

INTRODUCTION TO COST-EFFECTIVENESS ANALYSIS

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CLEAR SOUTH ASIA

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INTRODUCTION TO COST-EFFECTIVENESS ANALYSIS

THE IMPORTANCE OF PROGRAM COST DATA

Suppose the Department of Health and Family Welfare has conducted a rigorous evaluation to determine the impact of a maternal and child health program on a range of health outcomes. The results of the evaluation show that the program has had a significant, positive and high magnitude effect on a number of important health outcomes. The Health and Family Welfare Department is pleased to know that the program is effective, but wants to know what policy action to take given this positive impact. Should the program be continued, stopped, modified, or scaled up?

Consider another example. A community's water supply has been contaminated with effluents leading to a large incidence of diarrhea within the population. An international aid organization has come up with two very different strategies to tackle this problem. One project manager in the organization is advocating for investments in modern water and sanitation infrastructure, including sewage and a piped-water supply, while another manager has proposed a distribution system where households are given free chlorine tablets to treat their own water at home. Through a randomized impact evaluation, these two methods were shown to be equally effective – each reducing diarrheal incidence by 80 percent. Which intervention should the organization implement?

Before we can answer both of these questions, we need to know additional information related to the costs of the program. Perhaps the maternal and child health program, while effective, is actually so costly that government budgets would not be able to sustainably afford a statewide scale up. In the second example, it is highly likely that modern infrastructure investments in an otherwise remote village would be prohibitively expensive. In this case, distributing chlorine tablets may well be the better program to implement.

Any program or policy we introduce has opportunity costs. In other words, there are alternative ways to spend money and time. It is not always enough to know that a policy or program has a positive impact on the lives of the poor; it is helpful to know whether the program is the best use of limited resources. Users of evidence, be it government, NGOs, donors, or other organizations that make evidence-informed policy, would like to consider not only whether or not a program had a positive impact, but also whether the program, when compared to its costs, is of sufficiently good value. The term “sufficiently good value” can be an abstract concept when comparing one program in isolation, but if we have information on the impact and costs of other related programs, we can begin to compare across programs to determine which yields the greatest value for money. One way of doing this is to conduct a **Cost-Effectiveness Analysis**, which is a method of summarizing complex programs in terms of a simple ratio of impacts to costs.

This manual introduces the concept of a Cost-Effectiveness Analysis (CEA) and provides practical steps to conducting this method of program evaluation.

WHAT IS COST-EFFECTIVENESS AND COMPARATIVE COST-EFFECTIVENESS ANALYSIS?

Cost-Effectiveness Analysis (CEA) – A CEA shows the impact of a program on one outcome measure for a given cost incurred. To calculate this, take the impact of a program on a particular outcome (e.g. percent reduction in the incidence of diarrhea) and divide by the total cost of the program. Formally, a cost-effectiveness analysis is calculated using the following equation:

CE Ratio=

$$\frac{\text{(Total Impact of the Program on a Specified Outcome)}}{\text{(Total Cost of Implementing the Program)}}$$

The resulting cost-effectiveness ratio is a statistic that describes *the number of cases of diarrhea prevented per rupee spent*. Or, if the ratio is flipped, *the amount it costs to reduce the incidence of diarrhea by one case*. Both measures give an indication of the value for money of a particular program.

Comparative Cost-Effectiveness Analysis – Takes multiple programs (possibly from different contexts) and compares them using the same ratio of costs to impact. This ratio, calculated across a range of alternative programs that address the same policy goal, conveys the relative impacts and costs of these programs in an easily understandable and intuitive way. In this manner, policymakers can ask: per US dollar spent, how much do each of these programs reduce diarrhea? Comparing CEA calculations across multiple programs in this manner provides an indication of the program that gives the most “bang for the buck,” which can help government or other organizations make the most out of limited budgets.

¹ Dhaliwal, Iqbal, Esther Duflo, Rachel Glennerster, and Caitlin Tulloch. 2013. “Comparative Cost-Effectiveness Analysis to Inform Policy in Developing Countries: A General Framework with Applications for Education.” *Education Policy in Developing Countries*. 285-338 | [Available online](#).

It is important to note a few defining features of a CEA:

1. Before a CEA can be conducted, some measure of the program's impact must be known. Therefore, a CEA usually follows from a rigorous impact evaluation.
2. It is important to emphasize that the relevant cost measure is **not** the cost of the evaluation; it is strictly the total aggregate cost of all components of implementing the program itself.
3. A comparative CEA provides an estimate of the relative effectiveness of a variety of programs on one outcome and does not rely on any judgements about the monetary value of the outcomes.
4. A CEA of a single program can only provide an estimate of how much effect that program generates per currency unit spent. While this can be a useful starting point, rarely does it provide adequate information to base investment

