Statistical Analysis Plan

Section 1: Administrative information

Title: Addressing healthcare access needs for people with functional difficulties in Luuka district, Uganda: a cluster-randomized controlled trial with economic and process evaluations

Version: 1.1 (29th April 2024)
Protocol version: 2.3 (15th April 2024)
Trial Registration: ISRCTN registry, ISRCTN66594817 (24/05/2024)

Section 2: Introduction

2.1 Background and rational

Globally, there are approximately 1.3 billion people with disabilities, with the vast majority (80%) living in low- and middle-income countries (LMICs) such as Uganda. People with disabilities face widespread exclusion and discrimination, including barriers to accessing health services, leading to worse health outcomes and a significantly shorter life expectancy compared to the general population. Improving access to healthcare for people with disabilities is an urgent priority, but evidence on effective interventions in LMICs is scarce.

Participatory Learning and Action (PLA) approaches have been successfully used to empower communities to generate local solutions and improve health outcomes. However, PLA has not been explicitly used for people with disabilities before this study. The present cluster-randomized controlled trial aims to assess whether a novel intervention, Participatory Learning and Action for Disability (PLA-D), can improve access to healthcare and reduce mortality and unplanned hospitalization among people with disabilities in rural Uganda. The trial will also evaluate the implementation, costs, and potential mechanisms of action of PLA-D.

The study will use a cluster-randomized controlled trial design with 100 clusters and a sample size of 5,000 people with disabilities for the primary outcomes and a sub-sample of 2,000 people with disabilities for the secondary outcomes. The intervention arm will receive PLA-D in addition to health system strengthening interventions (healthcare worker training and health facility accessibility audits), while the control arm will receive only the health system strengthening interventions.

The primary research questions are:

- Does PLA-D, in combination with health system strengthening interventions, reduce mortality and unplanned hospitalization among people with disabilities compared to health system strengthening interventions alone?
- Is PLA-D feasible, acceptable, and cost-effective when integrated into the Ugandan health system?

This will be the first trial assessing the effectiveness of a participatory approach in addressing the urgent need for inclusive healthcare access interventions for people with disabilities in a LMIC setting. The results will inform efforts to improve health outcomes and reduce health inequities faced by people with disabilities in Uganda and other similar contexts.

2.2 Objectives

The main objectives are to evaluate the impact, implementation, and cost-effectiveness of the PLA-D intervention in combination with health system strengthening interventions when integrated into the Ugandan health system compared to health system strengthening interventions alone. The key hypotheses are that the PLA-D intervention will improve access to healthcare, reduce mortality and unplanned hospitalization, and will be a feasible, acceptable, and cost-effective model within the health system. Specifically,

Objectives:

- Evaluate the impact of PLA-D and other disability-inclusive health system strengthening interventions on mortality and unplanned hospitalization for people with disabilities, compared to disability-inclusive health system strengthening interventions alone.
- Estimate the set-up and implementation costs and incremental cost-effectiveness of PLA-D.
- Evaluate the feasibility and acceptability of intervention implementation, potential mechanisms of action, and strategies for scale-up of the program components (PLA-D, healthcare worker training, health facility audit).

Hypotheses:

- Primary effectiveness hypothesis: The PLA-D intervention, in combination with health system strengthening interventions, is effective in reducing mortality and unplanned hospitalization among people with disabilities, compared to health system strengthening interventions alone.
- Primary implementation hypothesis: The integrated PLA-D intervention is feasible, acceptable, and results in high-fidelity adoption of the program at the district level, promoting reach and coverage of inclusive healthcare services for people with disabilities.

This statistical analysis plan describes the quantitative analyses to be conducted for objectives 1 and 2. Objective 3 will be assessed through qualitative analyses and will be described separately.

Section 3: Study Methods

3.1 Trial design

This is a pragmatic, parallel-group, two-arm, cluster-randomized controlled trial with a 1:1 allocation ratio. The participants are people with disabilities living in rural villages of Luuka district, Uganda. Clusters are defined as villages, with approximately 50 people

with disabilities per cluster. The intervention arm will receive the PLA-D intervention in addition to health system strengthening components (healthcare worker training and accessibility audits). The control arm will receive only the health system strengthening components. There will be a baseline survey and a 24-month follow-up assessment.

