Marklate don cam: Scaling bundled health services in rural Sierra Leone

GiveWell Research proposal

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This document describes the analysis plan for a randomized field experiment examining the cost-effectiveness of a bundle of health treatments and vaccinations delivered to remote rural communities in Sierra Leone. This plan outlines the design of the study, the outcomes of interest, and the econometric approach to analyze the results.

Introduction

Figure 1: Vaccine Team Visits Procedure (2022 RCT)

Step 1: Meet with community leaders

Step 2: Organize community meeting

Step 3: Bring vaccines and nurses to these remote communities

Step 4: Set up a temporary clinic for the next two-three days

Step 5A: Treatment 1 - Door-to-door mobilisation

Step 5B: Treatment 2 - Small group mobilisation

Globally 646 million people cannot reach healthcare within one hour even if they have access to motorized vehicles, and 3.16 billion people cannot reach a health facility by foot within one hour (Weiss et al, 2020). In Sub-Saharan Africa (SSA) alone, 200 million people live more than two hours away from a hospital and an additional 150 million people live more than one hour away from the nearest health center. For those living in more remote areas, the poor state of the road infrastructure and the limited options for motorized transport makes access extremely challenging, especially for the poor (Falchetta et al., 2020). Such deficiencies in access can result in high mortality and morbidity from easily preventable conditions, including vaccine-preventable diseases. The 2020 DHS data indicates that only 56% of Sierra Leonean children complete the basic vaccination schedule recommended for infants.

In 2022, our team visited remote villages in Sierra Leone as part of a study to increase access to COVID-19 vaccines.[1] Using a randomized controlled trial, the team demonstrated that this intervention induces on average over 50 people in each community to get vaccinated within 48-72 hours, compared to 5 people in the control group, at an average cost of $32 per person vaccinated (Meriggi et al., 2024). Transportation costs to reach these remote villages was the largest component of intervention costs.

An immediate implication is that it would be much more cost-effective to deliver a bundle of useful health services and products simultaneously on that same trip. We therefore conducted a search of the medical and public health literature and engaged in consultation with experts to identify health products with the largest potential gains to population health that could be bundled under this same delivery mechanism. We prioritized routine immunizations that are highly effective in reducing mortality.[2] Rural Sierra Leone is still far from achieving WHO vaccine target rates (see Appendix A.1 overview table). Addressing poor water quality and associated diseases also emerged as a priority. In our pilot data from rural communities, 22% of infants had diarrhea over a one-week recall, but only 43% of households gave their children ORS. Water inspected by our enumerators could be classified as "transparent" in only 58% of rural households, but only 8% use chlorine to treat their water. A recent meta-analysis of water treatment randomized controlled trials (RCTs) finds a reduction of all-cause mortality of 30% (Kremer et al 2023).[3] Immunizing adolescent girls with HPV vaccines is a stated priority for the Sierra Leone government and its development partners, but the current HPV vaccination rate is in the single digits. Cervical cancer is the fourth most common cancer among women globally, with an estimated 570,000 new cases in 2018. School-based delivery models are likely to be insufficient because the majority of rural girls are not enrolled or do not attend school regularly (Bandiera et al 2020).

The proposed research therefore aims to deploy a similar delivery model as in our 2022 work to extend access to a bundle of child immunizations, and other health products and services believed to be highly consequential for human health and well-being. This document outlines the design for this study, the outcomes of interest, and the econometric approach.

[1] Low COVID-19 immunization rates were a concern at that time because it kept many African countries vulnerable to the threat of disease recurrence, and a renewed possibility of costly lockdowns capable of undermining employment, income generation, and food security (Egger et al., 2021). Low vaccination coverage also raises the hazard of new sub-variants emerging that puts the entire globe at risk (Oehler and Vega., 2022).

[2] Global immunization efforts have saved an estimated 154 million lives over the past 50 years: vaccination against 14 diseases (diphtheria, Haemophilus influenzae type B, hepatitis B, Japanese encephalitis, measles, meningitis A, pertussis, invasive pneumococcal disease, polio, rotavirus, rubella, tetanus, tuberculosis, and yellow fever) has directly contributed to reducing infant deaths by 40% globally, and by more than 50% in the African Region (WHO, 2024).

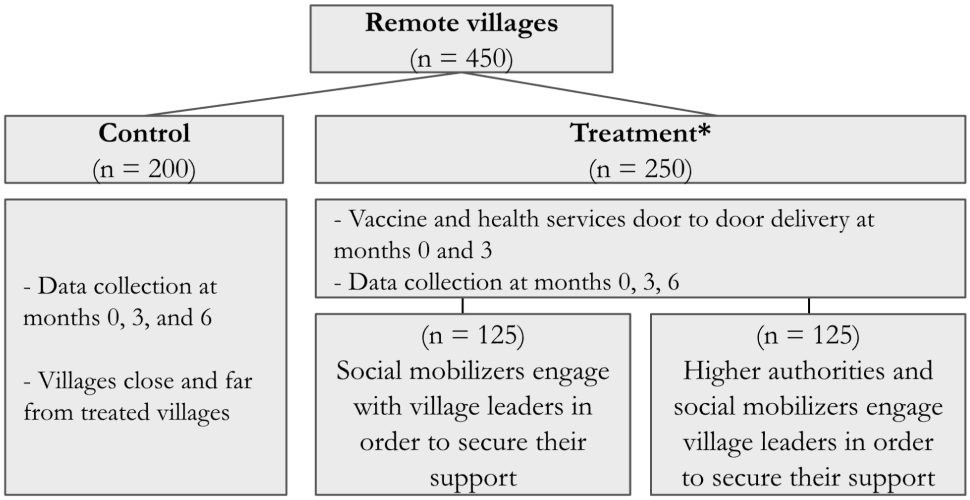
[3] It is also estimated that improving the quality of drinking water could avert a least 395,000 deaths of children under 5 every year (WHO, 2023).