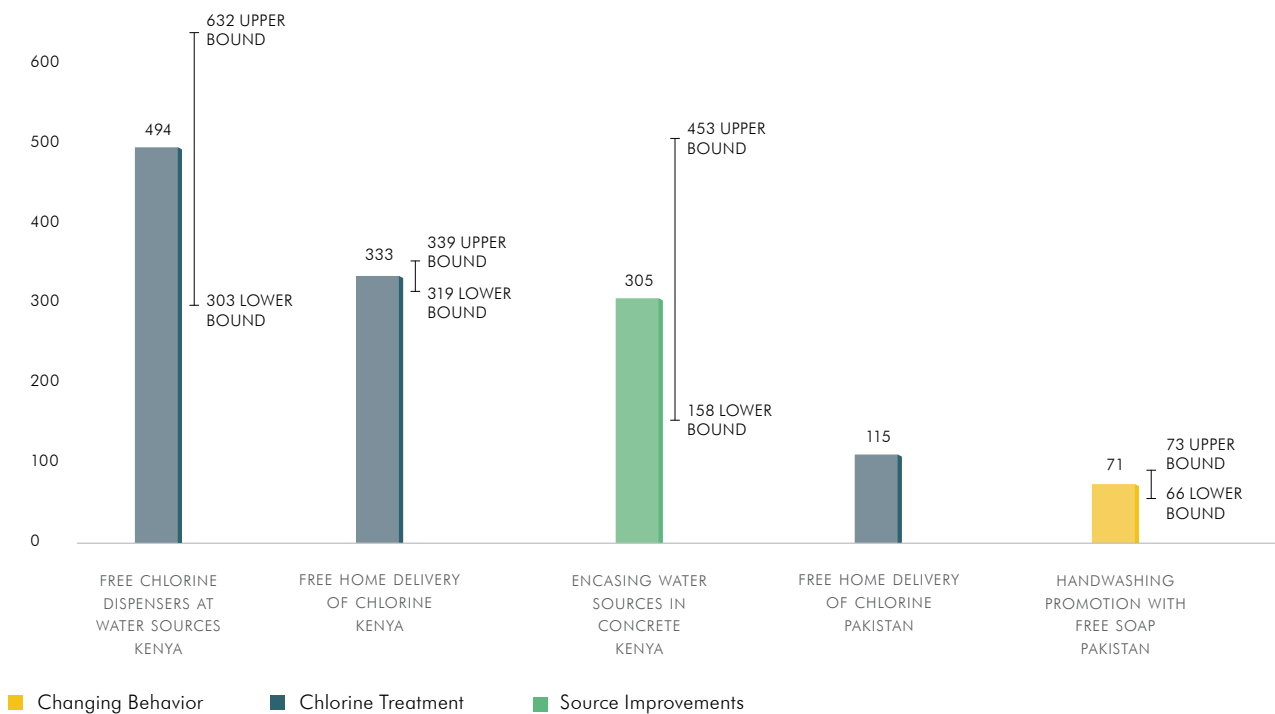
decisions. On the other hand, comparative CEA can help inform investment decisions by allowing users to compare the value of a particular intervention with other policy alternatives.

5. Any comparative CEA relies on comprehensive and consistent calculation of costs and effects across the studies included. *The ability to draw comparisons across different projects requires comparability between the ways program costs are measured.* To achieve comparability, a number of assumptions must be made on how to measure costs and standardize impacts.
6. CEA is just one input into the policymaking process. Comparative CEA provides policymakers with a ranking of how cost-effective various programs have been in the specific context in which they were evaluated. CEA should not be interpreted as a promise for exactly how cost-effective a program model will be in every context.

EXAMPLE: DIARRHEAL DISEASE COST-EFFECTIVENESS ANALYSIS

The CEA depicted below shows an example of a comparative CEA that the Abdul Latif Jameel Poverty Action Lab (J-PAL) undertook to compare the reduction in diarrheal disease incidents per US\$1000 spent across five different programs implemented across various contexts¹. These numbers and assumptions are based on a report from 2015, which may be out of date. Note that each of the five interventions is compared across a single outcome measure: reduction in diarrheal incidents. While a program may actually show impact on a number of different outcomes, a CEA ensures comparability by only focusing on one key outcome.

FIGURE 1. SENSITIVITY TO POPULATION DENSITY



Three of the five interventions involve dispensing chlorine treatment, one program provides improvements to the water source, and one intervention focuses on changing health behavior through the promotion of hand-washing with soap. The analysis shows that dispensing chlorine for free at community water sources was the most cost-effective way of those tested to prevent diarrheal disease, leading to 494 fewer diarrhea incidents for each US\$1,000 spent on the program. In comparison, free home delivery of chlorine treatment prevented anywhere from 115 to 333 diarrheal incidents per US\$1,000 spent. A hand-washing promotion intervention in Pakistan had the lowest impact per US\$1,000 spent, reducing diarrheal disease by 71 incidents. This analysis provides useful information for a government department on what is the best way to maximize reductions in diarrheal incidence for a fixed pool of resources.

There are a number of caveats and assumptions behind these figures, which we will discuss in detail throughout the rest of this manual. But even when we change these assumptions, some programs consistently generate a much greater reduction in diarrhea per US\$1,000 spent than other programs.

WHEN TO CONDUCT A COST-EFFECTIVENESS ANALYSIS

Cost-effectiveness calculations are most useful when:

1. You have a specific outcome measure you want to affect and there are many possible interventions that address this goal.

Many solutions to the problem of low student attendance have been proposed. For example, J-PAL affiliates have evaluated a number of programs that aim to increase student attendance such as conditional cash transfers, merit scholarships, free primary school uniforms, menstrual cups for teenage girls, information sessions on the returns to education, midday meals, iron supplementation programs, and many others. In this case, a comparative CEA could answer the question: out of these programs, which one increases attendance the most per a given cost.

2. You want to demonstrate that a non-obvious program is a good idea.

One non-obvious program that has an impact on school attendance is providing children with deworming pills. Due to the low cost of these pills, deworming has been found to be incredibly cost-effective, increasing student participation by 12.5 years per US\$100 spent on the program. This finding provided the important information that led to the scale-up of mass school-based deworming programs throughout the world.

3. You want to understand how the cost-effectiveness of a program could vary with contextual and implementation factors.

Say an NGO focused on education for disadvantaged children learned about the cost-effectiveness of school based deworming in Kenya, and as a result wants to implement a similar intervention across the Indian state of Tamil Nadu. However, the NGO is not sure whether procuring the deworming pill would be more expensive in Tamil Nadu and thus negate the cost-effectiveness of the program. To check whether this is the case, the NGO can use the Kenyan deworming cost-effectiveness data to conduct what is known as a **sensitivity analysis**.

A sensitivity analysis involves repeating the initial analysis but substituting alternate decisions or a range of values to understand how results would differ according to contextual factors. In this case, the NGO could calculate the same CE ratio as the Kenyan study but to account for the ambiguity on pill price conduct three separate analyses. The first analysis, the worst-case scenario, could use a very high pill price, while the second and third analyses could use a middle and low price respectively. Comparing the CE ratios of these three sensitivity analyses with CE ratios for other education programs that the NGO could implement, will provide valuable information as to whether the deworming program remains comparably cost-effective at different price levels.

COST BENEFIT VERSUS COST-EFFECTIVENESS ANALYSIS

Cost-Benefit Analysis (CBA) is another method to estimate the value of a program. The key difference is that a CBA compares the monetary value of **all** program **benefits** to the costs, whereas a CEA shows the impact of a program on a single outcome relative to cost. While a CEA gives us an estimate of the effectiveness of the program versus its cost, CBA monetizes the benefit due to a program and compares this with the cost.

