Evaluating Saving Lives at Birth (E-SL@B)

Report, September 2020

Insights and Lessons Learned from the E-SL@B team on Conducting Cost Effectiveness Analyses (CEA) for Selected SL@B Grantees

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Key messages

- Economic evaluations, such as cost-effectiveness analyses (CEAs), of innovations that are poised to scale-up can inform decision-making for a range of relevant stakeholders including the innovators, governments, other public health agencies, development agencies and the private sector.
- It is important to note that CEA is one among several economic evaluation approaches that could help stakeholders make informed decisions.
- Common challenges to conducting CEAs of early stage healthcare innovations include limited availability of data on costs and effectiveness.
- In many cases, lack of direct data on effectiveness of an intervention/program constrains the type of analytic methods adopted to conduct CEAs. As a result, these CEAs often rely on decision analytic methods based on program information if CEAs integrated into randomized controlled trials (RCTs) are not feasible.
- Due to the rapidly changing nature of some innovations, results from CEAs should be taken as snapshots in time that will change as more data become available and modifications are made to the innovation and intended scaling pathways. CEAs conducted by the ESL@B team take account of this variation through sensitivity and simulation analysis that provide a range of estimates.
- It is important to consider circumstances that CEAs are most suited for (e.g. stages of innovations) and ensure that there are stakeholders interested in the results to increase the value of CEAs.
- Innovators that partnered with the ESL@B team for a CEA indicated that the CEA process itself helped them to more deeply understand their program and think about how the results would support scale-up pathways. Therefore, active participation of innovators is critical.
- Having a multidisciplinary team is important to conduct a CEA as different areas of expertise are needed to consider various perspectives.

The Evaluation of Saving Lives at Birth (ESL@B) team based at Duke University was tasked to estimate the costs and benefits of bringing selected SL@B innovations to scale. The multidisciplinary team was comprised of physicians, policy analysts, economists, evaluation research experts and maternal and newborn health experts. This reflection paper gives an overview of the ESL@B team's approach to conducting cost effectiveness analyses for four unique SL@B innovations. It describes the process of conducting the four CEAs, implications of the results, as well as lessons learned through the process. Furthermore, the paper provides recommendations to innovators, funders, and researchers that would help to maximize the use and impact of CEAs in scaling up global health innovations.

I. Cost Effectiveness Analysis (CEA)

Cost effectiveness analysis is the economic assessment of resources (direct and indirect costs) needed to obtain a health impact e.g. reduction of mortality in a society. A CEA can be used to compare an innovation with existing (or non-existing) intervention(s) to help improve allocation of resources (Sanders et al., 2016). When an innovation/program is implemented, different stakeholders are involved and need different types of evidence to pursue that particular program. Therefore, a CEA can be conducted from different perspectives (discussed below) so that it generates the necessary evidence for interested stakeholders.

An important consideration to make when conducting a CEA is whose perspective to adopt. Standard recommendations suggest adopting more than one perspective but it is also possible to adopt a single perspective. Perspectives typically considered in CEAs include a patient/user perspective, a service provider perspective, a health systems perspective, and a societal perspective (Kim et al., 2020). Our analysis focused on service's provider perspective i.e. innovators' perspective in our case. It also included health systems (government) perspective whenever possible. Estimates from the innovator's perspective help the innovator understand the feasibility of their innovation and the likelihood of scaling, while estimates from the government's perspective allow for a more comprehensive view of the innovation.

II. Process of conducting CEAs

We conducted the economic evaluations in three complimentary phases. First, we reviewed the portfolio of SL@B innovations and selected four priority innovations with whom to conduct CEAs, and then we validated their impact models and collected cost data for our analysis using tools developed by our team. Lastly, we conducted the CEA using the models built and data collected. Details of each stage are below.

