

Original Article



Immunization decision-making capacity building in low- and middle-income countries through teaching vaccine economics everywhere: a program evaluation

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ABSTRACT

Background: National immunization program staff have limited prior training in economics, despite a need to make difficult economic choices in financing and operating their programs. Teaching Vaccine Economics Everywhere (TVEE) is an international consortium of 4 universities that provides vaccine economics and financing training to mid-career immunization program managers and policy-makers in low- and middle-income countries. Since 2017, TVEE has provided short training workshops at four regional hubs using a curriculum developed using real data and scenarios tailored to region-specific needs. The study aims to evaluate program impact of the first 2 years.

Methods: The impact of the program was evaluated based on the Kirkpatrick Model. The survey was developed and distributed using Qualtrics to all participants from all

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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regional hubs for whom contact information was available. Surveys were completed online anonymously and responses were grouped by regional hubs. Familiar local leaders sent multiple reminder to improve response rates. The final analysis of data collected was conducted in Microsoft Excel and Qualtrics.

Results: All respondents indicated that vaccine program costing and efficiency (69%) and economic evaluation (63%) were areas with the highest demand for skill-building. Findings show an improvement in knowledge of at least 1 point on a 4-point scale was observed for 59% respondents for cost analysis, 55% for cost effectiveness analysis, 56% for benefit incidence analysis and 56% for program efficiency analysis. After their training, 72% of respondents indicated having opportunities to apply their skills at work and 81% indicated acceptance of the new methods by their supervisor/team.

Conclusion: The results indicate that TVEE had a positive impact in the capacity building of mid-career immunization professionals who found it to be important and necessary in their work. With these results, TVEE will modify the pedagogy to teach theory using practical case-studies and offer hands-on training opportunities.

Keywords: Capacity strengthening; Immunization training; Health economics; Mid-career professionals

INTRODUCTION

As countries transition away from donor support, Expanded Program on Immunization (EPI) managers and policy makers need to develop the capacity to make evidence-based decisions to efficiently manage their national immunization programs. The competencies they need include understanding the economics of deploying limited financial and human resources, logistics and the sustainable financing of vaccine procurement and delivery. Informed decisions need to be made regarding vaccine introduction, which includes both the introduction of new vaccines or reformulations, increasing the coverage of existing vaccines and ensuring the quality and safety of vaccines. Studies that have surveyed EPI leadership in countries that have transitioned from Gavi support have revealed a need to strengthen immunization decision-making capacity at the country level.^{1,2} There is a need to build the capacity to sustainably finance, mobilize and allocate resources to the most effective alternatives, ensure sound financial management, and evaluate the health benefits/impacts of the immunization programs at the national level. One proven approach is to develop mid-career training opportunities.³⁻⁵ Scale up can occur using coalitions of teaching sites.⁶

METHODS

Program description and objectives

Teaching Vaccine Economics Everywhere (TVEE) was launched in late 2016 to promote the efficient use of resources in the development of vaccine delivery programs in low- and middle-income countries (LMICs) through capacity building in the field of vaccine economics, pharmaco-economics, and program financing. Specifically, the objective of this program is to develop appropriate curriculum and sustainable teaching platforms that provide training to mid-career immunization program managers and policy-makers in LMICs on vaccine delivery costs and outcomes for building equitable and sustainable immunization programs.

TVEE is a collaborative global partnership, with faculty from Johns Hopkins University in the United States, Makerere University School of Public Health in Uganda, Aga Khan University (AKU) in Pakistan, Indian Institute of Health Management Research (IIHMR) in India, and Wits University School of Public Health in South Africa. The collaboration expects to add partners in Mahidol University in Thailand and Ouagadougou University in Burkina Faso later in 2019.

As with similar programs aimed at immunization systems strengthening, there are several stakeholder groups with interests in the TVEE project and its outcomes. These include regional immunization decision makers like EPI managers and National Immunization Technical Advisory Groups (NITAGs), government staff (Ministry of Health officials, policy analysts), academics and international organizations or non-governmental organizations (NGOs).