FIGURE 2. COST-EFFECTIVENESS ANALYSIS VS COST-BENEFIT ANALYSIS

Cost-Benefit Analysis	vs.	Cost-Effectiveness Analysis
Monetized dollar value of all benefits of the program		Non-monetized impact of the program on one outcome
Total dollar cost of the program		Total dollar cost of the program

Because CBA compares the monetary value of benefits, one advantage of using this method is that it makes it easier to assess a program with multiple outcomes. For example, suppose the corporate social responsibility arm of a large private organization wants to know something about the return of investing in an unconditional cash transfer program targeted at female primary school students. An impact evaluation of the cash transfer shows that the program has an impact on students' test scores as well as a smaller impact on student's health. A CBA will make a series of assumptions that determine a monetary value for the increase in test scores and the improvements in health, add the two values, and compare this total benefit to the total cost of the program.

Another advantage of CBA is that by putting both costs and benefits on a currency scale, we can identify not only a relative but an absolute judgement of whether the program is worth the investment. A CBA ratio of a single program that is less than one implies that the program may not be worth investing in, as the costs exceed the total benefits. This means that unlike CEA, CBA does not necessarily have to compare across different programs to give some idea of whether a program is a good investment.

The downside of CBA is the large number of detailed assumptions needed to estimate a monetary value for the different benefits of the program. In our example, how can we estimate the monetary value of increasing students' test scores? Similarly, for a program that reduces child mortality, a CBA will require that a monetary value be placed on saving a life. Different organizations or individuals may have very different views on assigning a monetary value to certain benefits. For the sake of simplicity and to remove the value judgement about the relative weight given to certain benefits, J-PAL conducts CEAs.



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CONDUCTING A COST-EFFECTIVENESS ANALYSIS

As outlined in the sections above, conducting a CEA requires quantifying two pieces of information: the **program impact** and the **program cost**. Again, the key concern when conducting a comparative CEA is ensuring that the way program costs and program impacts are measured is consistent across the various programs included in the analysis. This chapter describes how to conduct a CEA, by going through the steps required to quantify the impact (the numerator of the CE Ratio) and the cost (denominator of the CE Ratio) of a program. As we will see, conducting a CEA involves making many decisions, assumptions, and judgement calls about how to quantify costs and impact. What follows are the steps and practices employed by J-PAL.

STEP 1: QUANTIFYING IMPACT

Before a CEA can be conducted, a program's impact must be estimated through the use of a rigorous impact evaluation. The fact that the impact evaluation serves as the precursor to CEA underscores the importance of carrying out impact evaluations to generate precise estimates of the effect of various programs. Without a large body of rigorous evidence generated through impact evaluations it would be impossible to compare the relative cost-effectiveness of programs, thereby constraining our ability to make evidence informed policy decisions.

For every program included in a comparative CEA, it is not strictly necessary that an organization or agency itself conduct or commission the impact evaluation. Instead, an organization can draw from previous impact evaluations of programs inside and outside its operating location. The organization must decide on a set of standards and requirements for determining which impact evaluations warrant inclusion in their CEA. The key is to be transparent in these inclusion criteria. Some example criteria are the following:

- Studies that are of sufficiently large scale/sample. *E.g. only include evaluations that are drawn from samples that are representative of at least a district.*
- Studies which are sufficiently rigorous in terms of method. *E.g. only include randomized evaluations into the CEA.*
- Studies in a particular geography. *E.g. only include evaluations of Indian programs.*
- Studies that have been externally replicated, i.e. where the same program has been examined with a different dataset drawn from a different context or population. *E.g. only include evaluations of programs that have been externally replicated at least twice.*

For example, an organization might want to specify that their CEA will compare all impact evaluations of agricultural interventions in Southeast Asia whose main outcome of interest is crop yields and which use either a randomized evaluation or a regression discontinuity design.

For the purpose of this chapter, we will assume that an impact evaluation has been completed on a particular program, and we have a positive and statistically significant impact estimate on an outcome of interest. At J-PAL, if a program has a statistically insignificant impact on an outcome, that program remains part of the CEA but no cost-effectiveness ratio is calculated. Once an impact evaluation has been completed and we have an estimate of program impact, we are part way to having the denominator value of our CE Ratio. What remains to be done is to **aggregate total impact**, address **spillover effects**, and identify programs that achieve **multiple impacts**.

1. Aggregating Total Impact.

Often, the impact estimate of a program that is found through an impact evaluation is calculated in a manner that is difficult to interpret or is in terms of a single unit or a single beneficiary. For example, suppose a government ministry commissions an evaluation of a Midday Meal Scheme. Suppose that the evaluating agency finds that the program increases child attendance by 11 percentage points per year, from 60 percent to 71 percent. To get a simple and easily interpretable measure of program impact, we will need to convert this percentage point increase into a figure such as the number of additional school days or years for all children who benefited under the program.

If there are 180 days in the school year, then for one child the program increases the number of school days attended by approximately twenty (from 108 days without the Midday Meal Program (180×0.6) to 128 days with the Midday Meal Program (180×0.71)). Now, to get the total impact, the individual student impact must be extrapolated to the number of children that participated in the evaluation. Say that the program affected 10,000 children across 100 schools. In this case the total impact of the program would be 200,000 additional school days attended. If the program ran for two years, then the impact would have to be multiplied by two (400,000 additional school days).

In its simplest form, calculating the total impact of a program follows this formula:

$$\text{Total Impact} = \text{Impact (per unit)} \times \text{Sample Size} \times \text{Program Duration}$$

In the case of the midday meal example:

$$\text{Total Impact} = 20 \text{ days} \times 10,000 \text{ children} \times 2 \text{ years}$$

When calculating the program costs associated with the Midday Meal Program, make sure that the costs are associated with the same sample size and same duration as used to calculate the total impact. In our example, we will need the cost of implementing the Midday Meal Scheme for those 10,000 children in 100 schools over two years.

² For more information on spillover effects: see Duflo, Esther, Glennerster, Rachel, Kremer, Michael. "Using Randomization in Development Economics Research: A Toolkit." *Handbook of Development Economics*.