Research Design

The main objective of our study is to calculate the effectiveness and cost-effectiveness of an intervention in which we deploy mobile healthcare services delivery (including vaccination) teams to remote communities in Sierra Leone that are currently not well served by an existing government and NGO health services delivery programs. Our primary target is to compute the gains to disability-adjusted life years (DALYs) per dollar spent on this last mile delivery model, in order to gauge the scalability and cost-effectiveness of such programs.

The health system in rural Sierra Leone is organized around Community Health Centers (CHCs). Although the government has invested substantial resources to upgrade the CHC infrastructure with the support of UKAid and USAID, they remain under-utilized due to their physical distance from the populations they are designed to serve. More than half of the Sierra Leone population does not live within the catchment area of any CHC, defined by MoHS as the 5-mile radius around a CHC. Transport costs to reach CHCs are prohibitive for many poor people living in remote communities. The research team, together with the Sierra Leone Ministry of Health and Sanitation (MoHS) and the NGO Concern Worldwide (CWW), will operate a hub-and-spoke model wherein one CHC would serve as a logistical base for multiple mobile vaccination teams who will be traversing the "last mile" to those remote communities. Serving many more beneficiaries by removing last-mile access barriers will improve CHC utilization. We will track the uptake of targeted vaccines, ORS+Zinc, and chlorination among remote populations, comparing intervention and control communities using a RCT. Figure 1 summarizes our research design.

Figure 1: Research design



*Treatment villages can not be decreased because of commitments on outcomes to the SSRC Mercury project

The sampling frame for the study will be remote communities that fall outside the catchment area of any CHC. Under our current agreement with SSRC, who provided partial funding for this project, the research team will randomly assign communities to one of three groups: 1) bundle delivery with social mobilizers engagement, 2) bundle delivery with higher authorities engagement, and 3) a control group (please refer to the section on "Intervention Details" below for more information on the social mobilizers and higher authorities engagement).

We may stratify randomization such that control communities are split into two subgroups: villages that are located closer and further away from a treatment village. This allows us to assess potential spillover effects from treated to control villages (see secondary research questions for more details).

In both treatment conditions, we will deliver the same bundle of health services and vaccines. This bundle includes:

1. Child immunization for children under 5, including the following vaccines
    a. BCG
    b. Pneumococcal
    c. Rotavirus
    d. IPTi
    e. MCV
    f. Yellow fever
    g. Malaria RTS vaccine
    h. IPV vaccine
2. HPV vaccines for girls aged 10-17
3. Chlorination tablets for every household in the community to treat drinking and cooking water. If used correctly, the tablets delivered should be enough to treat water for 3 months.
4. Health services for children under 5:
    a. Vitamin A drops
    b. Deworming pills
    c. ORS/Zinc sachets to treat cases of diarrhea

We collected pilot data from 11 rural remote communities in Sierra Leone in March and April 2024. We visited 463 residential units where 775 unique households resided. The communities were chosen to be representative of the types of communities we intend to include in our RCT. The following table presents the average population size (and share) per community, for each of the groups that would be targeted by our study.

Table 1: Average target population size per community

Target group	Average	Population share
Total population	288.1	
Girls between 10-17 years old	23.6	8.0%
Children under 5	38.5	13.4%
Children under 10	77.63	26.9%
Children under 10 with diarrhea in the past week	12.7	15.9%
Children under 5 with diarrhea in the past week	8.5	22.07%

Intervention details

The mobile health services delivery team will consist of a trained nurse to administer vaccines, social mobilizers, and an MoHS approved data-clerk to register beneficiaries and issue vaccination cards. Social mobilizers are typically trained by the ministry to disseminate information about the health services. We will train our mobilizer to talk to parents about their children's vaccination schedule and the follow-up actions recommended for their family. The team will travel to remote villages (which we estimate takes about a day), primarily using motorbikes carrying health services and vaccines stored in a cool box. Those health service delivery teams only begin operations in a village once social mobilization teams obtain approval from village leaders. The health teams visit treatment communities for 3 consecutive days. Control villages will not host any mobile health services delivery team.

The intervention in treated villages will roll out as follows. In half of the villages assigned to receive the bundle, social mobilizers visit selected villages and meet with village leaders to explain the goal of the bundled health services campaign. In the other half, this communication strategy will be complemented by an endorsement from higher authorities (such as the Paramount Chief and District Medical Officer - representing authoritative informal and formal institutions), who will contact village leaders in order to express their support for the project and request cooperation from village authorities. Social mobilizers engage with them shortly thereafter. The remaining steps are the same across all treated villages.