There are 4 pillars to the TVEE strategy: developing content, building capacity, establishing sustainability and growing a global community.

1. Developing content for the curriculum of an online course, open-access handbook and workshops, focused on 6 themes:
 - Principles of vaccine economics
 - Costing in vaccine planning & programming
 - Economic evaluation of vaccine and immunization programs
 - Program evaluation of vaccine and immunization programs
 - Financing and expenditure analysis
 - Systems and logistics analysis
2. Building capacity for immunization decision-making through regionalized workshops offered at each partner institution acting as a regional hub, as well as pre-conference sessions at regional and international conferences and symposia.
3. Working with partners to develop a roadmap toward being able to offer courses in a sustainable manner such as capstone projects, training of trainers, and online courses.
4. Growing a global community through the participation in global immunization forums, creation of an email list, a social media group platform, and contribution to the ImmunizationEconomics.org monthly newsletter.

Program implementation

Content development

The content for the courses, workshops and handbook was developed collaboratively in an iterative manner. The TVEE faculty initially met to review the existing market analyses of the target audience and the existing curricula and training options.^{1,2} This review showed that most EPI staff lacked background in economic evaluation, costing, cost-effectiveness, financing, and resource tracking despite having to make daily decisions in resource allocation. Furthermore, the public health training institutions in most LMICs were not offering training opportunities that could fit the busy work schedules of mid-career professionals. The review also showed that the target audience preferred in-person workshops to online learning opportunities citing difficulty protecting the time for online learning as well as internet bandwidth obstacles. The faculty then assembled a final list of 89 target learning objectives that could be packaged into the 6 modules outlined in the previous section. Teams of faculty worked together to develop content around these 6 modules, including a combination of readings, lectures, and practical exercises. The developed content introduces vaccine economics theory, utilizing exercises and case studies based on real scenarios and policy applications. This content is available to the public through the Johns

Hopkins website JHSPH OCW (<http://ocw.jhsph.edu/index.cfm/go/find.browse#collections/collectionID/9/>). These course modules were also central to the series of 2–4 day workshops that were offered in each of the partner countries.

Building capacity

Since July 2017, TVEE has organized 21 training workshops at its four regional hubs in South Africa, Uganda, India and Pakistan, with 390 participants from 27 countries. These workshops have been primarily organized by the regional partner institutions, with material and practical exercises that were tailored to the context-specific needs of the target audience. Each workshop had approximately 20–30 attendees from various backgrounds and levels of involvement in immunization programs. Participants were drawn from multiple surrounding countries in a region. For example, participants from Kenya, Tanzania, and Ethiopia, attend courses in Uganda. Participants from Malawi, Zambia, Mozambique, and Angola attend courses in South Africa. Faculty were drawn from each anchor institution as well as regional and international subject matter experts.

Establishing sustainability

It is important to ensure that regional hubs and surrounding countries are able to carry on capacity building activities after the completion of the project. TVEE is working with regional and international partners to develop a sustainable training model that will continue to train participants in vaccine economics, support the training of future facilitators and provide project mentorship for alumni.

Growing a global community

The program established a global community of TVEE alumni connected via social media, including groups on LinkedIn and Twitter, with active ongoing engagement on current events and developments in the field of immunization economics. This allowed participants to have ongoing support for participants through peer-to-peer network, and pairing with a mentor for coaching.

Program evaluation

TVEE impact on the experiences of participants who attended TVEE workshops at each of the 4 regional hubs from 2017 to 2018 was evaluated to measure the extent to which participants have been able to incorporate what they have learned into their work. While immediate post-workshop evaluations at each site consistently observed positive reviews from the participants (above 80%), the focus of this evaluation was to analyze the skills and knowledge gained through the program and whether these have been utilized in a practical context. Respondents reported what obstacles, if any, exist in the application of the new knowledge. They also described the strengths and weaknesses of the curriculum and workshops, considering factors such as costs, timing, and training content. Lastly, the evaluation aimed to assess the national ability sustain ongoing capacity development efforts in this area. The results of the evaluation conducted can assist program developers regionally and globally in tailoring the project's future activities to better meet participant needs, a key component to ensure relevance and sustainability of the project.

