answer is “Yes.”
The largest portion of the cost of most training programs is personnel time, so it is important to value personnel time correctly. Clearly, the fee that trainers may require should be included. What about the time of the trainees? We are ultimately concerned with the use of resources, not with the transfer of money. Had they not attended the training, the trainees would have engaged in other productive work. That foregone productivity is valued at their compensation rate including fringe benefits.

The issue of how to value trainees’ time raises a general point; the distinction between resources and money is central for correct economic evaluation. We are concerned with the value of the opportunity that was forfeited by making a choice or its “opportunity cost”. The opportunity cost is often, but not always, represented by financial transfers. (See Appendix 2, “Glossary of Cost and Cost-Effectiveness Terms.”)

A challenge in costing training programs is selecting an appropriate unit of output. “Training” might consist of a one-hour lecture, a one-year fellowship, or six-weeks of on-site training and technical assistance for a team of health care providers. In routine reporting, someone who attended a one-hour lecture might be counted the same way as someone who completed a one-year fellowship, ie, as a “person trained”. Because of the large difference in resources required and presumably in the skills enhancement achieved, an analysis that simply compared the cost per trainee would be misleading. Even a more standardized measure such as the “cost per day of training delivered” could be misleading, because a longer training is not necessarily more effective.[17]
Limitations of cost analyses: A cost analysis answers the question: “What does it cost to produce a unit of output such as a trainee. This information may be adequate when an effective training program is targeted to people who can readily apply new skills in the context of implementing an evidence-based strategic plan. The outputs alone however, confer no health benefit. Consider a training program for HIV prevention educators who implement a mass media campaign to reduce risky behavior. If this campaign is conducted in a setting with very low and stable HIV prevalence, the training program will confer little health benefit no matter how well it was conceived and delivered. Cost analysis may provide information about the lowest cost per trainee. It will not however, tell program managers whether or not it is worth conducting the training. CEA can address this broader question.

Cost-effectiveness analysis (CEA)

As applied to health and medicine, cost-effectiveness is defined as the cost per unit of health outcome such as an HIV infection averted or a year of life gained. The fewer dollars required to achieve an outcome, the more favorable the cost-effectiveness ratio of that intervention. For example, an adult male circumcision program that costs $500 per HIV infection averted is more cost-effective than a Voluntary Counseling and Testing (VCT) program that costs $5,000 per case HIV infection averted. The same logic applies to training programs. If the net cost per outcome of a training program is lower than an alternative program, the training would be considered cost-effective.
Program managers can use these findings to make informed decisions about how to allocate resources.

As a practical matter, program managers who seek good value for money rarely have the time or funding to conduct a CEA that measures the specific contribution of a training program to health outcomes. Fortunately, an intermediate measure, such as the number of health care providers that perform a task competently, or an intermediate outcome such as the number of patients who adhere to treatment may be an appropriate denominator for some analyses. The scope of the analysis determines the denominator. An analysis with a narrow scope, such as a comparison of training methods could be conducted with an intermediate measure. For example, if a hospital director sought the most cost-effective way to train new employees on universal precautions, an intermediate measure would be number of trainees that competently practice blood injection safety. An intermediate measure of an initial training on ART might be the number of trainees who correctly stage a patient’s HIV disease.

Intermediate health outcomes are used in a CEA with a somewhat broader scope. Consider an agency that is committed to providing cotrimoxazole (CTX) to HIV-infected adults and children. Extending coverage and improving adherence are intermediate outcomes, because the health benefits of CTX are well-documented [18, 19]. The question for the program manager is thus “How can I allocate my budget to provide CTX with 95% adherence to the most patients?” This broader scope supports comparisons of training programs with other activities that may affect coverage and
adherence, such as pharmacy logistics, continuous quality improvement, or leadership initiatives.

For CEA with the broadest scope, the denominator is unit of life measured by changes in morbidity and mortality. Quality-Adjusted Life Years (QALYs) and Disability Adjusted Life Years (DALYs) are well-known measures that combine quality and quantity of life.