Conditional on obtaining village leaders' support, social mobilizers and the delivery team visit each residential structure in the community to deliver the bundle. They start the visit by privately discussing with residents about the efficacy and safety of the health services included in the bundle. This will include information on the importance of drinking clean water, the dangers of diarrhea for

children under 5, the importance of vaccines, and any concerns about the bundle that the household residents may have. The vaccinator will check the vaccination cards to determine which vaccines the children already have, and what doses are due. If the residents agree, the team will vaccinate the children under 5, girls aged 10 to 17 with the HPV vaccine, administer deworming pills, supply Vitamins A drops, and distribute appropriate dosages of ORS+Zinc sachets, chlorination tablets, and additional deworming pills and Vitamin A drops, enough to last to treat drinking water for 3 months or more. The vaccinators will also talk to the parents about when the next vaccine dose is due and where and when they should take their children to receive the required doses of immunization (i.e. the CHC closest to their community).

This door-to-door approach to delivering the bundle allows our team to customize the delivery to suit the varying requirements in each household, and enables recipients to receive the bundle when convenient and in between their household chores. Households that show interest in any element of the bundle, but were not available at the moment of the visit will be revisited whenever it is convenient for them. Relative to our previous trial which centralized vaccine delivery at a central point in each village, we believe that this door-to-door campaign will make more efficient use of the time that our staff members spend in each village. Based on our observations during the previous trial, we think that this last-meter delivery beyond the last-mile effort of reaching the village may be more effective

Our intervention protocol is thus designed to address the multiple barriers to access health services: (i) search costs of acquiring accurate vaccine and health services information, (ii) decision costs that impact an individual's final choice to get vaccinated, and most importantly, (iii) access costs associated with access to health facility sites.

Research questions

Main research question

What is the increase in DALYs per dollar spent delivering a bundle of health services to remote, rural communities in Sierra Leone?

The trial will produce data on the increase in immunizations and take-up of deworming pills in treated communities relative to control - both immediately, and after 3 months. We will also have data on increase in water chlorination, and take-up of vitamin A and ORS after 3 months. GiveWell funding allows us to include some of these additional health products to our bundle, and through these additions we expect an improvement in the main cost-effectiveness metric we are planning to track. The take-up of immunizations will be observed directly and measured immediately, and our SSRC-funded project was designed for that. With additional GiveWell funds we will conduct a second visit after 3 months to measure the take-up of chlorination and other health services not directly administered on day 1.

Other ancillary benefits of the second visit include (a) measuring the effects of the vaccination conversations and reminders to see whether it induces any follow-up actions by parents in the interim period, and (b) informing households that we will return in 3 months to re-stock chlorine and ORS may change adherence.

Our primary hope is that if the trial data shows that this last-mile delivery of a bundle of health services cost-effectively improves population health in remote communities, then we will inspire the Sierra Leone MoHS and its international development partners to deploy this strategy on a larger scale. Our team is well-positioned to directly communicate any actionable research results with this consortium of partners, due to our deep engagement in public health work in Sierra Leone since the start of the pandemic.

Secondary research questions

1. **What are the marginal gains from visiting a community a second time?**
   If we cover most households in the community with required vaccinations during the initial visit, it is possible that a second visit would have relatively low value-add. Perhaps those resources are better redirected towards initial visits for an entirely new set of communities. On the other hand, restocking of chlorine tablets and ORS packets may be very important for sustained use. And households' acceptance of all these interventions may improve through multiple visits instead of one. For example, community-wide vaccine acceptance and knowledge may improve over time, which in turn would help to make the 2nd visit very cost-effective. Cost effectiveness depends critically on how many households take up the interventions, after we pay the fixed cost of reaching that remote community.

2. **Heterogeneous treatment effects**
   The effectiveness and cost-effectiveness of this treatment may depend heavily on how remote a treated community is. This is because, in less remote places, the control group may find ways to access services at the CHC even absent our intervention. With more data and a larger sample size, we will have a better chance to track the heterogeneity of treatment effects across several community and household characteristics. Remoteness is a factor that is towards the top of our list for such heterogeneity tests. We are also interested in studying heterogeneous treatment effects by gender, age, initial attitudes towards vaccines, and initial attitudes of traditional authorities towards vaccines.

3. **Effects of in-home delivery of HPV relative to the standard in-school delivery**
   The standard approach to delivering HPV is in schools and our in-home delivery would be unique in this literature. We will compare the take-up of HPV vaccines in our study to the effects of in-school delivery previously published in the literature. Our approach is particularly relevant for contexts like rural Sierra Leone, where the majority of adolescent girls are not enrolled in school or do not attend regularly. In school campaigns would leave

such girls vulnerable to HPV exposure. To be clear, we would prioritize this research question, even absent any additional GiveWell funding.

4. **Spillover effects**
   We plan to stratify control villages by distance to the closest treated communities to track spillover effects. Since nearby control communities share the same CHC with the treated communities, that is one potential channel of spillover. There may be positive learning externalities through CHC staff. However, the enhanced workload for CHC staff and any congestion at the CHC may also crowd out health service access in control areas. Second, individuals can travel from nearby control communities to treatment communities in order to get vaccinated. In our previous study we found that many people traveled from surrounding villages to get vaccinated. Additional funding will allow us to increase the number of communities assigned to control and increase the study's statistical power to detect any such spillovers.