2. Spillover Effects.

In some cases, the effects of a particular program may spill over onto nonrecipient populations. For example, suppose private school students come to public schools to receive the midday meal. Or consider an anti-malarial program that provides free insecticide-treated bed nets to households within a certain district. Since an individual's risk of contracting malaria depends on the overall prevalence of the disease where they live, decreasing malaria rates within one district may have positive health spillovers on a neighbouring district².

When calculating a CEA for a program that contains a spillover effect, one must decide whether or not to include an estimate of this spillover in the total impact of a program. While there are no right or wrong answers, a useful thought experiment to consider when making this decision is to ask whether the spill-over benefit would be present in a scaled up version of the program. For example, if the anti-malarial bednet program was scaled up across all households in Tamil Nadu, then there would no longer be a district that does not receive the program and thus no additional spillover benefit. In this case, it makes sense to forgo the spillover effect in the calculation of program impact.

3. Programs Achieving Multiple Impacts.

As discussed above, by definition a CEA compares the costs and impacts of a set of programs on **one** outcome. However, a program may have multiple impacts on a variety of important outcomes. A conditional cash transfer might increase student attendance, but also have impacts on health outcomes and an individual's empowerment or confidence. A midday meal program may increase both student attendance and nutrition outcomes. Unfortunately, a CEA does not have a way to include multiple outcomes. At J-PAL, in order to call attention to this, we make a note in the CEA if a program has impacts on a number of different outcomes. While this is far from an ideal solution, it does highlight that the program's other impacts should also be taken into account.

STEP 2: QUANTIFYING COST

When quantifying costs, the goal is to include cost information on all the “ingredients” or components of a program to get a sense of **how much it costs to implement (or how much it would cost to replicate the program)**. Quantifying these costs can appear deceptively simple, particularly when aggregate cost data (such as the entire budgetary total or total personnel costs) are reported. However, without an adequate explanation of what the budget includes and over what time period, using this cost data can lead to an erroneous estimate of the total cost of the program.

To illustrate, suppose a program evaluation consulting firm is calculating a CEA of a computer-assisted learning program implemented by the School Education Department that provides underperforming schools in a particular district with computers and teacher training on how to effectively integrate the computers into the classroom. The School Education Department gives the

consultant an aggregate cost associated with implementation of the program, but fails to give a detailed breakdown of what is encapsulated within this budget. The consultant has no way of knowing whether the cost data accurately reflects the total cost of the program as it was implemented. Perhaps the aggregate figure does not include the cost of computers as computers were leftover from a previous government program or schools already had computers. Maybe the program budget failed to incorporate the opportunity cost to teachers for their time spent in computer training or perhaps the aggregate figure did not include the wages paid to the lead trainer for his time training the group of trainers since the lead trainer was already a government employee. Alternatively, maybe the budget included compensation for the lead trainer, but not the costs of the facilities and materials for the training.

As we will see, the costs of goods and services provided for free, user costs of beneficiaries giving their time, and costs associated with all aspects of staff training, are all important to keep in mind. Failure to include the costs of staff training for one program while doing so for another will lead to an inaccurate comparison and could lead policymakers to misallocate resources. To ensure consistency in cost calculations across programs, it is necessary to obtain detailed, granular cost data and be systematic in the way costs are collected.

A helpful way to do this is to use the **ingredients approach** to cost collection. This method is a way to ensure that all relevant costs have been included in an analysis. It requires a complete and accurate description of the program. Then, we can generate a complete listing of all the necessary resources or ingredients required (both items and amounts) for the program to achieve its impact. After a systematic specification of a program's ingredients, unit costs are gathered. Finally, following identification and valuation, the ingredients can be added together to produce a total cost figure. We outline the different components of the ingredients approach in more details below.

The ingredients approach involves four steps.

1. DEFINING THE PROGRAM
2. IDENTIFYING INGREDIENTS
3. GATHERING UNIT COST INFORMATION
4. STANDARDIZING COSTS ACROSS PROGRAMS

DEFINING THE PROGRAM

QUESTIONS TO CONSIDER

- What is the specific intervention or program the impact evaluation assesses?
- Is the program an extension or a modification of an existing intervention?
- What is the comparator case?
- What time period did the evaluation cover?

Before adding up the costs of ingredients, one must have a clear understanding of what is meant by “the program”. Defining the program can be a tricky endeavor because many evaluations examine different variations of an already existing program or simply add on to existing government or NGO infrastructure. In this case, a useful way of thinking about the constituents of the program is to imagine what the intervention would look like and what costs would be involved if it were being replicated in a new context. This thought exercise is another way of getting at the notion of a **comparator case**, which is the starting situation against which the program is being compared. Underlying all cost-effectiveness calculations is an implied basic level of costs and benefits that would exist even in the absence of the program. Recall that in the terminology of impact evaluation, the level of benefits that would exist without the program is called the **counterfactual**³. Likewise, the level of costs that would exist had the program not been implemented is the **comparator case**.

CE Ratio=

$$\frac{[\text{outcome with program}] - [\text{outcome that would have existed without program (counterfactual)}]}{[\text{costs with program}] - [\text{costs that would have existed without program (comparator case)}]}$$

(costs with program) – [costs that would have existed without program (**comparator case**)]

An understanding of the comparator case allows one to parse out the incremental costs of the program itself. In some cases, a program starts from a comparator case of zero. For example, a program implemented by a Department of Energy to hire an organization to distribute solar power LED-lights to low income households can be considered to start from zero, if there is no preexisting government infrastructure that the program is adding to, modifying, or extending. Supposing the costs in the absence of the solar energy program were zero, then all the costs of the program itself should be included in the CEA.

A program that provides merit scholarships to public school students based on their standardized test grades is an example of a program that does not start from a comparator case of zero. In this case, the verification of test scores and selection of winners would be done by school administrators, whose salaries would be paid even if the program did not exist. Since administrators would likely be present in most contexts in which the program is replicated, it is reasonable to assume that the costs of school administrators would be borne in the comparator case and thus not be included as an incremental cost of the merit-scholarship program itself.