A challenge for CEA is to amortize the investment in training over time. To the extent that newly-trained staff continue to work and maintain their new skills, benefits of training can be distributed over several years. The relevant cost in any one year is a portion of the cost of the training, which could be compared to an annual measure of outcome. Unless strong setting-specific data suggests otherwise, the maximum life of an investment in training might be six years for a highly effective training program based on guidelines; research in the United States showed that 50% of practice guidelines were outdated in 5.8 years.[20] Training programs for employees with high turnover would reduce the life of the investment. Information on whether or not the alumni practice HIV care within one year of the training program could be used to begin to estimate the life of the investment in training. For example, a voluntary counseling and testing program in the Caribbean reported that 65% of the trainees provided this service at intervals of up to three years after training.[21]
Results and Discussion

The following are illustrative examples of economic analysis using the principles and methods described above.

Example 1 -- Two approaches to training clinicians to assess patients on ART

A program manager was planning to scale up ART services at a clinic. S/he compared two training programs to upgrade the skills of clinical staff in monitoring patients on ART. One was a computer-based training followed by a three-day practical workshop. The second was an intensive, two-week workshop followed by two on-site trainings. The program manager selected a set of clinical performance measures to compare the effects of the trainings. A graduate who performed 80% of the tasks met the standard. As shown in Table 1, the computer-based training cost $12,000 versus $20,000 for the intensive training. The cost analysis also included the time senior staff spent with graduates after the training, such as ad hoc sessions in the context of actual patient visits. The cost of the supervisors’ time in providing this additional support was $8,000 among graduates of the computer-based training versus $2,000 among graduates of the intensive training. In spite of the significant post-training support, only 65 graduates of the computer-based training met the standard, whereas 90 graduates of the intensive training did. Although the cost per trainee was lower for the computer-based training, the cost per successfully trained graduate of the computer-based training was $307 versus $244 for the intensive training.
Program implications: The intensive training was nearly 20% more cost-effective than the computer-based training. In the context of scaling up services, money would be better spent on the intensive training. To make this comparison it was essential to have clinical performance data on graduates. In a less attentively-managed program, or in an environment where success was measured simply by the number of trainees there would be a danger that the lower cost per graduate might displace competence as the standard for selecting a training regimen.

Example 2 – Training for ART adherence support among two types of health professions

A clinic was providing ART in an impoverished urban setting where many patients have substance abuse problems, or other challenges to adherence, where good adherence was defined as taking 95% of pills on schedule. To maintain this success however, relatively highly-paid doctors spent much of their time screening patients at risk for poor adherence, counseling them and referring them for additional support. Program managers saw an opportunity to enhance efficiency through task-shifting or task-sharing. They trained counselors to assume responsibility for the screening, counseling and referral activities. The program managers adopted an intermediate outcome to measure the effects of the training program; the number of patients maintaining 95% adherence. While good adherence is not a health outcome,
studies showed that the correlation between good adherence and good health outcomes was high.

As shown in the “Pre-training status quo” column of Table 2, ART services cost $150,000 and served 400 patients each year at a cost of $375 per patient. Adherence was 95% among 360 of 400 patients (90%) when doctors performed screening, counseling and referral activities at a cost of $417 per patient with 95% adherence.

The three columns to the right show different possible results of training counselors. In result “A”, program costs declined as doctors with high salaries were replaced by counselors. Training cost of $15,000 was amortized over three years for an annual cost of $5,000. (For simplicity, discounting is ignored in these example.) Net program cost declined from $150,000 to $135,000. Adherence was 95% among 90% of 400 patients. With result “A” the cost per patient with 95% adherence was $375 with counselor training and task shifting compared to $417 without and the training was cost-effective.

The cost of result “B” was identical to “A” except we posit that the counselors were not as effective as doctors. Adherence was 95% among 85% of 400 patients. Nevertheless, cost per patient with 95% adherence was $397 with counselor training and task shifting compared to $417 without, and the training was cost-effective.
In result “C”, the training has far-reaching effects on the program’s cost structure, service volume and outcomes. Program cost declined from $150,000 to $140,000, because the salary difference between doctors and counselors was smaller and replacing doctors with counselors didn’t save as much money. The training was more intensive and twice as costly, $30,000 ($10,000 per year). The training however, greatly improved the counselors’ skills. They moved patients through the ART screening, counseling, and referral process quickly, which increased service capacity. Finally, the quality of the new screening, counseling and referral activity increased the percentage of patients achieving 95% from 90% to 95%. The net result was a cost of $359 per patient with good adherence.