5. **Longer-run Effects**
   Even with the additional GiveWell funding under discussion, we will not immediately be able to track longer run effects. However, through this trial, if we find that our intervention produces a strong first stage with large increases in the take-up of childhood immunizations, the new malaria vaccine, HPV vaccines, water chlorination, ORS use, etc then we will be keen to track longer run effects. If we find large enough first-aid effects, then we will leverage those findings to apply for new research funding to revisit treatment and control communities after several months or a year or two. If life expectancy and overall health improves sufficiently, that may affect the human capital investments that parents are willing to make in their children. Sustained chlorine use may change households' perceptions of acceptable taste of water, and that may lead to new chlorine use habits in the longer run that we would want to track. People may also get opportunities to learn about efficacy and value from the first 6 months of chlorine and ORS use, and may lead them to procure chlorine and ORS/Zinc on their own, and increase trips to health facilities.

Data analysis

Our primary analysis estimates the following specification using an OLS regression with pooled treatment data from surveys conducted during the first visit and the second visit after 3 months (and further rounds):

$$y_{i,c,t} = \alpha + \beta\, Treated_c + X_{i,c,t=0}'\gamma + \delta_t + \varepsilon_{i,c,t} \quad (1)$$

Where *i* indexes individuals; *c* indexes communities; *t* indexed survey waves; *y* is the outcome of interest; *Treated* is an indicator that a community *c* was assigned to receive the bundle; *X* is a set of

pre-specified baseline covariates (including randomization stratum fixed effects); and δ are survey wave fixed effects, and $\varepsilon_{i,c,t}$ is the error term clustered at the community level.

The coefficient β estimates the causal effects of the treatment relative to the control group.

To explore heterogeneities by demographic variables remoteness, initial attitudes towards vaccines, and attitudes of traditional authorities we interact the treatment with each characteristic (*Z)*:

$$y_{i,c,t} = \alpha + \beta\, Treated_{c,t} + \lambda\, Treated_{c} * Z_{i,c,\,t=0} + \eta\, Z_{i,c,\,t=0} + X_{i,c,t=0}'\gamma + \delta_{t} + \varepsilon_{i,c,t} \quad (2)$$

We will explore spillovers by comparing close control and far control communities:

$$y_{i,c,t} = \alpha + \beta\, Treated_{c,t} + \zeta\, FarControl_{c,t} + X_{i,c,t=0}'\gamma + \delta_{t} + \varepsilon_{i,c,t} \quad (3)$$

Finally, to study differences in take-up rates across villages with engagement from higher authorities and with engagement only from social mobilizers we estimate the following specification using OLS:

$$y_{i,c,t} = \alpha + \beta_0\, HigherAuthorities_{c} + \beta_1\, SocialMobilizers_{c} + X_{i,c,t=0}'\gamma + \delta_{t} + \varepsilon_{i,c,t} \quad (4)$$

Measurement of outcomes

Our primary outcomes are:

1. **Take-up of vaccines:** measured as the vaccination status verified by physically inspecting vaccination cards and direct observation of delivery during the implementation. This follows the standard protocol of the MoHS because they consider a person properly vaccinated in official records only if it can be verified by the government-issued vaccination card. Retaining this card and treating it as an important document is the norm in rural Sierra Leone. People with local public health expertise believe that card-verified vaccinations are a much more reliable metric than self-reported vaccinations. And in our second visit after 3 months, we will be able to verify what proportion of vaccinated people are able to produce the card on demand, since we will have independent vaccination records based on our direct observations during the first visit.
2. **Take-up of deworming pills and Vitamin A drops:** measured by checking the vaccination cards of the participants and by direct observation of delivery during the implementation. The vaccination cards in Sierra Leone record Vitamin A drops and deworming pills administered by the MoHS.
3. **Use of Chlorine, and water quality measures:**
    a. We will conduct "spot check" chlorine tests to measure whether the drinking water in the household at the time of our unannounced visit has any chlorine.
    b. We will ask households about their use of chlorine in the past month.

   c. Enumerators will observe the water that respondents would normally drink that day and note down the color of the water.
4. **Cases of diarrhea and use of ORS/Zinc:** we will survey respondents to ask them about the cases of diarrhea from children under 5 and whether they have used ORS/Zinc to treat the episodes. We will prioritize a seven-day recall, and otherwise conform to the accepted standards in the diarrhea literature.
5. **Other outcomes:** we will survey respondents to collect information on:
   a. Visits to health facilities.
   b. Knowledge and attitudes towards vaccines, importance of water quality, ORS/Zinc, and chlorination.
   c. Number of sick days.
   d. School attendance of children.
   e. If feasible within our budget, we will take height and weight measurements of infants and children

We intend to conduct two rounds of data collection on all of these outcomes, on the day of intervention delivery (month 0) and during the second delivery (month 3). If the budget allows for a third visit, we may conduct that visit either at (a) month 6 to collect measures of chlorine and ORS use before their stock runs out, or (b) sometime during months 7-9 to observe whether households choose to procure chlorine by themselves after the provided stock runs out, or (c) sometime during months 12 to 24 to study the longer-term effects of improved health on children and household decision-making.