As a final example, let’s consider the comparator case of the computer assisted learning program mentioned earlier. Suppose that all of the underperforming schools in the district already had computers, but they were underutilized. Technically, the comparator case in this example would include computers that were already present in the schools, meaning that the cost of the computers would not show up in the program’s cost. This analysis answers the question: “what is the cost-effectiveness of the computer-assisted learning program in contexts where schools already have computers?” However, the existence of the computers prior to the program

should be clearly stated in the assumptions, as one may still consider including the cost of the existing computers in the CEA if conducting a sensitivity analysis for another context. If the Education Department were looking to scale up the program to a new district where schools did not have computers, the relevant question would be: “what is the cost-effectiveness of the computer-assisted learning program if the school district needed to buy computers?” It is possible to do the cost calculation either way – with or without the cost of computers – but the general rule is to include the marginal costs of the program as it was implemented and clearly state assumptions and details about the context.

IDENTIFYING INGREDIENTS

QUESTIONS TO CONSIDER

- What are the necessary ingredients of the program?
- Is the program or intervention saving any cost formerly incurred?
- Are there any donated goods and services provided for free?
- Does the program impose on beneficiaries any implicit or explicit cost?

Some important cost categories are as follows:

1. Program Administration Costs
2. Targeting Costs
3. Staff Training Costs
4. User Training Costs
5. Implementation Costs
6. User Costs
7. Averted Costs
8. Monitoring Costs

A few notes before describing each category in more detail:

- Programs differ substantially in terms of resources required and as such, some cost categories may not be necessarily relevant to the program in question or conversely additional cost categories may need to be added. The listing of these eight cost categories is only intended as a framework for thinking methodically about the possible costs of a program.
- Sometimes the numerical cost figure will not exist for a certain line item under a cost category and an estimate will have to

³ For a fulsome overview of the counterfactual and the intuition of impact evaluation, see the “Intro to Evaluations” section of the J-PAL website: <https://www.povertyactionlab.org/research-resources/introduction-evaluations>

be made. In these cases, it is important to make explicit the assumptions used and if possible also include a minimum and maximum value that the cost figure may take.

Program Administration Costs: This major cost item represented in this category is **staff costs**. We want to include all costs associated with hiring the staff involved in the implementation (**not** the evaluation!) of the program. Be sure to include cost values for full-time salaried staff as well as non-salaried full-time staff. Also included in this category are any capital costs incurred for the purchase of facilities, utilities, and other materials needed to support program implementation.

Targeting Costs: Were there any costs associated with identifying the location of the program catchment area or the location of the beneficiaries? Did the implementer have to raise popular awareness of the existence of the program? Was any money spent on identifying beneficiaries themselves? If the answer is "yes" to either of these questions, the program will incur targeting costs. Examples of costs in this category could include the costs of doing a census, a participatory rural appraisal, a proxy means test survey, a door-to-door informational campaign, putting up flyers or other marketing materials, etc.

Staff Training Costs: Was there any cost associated with training the staff responsible for implementing the program? For example, were workers at a government department trained in using a new technology that they would then teach program beneficiaries to use? Staff training costs may comprise remuneration for external trainers (not full-time staff) including their fees, labor, lodging, and transport; costs for facilities, materials, and food; and for non-full time staff the wages that trainees would earn while participating at the training (costs for full time staff would already be captured under program administrative costs).

User Training Costs: Are program beneficiaries required to receive any training? If so, relevant costs to include are: capital costs of the event (facilities, materials, food, etc.), wages, transportation, and lodging for **non-full time staff** (again, full-time staff are covered under program administrative costs).

Compensating Users' Time: J-PAL includes in the User Training Cost category an estimate of a beneficiary's opportunity cost for attending a required training (including significant amounts of travel time). While this is not a direct accounting cost for a government or implementing organization, the time spent in training does represent a real cost to the user and is therefore included. To estimate the value of forgone income, we either use an average measure of household income that is collected in the evaluation itself, or when this data is not available, we use the local wage rate.

Including a compensating value for the time beneficiaries spend contributing to the program is another example of a discretionary choice to be made by the researcher. Like all judgement decisions in a CEA, either choice is acceptable so long as the researcher can explain their reasoning **and** the decision is consistent across all of the different programs within the same CEA.

Implementation Costs: For many projects, implementation will be the largest and most important category. Captured here would be all costs directly associated with the implementation of the program, such as asset or in-kind transfers, vouchers, incentive or award payments, holding meetings, developing and printing material, etc.

Goods and Services Provided for Free: Another question is whether or not to include the cost of goods and services that are provided for free. The answer depends on how the CEA will be used. As an example, say an NGO implemented a program to provide households with fully subsidized improved cook stoves. As part of the program, the NGO had planned on contracting an organization to go door-to-door to maintain and repair cook stoves, but instead members of the village decided to mobilize and volunteer their time and labor to fix damaged and non-functional cook stoves within their community. If the objective is to examine the costs to society as a whole, then one should include an estimate of the market cost of the services provided by the volunteers. Furthermore, another consideration is to ask whether the inputs provided for free in a particular context would be made available at no cost if the program were to be scaled up in a different context. If one can rationalize that even in a different context a volunteer cadre would form to maintain the cook stoves, then it may make sense to not include this cost item.

Transfer Payments: Monetary transfer payments, such as a cash stipend provided in conditional and unconditional transfer programs, represents a redistribution of wealth from one party to another and not a change in the size of the total resource pie. If the CEA is being conducted from a broader social planner standpoint, then we should not include transfers as a cost. However, if we are concerned with what the program costs to implement then transfers should be included under the implementation cost ingredient category.

User Costs: This includes the cost that a particular program imposes on beneficiaries, including the cost of their time (apart from beneficiaries' opportunity costs for attending a training – as this is collected under User Training Costs). If a program partially subsidizes a good or service, the remainder cost borne by the beneficiary is included under this category. These costs can be divided into new costs and averted user costs. Averted user costs would occur if program beneficiaries worked fewer hours as a result of the program or if beneficiaries used fewer capital goods. As the costs to labor and capital are no longer incurred due to the program, they must be reported as negative costs or program savings.

Averted Costs: Were there any existing programs or non-user costs that were discontinued or reduced in size as a result of the program? For example, say a government's agricultural department had a program to send qualified trainers to farms to answer farmers' questions and provide extension services. This year, however, a new intervention was introduced by the Agricultural Department that provided the same service over cell phones, thus rendering the trainer program obsolete. In this

case, the labor cost savings of the now obsolete trainers would enter the CEA as a positive saving. Note that if a new program completely supplants an existing one, it is likely that averted costs will arise across many different cost categories such as program administration, implementation costs, staff training, etc. The monetary value of these averted ingredients should be included under this category.

