



FINAL REPORT
MOTS Costing Exercise
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FINAL REPORT

MOTS Costing Exercise

Executive Summary

In an effort to minimize the future impact of Ebola in Africa, numerous donors and stakeholders have worked together to develop an Ebola vaccine, to disseminate information and training to health workers and populations in communities at risk of an Ebola outbreak, and to reinforce communication and trust between national health systems and the broader population. The Ebola Vaccine Deployment, Acceptance and Compliance project (EBODAC, www.ebovac.org/EBODAC) carried out by a consortium in Sierra Leone from 2016 to 2019 tested a mobile-based IVR refresher training, known as the Mobile Training and Support (MOTS) service to strengthen the knowledge, skills and attitudes of community health workers (CHWs) in Sierra Leone following their in-person foundational training with the Ministry of Health and Sanitation (MOHS) on Ebola readiness and vaccination. As part of the MOTS implementation, a costing study was commissioned, which is the subject of this report.

The key questions analyzed through the MOTS costing study are:

- ⇒ What will be the regular, ongoing cost to the MOHS of providing mobile-based refresher training to CHWs throughout Sierra Leone?
- ⇒ How does the expected cost to MOHS of offering MOTS refresher training compare to that of the alternatives—in-person refresher training or no refresher training at all?
- ⇒ What are the benefits of the mobile-based refresher training for the MOH (or another implementing organization), and what are the tradeoffs compared to in-person refresher training?
- ⇒ What are the costs (as well as benefits and drawbacks) to CHWs of the mobile-based refresher training?

In investigating the costs and benefits of MOHS implementing mobile-based refresher training, based on the MOTS pilot project, the costing study finds that:

- The cost for MOHS to provide mobile-based refresher training to all CHWs in a single district within one year would be about \$25,000, compared to \$52,000 for in-person refresher training—a savings of \$27,000;
- The annual cost for the MOHS to extend a mobile-based refresher training to all 16,000 CHWs nationwide is estimated to be around \$190,607, which amounts to approximately \$12 per year per CHW, and \$1.19 per household reached;
- CHWs incur low opportunity cost when attending in-person training and incur low/no opportunity and airtime costs in accessing the mobile-based IVR refresher trainings, which are available according to their schedule and preferences;
- This mobile-based refresher training mechanism is a game-changing innovation in contexts with widespread and hard-to-reach rural populations; MOTS enables a dramatically more efficient and widespread community health outreach, builds sustained engagement with decentralized health workers and can provide a critical safeguard in the case of health emergencies;
- The MOHS could put in place the foundation for mobile-based refresher training and CHW communication for a low, fixed annual fee (under \$14,000 for the technology infrastructure and translation and recording of the IVR audio content), and then disseminate education modules selectively according to available funds to cover the variable expenses;
- Although implementing the mobile-based refresher system entails significant annual expense, the potential benefits of enhancing CHW performance and by extension community health and readiness—thereby reducing the occurrence and impact of various diseases including Ebola—

appear to outweigh the marginal cost¹ of implementing the mobile-based refresher system and should be supported by donors.

This report provides an overview of the costing data collection, analysis and findings, presents a discussion of the assumptions, considerations, implications and conclusions with the goal of informing decision-making and budgeting for mobile-based refresher training in Sierra Leone, as well as other sub-Saharan African countries.

¹ Note that throughout this report, we use the term ‘marginal cost’ in the cost accounting sense—indicating the cost that is *over and above* the current level. This costing exercise does not take into account the *total* expense of refresher training, but rather analyzes the *additional* investment required to implement refresher training.

Part One: Findings

I. Project Background

Ebola caused the loss of more than 11,000 lives in three countries of West Africa in 2013-2016 and has continued periodically to threaten and ravage communities in other sub-Saharan African countries through 2019. Estimates of economic loss as a result of this regional Ebola crisis range from \$2.8 billion to \$53 billion when accounting for the diversion of health resources that also led to deaths from other diseases.² Three main factors contributed to the spread and deadliness of Ebola in Sierra Leone:

- The contagiousness, rapid onset and acuteness of the Ebola virus itself, coupled with the lack of preventive immunization or specific treatment;
- Insufficient knowledge, awareness and readiness of health workers and the broader population around Ebola symptoms, containment and treatment; and
- Community-level mistrust of government information, extending to health workers, rooted in sociopolitical issues and suspicions.

In order to minimize the future impact of Ebola in Africa, numerous donors and stakeholders have worked together in recent years to develop an Ebola vaccine, to disseminate information and training to health workers and populations in communities at risk of an Ebola outbreak, and to reinforce communication and trust between national health systems and the broader population, with the goal of ensuring accurate, reliable and efficient information flows in the case of Ebola and other health emergencies.

In this context, a consortium comprised of the London School of Hygiene & Tropical Medicine, Janssen Pharmaceutical Companies of Johnson & Johnson, World Vision Ireland and Grameen Foundation, carried out the Ebola Vaccine Deployment, Acceptance and Compliance (EBODAC) project in Sierra Leone, alongside a clinical trial of the Ebola vaccine through the European Union's Innovative Medicines Initiatives Ebola+ Programme. The EBODAC project in Sierra Leone has aimed to develop strategies and tools to maximize the impact of Ebola vaccination programs and to equip community health workers, and through them the local population, with the information they need to protect themselves and their communities in the case of Ebola outbreak.

EBODAC employs Grameen Foundation's MOTECH mobile health technology to deliver "refresher" training to community health workers through a mobile phone-based service called the Mobile Training and Support Service (MOTS). Community health workers access pre-recorded IVR health training modules on their mobile feature phones, review training material in one of five local languages, and enter their responses to voice prompts to validate their understanding. Health supervisors are able to remotely monitor their team's usage of the mobile training tool and provide in-person support when needed. Over the course of the EBODAC project from 2016-2019, MOTS has been rolled out and evaluated throughout Kambia, one of 16 districts of Sierra Leone. The Sierra Leone Ministry of Health and Sanitation (MOHS) hopes to extend MOTS across all 16 districts in coming years, using the channel to deliver refresher training modules on Ebola readiness and vaccinations, as well as other key health topics for local community health workers.

The objective of EBODAC-MOTS is to reinforce the knowledge, skills and attitudes of community health workers across the country in an efficient, effective and affordable manner. The MOHS already provides community health workers with in-person training that is costly and time consuming to extend nationwide. While in-person foundational training is considered and will continue to be an important starting point, the MOHS and the EBODAC-MOTS consortium hope that mobile-based refresher training will be an affordable way to increase regular interaction between community health workers and the MOHS and

² <https://www.reuters.com/article/us-health-ebola-cost/west-africas-ebola-outbreak-cost-53-billion-study-idUSKCN1MY2F8>

help keep health workers' skills and information fresh and up to date. Thus, in addition to Ebola-related training, MOTS may be an efficient vehicle for reinforcing a range of health modules, maintaining strong relationships between governments and the community health system, and rapidly disseminating key messages across the community health network and to remote areas in case of urgent need.

II. Purpose of the Costing Exercise

Implementing a new system for health-related training and communication is a weighty decision with implications for the implementing organization's budget, personnel, operations, outputs, outcomes and impacts. The question at the crux of this study is whether applying the new technology of MOTS to reinforce Ebola-related and other health training for community health workers in sub-Saharan Africa is cost-effective, yields satisfactory outcomes for the population targeted and demonstrates good value for money for the potential implementing body—in this case the MOHS. The results of this study are also intended to inform MOTS implementation decisions in other countries at risk of Ebola outbreaks, as well as shed light on the comparative costs (and benefits) of MOTECH training more generally.

In response to project objectives and a direct request from the Sierra Leone MOHS, the EBODAC-MOTS consortium commissioned a study of the costs associated with offering (and participating in) mobile-phone based refresher training for community health workers (CHWs) in Sierra Leone. The current report presents the key questions, findings and implications of the EBODAC-MOTS economic evaluation.