3.2 Randomization

A total of 100 villages (clusters) will be randomly selected from the eligible villages in Luuka district, Uganda. Prior to randomization, the characteristics of the villages will be reviewed, and villages that are too close together (<5km), too small (<250 inhabitants), too large (>750 inhabitants), or too insecure will be excluded. Additionally, villages that participated in the pilot of the PLA-D intervention will be excluded. Restricted randomization will be used to ensure balance between the intervention and control arms on key criteria, including demographic characteristics, cluster size, and distribution across sub-counties, as well as on one of the primary outcomes, hospitalization. The randomization will be performed by the London School of Hygiene & Tropical Medicine (LSHTM) using Stata (StataCorp. College Station, TX: StataCorp LLC) or an equivalent software. The allocation of villages to the intervention and control arms will occur at a single time point after the baseline survey, but before the implementation of the intervention.

3.3 Sample size

The trial has a joint primary outcome of mortality and unplanned hospitalization among people with disabilities over the 24 months of follow-up. The sample size has been calculated based on mortality, as it is far lower than hospitalization (0.05 person-year vs. 0.42 person-year). Each cluster (village) in Uganda has an average of 617 people. With an expected prevalence of disability of 8% (conservative estimate), each village would include approximately 50 people with disabilities. Assuming a coefficient of variation of 0.1 based on data from other trials in Uganda and two years of follow-up (100 person-years per cluster), 50 clusters per arm will be required to detect a 25% reduction from a baseline mortality rate of 50 deaths per 1,000 person-years, with 82.1% power. This equates to a sample size of 2,500 people with disabilities in the control arm and 2,500 in the intervention arm. This estimate is conservative, as the expected prevalence of disability in Luuka district is 10.6% rather than 8%, and the baseline mortality rate is likely to be even higher. The assumed 25% reduction in mortality rate over 2 years is consistent with the mortality reductions observed in existing PLA trials. Under this sample size, there is near 100% power to detect a 25% reduction in hospitalization from 0.42 person-years, with a confidence of 99.98% (corresponding alpha = 0.0001). Therefore, for the joint outcome, the probability of making Type I and Type II errors remains acceptable, at almost 95% and 80%, respectively.

For the secondary outcomes, in-depth quantitative data will be collected from a sample of the total participants due to restricted budget availability. The reduced sample size has been calculated based on the secondary outcome of quality of life. With two years of follow-up, 20 participants with disabilities per cluster in each arm (i.e., 1,000 participants per arm) will be required to detect a 15% improvement from a baseline quality of life score of 43.19, with a between-cluster variance of 9.5 and a within-cluster variance of 185.5 (estimate based on data from the pilot study), with 91% power. The study team believes

that achieving a 15% improvement in quality of life over 2 years is realistic.

3.4 Framework

This is a superiority trial design evaluating whether the PLA-D intervention combined with health system strengthening is superior to health system strengthening alone in reducing mortality and unplanned hospitalization among people with disabilities. The co-primary outcomes are mortality and unplanned hospitalization rates over 24 months of follow-up. The trial hypotheses are that participants receiving the PLA-D intervention plus health system strengthening will have significantly lower mortality and unplanned hospitalization rates compared to participants receiving only health system strengthening. Between-arm comparisons will be made for the co-primary and secondary outcomes using intention-to-treat analyses. Superiority will be demonstrated if there are statistically significantly greater reductions in mortality and unplanned hospitalization rates in the intervention arm versus the control arm.

3.5 Statistical interim analyses and stopping guidance

Interim analyses: No formal interim analyses are planned.

Adjustment of significance level: No adjustment of the significance level is planned for interim reviews by the DMC. The overall Type I error rate will be maintained at 5% for the primary effectiveness outcomes.

Guidelines for stopping early: There are no statistical guidelines for early stopping of the trial, as there is no expected side effect or harm from the intervention.