Evaluation design

The evaluation was based on the Kirkpatrick model of evaluation.⁷ In this framework, level 1 refers to immediate post training surveys of learners, while evaluation at level 3 measures whether the knowledge and skills that the training participants have learned in the training

are applied to their work. Level 4 which measures the results of the training; however, it usually takes more than a few months to observe these results.

Immediate post-workshop evaluations conducted were not helpful in assessing the degree to which new skills and knowledge were used and their importance in the participants' work. Any secondary impacts in their workplace such as increased peer-to-peer learning and financial support could not be observed. Thus, this evaluation was undertaken to help the team assess these parameters and adjust project activities to fill in any gaps observed.

To evaluate the first two years of the program, participants were emailed surveys to complete online anonymously. Participant feedback was grouped by regional hub, analyzing both trends within and between groups. The survey (approximately 10 minutes long) was developed and distributed using Qualtrics to all participants from all regional hubs for whom contact information was available. The brevity of the survey was designed to limit respondent burden and minimize dropout, but this comes at the expense of less in-depth questioning. This approach allowed progressive tracking of responses and evaluation on an ongoing basis. Multiple reminders from familiar local leaders were used to improve response rates.⁸

The aim of the survey was to assess the effectiveness and impact of the TVEE workshops. Specifically, these themes were explored:

1. Did the workshops and the curriculum meet the needs and demands of the participant?
2. Were the workshops accessible and affordable in terms of cost, content, timings and venue?
3. Is there a desire to appropriately change/adapt current work based on the workshop(s)?
4. Does the participant know what to do, when to do, and how to do it?
5. Does the participant work in the right climate to support the changes?
6. Is the participant rewarded/appreciated for making the changes?
7. Does the participant and their team see a positive future impact of the changes made?
8. Is the participant able to transfer knowledge and skills learnt to their peers?
9. Do the participant's peers demand similar trainings for themselves?

The final analysis of data collected via surveys was conducted in Microsoft Excel and Qualtrics.

This was research motivated to expand the market for the curriculum and to better tailor the curriculum to meet the needs of participants.

RESULTS

Survey results

Invitations to complete the survey were sent out to 200 workshop participants, and 86 responses were received (43% response rate). Fifteen responses were less than 10% complete, so were excluded from this analysis, leading to a sample of 71 for the included analyses of which nine were partially completed. Of these, 30 respondents were from the South Africa workshops, 26 were from the Uganda workshops, 5 were from the Pakistan workshops and 7 from the India workshops. Three responses did not indicate the location where they attended the workshop. The low response rates could be attributed to the fact that many of these participants were contacted after more than 6 months, and were lost to follow up. These response rates are consistent with those in other evaluations of adult learner education programs.⁹

Participant backgrounds

Respondents came from diverse backgrounds and stakeholder groups discussed in previously. Specifically, 27 (up to 38%) work in regional or national EPI programs of which 7 were in managerial positions. 32 respondents (up to 45%) work in immunization projects in governmental agencies (including Ministries of Health, Public Health and Finance) and non-governmental agencies (including United Nations Development Programme, Program for Appropriate Technology in Health, and John Snow, Inc.). Lastly, 12 respondents (up to 17%) are affiliated with academic institutions (with roles ranging from graduate students and researchers to lecturers). The majority of respondents were early or mid-career professionals, with 69% falling in the range of 1 to 10 years of experience (Supplementary Table 1).