Power calculations

We conduct power calculations for an RCT clustered at the community level. We estimate the minimum detectable effect (MDE) for each of the items that we intend to include in our bundle for an 80% power, a 5% probability of a type I error, and an intra cluster correlation (ICC) of 0.3.[4]

We used our 7-community pilot data to guide our assumptions on baseline coverage (see Figure 2) and the cluster size.[5] We estimated that on average there are 65 households, 22 girls aged 10-17, and 36 children under 5 in each community. We support calculations below. Assuming that we will collect data on 25 people in each community for a given outcome. We also showed changes in power when the cluster size is instead assumed to be 15

We calculate the power for a comparison across the control and the pooled treatment villages because that is the main comparison of interest to Givewell. We assume that we will visit 250

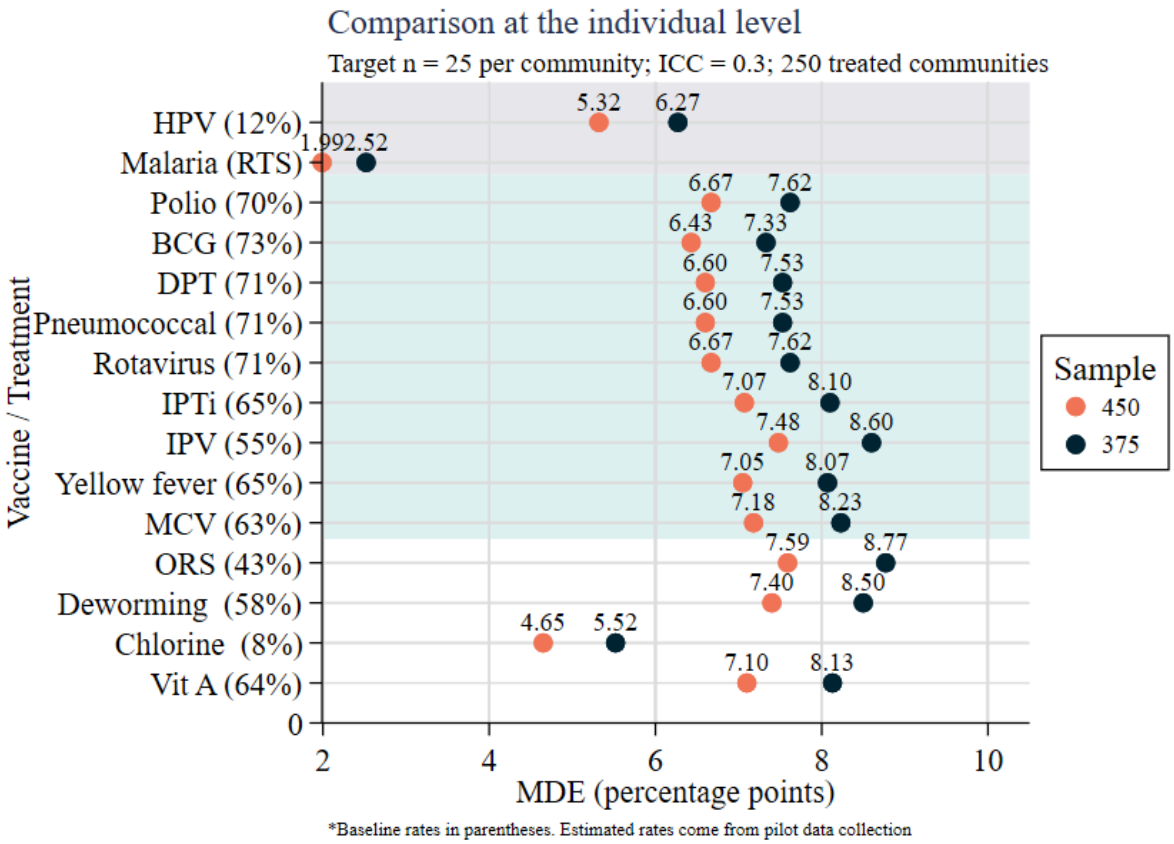
[4] Using our RCT 2022 study, we measure an ICC of 0.28 (C.I. = [0.23;0.34] at the 95% level) for the Covid vaccination rates.
[5] We collected data in March and April 2024 on 11 rural remote communities, similar to the communities we intend to include in our study. We collected information from 463 residential units, with 775 households.

treatment villages. Given our ongoing conversation about the budget for an expanded sample size, we estimate power for 200 and 125 control villages respectively. Increasing the number of control villages to 200 will produce a more balanced treatment and control arms, which has some additional benefits in terms of power for the pooled comparison.

Figure 2 summarizes the results of this exercise. Excluding the items observed to have very low take up in our pilot data (chlorine, HPV and malaria RTS vaccine) the MDE with 125 control communities ranges between 7.33-8.77 percentage points (pp). If we increase the size of the control group to 200, we gain about 1 percentage point, and the MDE ranges between 6.43-7.59pp.

Table A.1. from the appendix summarizes health products and vaccines targets set by Unicef and the WHO, their current coverage in Sierra Leone from our pilot data collection, and treatment effects found in the literature on these interventions. In light of findings from previous studies, these are reasonable MDE on the effect sizes we expect.