Monitoring Costs: Was there any expenditure related to overseeing, monitoring, or measuring the progress of beneficiaries or staff? The answer to this question would be "yes", if for example, administrators must monitor whether beneficiaries meet the conditionality imposed in a cash transfer program, or if an education program employs a group of monitors to conduct periodic spot checks to ensure that teachers are implementing the correct teaching materials. If a program does have monitoring outlays, be sure to include the cost of monitoring materials (e.g. cameras, questionnaires, etc.), the cost of aggregating and analyzing the monitoring data (again, this is separate from analyzing data from the evaluation!), and the labor of part-time staff involved in monitoring activities, as well as their conveyance, and accommodation (costs for full time staff are included in the program administration category).

GATHERING UNIT COST INFORMATION

QUESTIONS TO CONSIDER

- Where will you get your data on each of the cost items?
- At what stage of the program should you collect this data?
- Is the CEA a prospective or retrospective analysis?
- Who should you work with to collect this information?

Once we know the program's ingredients and the specific cost items that are needed under each ingredient category, we need to collect the relevant data. The cost collection process will be quite different depending on whether an organization is calculating the cost-effectiveness of one of their own evaluations or if the organization is including a previous study done by other researchers. If it is the latter, and if the study does not include a cost-effectiveness calculation, the organization will have to define the program, identify its ingredients, and identify costs on behalf of the researchers. This can be a difficult task, especially if the program is conducted in a foreign context. In such a case, most, if not all, cost figures will have to be gathered through secondary data sources and be supplemented with assumptions and estimations, which will decrease the reliability of estimates and potentially jeopardize the validity of CE ratios. It is a good practice to try to contact the researchers for more clarification before attempting to take this on.

Collecting accurate cost data will be much easier for those evaluations that an organization itself is conducting or commissioning. However, it is crucial that cost collection is seen as an integral component of the evaluation and not as an afterthought. Cost collection should be explicitly included in any terms of reference that is created and it should be built in as a general expectation that the evaluator will be collecting this program data for the duration of the evaluation.

The evaluator should work with the implementing organization or government department to collect these costs. The implementing agency may have many of the main cost estimates readily available in the form of program budgets and the main work required will be ensuring that the data can be shared. Cost data from program budgets can be supplemented with secondary data sources (e.g., data on district-wide wage rate) as well as primary data collected by the evaluating agency during general data collection (e.g., data on beneficiaries' indirect costs due to the program).

When to Collect Cost Data: Generally, a CEA can take place at two distinct stages of program implementation:

- A **Prospective Analysis** takes place prior to the start of a program or pilot and before an actual impact evaluation has been undertaken. A prospective analysis uses projected or budgeted costs and impact estimates from impact evaluations of comparable programs in other contexts. This analysis cannot yield a precise prediction of the actual CEA of the program; it is only an indication of the program's potential CEA if all of the assumptions play out as anticipated. This type of preliminary or scoping analysis can help to answer the following questions:
 - "Roughly how cost-effective could this proposed program be?"
 - "How big an impact must this program achieve to meet our minimum cost-effectiveness requirement to make the program worthwhile?"

For example, say the Labor and Employment Department of a particular government wants to test the feasibility of a new job training program. The department is unsure whether this would be a good investment to make and so, before they implement the program they decide to examine whether the training program will reduce the youth unemployment rate in a cost-effective manner. In such a case, the department would be conducting a prospective analysis.

- A **Retrospective Analysis** – This takes place after the program is implemented and following an impact evaluation. Although a retrospective CEA is conducted following an evaluation, ideally cost data will be collected during the program evaluation and not after the evaluation has concluded. Cost collection that is built into the evaluation itself and occurs in conjunction with program implementation provides the most accurate data for CEAs. A retrospective CEA can answer:
 - "Exactly how cost-effective was the program in the context it was evaluated?"

- “Roughly how cost-effective might we expect this program to be if it were rolled out on a larger scale?”

STANDARDIZING COSTS ACROSS PROGRAMS

QUESTIONS TO CONSIDER

- What is the base year? What is the year of analysis?
- Do costs across programs need to be converted to the same currency?
- Do costs over multiple years need to be discounted into the base year?
- Do inflation rates need to be taken into account?

Emphasized throughout this chapter has been the one-word rule for conducting a comparative CEA - **consistency**. Consistency is essential because it ensures that the differences in cost-effectiveness across programs are not due to discrepancies in calculation, but instead due to actual differences in the relative value for money of programs. Consistency is the prerequisite for comparability. We established that consistency matters at all stages of the CEA, from forming a uniform selection process for determining evaluations to include in the CEA, to consistency in calculating the impacts and costs of programs, to detailing assumptions.

The last step in calculating costs, standardizing cost data across programs, is directly related to this idea of consistency. Included in comparative CEAs are impacts and costs of programs that have been calculated at different points in time and across different contexts. Costs inherently vary due to time and location. US\$100 spent on a program in India in 2006 does not equal US\$100 spent on a program in Spain in 2015. Even within the same program, a dollar spent in year 1 of implementation is not the same as a dollar spent in year 2. Due to variations in time and context, we must ensure that consistency across and within programs is upheld by standardizing costs across time and location.

Following collection of cost data for each respective program included in a comparative CEA, aggregate program costs need to be standardized by accounting for three additional factors: time discounting, inflation, and currency exchange rates. In the process of standardizing costs, it is important to distinguish between two temporal concepts, **base year** and **year of analysis**.

Base Year - The year that the program begins (usually coincides with the year that the program costs were incurred). This is the year in which the present value is taken.

Year of Analysis – The year in which the actual cost-effectiveness calculation is undertaken.