3.6 Timing of final analysis

The final analysis for the primary and secondary outcomes will be conducted collectively after the completion of the 24-month follow-up period for all participants. This will occur once the endline survey data collection is completed and the dataset has been cleaned and locked. The primary outcomes, mortality and unplanned hospitalization, will be analyzed using data collected from all participants with disabilities identified during the baseline survey and followed up at 24 months. The secondary outcomes, including quality of life, participation, morbidity, healthcare expenditure, and health access, will be analyzed using data collected from the subsample of participants who completed the in-depth questionnaires at both baseline and endline.

All outcomes will be analyzed together, as the study does not have different planned lengths of follow-up for different outcomes. The timing of the final analysis will be determined by the completion of the 24-month follow-up period for all participants and the availability of the final cleaned and locked dataset.

3.7 Timing of outcome assessments

The primary and secondary outcomes will be assessed at two time points: baseline (May-July 2024, before randomization) and endline (May-July 2026, 24 months post-baseline ± 1 month). At baseline, adults and children in households will be screened for disability and poverty status, informed consent will be obtained, and a short survey will be conducted to collect data on primary outcomes (unplanned hospitalization) for all participants, with an in-depth survey collecting data in a sub-sample on secondary

outcomes (quality of life, participation, morbidity, healthcare expenditure, and health access) for a subsample. At endline, informed consent will be obtained, and the short and in-depth surveys will be repeated. For the primary outcomes, data will be collected for the entire 24-month follow-up period, with verbal autopsies for deaths and a verbal autopsy-type approach for a subset of unplanned hospitalizations conducted for events reported in the 6 months prior to the endline assessment.

Section 4: Statistical Principles

4.1 Confidence intervals and P values

We will report the estimation as standard mean difference (SMD) for continuous outcomes, OR for binary outcomes, and HR for time-to-event outcomes, as well as their 95% confidence interval (CI). P value < 0.05 will be the level of statistical significance.

4.2 Adherence and protocol deviations

Adherence to the intervention will be defined as the extent to which participants in the intervention arm attend and engage with the PLA-D group meetings. Adherence to the intervention will be assessed through self-reported attendance at PLA-D group meetings, collected during the endline survey. Participants in the intervention arm will be asked to report the number of PLA-D sessions they attended. The overall attendance rate will be calculated as the proportion of sessions attended out of the total number of sessions held, based on the self-reported data. Exposure to the intervention will be considered sufficient if a participant attends at least 50% of the PLA-D group meetings. Adherence to the intervention will be presented as the proportion of participants in the intervention arm who attended at least 50% of the PLA-D group meetings, along with the mean, median, and range of the number of sessions attended. Adherence will be summarized overall and stratified by key demographic characteristics, such as age and gender. For monitoring and process evaluation purposes, attendance records maintained by the PLA-D group facilitators will be used to assess the overall level of participation in the intervention. However, due to the inability to link individuals from the PLA-D groups to the survey data, these attendance records will not be used to assess individual-level adherence in the primary analysis.

Protocol deviations will be defined as any departure from the study protocol that may impact the study's integrity, participant safety, or data quality, such as enrolment of ineligible participants, failure to obtain informed consent, incorrect assignment of participants to study arms, failure to adhere to the intervention protocol, failure to complete outcome assessments within the specified time window, or breach of participant confidentiality. All protocol deviations will be documented and summarized, reporting the number and proportion of deviations overall and by study arm, including participants enrolled who did not meet eligibility criteria, participants for whom informed consent was not obtained before data collection, participants incorrectly assigned to study arms, PLA-D group meetings not held as planned, outcome assessments completed outside the specified time window, and participant confidentiality breaches. Significant protocol deviations that may impact the interpretation of the study results will be discussed in the final analysis.

4.3 Analysis populations

The primary analysis will be conducted using an intention-to-treat (ITT) approach, which includes all participants according to the study arm to which they were randomized, regardless of their adherence to the assigned intervention or subsequent withdrawal from the study. The ITT population will consist of all participants with disabilities identified during the baseline survey, and their outcomes will be analysed according to their assigned study arm.

