Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Process Evaluation of two community-based sanitation and hygiene interventions in rural Malawi

Mindy Panulo
mindy.panulo@strath.ac.uk

Malawi University of Business and Applied Sciences
Kondwani Chidziwisano
Malawi University of Business and Applied Sciences
Clara MacLeod
London School of Hygiene & Tropical Medicine
Blessings White
Malawi University of Business and Applied Sciences
Gray Sidira
World Vision Malawi
Robert Dreibelbis
London School of Hygiene & Tropical Medicine
Tara K Beattie
University of Strathclyde
Tracy Morse
University of Strathclyde

Research Article

Keywords: Community-Led Total Sanitation, Process Evaluation, WASH, Care Groups, Malawi

Posted Date: June 22nd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9509834/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Community-Led Total Sanitation (CLTS) is widely implemented to eliminate open defaecation in rural low-income settings, yet sustaining gains and ensuring consistent programme delivery remains challenging. Integrating CLTS with community-based strategies such as the Care Group (CG) model may strengthen behavioural and health outcomes. This study presents a process evaluation of a controlled before-and-after trial of a standard CLTS and a CLTS integrated with the CG model (CLTS+CG), both delivered alongside district hygiene campaigns in rural Malawi. Data were collected through household surveys (n = 800), observations (n = 14), interviews (n = 28), and programme documentation. Analysis followed the UK Medical Research Council process evaluation framework, examining implementation fidelity, reach, dose, and mechanisms of impact. All intervention components were delivered; however, fidelity was compromised by inconsistent use of participatory CLTS triggering methods. Integration of the CG model expanded household engagement but was constrained by insufficient training, unclear role differentiation, and lack of behaviour change communication materials. Full participation in CLTS triggering and follow-up visits was associated with higher sanitation coverage in both groups (CLTS: aOR = 13.17, CI 3.46–50.18; CLTS+CG: aOR = 3.05, CI 1.20–7.76). However, neither CLTS participation nor hygiene campaign exposure was associated with the availability of handwashing facilities. These findings suggest that sustained sanitation and hygiene outcomes depend not only on community engagement but also on strong implementation fidelity, effective supervision, and clear role definition. Integration of the CG model into WASH systems must be supported by institutional mechanisms that ensure accountability and programme quality.

Introduction

The Community-Led Total Sanitation (CLTS) approach has been widely implemented by local governments and development partners in low-income countries to improve sanitation and hygiene in rural communities (Zuin et al., 2019). CLTS uses participatory methods to end open defaecation (OD), promote latrine construction and use, and improve hygiene practices (Harter, 2018). The approach follows three phases: pre-triggering, triggering, and post-triggering, which are designed to leverage social and emotional drivers to change community attitudes and practices related to OD. The “pre-triggering” phase involves preparatory activities such as community entry, stakeholder engagement, and gathering information about sanitation practices. The “triggering” phase is the central participatory event where facilitators guide communities to collectively realise that OD exposes them to their own faeces, often evoking feelings of disgust, shame, or concern that motivate behaviour change. The “post-triggering” phase focuses on follow-up activities, community monitoring, and support to sustain behaviour change and achieve open defaecation free (ODF) status (Kar & Chambers, 2008).

Despite wide application, CLTS outcomes have been mixed (USAID, 2018; Zuin et al., 2019). While impact evaluations show improvements in latrine coverage and reductions in diarrhoeal disease (Bushen et al., 2022; Cha et al., 2021; Harter et al., 2020), sustaining open defaecation free (ODF) status remains a persistent challenge (Abebe & Tucho, 2020; Hinton et al., 2024). These limitations are often linked to implementation challenges across the CLTS lifecycle, including limited prioritisation during pre-triggering, weaknesses in facilitation during triggering, and inadequate follow-up and monitoring in the post-triggering phase (Abebe & Tucho, 2020; Clarke et al., 2021; Crocker et al., 2017; Harter et al., 2019; Kennedy & Meek, 2013; Kouassi et al., 2023; Novotný et al., 2018; Pasteur, 2017). Evidence suggests that sustained sanitation outcomes require continued behaviour change programming, stronger community engagement, and consistent community-level monitoring (Hanchett et al., 2011; Panulo et al., 2026). Consequently, there have been calls to strengthen and adapt CLTS through approaches that enhance behaviour change, reinforce local accountability, and support ongoing engagement of community actors (Crocker et al., 2016; Harter, 2018). One such approach is the Care Group (CG) model, which offers a structured, community-based mechanism to deliver sustained behaviour change through peer-to-peer engagement.