Overall need and demand for vaccine economics training

To establish a better understanding of the needs at each regional hub, respondents were asked to identify whether any of six potential challenges to vaccine delivery systems were applicable to their countries. These included weak service delivery, financial constraints, ineffective planning and decision-making, inadequate supply of vaccines, insufficient awareness of clients and religious/cultural barriers, with an “other” option to specify additional unlisted challenges. Although region-specific subsamples are too small to allow for confidence in comparisons, trends suggest that there is geographic variation to the needs of vaccine systems. For example, we can see in Fig. 1 that a majority of the respondents at the South African hub (77%) identified financial constraints as a major challenge, compared to 29% of respondents at the India hub. On the other hand, 43% of respondents from the India hub selected ‘insufficient awareness’ as a challenge, compared to a lower 27% of respondents at the South Africa hub. Overall, 66% of participants identified ‘financial constraints,’ 46% identified ‘weak service delivery,’ 41% identified ‘ineffective planning,’ 39% selected ‘inadequate supply,’ 48% ‘vaccine hesitancy,’ and 35% ‘insufficient awareness’ as being major challenges in their vaccine systems. This data suggests that even though there are factors such as ‘cultural barriers’ and ‘insufficient awareness’ that are not within the scope of the TVEE approach, there is a need for improved economic and logistical planning and decision-making capacities in both the finances and supply chain of the immunization programs.

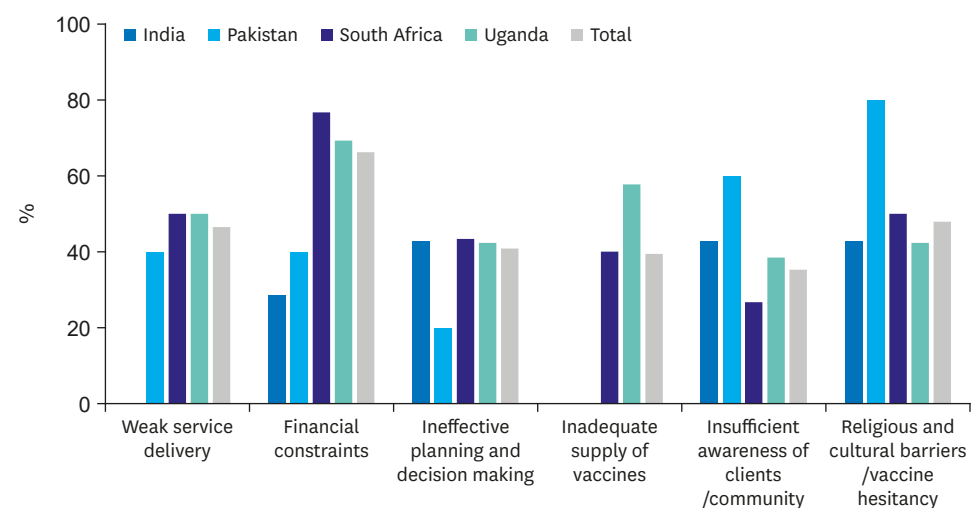


Fig. 1. Percentage of respondents for major challenges to vaccine delivery systems.