Key questions

The purpose of the MOTS costing analysis was to identify and document the costs of mobile refresher training as compared to the cost of in-person refresher training as experienced by MOHS (or another implementing organization) and CHWs (those participating in the training). To do this, we examined the costs associated with (a) MOHS in-person training, (b) the EBODAC roll-out of MOTS, and (c) the theoretical case of MOHS implementing mobile-based refresher training.

The key questions that we sought to answer through this costing analysis of MOTS were:

- ⇒ What will be the regular, ongoing cost to the MOHS of providing mobile-based refresher training to CHWs throughout Sierra Leone?
- ⇒ How does the expected cost to MOHS of offering MOTS refresher training compare to that of the alternatives—in-person refresher training or no refresher training at all?
- ⇒ (To the extent possible under this study) what are the benefits of the mobile-based refresher training for the MOH (or another implementing organization), and what are the tradeoffs compared to in-person refresher training?
- ⇒ What are the costs (as well as benefits and drawbacks) to CHWs of the mobile-based refresher training?

Report objectives

The purpose of this MOTS costing report is to address the key questions above and to:

- ◆ Document and compare the costs of delivering refresher training to community health workers in Sierra Leone via traditional in-person training and via MOTS;
- ◆ Explore the assumptions, considerations and trade-offs of delivering health refresher training with the two mechanisms (in-person versus mobile-based);
- ◆ Provide practical and actionable insights for decision-making, budgeting and planning for the future delivery of refresher training to community health workers in Sierra Leone and beyond.

III. Overview of Methodology

The costing data collection and analyses were led by a consultant in collaboration with project stakeholders (Grameen Foundation, World Vision and MOHS) from March to November 2019, through both remote and on-site work in Sierra Leone and Ghana. Figure 1 summarizes the key steps undertaken in the process.

Hypotheses

The Consultant and EBODAC project team launched this economic evaluation with the following hypotheses:

1. The MOH cost of offering MOTS to an equivalent number of CHWs is less than the cost of providing comparable in-person refresher training.
2. The cost to CHWs of participating in mobile refresher training is lower than attending in-person training (due to opportunity costs and convenience).
3. Knowledge transfer with MOTS is approximately equivalent to in-person refresher training, and any deficit (e.g., due to lower interpersonal support, clarification of questions and doubts, confidence-building) is offset by other benefits of MOTS.

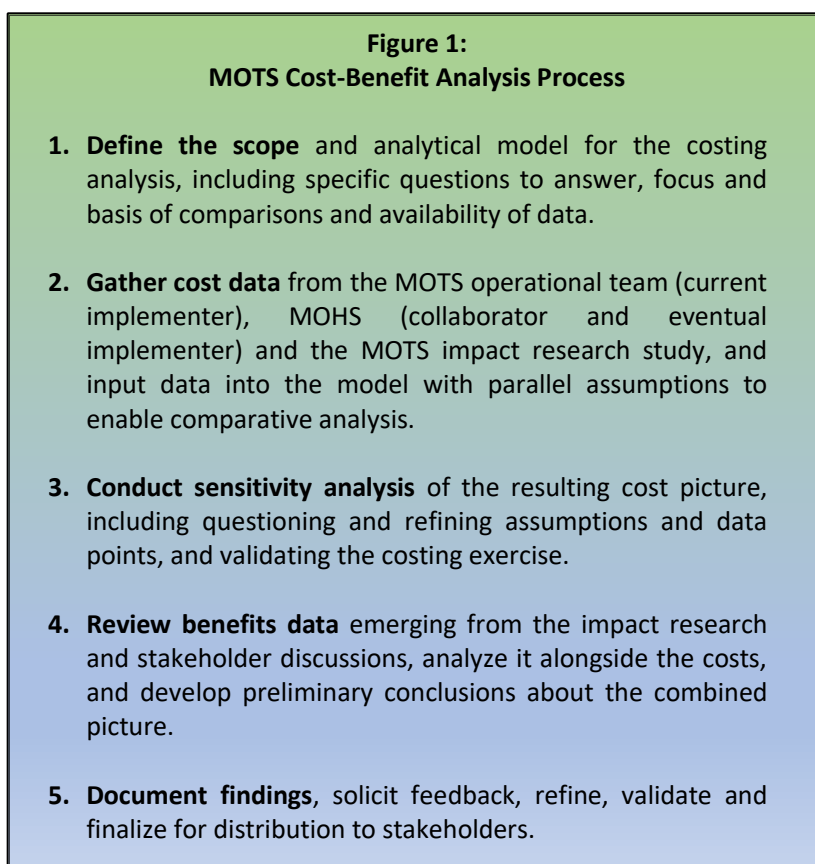
Scope

In order to provide a clear and solid foundation for the collection of cost-benefit data in the field the Consultant, MOTS team and MOHS representatives zeroed in on the following specific scope:

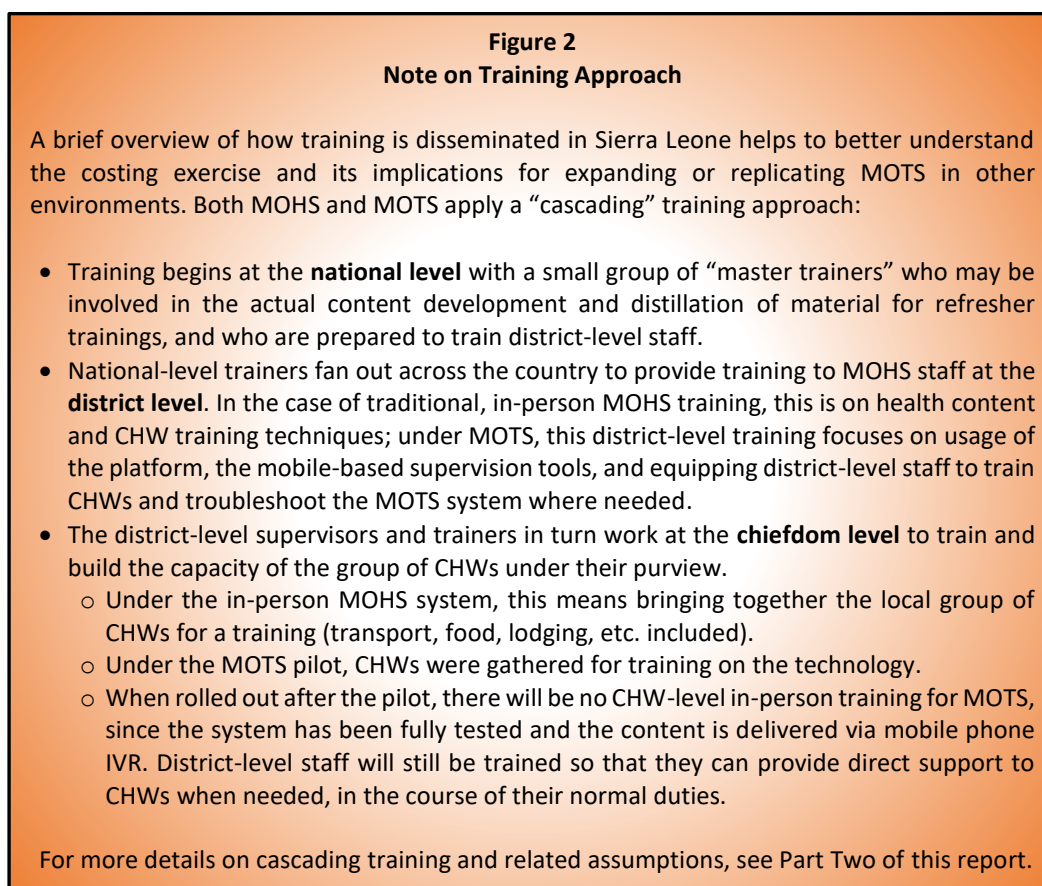
- Compare three main categories of refresher training:
 - ⇒ MOHS in-person refresher training (cost of theoretical refresher training,³ based on current, actual cost of MOHS in-person training in one district—Kambia)
 - ⇒ MOTS refresher training (pilot project operational project costs to deliver IVR refresher in one sample district—Kambia)
 - ⇒ MOHS-MOTS refresher training (estimated cost of MOHS delivering MOTS refresher training as part of their system, based on actual MOTS and MOHS costs and the transition concept currently under development)
- For the sake of comparability, narrow the costing focus to:
 - ⇒ A single module of refresher training (on any topic⁴)

³ Note that the MOHS is not yet offering refresher training to CHWs. While they perceive a critical need and have a plan to do so, MOHS in-person refresher training has remained unfunded, and the MOHS has expressed interest in adopting MOTS as a cost-effective method of reinforcing their in-person foundational trainings with regular refreshers—potentially on all of the current CHW training modules.