Review of innovations and organization into groups

We conducted a review of the SL@B portfolio to select innovations that might be suited for a CEA. The SL@B portfolio is comprised of 116 unique innovations that span different types and stages of innovations. The innovations are awarded at three stages where innovations receive: 1) Around 250K for up to two years to support development of early stage ideas (seed award); 2) Around 250K for up to two years to test the effectiveness of an innovation (validation award); and 3) Around 2 million for up to four years to support scaling of an innovation (Transition-to-scale [TTS] award) (Lalli et al., 2018). Types of innovations included devices, drugs/ vaccines, mhealth technologies, and service delivery approaches. These innovations primarily address neonatal mortality, maternal mortality or both. Among these key characteristics of the SL@B portfolio, the primary selection criteria for our team to conduct CEAs was the stage of the innovation. Conducting a CEA requires a certain level of data, which led our team to focus on those that were advanced in their pathway to scale i.e. those at the TTS stage. Our team looked into 19 out of the total 26 TTS innovations funded, and selected four innovations to conduct CEAs. The rest of the 15 innovations were not pursued due to the following reasons: innovators were not interested (and our team needed their participation for cost data), the innovations did

not have an impact model yet, and/or the innovators had already conducted their own economic analyses including published RCTs and CEAs.

The four innovations selected for cost effectiveness analyses by the ESL@B team included:

- Bempu bracelet – a device that continuously monitors a newborn's temperature, and alerts parents and healthcare providers in case of hypothermia in India. [BEMPU Health]
- Pratt pouch – a novel way to deliver Nevirapine, an antiretroviral prophylaxis, in a small sachet to HIV-exposed infants in Uganda. [Elizabeth Glaser Pediatric AIDS Foundation (EGPAF)]
- All Babies Count – an 18-month long program that is comprised of training and mentorship, systems-strengthening initiatives, and quality improvement strategies to improve the healthcare system in community health centers as well as hospitals in Rwanda. [Partners in Health (PIH)]
- Bilikit™ – a combination of three technologies: Bili-ruler™, Bilistick® and Bili-Hut™ developed by INMED's technology partners: Brigham & Women's, Bilimetrix and Little Sparrows Technology, respectively, that allow for rapid and accurate screening, diagnosis and treatment of neonatal jaundice in Peru. [INMED]

Data collection

Cost data

The impact and cost data were directly collected from the innovators themselves because of lack of published effectiveness and costing studies. Most innovations have limited publicly available data given that they are new in the space they are operating. The first step for collecting cost data included conducting a literature review of existing costing tools. Through the review, our team did not find a tool that incorporated the salient features we were looking for: innovator friendly, minimal computing requirement, and categories that allow entry of different cost categories for different types of innovations. To that end, our team developed a new Excel-based costing tool that is particularly relevant and easy to use for SL@B innovators. The tool was developed through an iterative process that included frequent consultations with SL@B innovators and pilot testing to reach a deep understanding of typical cost categories they use to make it innovator friendly.

Upon finalizing, the newly developed Costing Tool was used to collect historical cost data along with cost projections for scaling until 2030 provided by innovators. Innovators completed the tool with the assistance of the ESL@B team. Major costing categories that innovators provided data on include: labor, capital, commodities, recurring costs, training, overhead, supplies and service provision. The tool was also flexible enough to let innovators add a category if not automatically populated.

Impact Model

Lives-saved estimates were obtained from individual impact models that were originally developed by one of the SL@B partners, Grand Challenges Canada (GCC). The ESL@B team created a new innovation modeling checklist to validate and pressure test the models before using them to conduct CEAs. The checklist includes standardized elements and assumptions that needed to be addressed in each impact model, including: 1) The population of interest that the innovation will target; 2) Disease burden, or how the at-risk population will change over time with and without the innovation; 3) Efficacy of the innovation in situations in which it is used correctly (and incorrectly) compared to a counterfactual; 4) Fidelity to treatment or taking account of the quality of service delivery by a health worker, family member, or beneficiary him/herself; 5) Access to innovation across different populations such as rural vs. urban, or across vulnerable populations; 6) Stock outs in supplies or attrition of health personnel; 7) Referral of severe cases; and 8) Scale up scenarios, which can include scaling to multiple districts within a country, national scale-up or cross-country scale-up (e.g. two of the four models that were built by GCC were expanded to a national scale up scenario by the Duke team). National scale up scenarios were used when possible because they standardize geographic measures and could have more weight for government uptake decisions. Revisions made to the models based on the above listed validation criteria resulted in updated lives-saved estimates which are then used to conduct the CEAs.