Secondary analyses will be performed using a per-protocol (PP) approach, which includes only participants who adhered to the study protocol and completed the assigned intervention. For the PLA-D intervention, the PP population will include participants in the intervention arm who attended at least 50% of the PLA-D group meetings and completed the 24-month follow-up assessment. The PP analysis will be used to assess the effect of the intervention among participants who received the intended exposure.

A complete case analysis will be conducted as a sensitivity analysis, including only participants with complete data for the primary and secondary outcomes at both baseline and endline assessments. This analysis will be used to assess the robustness of the primary findings to missing data.

Safety analyses will not be conducted, as the PLA-D intervention and health system strengthening components are not expected to have any significant adverse effects on participants. However, if any adverse events are reported during the study period, they will be documented and summarized descriptively.

Section 5: Trial Population

5.1 Screening data

The study will report on the screening process from the initial identification of potentially eligible participants to the final enrolment and inclusion in the analysis. The number of households and individuals screened, and the number and proportion of individuals identified as having a disability (overall and stratified by age and sex). The number of participants who were offered enrolment, provided consent, and completed baseline assessments will be presented in a flow diagram by study arm. Reasons for exclusion at each stage will be summarized. Key baseline characteristics of enrolled participants, such as age, sex, and disability type, will be compared to the overall population of people with disabilities in Luuka district, based on available data, to assess the representativeness of the study sample. These analyses will provide transparency on the screening process, enrolment, exclusions, and the extent to which the final study sample reflects the underlying population of people with disabilities in the study area, informing the generalizability of the findings.

5.2 Eligibility

Participants will be eligible if they are residents of the selected villages in Luuka district, Uganda, and have a disability. Disability will be assessed using the Washington Group Short Set on Functioning - Enhanced for adults and children aged 5-17 years, with a disability defined as reporting "a lot of difficulty" or more in at least one domain or having

albinism or short stature. For children aged 2-4 years, the Washington Group/UNICEF Child Functioning Module will be used, with disability defined as reporting "a lot of difficulty" or more in at least one domain or having albinism or short stature. Children under 2 years will be considered to have a disability based on caregiver report, including the presence of albinism. In the case of children <18 years old or where direct interview is not possible (e.g. hearing/cognitive impairment), family member/caregiver will report. There are no specific exclusion criteria based on individual characteristics. Eligible clusters are defined as villages within Luuka district that meet the specified size, proximity, and security criteria. The broad eligibility criteria aim to identify a diverse group of people with disabilities to evaluate the integrated PLA-D program when delivered under real-world conditions.

5.3 Recruitment

Information that will be included in the CONSORT flow diagram for this study:

- Number of villages (clusters) assessed for eligibility, excluded with reasons, and randomly allocated to each study arm
- Number of households screened in each study arm
- Number of individuals assessed for eligibility within the screened households in each study arm
- Number of individuals excluded at the eligibility assessment stage with reasons, in each study arm
- Number of eligible individuals in each study arm
- Number of eligible individuals enrolled (consented) in each study arm
- Number of participants in each arm (PLA-D and health system strengthening, vs health system strengthening alone)
- Number of participants with protocol deviations in each arm
- Number of participants lost to follow-up at endline (24 months) in each arm with reasons
- Number of participants discontinuing participation in the study in each arm with reasons
- Number of participants included in the primary and secondary outcome analyses in each arm
- Summary of baseline characteristics and imbalances between study arms
- Summary of intervention fidelity and adherence in each arm

This information will provide a comprehensive overview of the flow of clusters and participants through the study, from village selection and household screening to enrolment, intervention delivery, follow-up, and analysis. The flow diagram will visually present the progress through the study, allowing for the evaluation of representativeness, potential sources of bias, and the impact of participant retention and intervention fidelity on the study results. The details on enrolment, protocol deviations, retention, and intervention delivery will be essential for interpreting the validity and generalizability of the study findings.