⁴ Considerable consideration was given to how to compare MOTS with existing MOHS training. At the CHW level, MOTS training is delivered by (a) in-person trainings on how to use the MOTS technology, and (b) IVR conveyance of



- ⇒ Delivery to all CHWs in one district (using MOHS target of 1,000 per district,⁵ and basing costs on Kambia)
- ⇒ Taking into account a cascading TOT approach that covers (a) national, (b) district and (c) CHW levels for all three categories (see Figure 2: Note on Training Approach).
- ⇒ Omit salary and time expense of existing MOTS and MOHS staff from the cost analysis, in order to ensure apples-to-apples comparison of the *marginal* expense associated with refresher training approaches.⁶



the health content. In addition to CHW-level training, MOTS implements technology-focused TOTs at the district level. MOHS trainings of CHWs, district-level and national staff, in contrast, cover the actual health content. Hence the expertise and time required to deliver MOTS and MOHS training vary considerably. Due to these substantial differences, the consultant, MOTS and MOHS representatives decided to focus on the cascading training necessary to deliver any single refresher module.

⁵ There are 16 districts in Sierra Leone. The MOHS currently covers 14 districts with CHWs. Their target is to have 1,000 CHWs per district in all 16 districts. Kambia currently has approximately 860 CHWs. The MOHS is planning to conduct a national campaign to replace CHWs lost through attrition and establish the 1,000 target in all districts.

⁶ MOHS salary data and percentage of time spent on specific tasks are sensitive and difficult to obtain; the salary rates and time spent of international and temporary project staff are not necessarily comparable or applicable to the ongoing delivery of MOTS; the team agreed that the time and effort to obtain and render useable such salary and level of effort data was not matched by the value of the resulting information. Instead, we omitted all salary data on both sides (MOTS and MOHS) to level the field; we assumed that existing MOHS staff will replace some current duties with MOTS-related duties at no additional expense; and we took into account only marginal personnel costs (additional hires or expense to accommodate the new tool).

General assumptions

- This study focuses on the costs and benefits associated with refresher training only. We assume that foundational in-person training will continue to be provided and that the MOTS tool will supplement health workers' knowledge, skills and attitudes, rather than introduce brand new information and practices. As such, this economic evaluation is limited to refresher training or the equivalent (in duration, personnel and expense).
- The study emphasizes forward-looking operational costs—focusing on the expense of extending health content through the MOTS mechanism (compared to in-person refresher trainings). The study does not delve into the full research and development costs of the EBODAC-MOTS project, treating these as sunk costs paid for by donor funds, managed by a temporary pilot project team of international and regional experts, already incurred, and not anticipated to recur.
- The study focuses on an economic comparison of MOTS and in-person training as a distribution mechanism that can be used not only for Ebola and vaccine-related refresher training (as in the case of the EBODAC project), but also for any number of other health refresher trainings. The costs are analyzed on the basis of any single health training refresher module of a similar length (around 45 total minutes of content material) on a per district basis.

Data sources

Data was collected from the MOTS operations team and the MOHS; preliminary results of the EBODAC impact research study were also considered to inform the assessment of benefits. Training expenses are based on actual project records, official MOHS rates and reimbursement policies; they reflect the actual rate budgeted or paid by MOTS and MOHS, as of June 2019. Note that figures do not account for inflation, and the exchange rate is maintained at a stable rate of 8,874 Leones per \$1 USD.

Acknowledgements

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IV. Discussion of Findings

This chapter addresses the key questions laid out in section II, drawing on the costing exercise (detailed in Part Two) and discussing the results, nuances and considerations of these findings. (The following figures are based on the full analysis presented in Table 6 in Part Two.)

A. Implementer Costs

The first two key questions focus on the expense to the MOHS of delivering refresher training to CHWs:

- ⇒ **What will be the regular, ongoing cost to the MOHS of providing mobile-based IVR refresher training to CHWs throughout Sierra Leone?**
- ⇒ **How does the expected cost to MOHS of offering MOTS refresher training compare to that of alternative (in-person) MOHS refresher training?**

Although the MOHS perceives an important need to reinforce CHW training with periodic “refresher” training, such “refreshers” have not yet been on offer. The MOHS must secure funding to help cover the

cost of any CHW training, whether foundational or refresher. Since the MOHS is not yet offering systematic refresher training to CHWs, the costing study examined what the additional (marginal) expense would be to begin offering refresher training on the Ministry’s existing health modules—comparing the cost of a single MOTS module and the cost of a theoretical, comparable in-person refresher training.

DISTRICT LEVEL ANALYSIS

Comparison of costs at the district level

This costing study directly analyzed training dissemination across a single district. Therefore this section reports on those district-level findings, from which we extrapolated the nationwide findings that follow in the next sections.

The study found that the marginal cost to the MOHS of offering one refresher training in a single district, reaching a total of 1,000 CHW would be **\$51,579 for in-person training**, versus **\$24,942 for mobile-based training** (Table 1).

- On the in-person training side, this includes cascading trainings at the national, district and CHW levels; neither calculation includes the staff time required to adapt full-length training material into refresher trainings, and we consider that this will continue to be undertaken by existing MOHS staff as part of their current roles, regardless of the refresher training format (in-person or mobile-based).
- On the mobile-based side, this similarly excludes the expense of adapting existing material to the MOTS format, which was undertaken by the donor-funded pilot project; we anticipate that the existing MOHS team will undertake this distillation going forward. The mobile-based expense does include translating into five languages, IVR recording and configuring in the MOTS system, as well as cascading trainings at the national and district level (the CHW level will be covered via mobile), and the base cost of the platform and data usage.⁷

Hence the cost of offering mobile-based refreshers would be about 40% of the cost of in-person refresher trainings, with a 52% **cost savings of \$26,637**.

Table 1: Comparison of the costs to deliver a single refresher module throughout one district			
Costs (USD)	<u>In-Person Refresher</u>	<u>Mobile-based Refresher</u>	<u>Cost Difference</u>
1- Project/national level	5,117	9,497	(4,797)
2- District level TOT	4,234	4,831	(597)
3- CHW (chiefdom) level	42,229	6,214	36,015
4- Technology	-	4,400	(4,400)
Total	\$51,579	\$24,942	\$26,637

Cost per CHW, household and individual reached

This expense breaks down to a **per-CHW cost of \$52 for in-person** and **\$25 for mobile-based training for the first module in the first year**. Given that each CHW covers at least 10 households, this comes to a per household expense of \$5.16 for in-person or \$2.49 for mobile-based. And assuming an average of five individuals per household, the expense is around **\$1.03 per community member reached** for in-person, versus **\$.50 for mobile-based training** (Table 2). It is important to note that while these are district-level costs, they include the expense of the basic technology infrastructure necessary to serve all 16 districts nationwide.

⁷ The technological costs are based on the EBODAC-MOTS team “concept” that has been discussed and revised with MOHS input, combined with best estimates based on our current understanding of the MOHS plan.