Data analysis and estimation of cost-effectiveness estimates

A decision analytic model was developed for each of the four innovations. Decision analytic CEA models have an advantage over other CEA approaches (e.g. a CEA linked to a randomized controlled trial) because they are cheaper to implement and make use of data available from multiple sources. They are also more suitable for questions such as scale-up which extend outside the feasibility boundaries of typical randomized control trials. Each decision model was developed to capture the innovators' perspective and cover the period between inception (historical data) and projections to 2030 (Sustainable Development Goals target date).

For each innovation, **incremental ratios comprised of Cost per beneficiary, Cost per Lives Saved, Cost per Years of Life Saved were calculated.** Based on Years of Lives Saved (YLS), which is WHO's GDP[1] (Gross Domestic Product) threshold for gauging cost-effectiveness of innovations, all four innovations were found to be cost-effective. Sensitivity analyses of base incremental ratios were conducted to test the efficacy in different scenarios using deterministic sensitivity analysis and probabilistic sensitivity analysis. The fact that all four innovations were found cost effective could partially be explained by the mortality benefit of the newborn health space, and the SL@B program sourcing relatively low-cost innovations suitable for resource-limited settings. Even though most innovations in the maternal and newborn health space tend to

[1] The WHO-CHOICE criteria suggest that interventions are "very cost-effective" if the incremental cost-effectiveness ratio (ICER) of cost per disability-adjusted life years (cost per years of life saved) is less than the country's GDP per capita, "cost effective" if it is between one and three times the country's GDP per capita, and "not cost-effective" if it is greater than three times the country's GDP per capita.

be cost effective, it would still matter how cost-effective one innovation is compared to others in the same space.

III. Use of Results

The different estimates that the four individual CEA reports provided are**: 1) Incremental costs per new beneficiary, 2) Incremental costs per newborn life saved, and 3) Incremental costs per life-year saved.** These estimates could be used to achieve diverse objectives and might resonate differently with various stakeholders.

Innovators

From an innovator's perspective, it is important to know the incremental cost per beneficiary to decide on resource allocation, day-to-day monitoring, budgetary program mapping, seeking additional funding, exploring marketability, and advocating for adoption of their innovation. Depending on the innovation's stage, the CEA results can have immediate or long-term use implications. For example, one SL@B innovator with whom we partnered for a CEA, is in the midst of determining their optimal scaling pathway (private vs. public vs. hybrid). The SL@B innovator indicated that being engaged in the CEA process and thinking through the assumptions used in the models informed their decision-making as they navigated their scale-up strategy. For the other three innovations, the partners indicated that the CEA estimates would help illustrate the efficiency of their innovations and leverage additional funding or buy-in from the local governments in which they operate.

Funders/ Government

Incremental cost per lives saved and cost per years of lives saved estimates are important from the perspective of Ministries of Health and funders for comparative purposes while selecting innovations. These estimates show the resources needed for innovations to reach the number of beneficiaries that the innovators intended to reach by 2030. They also show that the innovations are cost effective, which will help stakeholders make informed decisions related to the investment.

Additional Considerations

It is important to note that CEAs are not static. CEAs are a snapshot in time, and therefore subject to change when conditions change. For example, an innovator's plan to scale in the private sector vs. public sector could change to some extent after the CEA is completed, which could affect the CEA results. Another example is when an innovator receives more funding than projected, and therefore, has an increased ability to expand to more settings, could affect the CEA results. The innovation itself could evolve, leading to a cheaper or more expensive price for users, having an impact on demand and CEA results. These examples highlight cases of possible changes and serve to show that the CEAs conducted for the four SL@B innovations only capture the impact of the innovations based on the current availability of data. Furthermore, CEA is only one type of economic analysis that could inform program/funding decisions, and it may not represent a holistic view of every economic element around the innovation. Expanding CEA to understand the innovation's reach with other measures such as equity could help to more fully

evaluate the social impact of a program. Extended Cost Effectiveness Analysis is one method that is increasingly being used to address equity in CEAs taking into account parameters such as income quintiles (Verguet, Kim, & Jamison, 2016).