The standard order of operations across all CEAs is the following:

STEP#	OPERATION	UNIT OF CURRENCY FOR A 3-YEAR PROGRAM BEGINNING IN 2004 (BASE YEAR)
1.	Gather cost data for programs using the ingredients approach	Year 1: 2004 (USD) Year 2: 2005 (USD) Year 3: 2006 (USD)
2.	Exchange into the CEA's common currency using year-specific exchange rates	Year 1: 2004 (INR) Year 2: 2005 (INR) Year 3: 2006 (INR)
3.	Deflate nominal costs back to the real value in a particular base year prices. Use average annual inflation rates over time between base year selected and incursion of costs	2004 (INR) (incurred in 2004, 2005, and 2006)
4.	Time discounting - take present value (PV) of cost stream for programmes that incur costs over multiple years	PV of cost stream in 2004 (in 2004 INR)
5.	Inflate costs forward from the common base year to the year of analysis. Use average annual inflation rates (for the currency of analysis) over time between base year selected and year of analysis	PV of cost stream in 2015 (in 2015 INR)

1. Exchanging into a common currency: Due to the varying purchasing powers of different currencies, if programs report costs in multiple currencies, it is necessary to exchange them into a common unit (e.g., US dollar or Indian rupee). Of course, converting into a common currency is not needed when comparing in a comparative CEA two or more programs that all run in the same country. The decision whether to use a purchasing power parity (PPP) exchange rate, which is the rate of currency conversion that equalizes the buying power of different currencies, versus a standard exchange rate is at the researcher's discretion. Standard and PPP exchange rates both entail certain advantages and drawbacks. Generally using a PPP versus a standard exchange rate does not change the relative cost-effectiveness of programs, as long as this decision does not change for different programs within the same comparative CEA.

2. Deflate nominal costs to the real value in the base year: A real value is a value that has adjusted to remove the effects of changes in the price level (inflation or deflation), whereas a nominal figure is unadjusted to the price level. Program costs are usually entered as nominal costs. Therefore, when nominal costs are compared across time, any difference may be due to two things: (1) underlying differences in costs, and (2) changes in the price level that have occurred between the two time periods. It is crucial to convert nominal figures into real figures so that we can only look at the underlying differences in costs that are not associated with changes in prices.

To do this, it is important to identify the appropriate base year for each program and deflate all cost data to that base year. In the table above, the costs for the example program incurred in 2005 (year 2) and 2006 (year 3) were converted to 2004 Indian rupee amounts. This is done using the average inflation rate for the common currency (measured by the consumer price index [CPI]) and making the following calculation:

$$\text{Real value in base year} = \frac{\text{(nominal value in year cost incurred)}}{\text{(average inflation rate between base year and year cost incurred)}}$$

3. Time Discounting: Time discounting or taking the present value, is a necessary step when evaluations report the impacts and costs for more than one year. Disregard this step if all of the evaluations of programs in your CEA are one year long (i.e., do not have costs and impacts distributed over different years). The rationale for discounting is given by the **time value of money**, which suggests that a dollar is worth more today than tomorrow because a dollar today can earn interest. The discounting of costs is representative of the choice a funder faces between incurring costs this year, or deferring expenditures to invest for a year and then incurring costs the next year. Therefore, with multiple year programs we must discount costs after the second year back into the first year using what is known as a discount rate, usually calculated as the **Social Opportunity Cost of Capital**, which is the forgone rate of return on capital

markets. Generally, J-PAL uses a social opportunity cost of capital of 10 percent, which is approximately the median rate according to the Asian Development Bank. It is important to realize that the discount rate choice will have implications on long-run programs that have very different benefit-cost streams. A sensitivity analysis can be conducted to test the impact of using different discount rates.

Say a program has the following stream of costs: a large upfront fixed cost of US\$1,000 in year one and subsequent costs in year 2 of US\$300 and US\$400 in year 3. The program's impact was measured as a three-year impact so we need the corresponding three-year cost of this program. To calculate this cost we must calculate the following

Present Value of Costs=

$$I_0 + \frac{I_1}{(1+r)} + \frac{I_2}{(1+r)^2} + \dots + \frac{I_n}{(1+r)^n}$$

Where r is equal to the social opportunity cost of capital, I_0 represents the initial outlay at time zero, and I_1, I_2, \dots, I_n are the costs associated in time period 1, 2, all the way to the last time period, n.

4. Inflate Costs to the Year of Analysis: The second inflation related adjustment is to inflate the common currency, present valued costs for each program from the base year to the year of analysis. This is calculated similarly to step 2 but using the average inflation rate for the common currency that occurred between the base year and the year of analysis.

PUTTING TOGETHER COSTS AND BENEFITS

Following completion of this four-step cost standardization process, the calculated costs of a program should reflect the actual costs of the program **and** across programs, costs should be standardized. We are now ready to integrate program cost data with program impact data and calculate the final CE Ratio. Recall that this requires dividing the aggregated cost of the program by the impact of the program on a specified outcome.

Cost-Effectiveness Ratio=

$$\frac{\text{Total Impact of the Program on a Specified Outcome}}{\text{Total Cost of Implementing a Program}}$$

Following calculation of the cost-effectiveness ratio for each program, the final step is to present the CE Ratios for each program in a visually appealing way that allows the reader to easily discern the relative cost-effectiveness of programs.



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EXAMPLE — IMMUNIZATION INCENTIVES PROGRAM

The next section presents a simplified example of a CEA of an immunization program that was run in 134 villages in rural Udaipur, Rajasthan from 2004-2007. The immunization program was implemented by the NGO Seva Mandir and evaluated by J-PAL affiliated researchers (Abhijit Banerjee, Esther Duflo, and Rachel Glennerster) using a randomized evaluation⁴.

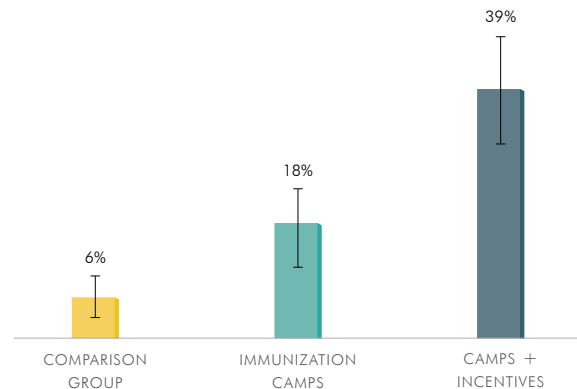
Background on the Program: Although immunization is a very cheap and effective way of improving child survival, only 22 percent of children in rural Rajasthan have received the basic package of immunizations. This rate is even lower for those living in tribal areas. The public health facilities serving rural and tribal areas are characterized by high absenteeism: 45 percent of Auxiliary Nurse Midwives (ANM) who carry out immunizations are absent from their village-level health center on any given day. Given that a full immunization course requires at least five visits to a public health facility, the unreliability of the ANMs increases the opportunity cost of a visit to the sub-center and may deter families from taking their children to complete their full immunization schedule.