Costs (USD)	<u>In-Person Refresher</u>	<u>Mobile-based Refresher</u>	<u>Cost Difference</u>
Total Cost of 1st module in 1 district	\$51,579	\$24,942	\$26,637
Cost per CHW (1,000 per district)	52	25	27
Cost per household (10 per CHW)	5.16	2.49	2.66
Cost per individual (5 per household)	1.03	.50	.53

Proportion of costs

Mobile-based training requires an upfront investment (of about \$14,000 annually) to pay for the technology platform and prepare the IVR content for one module. Once these are in place, however, the cost of disseminating content is much lower and more scalable than in-person training. One way of examining this cost differential is to consider the redistribution of expenses by category. With in-person training, 10% of costs occur at the national level, while 90% are related to the direct, in-person training of all the CHWs. In the anticipated case where mobile-based refresher training is integrated into the MOHS community health approach, over half of the costs (56%) are associated with national-level training and technology—especially translation and recording of the IVR content in five languages and the mobile platform infrastructure. With mobile-based refresher training, CHW training expenses account for about 25% of overall costs and are comprised entirely of airtime and SMS charges for CHWs and their supervisors—a variable expense that is directly dependent on the number of users (Table 3). These cost proportions of course closely reflect the fixed/variable cost breakdown described at the national level, below (Table 5).

	MOHS Refresher In-Person		MOTS Pilot Mobile-Based	Theoretical Future MOH MOTS Refresher	
Proportion of Costs Table	A	%	B	C	%
1- Project/national level costs	5,117*	10%	13,826	9,497	38%
2- District TOT costs	4,234	8%	8,701	4,831	19%
3- CHW training costs	42,229	82%	8,660	6,214	25%
4- Technology costs	-	0%	32,799	4,400	18%
TOTAL MARGINAL COST OF ONE DISTRICT-WIDE REFRESHER	51,579	100%	63,986	24,942	100%

*Assumes that no translation expenses are incurred because the cascading training is conducted by staff at the national and district levels who are capable of translating the materials live in the training and that no written/printed materials are required in languages other than English or Krio.

NATIONAL LEVEL ANALYSIS

In an effort to explore the implications of the fixed expense ratio and its impacts on scalability of the refresher training, the following sections present the economies of scale achieved when training is delivered nationwide, and when that nationwide channel is used to deliver not just a single module, but quarterly refresher training (four modules per year).

Economies of scale: nationwide dissemination of a single module

The cost differential between in-person and mobile-based refresher training is more significant when considering national dissemination. This is because in-person training has high variable costs and low

economies of scale, while mobile-based training can be extended nationwide at a low marginal cost per additional district (and per module) once the annual technology cost is covered. The in-person training requires repeated, variable expense (for transportation, per diem and other costs at the district and CHW levels) for each training, which leads to a linear increase in costs. On the other hand, the mobile channel requires a substantial upfront cost in technology (hence higher fixed expense) but then enables much more efficient and cost-effective outreach (lower variable expense).

Thus, the MOHS will achieve economies of scale when extending the refresher training to all 16 districts throughout the country. The marginal cost of providing a single module of refresher training to a total of 16,000 CHWs across the 16 districts within one year is estimated⁸ to be **\$748,513 for nationwide in-person training** (\$47 per CHW), or **\$190,607 for mobile-based training** (\$12 per CHW). This per-CHW cost savings associated with MOTS (\$12 per CHW at nationwide scale versus \$25 per CHW within a single district) is due to spreading the fixed costs across a larger group of CHWs.

Economies of scale: nationwide dissemination of quarterly modules

Mobile redistribution of existing modules also contributes to economies of scale. Once the technology is in place and a MOTS module has already been developed, the marginal expense of distributing training content via mobile phone/IVR will go down. For instance, if the MOHS opted simply to extend one of the existing EBODAC-MOTS modules across the country, the expense would be about \$174,895, because the costs of translating and recording the material, training the national level team and laying the technology foundation would be saved.

Since the MOHS has indicated interest in offering refresher training on a range of topics, we also analyzed the expected expense of extending quarterly refresher training nationwide, for a total of four refresher trainings delivered annually to 16,000 CHWs across the country. This assumes that the MOHS uses the time of existing staff to adapt materials for the refreshers (whether in-person or mobile-based), but pays for translation, recording and coding of materials for the mobile platform (at a price estimated to be about half of what the pilot project paid to pioneer the materials and approach – see Part Two for more details on assumptions).

The annual nationwide cost for adapting and delivering four refreshers on different topics would then come to **\$903,249 for in-person refreshers** (\$56 per CHW and \$5.65 per household), versus **\$542,684 for mobile-based training** (\$34 per CHW and \$3.39 per household) per year in five languages. Assuming that the MOHS seeks to adapt and deliver a total of eight refresher trainings and that no significantly new material is added after year 2, the annual cost of offering four existing refresher trainings per year via the mobile-based system would be about **\$470,000** (saving the expense of new material development and conducting trainings at the national and district level only once annually) (Table 4).

Costs (USD)	<u>In-Person Refresher</u>	<u>Mobile-based Refresher</u>	<u>Cost Difference</u>
Total Cost of 1st module in 1 district	\$51,579	\$24,942	\$26,637
Cost of 1st module delivered across 16 districts	748,513	190,607	557,906
Cost per CHW of 1 st module (16,000 CHWs)	47	12	35
Nationwide distribution of 4 new modules/year	903,249	542,684	360,565
Cost per CHW of 4 modules/year	56	34	23
Nationwide distribution of 4 existing modules/year	743,396	468,080	275,316

⁸ Based on current, actual MOHS training expenses, reduced to a shorter number of days as agreed with MOHS and MOTS team would be needed to provide cascading training on the refresher module.

Thus for around twice the cost of delivering one refresher module nationwide annually, the MOHS could deliver four refresher modules nationwide each year. Note that shorter modules or simple announcements made through the system would result in lower variable costs, but the efficacy of briefer IVR communications should be taken into account.

In summary, the MOHS would need to budget about **\$543,000 annually** in additional expenses for the next two years in order to cover the cost of developing and disseminating eight mobile-based refresher trainings to 16,000 CHWs nationwide, at a per-CHW cost of \$34 per year. In the third year, it is expected that the annual cost would go down to around \$470,000 for the (re)delivery of the existing eight refresher modules. Note that with a sustained annual budget increase of \$540,000, the MOHS could expect to develop or adapt new refresher training material annually beginning in Year 3 (with new module translation, configuration and national level training of trainers estimated at about \$9,500 per module). (Please see more on cost drivers, assumptions and opportunities for cost reduction in Part Two.)

Fixed and variable expenses (national level data)

Since the fixed expenses presented with the district-level data above allow for national-level distribution, the fixed cost ratio goes down dramatically when applied to all 16 districts. The fixed cost for implementation of the mobile based system in Sierra Leone is estimated to be \$13,897 annually, which is only about 7% of total costs to disseminate nationwide. These fixed costs are comprised of nationwide technology expenses (license, platform, dedicated line and short code for all 16 districts) and the national-level module translation and training of trainers costs.

Variable costs for disseminating a single module will be about \$176,709 (to reach 16,000 CHWs), or 93% of overall costs. This means that the MOHS could put in place the foundation for mobile-based refresher training and CHW communication for a low, fixed annual fee (under \$14,000), and then disseminate education modules selectively according to available funds to cover the variable expenses (Table 5).

Table 5: Fixed and variable expenses dissemination of a single module nationwide	
Costs (USD)	Mobile-based Refresher
Fixed expenses	13,897
<i>% of total costs</i>	<i>7%</i>
Variable expenses	176,709
<i>% of total costs</i>	<i>93%</i>
Total fixed + variable	190,607
<i>% of total costs</i>	<i>100%</i>

The question that follows from this cost estimate is whether the resulting value of such an investment in CHW refresher training warrants this expense. While a separate, parallel impact study will shed more light on the benefits of mobile-based refresher training, the following section discusses some hypothetical and anecdotal benefits in relation to the costs described above.

B. Implementer Benefits

Although implementing a mobile-based refresher training system for CHWs would result in significant cost savings compared to offering in-person refreshers, the MOHS will have to raise this additional funding and therefore needs to show clearly the benefits of such an investment.