5.4 Withdrawal/follow-up

Participants may withdraw from the study or be lost to follow-up during the 24-month

period between the baseline and endline assessments. The level of withdrawal and loss to follow-up will be reported for the study as a whole, as it is not possible to accurately capture withdrawal from the PLA-D intervention due to its open group format and the potential for participants to move in and out of the groups. The number and percentage of participants withdrawal or lost to follow-up assessments will be reported overall and by study arm in the CONSORT flow diagram. Reasons for withdrawal and loss to follow-up will be summarized descriptively using frequencies and percentages for predefined categories, such as refusal, relocation, and inability to contact. Comparisons between study arms will be made to evaluate differential retention. This comprehensive numerical and visual description will allow for the assessment of study retention patterns and potential impacts on the results. Efforts will be made to collect vital status and primary outcome data (mortality and unplanned hospitalization) for all participants lost to follow-up, through phone calls or visits to the participant's last known address, to minimize the impact of missing data on the primary analysis.

5.5 Baseline patient characteristics

Baseline characteristics to be summarized include:

1. Participant demographics: age, sex, and disability type
2. Household characteristics: family size, residence, wealth quintile, and assets
3. Primary and secondary outcome measures: unplanned hospitalization, quality of life, participation, morbidity, healthcare expenditure, and health access

These characteristics will be summarized descriptively using frequencies and percentages for categorical variables and means, standard deviations, medians, and interquartile ranges for continuous variables. Characteristics will be summarized for the overall trial population and by study arm. Tables will be used to present summaries of key variables such as participant age, sex, and disability type. Graphs, such as age distribution plots or bar charts for categorical variables, may also be used to visually present the baseline characteristics.

Section 6: Analysis

6.1 Outcome definitions

Outcomes for objective 1.

There are two co-primary outcomes (POs) that will be used to evaluate the effectiveness of the PLA-D intervention:

1. **PO1, Mortality** (time-to-event outcome): This will be measured as the proportion of participants who have died at the 24-month follow-up, based on reports from household members and verified through two sources (e.g., family and neighbour/death certificate). Verbal autopsy will be conducted for all reported deaths in the preceding 6 months before the endline. Mortality will be measured at endline (24 months post-baseline).
2. **PO2, Unplanned hospitalization** (binary outcome): This will be measured as the proportion of participants who have experienced an unplanned overnight hospital stay at the 24-month follow-up, based on participant or household member reports and verified through the participant's hospital book. A verbal autopsy-type approach will be undertaken for at least 10% of unplanned hospitalizations in the preceding 6 months from the endline. This will be measured at endline (24 months

post-baseline).

The secondary outcomes (SOs) are:

1. **SO1, Quality of life** (continuous outcome): This will be measured using the WHO-QOL BREF for adults (18+ years) and the PedsQL Parent Report for children (2-18 years). The WHO-QOL BREF is a 26-item measure that assesses quality of life across four domains: physical health, psychological health, social relationships, and environment. The PedsQL Parent Report is a 23-item measure that assesses quality of life across four domains: physical functioning, emotional functioning, social functioning, and school functioning. Both measures will be administered at baseline and endline (24 months post-baseline), and overall scores will be calculated based on corresponding guidelines.
2. **SO2, Participation** (continuous outcome): This will be measured using the SINTEF participation questionnaire for participants aged 18+ years and the CASP question set for children aged 5-18 years. The SINTEF questionnaire assesses participation in various life domains, such as education, employment, and community activities. The CASP question set assesses participation in home, school, and community activities. Both measures will be administered at baseline and endline (24 months post-baseline) and scored based on their corresponding guidelines.
3. **SO3, Morbidity** (continuous outcome): This will be measured using the Model Disability Survey question set, which assesses the presence and severity of 23 health conditions. This will be administered at baseline and endline (24 months post-baseline). Scored as whether any/none, and total number of conditions reported.
4. **SO4, Healthcare expenditure** (continuous outcome): This will be measured through participant self-report of healthcare costs incurred over the past 6 months, including direct costs (e.g., consultation fees, medication costs) and indirect costs (e.g., transportation costs). This will be assessed at baseline and endline (24 months post-baseline).
5. **SO5, Health access** (continuous outcome): This will be measured using a composite score derived from principal components analysis of items assessing coverage, quality, affordability, and barriers to healthcare access. This will be assessed at baseline and endline (24 months post-baseline).
6. **SO6, Attitudes** (continuous outcome): This will be measured using the Model Disability Survey question set on attitudes towards disability, which assesses both personal and perceived societal attitudes. This will be administered to participants aged 18+ years at baseline and endline (24 months post-baseline). Scores will be calculated based on guidance for analysing the Model Disability Survey (MDS) issued by WHO where available, and mean total scores reported.