Program implications: The cost per patient with 95% adherence was lower than the status quo for all three results and thus preferable to the pre-training status quo. For result “B” however, the quality of services declined, ie; the percentage of patients achieving good adherence decreased from 90% to 85%. Is this an acceptable outcome? To answer this question, an analyst might broaden the scope of the CEA to include the consequences of lower adherence such as poorer health outcomes for the patient or increased risk of HIV transmission to his/her partners.

Example 3 -- Cost-effectiveness of skills enhancement training as part of a PMTCT program
A PMTCT program in a district hospital cost $100,000 per year. The program manager wanted to know if money spent on a counselors’ skills enhancement program was well spent. If so, s/he would seek funding to extend this training to other PMTCT sites. Before the training program, costs were apportioned across expenditure categories as shown in Table 3 below:

- **Direct services personnel:** The sum of $65,000 was obtained by multiplying the number of full-time equivalent (FTE) staff providing counseling, HIV testing and ART screening and administration by the full compensation rate (salary and fringe) per FTE.

- **Administrative and other support activities:** The compensation rate of relevant staff such as supervisors and drivers was multiplied by the portion of their time spent supporting PMTCT for a total of $15,000.

- **Supplies:** For the PMTCT patients served, $15,000 was spent on ARV drugs, HIV test kits and miscellaneous other medical and non-medical supplies.

- **Transportation:** $3,000 was spent on amortized vehicle purchase cost, fuel and maintenance.

- **Capital equipment:** Amortized cost of durable items such as refrigerators, computers and furniture was $500 in this example. This is usually a small portion of HIV prevention activity costs.

- **Building space.** The hospital building was provided by the Ministry of Health and no money was spent on it by the PMTCT program. Nevertheless, absent PMTCT, the space in that building could have been used for other worthwhile
activities. Its “opportunity cost” was approximated by the annual rent that would otherwise be paid for the equivalent space if procured on the open market, or $2,000 in this example.

The program averted 300 cases of infant HIV each year. This figure was obtained by multiplying the number of women-infant pairs who complete the ARV regimen by published estimates of efficacy for the regimen provided and the PMTCT transmission rates in this setting. Before the training, the cost per infant HIV infection averted was $333.

After the training, the cost changed in important ways. Because the counseling protocol required longer training sessions and smaller group sizes, the cost of direct services provision increased from $65,000 to $72,000 annually. The training included routine record keeping however, and allowed senior nurses to take on supervisory functions formerly left to more highly paid administrators. The result was a reduction in administrative costs from $15,000 to $12,000 per year. The cost of supplies increased from $15,000 to $17,000, because more women completed the PMTCT sequence and consequently used test kits and ARV drugs. The training program cost $20,000 and was estimated to have four years of benefit before skills degraded or staff members left, or an amortized cost of $5,000 per year. The number of infant HIV infections averted rose to 375. Both cost and effectiveness increased and the net result was a decrease in the cost per infant HIV infection averted from $333 to $296.
Program implication: The training significantly enhanced the cost-effectiveness of this PMTCT program. A CEA based on health outcomes was possible because of published information HIV prevalence among pregnant women and the relative ease of estimating the effectiveness of antiretroviral prophylaxis for PMTCT.

Conclusions

Cost analyses can be used to identify training programs with the lowest cost per trainee and to develop realistic budgets. They can be misleading however, when the effectiveness of the training programs differ. CEA with a narrow scope are feasible for many training programs, as are CEA based on intermediate outcomes or based on published estimates of program effectiveness. CEA can guide program managers to make the best investments in training and capacity-building.

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Authors’ Contributions

GO Participated in manuscript conceptualization and outline, conducted literature review, and edited multiple manuscript iterations including contributing original text.

EM provided substantial edits and contributed original text.

MW provided early drafts, edits, and final review of the manuscript.

All authors read and approved the final manuscript.
References


Additional files provided with this submission:

Additional file 1: O'Malley-Cost Effectiveness_Tables+Appendices.docx, 24K