The costing study investigated the following questions:

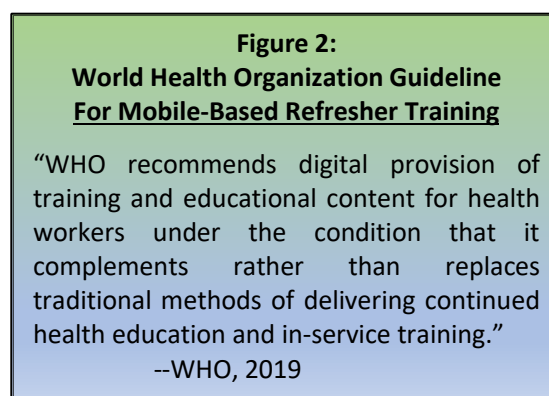
- ⇒ **What are the benefits and net value of the mobile-based refresher training for the MOH (or another implementing organization)?**
- ⇒ **How do these benefits compare to those achieved through in-person refresher training, and what are the trade-offs?**

The value of any kind of refresher training is to reinforce CHW knowledge, skills and attitudes, thereby enhancing the MOHS investment in CHW foundational training and network maintenance. While in-person training might be optimal, and CHWs should receive upfront training in person, the prohibitive cost of providing regular, in-person refresher training simply excludes its use in Sierra Leone and many contexts. Ultimately, the benefits of a MOTS refresher training system come down to two main points:

1. Efficacy

The MOHS has invested in the development and provision of a community health system and an array of foundational trainings to equip widespread health personnel and volunteers to support the improvement of health outcomes for communities throughout Sierra Leone. The value of the Ministry's existing health network, foundational in-person training and dissemination of critical, basic information on major and common diseases cannot be underestimated. But the **MOHS has recognized the need for reinforcing this initial training with periodic reminders** to update and boost awareness, factual knowledge and recommended practices of key health issues on the frontlines of community health. By instituting refresher training, the MOHS can expect to reinforce the knowledge, skills and awareness of health staff and volunteers throughout the system, who provide support and reinforce recommended health practices throughout their far-flung communities.

In terms of selecting a refresher method, according to its 2019 Recommendations on Digital Interventions for Health System Strengthening, **the World Health Organization endorses mobile-based refresher training for health workers** as tool for reinforcing foundational training (Figure 2). The guideline points out that comparative research on in-person versus mobile-based training remains scarce, and that more evidence is needed. Due to the lack of comparable in-person refresher training, the EBODAC project was not able to make this comparison.



On the one hand, it seems evident that direct, face-to-face training with a skilled trainer would achieve better outcomes in terms of knowledge transfer and mastery. But the EBODAC team does not suggest (nor recommend) replacing in-person training for CHWs. Unfortunately, **the prohibitive cost of providing in-person refresher training has presented a barrier to the MOHS goal of regularly reinforcing CHW training**, which could be addressed affordably by implementing mobile-based refreshers. A realistic expectation of EBODAC-MOTS is that CHWs who have more regular contact with the training material and can reference the material readily, for example,

replaying IVR messages with their community constituents, will have increased knowledge, confidence and performance in the field. Moreover, regular contact with the MOHS and CHW supervisors via MOTS may enhance the trust of CHWs, and by extension their communities, vis à vis the public health system.

2. Efficiency

Perhaps the most important benefit of mobile-based training is its efficiency. Once the MOTS platform is established and key actors at the national, district and chiefdom level have been trained to use the system, substantive health refresher trainings and even urgent health messages can be rapidly disseminated across the country. Even rural and isolated areas lacking in accessible year-round transportation infrastructure can be reached in a very short period of time and at a fraction of the cost (and health risk) of sending MOHS staff overland. This **game-changing mechanism enables a dramatically more efficient and widespread community health outreach**, builds sustained engagement and provides a safeguard in the case of emergency.

With the benefits of efficacy and efficiency in mind, the estimated marginal investment of \$191,000 per year seems reasonable. Donors and the Government of Sierra Leone should consider the extensive benefits of this highly scalable component for reinforcing the national community health system. This mobile-based dissemination mechanism would be fully integrated into MOHS operations and supervision. Once in place, it can be leveraged for a wide array of content-rich and time-sensitive health messaging that serve to enhance the relationship between the MOHS and its grassroots community health network and the efficacy of national health initiatives.

Furthermore, compared to the potential savings from preventing and containing disease outbreaks, the expense of MOTS appears almost trivial. If we take the low end estimate by the World Bank of economic losses due to the 2013-2016 Ebola outbreak, amounting to \$2.8 billion across the three countries, and we attribute losses to Sierra Leone as a function of the number of Ebola deaths (about 4,000 of 11,300, or 35%), then **the country realized a loss of around \$990 million due to the Ebola crisis**. The Journal of Infectious diseases considered deaths from other diseases during the period due to lack of available health personnel and other effect to reach an estimated \$53 billion in losses across the three countries. Considering such losses, on top of the ongoing loss of productive capacity due to preventable diseases such as malaria and cholera, **if the mobile-based refresher training equipped CHWs to avert even a fraction more of such medical issues each year, then the investment will more than pay for itself**—an argument that should appeal to international donors considering an investment in resilience in Sierra Leone and other countries faced with Ebola.

C. Health Worker Costs and Benefits

Sierra Leone Community Health Workers (CHWs) are men and women volunteers who provide health extension services in their communities in connection with the MOHS national health system. CHWs are trained in basic health and disease prevention, detection and management. They pay regular visits to households in their communities to encourage prenatal visits and vaccination, encourage other disease prevention measures such as handwashing, and convey key health messages from the district health center. The MOHS targets a total CHW force of 1,000 per district, or 16,000 across the country's 16 districts. Each CHW serves at least 10 households (figure as per MOHS hub; note that CHWs may cover significantly more households). Given the low socioeconomic level of most CHWs, we sought to identify any costs, including opportunity costs, and benefits that they experience as a result of their health extension work.

The key question examined regarding CHWs was:

⇒ **What are the costs and benefits to CHWs of the mobile-based refresher training?**

By participating in refresher training, CHWs stand to realize benefits in terms of increased knowledge of community health protection and their capacity to successfully fulfill their duties as MOHS extension workers, thereby contributing positively to the health of individuals, households and communities. Their costs of training are largely offset, as described below. And although the mobile-based training offers fewer “perks” than the in-person training, it is also more convenient, flexible and rapid to undertake. Since MOHS plans to continue providing foundational training in person, complemented by additional training in the form of mobile-based refreshers, the study finds the impacts on CHWs to be a net positive.

When CHWs receive MOHS in-person training (so far only foundational, on various topics), they usually travel to a special training location and stay overnight to participate over the course of two full days. Their opportunity costs include lost time for their other income-generating activities (so around \$1.50 on average for a typical two-day training). While CHW household visits and related duties are flexible and informal, there is an opportunity cost associated with this time away from their homes, businesses, families and leisure activities.

The MOHS provides CHWs with a monthly stipend equivalent to about \$17 per month, paid via mobile money. Based on the EBODAC baseline study in Kambia, this income would be roughly equal to the \$.75 average daily earnings that CHWs derive from their other income-generating activities, such as farming, casual labor and petty trading. In addition, when they travel for training, CHWs receive transportation reimbursement, meals on-site and per diem of as much as \$11 for a two-day training. Hence the income from CHW work is not negligible.

There may also be some status ramifications from being a CHW. These can be positive—the special extra income, training, a certain authority in the community, and travel opportunities. Or they could also be negative—association with the government, which can be negative under certain administrations and conditions; and association with international community health messaging that is sometimes suspected of ulterior motives such as population control. The value of these benefits or drawbacks is worth pointing out but difficult to estimate in economic terms.