Figure 2: power calculations for 125 and 200 control communities

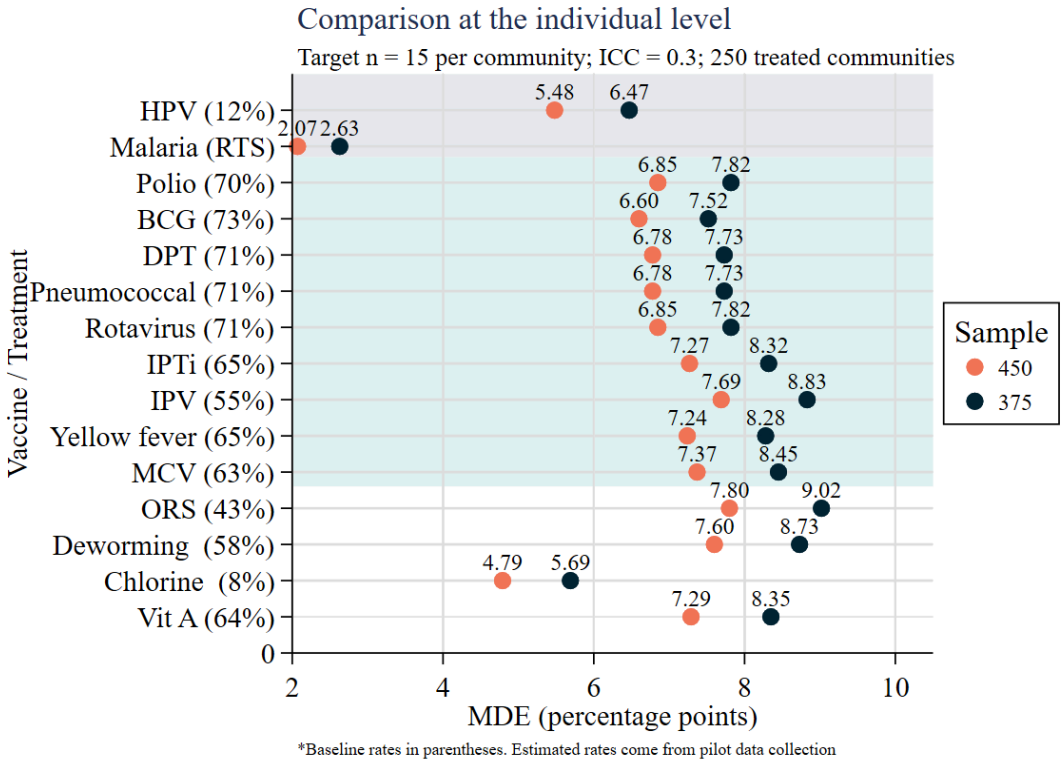


Chlorination and ORS/Zinc may be substitutes for each other: the higher the use of chlorination, the lower the cases of diarrhea, and therefore the lower the use of ORS/Zinc in the extensive margin. We reduce the target population per cluster to 15 to take this into account (see Figure 3

below). Here MDE ranges 7.52-9.02 pp with 125 control communities and 6.6-7.8pp with 200 control communities, respectively. Compared to a cluster size of 25, the differences are small (about 0.2 pp) because the effective sample size is driven by the number of clusters/communities included in the study (instead of the cluster size).