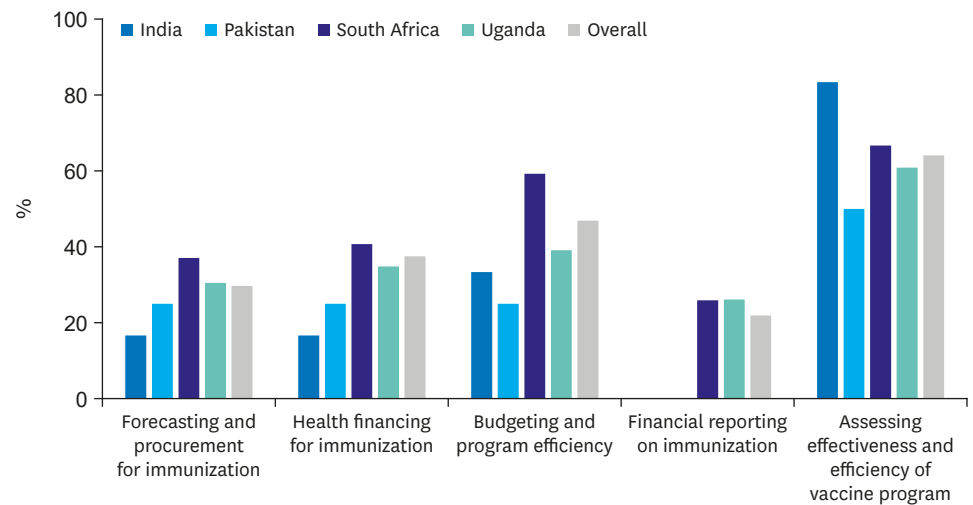


Fig. 2. Various applications of vaccine economics and the proportion of participants who are involved in each.

Participants were provided with a list of job functions that may be aided by training in vaccine financing and economics, and asked to indicate which of the activities they were involved in. As indicated by Fig. 2, the activities that had the most practical applicability were ‘assessing effectiveness and efficacy’ and ‘budgeting and program efficiency.’

Lastly, participants were asked to identify areas that required skill-building in their work from a list of 7 sub-disciplines of vaccine economics: economic evaluation and modeling economic benefits, vaccine program costing and efficiency, financing vaccine programs, budgets, monitoring and resource tracking, immunization systems analysis, economics of demand and economics of supply. The areas with the highest demand for skill-building amongst all respondents (presented in Fig. 3 and Supplementary Table 2) were economic evaluation (63%), vaccine program costing and efficiency (69%), immunization systems analysis (57%) and budgets, monitoring and resource tracking (56%).

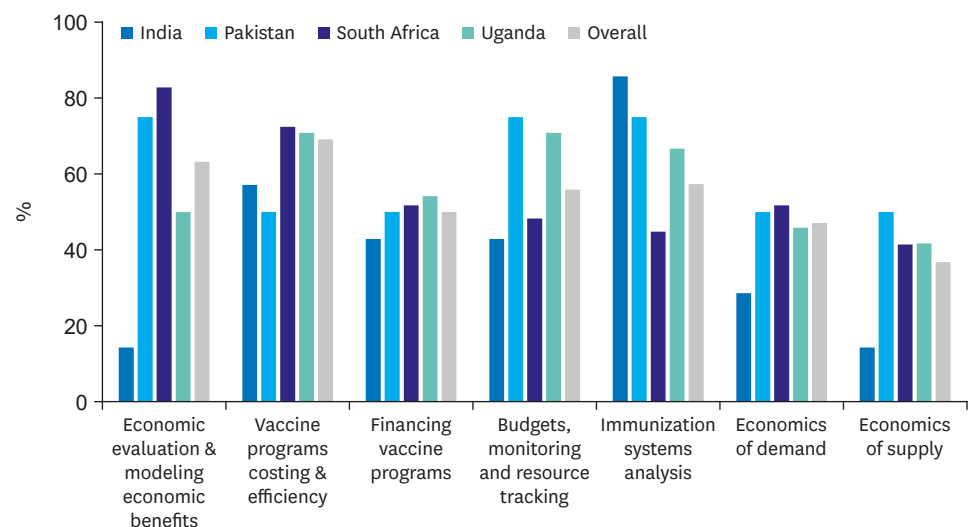


Fig. 3. Vaccine economics subdisciplines identified as requiring skill-building for job.

Overall impact of TVEE

Overall, respondents indicated that the program had a positive impact on their work, irrespective of the site. In order to gauge the magnitude of knowledge change, respondents were asked to rate their understanding before and after their participation in the workshop of four different economic analyses—cost analysis (CA), cost-effectiveness analysis (CEA), budget impact analysis (BIA), and program efficiency assessment (PEA) on an ordinal 5-point Likert scale going from ‘none’ to ‘excellent.’ The difference in knowledge was calculated for each participant by assigning a 0 to 4-point value and the magnitude of knowledge improvement was reported as the difference between the before and after states. The average of these individual differences was calculated for each analysis type. **Supplementary Table 3** presents detailed results of this analysis where a reported improvement in knowledge of at least 1 point on the 4-point scale was observed for 59% respondents for CA, 55% respondents for CEA, 56% respondents for BIA, and 56% respondents for PEA. The median improvement was in the 1-point range, with 36% of respondents reporting a 1-point improvement in CA knowledge, 43% for CEA, 40% for BIA, and 45% for PIA. The results are indicative of differences in improvements between regional hubs, however it is difficult to compare due to differences in the sample size of each hub.