V. Conclusions

In summary, the study reached the conclusion that implementing MOTS (mobile-based training) is likely to yield net benefits for both the MOHS and CHWs. Assuming even a small positive impact on CHWs' performance and health indicators in their communities, the system would pay for itself, in terms of community health protection, related government expenses and broader economic impacts. The alternative of not implementing health refresher training for CHWs appears ill-advised, given WHO guidelines and health sector findings; and the alternative of implementing in-person refresher training appears prohibitively expensive. The best choice among these three options therefore seems clear: instituting a mobile-based communications and refresher training channel for CHWs would be a sound and promising investment.

The estimated additional, annual budget for MOHS to implement mobile-based refresher training comes to approximately \$191,000 to disseminate one refresher module per year to every CHW across the country (about 16,000 CHWs), including the cost of transforming health content into IVR audio modules in five languages and the national and district level support and monitoring necessary to ensure quality roll-out, uptake and backstopping. This expense for annual mobile-based refresher training dissemination thus equates to \$12 per year per CHW, or about \$1.19 per household reached—a level of expense that many donors should be willing to help cover.

This investment in refresher training is likely to reinforce the MOHS' existing investment in its network, training and management of CHWs, while also enhancing CHWs' knowledge, skills, attitudes and performance of their duties with benefits accruing to the communities served. The analysis of CHW-level impacts shows that the flexibility and brevity of the mobile-based refreshers, in combination with in-person foundational training that will continue to be provided, does not incur a high cost to participants in terms of lost income and may in fact increase status and authority of CHWs in their communities. In light of the sharp economic losses realized due to the past Ebola crisis and other endemic, preventable and containable diseases, this investment in an efficient and cost-effective CHW communications channel with the potential to reduce the occurrence and impact of future disease appears justified and recommended for Sierra Leone.

Although this study focused on the case of MOTS in Sierra Leone, the results may also help inform investments in mobile-based Ebola and other health-related refresher training in similar contexts. When considering this cost analysis for application in another country, it is important to note the key cost drivers that will directly affect the expense:

- The cost of translation, IVR recording and configuration (including number of languages and local fee rates of relevant service providers)
- Technology costs including local license fees, choice of platform and related management costs, the going rate for mobile network airtime and data usage
- Local training-related costs for national and district/regional level training, impacted by distances and market rates for transportation, lodging and refreshments

In many markets, the costs for these line items could differ significantly from those in Sierra Leone, and negotiation of these cost drivers could potentially lower the expected cost of mobile-based refresher implementation. Please see Part Two for further details on cost assumptions and ranges.

Part Two: Cost Data and Assumptions

I. Overview of Data

A consultant worked with the MOTS team beginning in March 2019 to define the scope and framework of the analysis and to populate the costing model with preliminary data. The consultant then visited Kambia, Sierra Leone in June 2019 to interview MOTS and MOHS representatives with the purpose of refining the scope of the study, collecting additional data, refining and validating the documented costs, and conducting a preliminary cost analysis in concertation with stakeholders in the field. A preliminary costing report was shared with the MOTS team, and additional refinement took place over several months in collaboration with team members from Grameen Foundation and World Vision, resulting in the current report. Numerous MOTS and MOHS team members provided time and support for this costing exercise.

Table 6 presents an overview of the costing analysis. In order to examine a set of comparable costs across the different approaches, this overarching analysis zeroed in on the provision of a single module of refresher training in a single district. Note that as explained above, staff expense is omitted across the board so that the study looks at marginal expense, based on maintaining current staff levels.

The data is presented in three categories/columns across the top:

- **A: MOHS Refresher In-Person**
These are the estimated costs of extending refresher training in person. These costs are based on *actual* MOHS costs of delivering foundational in-person training, but because MOHS does not (yet) offer regular, refresher training, these are considered “theoretical”. Note that because this is in-person training, there are no training-related technology expenses.
- **B: MOTS Refresher Mobile-based Pilot**
These are the actual costs of the EBODAC MOTS pilot in Kambia (excluding staff expense). Clearly, because this was a pilot and the technology solutions were selected for flexible testing rather than long-term scalability, expenses were high. National-level expenses were primarily for content transformation to the MOTS system, and training was conducted beginning at the district level with some national staff in attendance.
- **C: MOHS Refresher Mobile-based**
These are the projected costs of the MOHS providing mobile-based refreshers. These costs are based on a carefully analyzed combination of: MOHS operations, expenses and preferences for the MOTS roll-out as agreed in an onsite working session; experience of the MOTS pilot, including lessons learned on training and technology; strategic planning between MOHS and EBODAC for possible handover. The costs are considered theoretical but are based on actual expense data.
- In the final column, we have provided the difference between MOHS in-person (A) and MOHS mobile-based (C). Note that a positive figure therefore means that in-person training is more expensive than MOTS, while a negative figure indicates that MOTS costs more in that category or line item than in-person training.

Master Table: MOTS COSTING EXERCISE

Table 6: Master Table of MOTS Costing Exercise

Comparison of the costs and benefits of a single refresher module delivered to one district

	Theoretical MOHS Refresher In-Person A	Actual Project MOTS Refresher Mobile-based Pilot B	Theoretical MOHS Refresher Mobile-based C	Difference (A - C)
1- Project/National Level				
Translation and recording of IVR content into 5 languages		13,410	6,705	
Configuration of IVR messages in MOTS		416	-	
Trainer time - additional expense	361		361	
Trainer transport	45		45	
Trainer per diem and accommodations	270		135	
Trainee transport	558		279	
Trainee per diem and accommodations	2,231		1,116	
Training venue	338		169	
Training lunch/refreshments	1,251		625	
Stationary/training materials	63		63	
1- Subtotal project/national level costs	5,117	13,826	9,497	(4,381)
2- TOT: District Level - per district				
Trainer time - additional expense	101	-	-	
Trainer transport	34	20	101	
Trainer per diem and accommodations	304	-	101	
Trainee transport	197	1,487	372	
Trainee per diem and accommodations	1,775	2,231	-	
Training venue	-	338	-	
Training lunch/refreshments	1,318	1,704	879	
Stationary/training materials	47	2,921	2,921	
Supervision and monitoring	456		456	
2- Subtotal district TOT costs	4,234	8,701	4,831	(597)

<i>(continued)</i>	<u>MOHS Refresher In-Person</u>	<u>MOTS Refresher Mobile-based Pilot</u>	<u>MOHS Refresher Mobile-based</u>	<u>Difference</u>
3- Training: CHWs - per district				
Trainer time - additional expense	-	-		
Trainer transport	322	338		
Trainer per diem and accommodations		-		
Trainee time (opportunity cost to CHWs)	1,500	937		
Trainee transport	22,538	423		
Trainee per diem and accommodations	-	-		
Training venue	-	-		
Training lunch/refreshments	17,869	3,662		
Stationary/training materials	-	3,300		
Airtime and SMS per district (1,000 CHWs)		30,630	5,470	
Supervision and monitoring (data costs for 66 in-charges)		744	744	
3- Subtotal CHW training costs	42,229	40,034	6,214	36,015
4- Technology (nationwide technology base)				
License fee		563	1,200	
Platform management fee and support		750	0	
Dedicated line		113	1,200	
Short code			2,000	
4- Subtotal technology costs	-	1,425	4,400	(4,400)
TOTAL MARGINAL COST OF ONE DISTRICT-WIDE REFRESHER	51,579	63,986	24,942	26,637

The data is also sub-divided into four groups in rows down the left-hand side:

- 1: Project/National level
This group involves the transformation of health content and the training of trainers at the national level. As throughout, this focuses on marginal costs. That is, we assume that MOHS existing staff will/would be able to distill health content provided through foundational training into refresher-type training with their current cost base. The Training of Trainers (TOT) costs were assigned for MOHS (both A and C) according to detailed discussions and assumptions set in collaboration with MOHS on the basis of their current and expected operations.
- 2: TOT/District level
This group of expenses covers the cascading training provided by National level to the District level staff who will then go on to train the CHWs in the field.
- 3: Training CHWs
This group involves the decentralized training provided directly to groups of CHWs by District level staff with National level supervision.
- 4: Technology
This group of expenses is separated out from the National level in order to isolate the most substantial investment required to deploy mobile-based training. The technology cost is significant, causing the pilot expenses to even exceed MOHS in-person costs. But given long-term, local technology resources and choices already discussed with MOHS, the expected cost of technology to support MOTS going forward brings costs down, well under in-person training costs. In category C, the technology costs are based on the IVR integration plan developed by MOHS and EBODAC/MOTS in 2019. Note that because many of the technology expense line items are paid on an annual basis, the timeframe of one year is important to bear in mind with regard to the mobile-based costs (as there is a base annual cost associated with the technology).