Figure 3: power calculations for 125 and 200 control communities

15 children per community

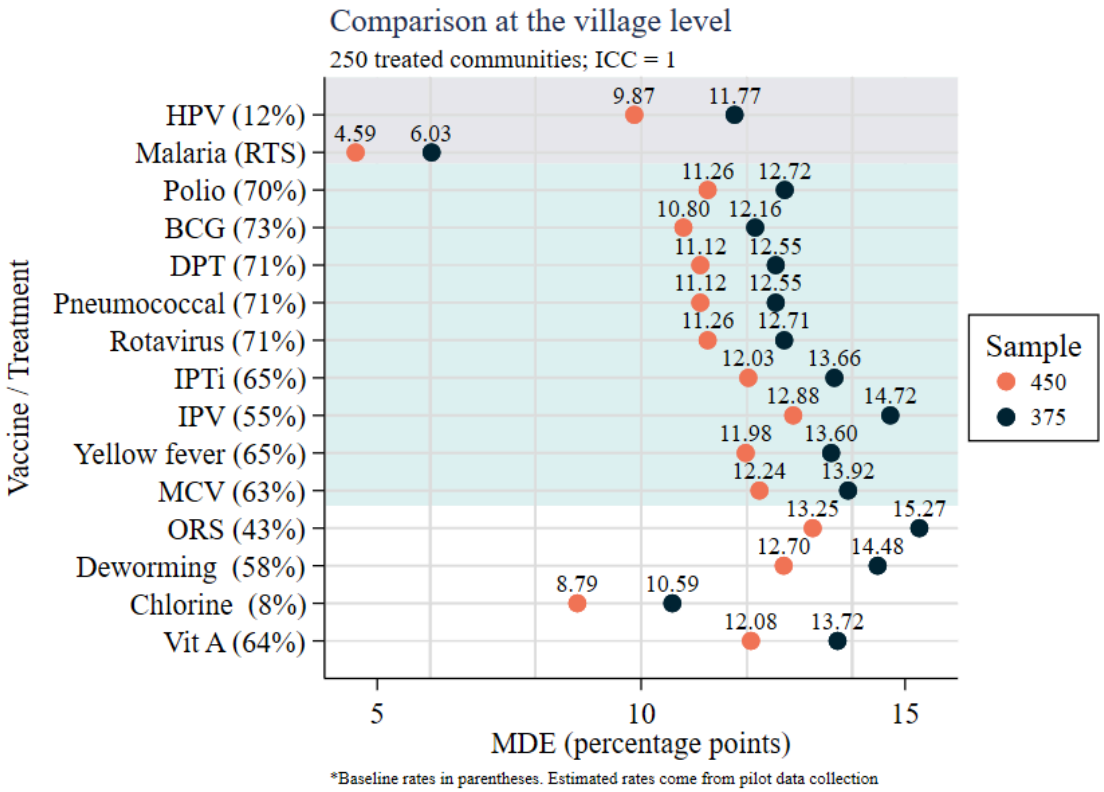


This approach however does not capture that the expected treatment effect may be lower, for example if improved water quality leads to a reduction in the share of diarrhea cases treated with ORS/Zinc (intensive margin utilization). However, it is difficult to guess how much the interaction with chlorination may change the ORS/Zinc use.

Finally, we also consider an analysis on the effect of the bundle at the village level. This is equivalent to considering a clustered trial with an ICC equal to 1, which implies that we can also interpret these calculations as upper bounds for the clustered analysis where the correlation across individual units within a cluster is high. With the exception of chlorine, the HPV vaccine, and the malaria RTS vaccine, the MDE ranges between 10.8pp-13.25pp with 125 control communities and 12.16-15.27pp with 200 control communities (Figure 4).

Figure 4: power calculations for 125 and 200 control communities

Analysis at the village level



*Baseline rates in parentheses. Estimated rates come from pilot data collection

Timeline

We plan to register our trial at ISRCTN, following the same process as with our previous study (reference https://www.isrctn.com/ISRCTN17878735). Trial registration will happen ahead of enrollment (into the survey and treatments). We obtained IRB approval from the Sierra Leone Ethics Review Committees and the IRB committees at Yale and Wageningen University for the SSRC design. We will amend the approval to accommodate the new design elements. Both registration and IRB amendment are expected to be submitted and approved during May 2024.

Budget

We have prepared a menu of budgets for four possible combinations that vary:

1. The number of control (total) communities 200 (450) and 125 (375).
2. 2 versus 3 rounds of data collection.

		Number of communities (control, treated)	
		Budget A 450 (200 control, 250 treated)	**Budget B** 375 (125 control, 250 treated)
Data collection rounds	3 rounds	$1,166,872	$1,058,302
	2 rounds	$834,754	$762,374

Please find an itemized budget here.

The numbers displayed in the table above are total funds requested from GiveWell, after the SSRC investments are taken into account. These budgets include the following:

1. Implementation costs: $429,712 (e.g. the cost of chlorine and other materials needed)
2. Data collection costs: ranging from $213,862 to $618,360
3. Yale research and policy outreach costs: $118,800 (around 52k in policy work, the rest for research)

Rationale Budget A vs. Budget B

Given our current assumptions, with 125 control communities we are powered to detect effect sizes of 7.33-8.60 pp for all of the health services included in the bundle. These are reasonable guesses on the effect sizes we expect, in light of findings from our previous work. However, given the current gaps in immunization in Sierra Leone, we have constructed Budget *B* that adds 75 control communities to detect even smaller effect sizes in the range of 6.43-7.59 pp. While the 1 percentage point difference is small, the additional sample size would increase the power to detect spillover effects on control communities, and when we conduct the heterogeneity tests described above.

Rationale for the third round of data collection

A third round of data collection will allow us to study the longer-term effects from the delivery of the bundle. If child immunization, life expectancy, and overall health in the household improves, we may observe downstream changes in two dimensions. First, households may form habits and choose to procure chlorine and ORS/Zinc on their own, or they may increase trips to health facilities. Second, households may change their investment in children's human capital. We would like to measure changes in children's height and weight than middle upper arm circumference. Some of these biometrics are very quickly sensitive to changes in the nutritional and disease environment, so we hope to do the 3rd visit somewhere between month 7 and month 18 post-intervention.

Implementation costs

Across all four budget options, we fixed the number of treated communities to 250 with two rounds of bundle delivery. The implementation costs sum to $429,712, and they include:

1. Procurement of the bundle - $248,100
   This includes procurement of chlorination tablets and ORS/Zinc for 40 children under 5 per community, enough to last for 3 months. The vaccines, deworming pills, and vitamin A are procured by the MoHS.
2. Central program team costs - $60,898.4
   Based on our previous work, we have budgeted for
   a. **Local personnel** including a project coordinator responsible for the bundle delivery operations, a district delivery manager to oversee and provide on the spot logistical support, and a monitoring and evaluation officer in charge of recording administrative vaccination data and tracking progress from the vaccination intervention into the MoHS/EPI system.
   b. **CWW personnel:** with 10% effort as their roles are shared across projects
3. Mobile vaccination team costs – $202,680
   Including training and team operations (as transport and lunch allowances) of the health service delivery team, vaccinators and social mobilizers.
4. Support functions and administrative costs – $49,770
   Including transport and administrative costs

We include a 7% ICR from CWW and subtract $171,038 funded by SSRC from the total. The excess implementation costs over and above SSRC funding stem from the following categories:
(1) the procurement of ORS/Zinc and chlorination tablets
(2) cost of the second (additional) round of vaccine and non-vaccine bundle delivery. The SSRC-funded project budgeted only for one round of data collection, since vaccine take-up would be observed instantaneously. Tracking chlorine and ORS use requires the additional round.