Adaptability to work and workplace barriers

The 81.82% of all respondents reported using specific knowledge/skills acquired from the workshop in the field of vaccine economics, economic evaluation, health financing and costing in their work. 70.77% reported having revisited material from the workshops for work-related reasons. Cited reasons for revisiting the material included the performance of costing, financial or cost-effectiveness analyses, development of a manuscript on cost-effectiveness of particular vaccines, and sharing the information with colleagues and students.

Participants were also asked to rate the favorability of their work place to the new knowledge and methods. Of those who replied “yes” to using the new methods in their work, an overall 62% (**Fig. 4** and **Supplementary Table 4**) indicated that appreciation for the new methods in their workplace was “somewhat above average” or “above average.” Those who reported having challenges implementing learnings in the workplace cited barriers due to the lack of peer and organizational understanding, the difficulty of the concepts and challenges in communicating the concepts to others. Results showed that 72% of participants indicated

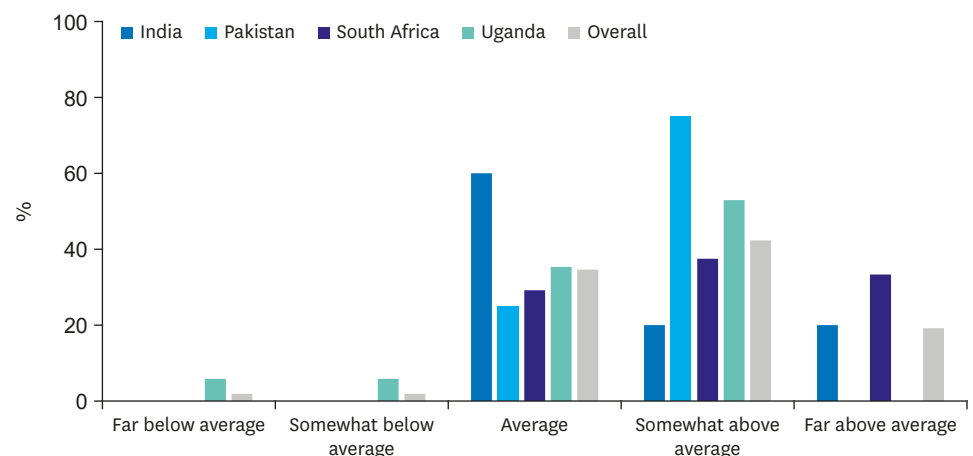


Fig. 4. Extent of appreciation expressed in the workplace for changes based on TVEE learnings. TVEE = Teaching Vaccine Economics Everywhere.

having opportunities to apply their skills at work and 81% indicated either 'definitely yes' or 'probably yes' to the acceptability of the new methods to their supervisor/team (**Supplementary Table 5**). According to the survey, 93% of participants thought that their peers would definitely be interested in attending the trainings. These results suggest that the participants have work environments that are relatively favorable to the introduction of these new methods and that there is demand for additional workshop sessions. Altogether, this confirms the potential impact TVEE training can have on immunization decision-making capacity building.

Accessibility and affordability of workshops

The majority of the TVEE participants were supported through scholarships provided by the regional hubs from the initial. Though 87% of the respondents agreed that the workshops were accessible and affordable, majority of them noted that it would be difficult to attend without scholarships and support. A few also noted that there were limited funds available from their organizations. It was also observed that the majority of the participants indicated increased opportunities of funding only when the organizations appreciated the new skills and knowledge attained to the highest extent.