The discussion that follows delves into details of the calculations underlying Table 4 in the categories and groups outlined. Note that the figures do not account for inflation; training costs reflect current rate budgeted/paid by MOTS and MOHS as of June 2019.

II. Data Assumptions by category

A. MOHS Data

MOHS data is based on MOHS budgeted costs (assumed to match actual costs) for existing, in-person training conducted to extend health content to CHWs throughout Sierra Leone. As noted above, MOHS does not currently provide refresher training to CHWs. Therefore, in order to zero in on a set of costs that would be relevant and comparable both to: (a) MOTS refresher training as currently provided, and (b) MOTS refresher training once it has been integrated into the MOHS system, the consultant worked with MOHS National Coordinator of the Community Health Workers Program (Alpha Bangura) to develop a set of assumptions on how the MOHS would implement in-person refresher training, if donor funding allowed. The consultant and National Coordinator then applied real MOHS training costs to these assumptions in order to arrive at a realistic, parallel scenario wherein MOHS extends refresher modules to MOHS trainers and then to CHWs.

The basic assumptions underlying the MOHS' cascade approach to training are highlighted in the tables below.

1. Trainers and training time

A- TOT: National level

# of trainers of National Master trainers	4
# of trainees per training (including one IT staff per district)	33
Trainers' days to prep/follow-up	0.5
Length of training (days)	2

B- TOT: District level

# of district level trainers (DHMTs and in-charges) per training	3
# of MOHS supervisor per training	1
Trainer time per training (days)	3
Trainee time per training (days)	3

C- CHW training

# of trainers (DHMT and in-charges) per training	2
# of CHW trainees per training (on average)	35
# of trainings needed to cover district (average, assuming 1,000 CHWs)	29
# of DHMT trainers	1
# of in-charge trainers	1
# of DMO and other DHMT staff	2
Trainer time per training (days)	2
Trainee time per training (days)	2

2. Stationary/training materials

MOHS provided an estimate of the expense associated with their habitual provision of notebooks, photocopied handouts and pens to each trainee, as well as the cost of training materials such as flipcharts and markers. This comes to approximately \$1.69 per trainee at the national level and \$1.35 at the district level (\$0 at the CHW level).

3. Transport, accommodations and meals

Expenses associated with trainers' and trainees' travel and logistics to attend trainings are based on MOHS current, budgeted amounts, depending on the pay grade of the participant and the distance traveled. The consultant and National Coordinator made estimated averages where costs varied (for example CHWs receive a range of transport reimbursement, depending on where they live in relation to the training). In general, MOHS costs for transport, lodging and training refreshments are higher per participant than those budgeted by MOTS. For example, lunch and tea breaks provided during training days comes to an average of \$11 per participant per day with MOHS, as compared to \$8 for MOTS. This combined with the longer trainings provided by MOHS (covering health content), account for the considerably higher training expenses incurred. For the CHW-level training in this category, we assumed that CHWs received two days of roundtrip transportation reimbursement, plus on-site lunch and tea break (but not per diem, since they return home between the two days of training).

4. Number of households served

Our figures are based on the assumption that each CHW serves an average of 10 households, or using the multiplier of 5 household members on average, 50 individuals. This would mean that with 1,000 CHWs per district across 16 districts, the total population reached by CHWs in Sierra Leone is 160,000 households

and 800,000 individuals. This assumption may be conservative. If CHWs in fact reach more than 10 households each, then the per household cost of this intervention is much lower than stated.

B. MOTS Data

MOTS cost data is based on actual training approach and average expenses in Kambia, as provided by the MOTS team. The following tables provide detail on assumptions and MOTS costs.

1. Trainers and training time

B- TOT: L. 1 Staff & in-charge training

Master trainers	1	trainer
Supporting trainers	5	trainers
Master trainer time	3	days
Supporting trainer time	2	days
Trainee time per training	2	days
Average (ideal) number of trainees per training	22	trainees
# of trainings to cover in-charges in 1 district	3	trainings

C- CHW training

Master trainer	1	per training
DHMT trainer	1	per training
In-charge trainer	1	per training
Trainer time per training	1	day
Trainee time per training	1	day
Number of CHWs per training	10	CHWs
Number of trainings to cover CHWs in district	100	trainings

2. Stationary/training materials

Data on MOTS training materials was provided as a USD value relative to a lot size. The consultant divided these figures to obtain a per trainee cost, and then multiplied the per trainee cost by the number of trainees, according to the relevant training (surmised as presented below).

Item	USD/unit	Use of item
<i>B- TOT: L. 1 Staff & in-charge training</i>		
Trainer guide	0.25 ⁹	Level 1 process flow (photocopy)
Trainer materials	30.00 ¹⁰	Level 1 systems support guide (printer)
MOH training materials	14.00 ¹¹	Supervisor user guide (for in charges and DHMT) (printer)
CHW visual aids for training	2.70 ¹²	Visual aids for training (printer)
CHW one-pager how-to	0.60 ¹³	Using phone for accessing system (photocopy)

3. CHW Opportunity Cost

⁹ Based on the rate of \$5 per lot of 20 copies, as paid by EBODAC during the project.

¹⁰ Based on the rate of \$300 per lot of 10 copies, as paid by EBODAC during the project.

¹¹ Based on the rate of \$350 per lot of 25 copies, as paid by EBODAC during the project.

¹² Based on the rate of \$1,350 per lot of 500 copies, as paid by EBODAC during the project.

¹³ Based on the rate of \$18 per lot of 30 copies, as paid by EBODAC during the project.

The impact research baseline study in Kambia gathered data on CHWs' income-generating activities outside of CHW stipend, which were used to inform the opportunity cost analysis.

The main sources of income cited by CHWs were:

1 Crop farming
2 Livestock
3 Permanent employment
4 Casual labour
5 Self-employment (mechanic, shop/business owner, mining, fishing)

Average daily income was reported by CHWs as follows:

	avg income (Le)	avg income (USD)		
Control	6,447	0.71		
Treatment1	6,446	0.71		
Treatment2	7,556	0.83	Avg of all 3 groups in USD	0.75

Opportunity cost was calculated on the basis of in-person attendance at MOTS training (on technology) for one day, plus 2 hours' time (1/4 of an 8-hour day) spent on the IVR system. The IVR system timing is based on the World Vision report of the total time required for a CHW to complete one module, if done in a single sitting. (CHWs can access and follow the module according to their own schedule.)

These assumptions and calculations yielded the following opportunity cost

Trainee CHW opportunity cost per day/pax	\$0.94
Trainee CHW opportunity cost per district (* 1,000 CHWs)	\$937

4. Transport, accommodations and meals

Expenses associated with trainers' and trainees' travel and logistics to attend trainings are based on budgeted/actual MOTS costs and vary according to level/pay grade of personnel and distance to training site. Transportation expense is based on the estimated average distance traveled by participants, multiplied by the current cost per liter of fuel. Food and tea breaks provided during trainings are costed at \$7.89 per participant (trainers and trainees alike) per day of training; and accommodations and per diem (for evening meal and incidentals) for trainers at the district level is costed at \$33.81 per night. MOTS tends to hold trainings closer to the majority of participants, paying for trainers' travel and overnights more than trainees'—in order to minimize financial and time costs.