The Program: Two different programs were implemented and evaluated. Thirty villages received program 1, thirty received program 2, and in thirty villages no new programs were implemented; this control group and received the status quo – access to the standard public health facilities).

- Program 1:** To increase the supply of infrastructure for immunization, Seva Mandir hired a mobile immunization team to conduct monthly immunization camps in villages. The camps were held on the same time each month and the presence of a nurse was verified. A Seva Mandir worker informed villages about the immunization camps and educated parents on the benefits of immunization.
- Program 2:** In addition to the immunization camps of program 1, an incentive scheme was instituted to simultaneously increase the demand for immunizations. The incentive scheme offered parents a 1 kg bag of lentils per immunization administered, and parents also received a set of plates once a child completed the full immunization course.

Impact Evaluation Results: Relative to the control group, reliable camps but no incentives (Program 1) increased the number of fully immunized children by 12 percentage points, from 6 percent in the comparison group to 18 percent in villages with reliable camps. The combined camps plus incentive (Program 2) caused fewer children to drop out after the first two or three immunizations. Camps plus incentives increased full immunization rates by 33 percentage points over the comparison group, and by 21 percentage points over Program 1.

FIGURE 3. PERCENTAGE OF CHILDREN AGED 1-3 YEARS FULLY IMMUNIZED BY TREATMENT STATUS



Which of the two programs was most cost-effective?

To answer this, J-PAL conducted a CEA comparing the two programs in terms of their respective cost per fully immunized child. First, the percentage increase in children fully immunized, which was calculated in the impact evaluation, was converted to an easier impact figure to interpret the number of fully immunized children. Next, costs were gathered for each of the two programs using the ingredients approach. In this case, costs were disaggregated using slightly different cost categories than those outlined above.

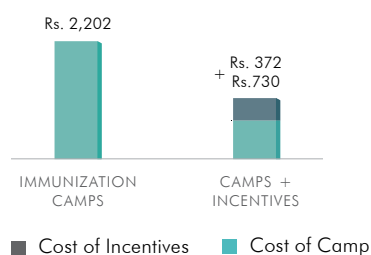
⁴ See J-PAL Policy Briefcase, "Incentives for Immunization", available at: <http://www.povertyactionlab.org/publication/incentives-immunization>. Academic paper: Banerjee, Abhijit V., Duflo, Esther, Glennerster, Rachel, and Dhruva Kothari. 2010. "Improving Immunisation Coverage in Rural India: Clustered Randomised Controlled Evaluation of Immunisation Campaigns with and without Incentives." *British Medical Journal*.

FIGURE 4. DISAGGREGATION OF CAMPS AND CAMPS PLUS INCENTIVES PROGRAM COST DATA

COST COMPONENTS	DETAILS	CAMPS WITH INCENTIVES	% OF TOTAL	CAMPS WITHOUT INCENTIVES	% OF TOTAL
Salary	Team of 4 GNMs and 4 GNM Assistants + Coordinators Salary	558,500	29%	558,500	46%
Travel	Staff and Incentive transport to camps	171,460	9%	63,460	5%
Honorarium	USD0.26 per child under 2 yrs per shot, given to village workers	119,580	6%	62,370	5%
Daily allowance	USD1.10 for attending bi-monthly meetings, given to village workers	19,500	1%	19,500	2%
Consultancy fees	Paid for training of nurses and assistants	2,200	0%	2,200	0%
Lodging + boarding	Expenses incurred during trainings	7,333	0%	7,333	1%
Travel	For village worker's transport to trainings	4,645	0%	4,645	0%
Training material	Office supplies disbursed during trainings	1,500	0%	1,500	0%
Medicines	Includes paracetamol, syringes and needles, needle cutters, blood pressure instruments, and stethoscopes	43,925	2%	15,320	1%
Refrigerators	For vaccine storage	25,178	1%	25,178	2%
Cost of Monitoring	Includes cameras, film, and manpower required for monitoring camps, entering, and analyzing data	446,480	23%	446,480	37%
Incentive	Utensils and lentils (includes storage boxes)	550,164	28%	-	0%
Total		1,950,465	100%	1,206,486	100%

And finally, the CE ratio was calculated for each program by dividing the costs (1,950,465 and 1,206,486 rupees) by the number of fully immunized children that occurred as a result of the program to get the costs per fully immunized child.

FIGURE 5. COSTS PER FULLY IMMUNIZED CHILD



These results show that providing incentives, in addition to improving the supply of services through immunization camps, actually **halved** the cost of fully immunizing an additional child. It turned out that the camps with incentives were busier than those without incentives, meaning that nurses' time was used more efficiently. Since more than twice as many children were fully vaccinated in camps with incentives, each nurse vaccinated more children, thus reducing the cost per shot. This is an incredibly valuable result for informing policy decisions. Since budgets are limited, a policymaker may be tempted to implement the less costly immunization camp program, forgoing the incentives. However, the CEA demonstrates that the relative value of the camps plus incentives was actually roughly twice that of just the immunization camps alone.



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ADDITIONAL RESOURCES

**FOR MORE INFORMATION ON CONDUCTING
CEAS CONSULT:**

1. [Comparative Cost-Effectiveness Analysis to Inform Policy in Developing Countries: A General Framework with Applications for Education](#): by Iqbal Dhaliwal, Esther Duflo, Rachel Glennerster, and Caitlin Tulloch
2. [J-PAL Costing Template](#): a template to help users generate an estimate of total program costs. It provides users with a comprehensive list of the different cost categories that may be included in a program and prompts the user to input various details about cost data for their respective program.
3. [J-PAL Costing Guidelines](#): a useful document accompanying the J-PAL costing template which instructs users on how to approach collecting cost information.

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