Suggestions to improve curriculum offerings

A majority of the respondents suggested offering the workshops online, adopting the curriculum into short academic programs, and including a practicum or field work project. A few of the respondents also mentioned the need to be connected to additional career resources for joint collaboration in immunization activities. Participants have persistently expressed a preference for more skill-building exercise more than didactic presentations.

Aside from the survey results there is evidence of sustainable impact as course materials have already been incorporated in pre-service classes being taught at the master level in 2 of the partner institutions. Videotapes of class sections are also being drawn on to reach audiences outside of the workshops at the Ugandan site.

DISCUSSION

The main limitation of the evaluation was the response rate of 43%. Since there was heavier representation of South Africa hub participants compared to the other three hubs, we cannot make inter-regional comparisons. Additionally, this means our overall data is heavily influenced by the experiences of the participants invited to the regional South African hub, who may not be representative of the entire population of TVEE participants. Thus, results have to be interpreted with caution about the representativeness of the sample due to the possibility of selection bias being present. Another limitation is that there is a known tendency for learners to respond favorably on scales used in course evaluations and this may bias results.¹⁰

While the Kirkpatrick evaluation model offers a straightforward and pragmatic way of helping facilitators evaluate and tailor their training programs, it is not without its weaknesses. The model assumes there is a simple casual linkage between all four levels of the model. However, further research has failed to confirm this linkage.¹¹ In this evaluation, we recognized that despite the positive results of level 1 evaluations of the participants, and their role in facilitating the learning and transfer process to some extent, they are not indicative of

any long-term behavioral change, or organizational impact. Thus, for this evaluation we have conceptualized level 3 and level 4 to be largely separated from the lower levels with perhaps a small degree of linkage. Furthermore, though this evaluation is not able to measure the primary intervening variables and their effect completely, it does provide a basis on to which future evaluations by TVEE can improve upon.

The evaluation has observed indicative trends in the impact of capacity building activities on participant outcomes. These results are invaluable to the TVEE's future goals and strategies. Thus, the team will be scheduling more rigorous evaluations periodically to assess the impact of the project. Future evaluations will consist of a short 10-minute survey, followed by an in-depth interview of the participants who consent to it. The short surveys will ensure a high completion rate by our adult participants and offer low requirements of time and effort to complete the surveys. The in-depth interviews will allow us to examine the evaluation themes in more detail. This includes obtaining information on adequate resources, organizational culture, performance consequences, managerial expectations and support, and any other key input factors.

The evaluations will be conducted every six months which will allow the participants enough time to apply their new skills and knowledge, while ensuring they are not lost to follow-up.

In conclusion, the findings of the survey indicate that the Teaching Vaccine Economics Everywhere program had a positive impact in the capacity building of mid-career immunization professionals. A majority of the respondents found the workshop and the curriculum to be important and necessary in their work.

The results of this evaluation have been instrumental in modifying our teaching methodology. This includes shifting the focus on theory-focused sessions to teaching theory using practical case-studies and exercises that give participants a more hands-on training. There will also be further inclusion of key experts in the region to provide participants with more context and discussion about the applicability of vaccine economics in the field, and obstacles faced in implementation.

In the coming years, TVEE will focus on strategies to provide online learning and practicums for the attendees, as well as additional exercises and take-home materials. The feedback received will further inform the ongoing design of the curriculum and workshops to ensure regional needs are answered while maintaining the affordability and accessibility of the workshops.

SUPPLEMENTARY MATERIALS

Supplementary Table 1

Showing the experience levels of the 19 respondents

[Click here to view](#)

Supplementary Table 2

Showing the subdisciplines of vaccine economics that were identified as requiring skill-building for work

[Click here to view](#)

Supplementary Table 3

Showing the magnitude of change in knowledge rating in 4 financial assessments after workshops in 4 regional hubs

[Click here to view](#)

Supplementary Table 4

Showing the proportion of participants who reported using learnings in their work, and of those who did, the appreciation/favorability of the workplace to the new methods

[Click here to view](#)

Supplementary Table 5

Showing Likert scale rating

[Click here to view](#)

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