C. MOHS-MOTS Data

This category refers to the hypothetical case in which MOHS integrates MOTS into its operations and begins providing mobile-based IVR refresher training to complement its in-person foundational training to CHWs. The assumptions and costs were developed by the consultant and National Coordinator of the CHW Program (Alpha Bangura), with input and support from the EBODAC-MOTS team. They combine the anticipated cascade approach of MOHS (TOTs at the National and District level, followed by CHW trainings at the chiefdom level), on the one hand, with the smaller batches and shorter, technology-focused trainings of MOTS, on the other. For example:

- The travel and logistical expenses are based on current MOHS budget/costs (found in the MOHS category above), while the stationary/training materials costs are based on current MOTS costs.
- The preferences of MOHS with regard to supervisory staff and composition of training teams have been respected and upheld in this category of costs.
- At the same time, the current MOHS practice of paying facilitation fees to experts has been omitted, with the understanding that the health expertise will go into the content delivered via IVR, and that

the TOTs will focus on MOTS technology use, as opposed to in-depth health content (which will remain at the level of in-person foundational training).

1. Assumptions on trainers and training time

The study assumes that CHWs will have received in-person foundational training on their roles and the specific health topics covered by the refresher training prior to engaging in refresher training (regardless of whether in-person or mobile-based). Neither the duration of the foundational training nor the time lag between foundational and refresher training has been specified. These may warrant further analysis with regard to the subsequent efficacy, outcomes and impacts of the refresher training.

In terms of the MOTS-related cascading training, the following assumptions underlie the calculations in Table 5:

National TOT training will take place in a rented hall in the capital (Freetown).

A- TOT: National level	Current MOHS (A)	MOHS-MOTS (C)
Trainers of Nat'l Master trainers	4	3
Number of trainees (including one IT staff per district)	33	33
Trainers' days to prep/follow-up	0.5	1
Length of training (days)	2	2

District level TOT training will take place at the District Hall or a PHU in each district.

B- TOT: District level	Current MOHS (A)	MOHS-MOTS (C)
Master trainer (from national level)	-	1
District level trainers (DHMT; in-charges)	3	3
MOHS supervisor	1	1
Trainer time	3	3
Trainee time per training	3	2
Average (ideal) number of trainees per training	35	22
Number of trainings to cover 1 district (around 68 in-charges)	1	3
Number of trainings to cover country	16	48

CHW-level training will take place at a health facility at the chiefdom level, with small batches of CHWs at a time.

C- CHW training	Current MOHS (A)	MOHS-MOTS (C)
# trainers (1 DHMT and 1 in-charge)	2	2
DMO and other DHMT staff (total #)	2	1
# days per training	2	1
Avg CHW trainees per training	35	10
# trainings needed to cover district (on avg, assuming 1,000 CHWs/district)	29	100
Trainer time per training (days)	2	1
Trainee time per training (days)	2	1

Note that in the case where multiple modules are diffused to CHWs within a single year, we assume that national and district staff will only be trained once per year. Annual training for these staff may be desirable for the purposes of refreshers on the technology, reinforcing their ability to troubleshoot, training new

staff due to turnover, and in the case of system changes or upgrades. However, this may also be overstating the cost of training, since annual training of all staff may not be required.

On the other hand, as new CHWs come on board, they will require training by their supervisors on utilizing the system. We estimate a CHW turnover/onboarding rate of 20% per year. But this CHW-level training expense is not taken into account in the costing model, since we assume that this will be handled locally by supervisors and CHWs in the scope of their regular paid time and duties.

2. Assumptions on content development

In order to offer refresher training, the content must be distilled from foundational training into appropriate refresher training material, including clear questions and multiple-choice answers that can be delivered via audio (IVR messaging) and to which users can respond using feature phones. This adaptation requires a significant degree of expertise, including deep knowledge of the health content itself, an ability to identify and prioritize key points for CHWs to know, and competence in writing succinct, understandable prompts.

Under the MOTS pilot project, this task was undertaken by the EBODAC-MOTS team. It was agreed with MOHS that if they implement MOTS, existing MOHS staff will undertake this refresher training content development. Hence it is considered as a staff expense in both columns, and no costs for this task are incorporated into the study.

3. Assumptions on translation and IVR recording

The refresher training, developed in a single language, then needs to be translated into all relevant languages and the content recorded orally for IVR distribution. While the MOTS pilot project price for translation to and recording in five languages came to \$13,410, based on the pilot experience, we believe that the MOHS will be able to establish a contract with a trusted, paid provider at a lower rate.

The future cost for this line item in Sierra Leone is likely to range from \$3,750 to \$13,000. A recent quote from Viamo obtained by the EBODAC-MOTS team quoted \$750 per language (\$3,750 for five), but the team's experience was also that there were few vendors available to provide such services in Sierra Leone. Experience to date in other countries indicates that the cost of translation and recording is likely to be lower in Rwanda, Uganda and the DRC than in Sierra Leone.

4. Assumptions on configuration

Once the refresher training content has been translated and recorded, it must be configured for delivery through the system. Thus each time there is a new refresher module or there are changes needed to an existing module, configuration is required. Under the MOTS pilot, this was handled by project software developers. On average, configuration took them between 8 and 16 hours per module at an hourly rate of \$26, for a price range of \$208 to \$416 per module. For this reason, \$416 per module was assumed for the MOTS pilot costing calculation. In the future, it is assumed that MOHS existing, full-time staff will handle configuration, at no additional (marginal) cost.

5. Assumptions on technology expenses

National-level technology expenses are comprised of license fee, platform management and support, dedicated line and short code. We assume in this analysis that the MOHS will use existing staff to cover platform management and support. This expense has the potential to be higher, though, if the MOHS requires outside support or new staff. A for-profit vendor would cost around \$1,000 per month—for an annual expense of \$12,000—while Viamo with its social mission charges \$750 per month for an added annual expense of \$9,000.

At the CHW-level, technology expenses to disseminate the training include airtime and SMS for CHWs to access and listen to the training material, and similar data costs for CHW supervisors (“in-

charges”) to access and utilize a virtual management tool that allows them to visualize and track their CHWs’ training progress. We assume an average of 68 minutes of airtime needed to interact with and potentially replay/review the material of a single refresher module. Going forward, the rate per minute is expected to be \$.08. For comparison, Viamo provided a quote of \$.06 in late 2019. Hence the airtime expense per CHW per module is estimated to be \$5.44.

Assuming 1,000 CHWs per district, this per district and per module expense is \$5,440 to which was added \$30 in SMS expense (based on the cost of \$.03 per SMS multiplied by 1,000 CHWs per district). It should also be noted that the sizable difference between this line item for the MOTS pilot project and in the future is due to anomalously data expenses due to an overseas server. The MOTS project incurred data expenses of \$.45/minute, compared to the rate of \$.08/minute as a realistic expectation for the configuration under MOHS.

We applied the technology expense necessary for nationwide outreach to the district-level cost analysis with the reasoning that such costs (license, platform management, dedicated line and short code) would not be reducible if only one or a few districts were served.

6. Assumptions regarding fixed and variable expenses

For the purposes of the fixed/variable expense analysis, we considered fixed expenses to be those expenses that are necessary to establish the mobile-based training “channel” and content. The following were considered fixed and variable expenses for that analysis:

Fixed expense line items	Variable expense line items
Translation, recording of IVR content - 5 languages	District level training trainer time
Configuration of IVR messages in MOTS	CHW-level training time
Trainer time - additional expense	Transport, lodging, meals and per diem for trainers
Trainer transport	Transport, lodging, meals and per diem for trainees
Trainer per diem and accommodations	Training venue and refreshments
Trainee transport	Training materials
Trainee per diem and accommodations	Supervision and monitoring
Training venue	Technology expense (airtime, SMS) for CHW trainees
Training lunch/refreshments	Technology expense (data charges) for supervisors
Stationary/training materials	
<i>Technology expenses:</i>	
License fee (16 districts)	
Platform management (16 districts)	
Dedicated line (16 districts)	
Short code	