Outcomes for objective 2.

Economic outcomes (EOs). The economic evaluation will collect and analyse the following cost-related data:

1. **EO1, Intervention costs**: This will include the costs of setting up and implementing the PLA-D intervention, such as:

a) Training costs for PLA-D facilitators, supervisors, and managers
b) Personnel costs (salaries and benefits) for PLA-D facilitators, supervisors, and managers
c) Materials and equipment costs for PLA-D meetings (e.g., printed materials, refreshments)
d) Transportation costs for PLA-D facilitators and supervisors
e) Overhead costs (e.g., rent, utilities) for PLA-D meeting spaces and offices
f) Monitoring and evaluation costs

2. **EO2, Health system strengthening costs**: This will include the costs of implementing the health system strengthening components in both study arms, such as:
   a) Training costs for healthcare workers on disability
   b) Personnel costs (salaries and benefits) for trainers and trainees
   c) Materials and equipment costs for training sessions
   d) Transportation costs for trainers and trainees
   e) Costs of conducting accessibility audits of healthcare facilities

3. **EO3, Participant costs**: This will include the costs incurred by participants in the intervention arm as a result of attending PLA-D meetings, such as:
   a) Transportation costs to and from PLA-D meetings
   b) Time costs (opportunity costs) of attending PLA-D meetings, based on reported income and time spent at meetings

4. **EO4, Healthcare utilization costs**: This will include the costs of healthcare services utilized by participants in both study arms over the 24-month follow-up period, such as:
   a) Direct medical costs (e.g., consultation fees, medication costs, diagnostic tests)
   b) Direct non-medical costs (e.g., transportation costs to and from healthcare facilities)
   c) Indirect costs (e.g., time costs of seeking healthcare, based on reported income and time spent)

All costs will be collected continuously throughout the study period using a combination of project financial records from Amref Health Africa (as the PLA-D provider), financial records from MRC/UVRI & LSHTM Uganda Research Unit (as the provider of healthcare worker training and accessibility audits), administrative data on health facility resources and utilization, and endline questionnaires to capture participants' healthcare-seeking costs. Costs will be analysed in Ugandan shillings (UGX) and converted to US dollars (USD) using the average exchange rate during the study period for comparability.

6.2 Analysis methods and additional analysis

The full analysis set (FAS) will be defined according to the intention-to-treat (ITT) principle, consisting of all randomized participants analysed according to their assigned study arm. Participants who withdraw consent for continued follow-up will be included in the main analysis using modern imputation methods for missing data.

For basic description, we will report the mean and standard deviation (or median and interquartile range) for continuous variables and number and percentage for categorical variables, by intervention status (yes or no) and by data wave (baseline vs follow-up). We will test the balance of the covariates by t-test (or Mann Whitney U test) for continuous variable and by chi-square test for categorical variables. Variables imbalanced between intervention and control arms in the standard of $p < 0.1$ will be controlled as confounders in the evaluation of intervention effects.