IV. Challenges/ Limitations Conducting CEAs

The major challenges that the ESL@B team encountered while conducting CEAs were related to data availability and collection. This limited the ability of the team to conduct evaluations from other perspectives (such as government and societal) and compare it with similar innovations in the space.

- Data
  - Issues related to evidence: most of the innovations evaluated are in the early phase of their product/service development cycle and as a result do not have sufficient data on important parameters such as effectiveness, future estimates of costs, etc.
  - Given that the innovations are in an earlier phase of scaling, they are subject to pivot, resulting in continual change in data and scaling up pathways, which can be difficult to incorporate in a model or analysis.
  - Innovators do not always collect the necessary data (on beneficiaries and impacts, as well as different categories of costs: general administration, personnel, supplies, etc.) to make accurate projections.
  - Many innovators have not yet thought deeply on their future expansion plans. This creates a huge impediment in projecting cost data.
- Perspectives
  - For many innovators, it was not clear how their innovation fit within the broader health systems architecture. Innovators had a deep understanding of the medical/clinical problem they wanted to solve, but knew less about the full administrative and economic context of the health system within which they operated. It was therefore difficult to get data for reliable estimation of costs from the health systems and societal perspectives. In some cases (e.g. monitoring devices shipped directly to patients), the innovations were such that any potential incremental costs to the health system would be minimal and therefore not significantly different from the innovators perspective. In all cases, however, conducting additional and detailed CEA for the government or societal perspective will require primary data collection in the different countries where scale-up was being proposed or implemented. Additional field data collection was not possible under the contractual conditions of this program.
- Comparative analysis
  - Our estimates in the four CEA reports were deemed cost-effective based on WHO's threshold of cost-effectiveness by comparing the innovations with the status quo, and not with other innovations in the space/country. Stakeholders such as funders might be interested to know how cost-effective an innovation is compared to other similar innovations. This was outside the scope of our project, but would benefit from further research.

V. Lessons Learned and Recommendations

In this section, we will present lessons learned from producing the four CEA reports for healthcare innovations that could be applicable to all interested stakeholders, followed by specific recommendations to innovators, funders, and researchers.

- CEA is capable of providing summary results for different stakeholders, about the feasibility of the innovation based on certain parameters which will help make informed decisions about replacing existing methods and achieving long term sustainability and scalability of operations.
- CEA is not the only analytic method to determine the impact of a program/intervention; other methods such as cost-benefit analysis can also be used to better understand impact and improve performance.
- Conducting CEA is a resource and time intensive process that requires various expertise; we suggest that funders/innovators/researchers allocate sufficient time and resources to complete a CEA.
- Stakeholders should interpret CEA results keeping in mind the results are a snapshot in time and therefore subject to change should conditions change.
- Conducting CEA in close collaboration with the innovators helped them reflect on their innovation and think deeply about their program and its position within the healthcare system and/or implication for scale-up, hence, most found the exercise to be quite valuable.
- CEAs will not be of value if the results will not be used by a certain group, therefore it is important to identify stakeholders that might be interested or benefit from the results.
- There might be cases that warrant CEAs assuming different scenarios e.g. a private sector scale up vs public sector scale up pathway.
- In cases where multiple scaling scenarios are being considered by an innovator, one can account for future uncertainties by creating multiple versions of impact models and cost projections based on the different scale up scenarios. Various ICERs could be obtained using cost and impact data from different projection scenarios. This process can help an innovator understand how the cost-effectiveness of their innovation change under different implementation scenarios. This kind of analysis, though very time consuming, can provide robust comparison, facilitating decision making related to implementation, investment, etc.
- CEA might not be necessary for all earlier stage interventions; interventions-specific circumstances should be considered. SL@B and similar donors, innovators, and researchers could take account of the below considerations when making informed decisions regarding whether to conduct a CEA or not.