Data collection costs

The data collection costs sum to $616,360 for a design with 200 control communities and 3 rounds of data collection. This sum includes:

1. Hiring of enumerators and field coordinators for $240,000 for each round of data collection. Enumerators and field coordinators are in charge of carrying out pre- and post-treatment data collection
2. Hiring a field research assistant for one year for $40,000.
   The field research assistant will oversee overall project management to ensure it runs on time and schedule, work closely and supervise the implementation partner, supervise the research and implementation teams, and coordinate between the various organizations involved in the project.
3. Materials for the data collection summing to $39,600 per data collection round
   This includes an internet bundle for the submission of the surveys, mobile credit for communication during the study, rental of tablets for completion of the surveys, rental of

vehicles for transportation of coordinators across communities, and chlorination tests for data collection.

We sum the cost from all rounds of data collection and a 10% indirect costs from Wageningen University and Research. We subtract $421,993 funded by SSRC from the total costs. The excess data collection costs over and above SSRC funding comes from (1) the second (and third) round of data collection, (2) chlorination tests, and (3) the additional 75 control villages.

Third data collection round: Keeping the number of control villages at 200, reducing from three to two data collection rounds brings down the total cost of data collection to $286,242. This comes from a reduction of $301,925 in direct data collection costs.

Number of Villages in Budget B: Reducing the number of control villages from 200 to 125 lowers the number of required days to complete the data collection. This brings the data collection budget to $509,790 and $213,862 for three and two rounds of data collection, respectively.

Yale research costs

Yale research costs sum to $118,800. This sum includes:

1. Policy outreach - $52,000. Our goal is to work on disseminating and communicating results with Sierra Leone MoHS high-level decision-makers, their international development partners like UNICEF, UNDP, WHO, UK and US government, and international NGOs with a local presence in Sierra Leone, To encourage replication and scale up depending on the trial results. This line item proved to be very useful and effective during Givewell's support of Y-RISE mask research, and we aim to replicate that process here. But strictly speaking, this line is not necessary to complete the trial.

2. PI time - $9,000 including fringe. This is the minimum that must be added to grant applications, per university guidelines.

3. A Yale research assistant time plus international travel - $47,000
   Working full time on the study during its entire length. This includes work on the design and coding of a questionnaire for data collection, supervising the quality of data collection (e.g., through high-frequency checks), and analyzing the final data. Part of a research assistant's time was already covered by the SSRC grant, but with the extension of the project timeline over at least three additional months, we need to employ an RA over a longer period, and budget for the additional times a day will have to spend in Sierra Leone.

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Appendix

Table A.1: Health products and vaccines targets, current coverage in Sierra Leone, treatment effects from the literature, and MDE

	WHO target	SL census pilot (n = 11)	Expected ATE	Treatment vs. Control MDE with 450 communities (25 obs per community)	
				ICC=1	ICC = 0.3
Unknown or new vaccines: with low take up and high expected ATE					
HPV (girls 10-17)	90% WHO's strategy to eliminate cervical cancer	12%	> 20%p *Meriggi et al (2024)	9.87% p	5.32%p
Malaria (RTS)		0%	> 20%p *Meriggi et al (2024)	4.59%p	1.99%p
Routine vaccines: with high take up and lower expected ATE					
OPV	More than 80% Polio Global eradication initiative	70%		11.26%p	6.67%p
BCG	More than 90% WHO's End TB strategy	73%*		10.8%p	6.43%p
DTP	> 90% WHO global vaccine action plan 2011-2020 (target was not reached in 2020)	71%*		11.12%p	6.6%p
Pneumococl		71%*		11.12%p	6.6%p
Rotavirus		71%*		11.26%p	6.67%p
IPTi		65%*		12.03%p	7.07%p
IPV	More than 80% Polio Global eradication initiative	55%*		12.88%p	7.48%p
Yellow fever	> 80% for countries at risk WHO immunization coverage	65%*		11.98%p	7.05%p
MCV	> 90% 2020 WHO global vaccine action plan	63%*		12.24%p	7.18%p
Health products (household level)					
ORS as Diarrhea treatment		43%	19%p *Wagner et al. (2019) *Coupons for ORS*	13.25%p	7.59%p
Deworming (< 5 yo)	75% Last large scale WHO programme (2017)	58%	78%p (first cohort). 0%p in counterfactual Miguel (2004) *Distribution of*	12.7%pp	7.4%p

	WHO target	SL census pilot (n = 11)	Expected ATE	Treatment vs. Control MDE with 450 communities (25 obs per community)	
				ICC=1	ICC = 0.3
Unknown or new vaccines: with low take up and high expected ATE					
HPV (girls 10-17)	90% WHO's strategy to eliminate cervical cancer	12%	> 20%p *Meriggi et al (2024)	9.87% p	5.32%p
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MCV	> 90% 2020 WHO global vaccine action plan	63%*		12.24%p	7.18%p
			deworming pills in schools		
Vit A	80% Considered as high coverage by Unicef	64%	10%p Awasthi et al. (2016) *mass-treatment days*	12.08%p	7.1%p
Chlorine	Unicef water game plan aims for universal access to safe water by 2030	8% (use)	20.4%p Dupas et al. (2016) *Vouchers' distribution for chlorine redemption*	8.79%p	4.65%p