To evaluate the impact of the PLA-D intervention on the primary and secondary outcomes (Objective 1), the following analysis methods will be used based on the data from endline:

1. Primary outcomes (mortality): For time to event outcome, Cox proportional hazards regression models with shared frailty terms for village-level clustering will be used to estimate hazard ratios and 95% confidence intervals. The proportional hazards assumption will be tested using Schoenfeld residuals, and if violated, the Cox model will be fitted with split follow-up time. Intervention effects will be reported as minimally-adjusted and fully-adjusted hazard ratios (FAHRs) with 95% CIs. The minimally-adjusted model included the treatment status as a fixed effect. The fully adjusted models also included fixed effects for any variables found to be imbalanced by loss to follow-up or at baseline.
2. Primary outcomes (unplanned hospitalization): For binary outcomes, intervention effects will be reported as minimally-adjusted and fully-adjusted odds ratios (FAORs) with 95% CIs, estimated using generalised estimating equations. Similar to the continuous outcomes, the minimally-adjusted model included the treatment status as a fixed effect. The fully adjusted models also included fixed effects for any variables found to be imbalanced by loss to follow-up or at baseline. In the generalised estimating equations framework, clustering was accounted for using an exchangeable working correlation matrix. Kauermann-Carroll bias-corrected standard errors were used to account for the small number of clusters.
3. Secondary outcomes (continuous variables): For continuous outcomes, intervention effects will be estimated using linear mixed-effects regression and reported as minimally-adjusted mean differences, fully-adjusted mean differences (FAMDs), with the difference of scores between follow-up and baseline as the outcome, and effect sizes defined as standardised mean differences, with corresponding 95% confidence intervals (CIs). Standardised mean differences and their 95% CIs were obtained using the method proposed by Hedges. The minimally-adjusted model included a fixed effect for the treatment status and a random intercept for cluster. Fully adjusted models additionally included variables found to be imbalanced by loss to follow-up or at baseline (determined using a significance level of $p<0.10$). Restricted maximum likelihood will be employed to fit the model.

The analysis will adjust for variables imbalanced between intervention and control arms. For each above outcome, both crude and adjusted estimations will be reported. To address potential multiplicity concerns, we'll apply the Bonferroni Correction or Bayesian modelling approaches.

A sensitivity analysis will be conducted by only including cases without missing values.

Subgroup analyses will be conducted by attendance status (attended ⩾50% of PLA-D meetings vs. attended <50% or did not attend), gender (male vs. female), and age group (children <18 years vs. adults ⩾18 years). Interaction terms between the intervention and subgroup variables will be included in the regression models to assess differential effects.

For the economic evaluation (Objective 2), the incremental cost-effectiveness ratio (ICER) will be calculated by dividing the incremental costs by the effectiveness determined through the multilevel linear regressions or Cox regression analyses described above. Monte Carlo simulations (n = 10,000) will be employed to account for uncertainties surrounding cost and effectiveness estimates, adhering to specific distributional assumptions (normal distributions for the change on continuous outcomes, and beta distributions for time-to-event outcomes). The mean and 2.5% and 97.5% quantiles of the simulations will be reported.

6.3 Missing data

Participants who withdraw consent for continued follow-up will be included in the main analysis by modern imputation methods for missing data, or excluded for sensitivity analysis.

6.4 Harms

Given the pragmatic nature of the trial and the low-risk intervention, there will be no formal adverse event coding, severity grading, or specialized safety analyses. The study will not actively solicit adverse event reports or conduct structured assessments of safety data. Nonetheless, if any adverse events are reported, they will be documented by Amref Health Africa as part of their routine monitoring activities. The reported adverse events will be summarized in terms of the type of event, timing of occurrence, and any potential relationship to the intervention. These summaries will be reviewed by the Data Monitoring Committee (DMC) to assess the need for any modifications to the study protocol or enhanced safety monitoring. In the event that any unexpected harms or safety concerns arise during the course of the trial, the study team will remain flexible and adapt the safety monitoring procedures as needed. This may include the implementation of more structured adverse event reporting and assessment processes, depending on the nature and severity of the identified concerns. While the planned safety analysis is minimal given the low-risk nature of the PLA-D intervention and health system strengthening components, the study will prioritize participant safety and well-being throughout the trial. Any relevant safety findings or protocol modifications will be transparently reported in the final study results.

6.5 Statistical software

All analysis will be conducted in Stata and R.