  i. CEAs can be valuable:
    - For innovations that need CEA results to seek additional funding
    - For countries that are scaling to achieve universal health coverage (UHC); they could greatly benefit from a CEA since they need to pick innovations to be included in a specific benefit package (Ji & Chen, 2016).

ii. CEAs might not be as applicable:
    - If an innovation has strong effectiveness data from RCTs and a relatively negligible cost per unit (e.g. medication that is considered essential). There may not be a need for a CEA if the scale-up is poised to happen regardless of CEA results (listed by WHO as essential drug or supply, already written in national health plan) based on existing evidence.
    - For most early stage innovations due to limitations in data related to effectiveness and future estimates of costs.

Lessons for Innovators

- Innovators interested in doing CEAs should record all the assumptions they make while projecting their future costs. This makes the modeling team's review process of cost data easier and helps avoid over-optimistic projections of cost.
- If an innovator is not able to conduct a CEA, an impact model at a minimum is recommended to demonstrate impact.
- Key data points can be collected during the pilot period of a program/intervention to ensure an impact model can incorporate certain relevant parameters.
  If possible, we suggest that CEAs should be done by an external/independent group to avoid conflict of interest and maintain validity.

Lessons for Funders

- For a subset of later stage innovations preparing to scale with critical partnerships, CEA could be a good investment for donors to consider as a strategy for illustrating impact and informing stakeholder decision-making.
- Funders could expose innovators to available tools such as the Costing Tool developed by the ESL@B team to collect necessary cost data in real time thereby positioning the innovators for a future CEA or other economic analysis.
- Funders could enhance their required M&E plans for innovators to include more routine reporting of impact and cost relevant data/metrics, again to better position innovators for more fully developed impact models and potential future CEAs.
- In addition to introducing tools to conduct CEAs and setting guidelines, funders could also consider providing financial support and technical assistance targeted towards CEA given that it is a process that requires extensive time and resources.

Lessons for Researchers

- The ESL@B team that conducted the CEAs is a multidisciplinary team (physicians, policy analysts, economists, evaluation research experts and maternal and newborn health experts) which was important to bring different perspectives and complete the analysis.
    - CEAs include costing, assumptions, comparative perspective of attractiveness, affordability and sustainability of interventions, in relation to other services in the same sector or other sectors. Furthermore, strategic and budgetary considerations for

the public and private sectors need to be systematically incorporated in a cost effectiveness framework. Therefore, having different team members with different areas of expertise is helpful to attend to the various elements needed for CEA.

- A substantial amount of technical support to the innovators is required as they often do not have the expertise to provide the relevant cost data and projections, therefore a realistic timeline should be considered while conducting a CEA.
- In addition to providing technical support, the timeline could be stretched because researchers might have to rely on costing estimates and other information from innovators, which reiterates the importance of setting a realistic timeline.
- It is important that researchers conducting the CEA engage the innovators in the process so that they understand how their inputs are used and contribute to the results. We found that innovators that fully understood why they are providing inputs and the potential benefits of having a rigorous CEA were more engaged than others.

VI. Conclusion

The ESL@B team conducted cost effectiveness analyses of four selected SL@B TTS innovations to estimate the costs and benefits of bringing them to nationwide scale by 2030 in the countries in which they operate. This paper summarizes the process used by the ESL@B team for producing the four CEA reports. A decision analytic model was developed for each innovation and yielded estimates that indicate each of the four innovations are cost effective per WHO's threshold of cost-effectiveness. These results can be used by innovators and funders to make informed decisions regarding scaling up and investing. However, it is important to note that CEA estimates are a snapshot in time and are subject to change should conditions for the innovations change. The ESL@B team learned important lessons when conducting CEAs. We hope that sharing the details of our work on conducting CEAs of healthcare innovations using a decision analytic model will provide valuable insights for innovators, funders, researchers and others that are tasked with similar cost effectiveness analysis work.

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