Orignally developed to improve maternal and child health in rural communities, the Care Group (CG) model is a community-based structure that delivers behaviour change interventions through peer-to-peer support. The CG model has been associated with improvements in family health and nutrition practices (Perry et al., 2015; Pieterse et al., 2020; Weiss et al., 2015; Wilner et al., 2017). There are a handful of studies where the CG model has improved sanitation and hygiene practices, such as safe disposal of child faeces and presence of soap for handwashing (Freeman et al., 2020; Matsungo et al., 2023; Morse et al., 2020). However, despite increasing interest in the use of CG structures to support sanitation and hygiene interventions, there remains limited empirical evidence on how CG programmes are implemented within sanitation programmes and how these structures support

community engagement, behaviour change communication, and monitoring of sanitation and hygiene behaviour. And while previous studies have documented implementation challenges associated with CLTS programmes, there is also limited empirical evidence on how CLTS is implemented across its different phases in routine programme settings. Much of the existing literature focuses on outcome or impact evaluations, particularly changes in latrine coverage and open defaecation practices, providing limited insight into implementation fidelity, stakeholder engagement, and contextual barriers influencing programme delivery (Crocker et al., 2017; Novotný et al., 2018). Process evaluations can help address these gaps by examining how CLTS activities are implemented in practice, how CG structures are integrated within sanitation programmes, and identifying implementation factors that influence community engagement, behaviour change processes, and the sustainability of ODF outcomes, areas for which empirical evidence remains limited (Panulo et al., 2026).

Process evaluations are increasingly used to understand how complex public health interventions are implemented and how implementation processes influence programme outcomes. According to guidance from the United Kingdom (UK) Medical Research Council, process evaluations examine key dimensions of programme delivery, including implementation fidelity, reach, dose, mechanisms of impact, and contextual factors that influence intervention delivery and effectiveness (Moore et al., 2015). By examining how interventions are delivered in real-world settings, process evaluations help explain variations in programme outcomes, identify implementation barriers and facilitators, and provide insights for improving programme design and scale-up. In sanitation and hygiene programmes, process evaluations are particularly important for understanding how community-based behaviour change interventions are implemented and how implementation processes influence the sustainability of sanitation behaviours (Snyder et al., 2026).

Implementation science provides frameworks for understanding how interventions are adopted, delivered, adapted, and sustained in real-world settings (Nilsen, 2020). Concepts such as implementation fidelity, adaptation, community engagement, co-design, acceptability, feasibility, and sustainability are increasingly recognised as critical determinants of WASH programme effectiveness. While process evaluations of sanitation programmes often assess programme delivery, fewer studies have explicitly examined implementation processes through an implementation science lens (Moore et al., 2015; Nilsen, 2020). This study therefore contributes to the implementation literature by examining how implementation fidelity, community-based delivery structures, stakeholder engagement, and programme adaptations influenced the delivery and outcomes of CLTS and CLTS integrated with the Care Group model.

This study describes a process evaluation of a controlled before-and-after trial delivered by the ‘WASH for Everyone’ (W4E) programme, consisting of two intervention groups, one delivering standard CLTS, the other delivering CLTS + CG (Chidziwisano et al., 2025), by examining how the W4E programme was implemented and how it achieved its planned outcomes. Specifically, the evaluation sought to assess the fidelity, dose, and reach of the two intervention models, explore the mechanisms through which they influenced sanitation and hygiene behaviours, and triangulate evidence across multiple data sources to explain variations in implementation and outcomes.

Methods

Process Evaluation

Adapting the UK Medical Research Council process evaluation framework (Moore et al., 2015), we developed a tailored process evaluation framework (Supplementary material A) to assess the implementation fidelity, dose, reach, and mechanism of impact of the W4E programme. We assessed multiple aspects of this framework through a mixed-methods process evaluation, consisting of structured household surveys, direct observation of intervention implementation, review of programme documents, and in-depth interviews in the two intervention areas.

Study Setting

The study was conducted in Chiradzulu District, Malawi (Fig. 1). In 2019, 10% of people in Chiradzulu District had access to improved sanitation facilities (defined as sanitation facilities designed to hygienically separate excreta from human contact) including: flush/pour flush toilets connected to piped sewer systems; septic tanks or pit latrines; pit latrines with slabs (including

ventilated pit latrines); and composting toilets (WHO/UNICEF, 2022). The open defaecation (defined as the disposal of human faeces in fields, forests, bushes, open bodies of water, beaches and other open spaces or with solid waste) rate in Chiradzulu District was 7% (National Statistical Office, 2019).

{PLACE FIGURE 1 HERE}

This evaluation was set within the W4E programme implemented by two non-governmental organisations (NGOs), World Vision Malawi and Water for People. The intervention was a district-wide initiative implemented in three sequential phases between January 2022 and December 2024. This study represents the process evaluation of the second year of programme implementation, building on findings from the first year, which have been reported elsewhere (Panulo et al., 2026). This study only focuses on two Traditional Authorities (TAs), i.e. local administrative regions, with the district, these were TA Ntchema (henceforth referred to as TA 1) and TA Chitera (henceforth referred to as TA 2) (Fig. 1). These two TAs were part of the intervention group for a controlled before-and-after study evaluating the impact of CLTS programmes on sanitation and hygiene outcomes (Chidziwisano et al., 2025).

In both TAs, CLTS was the principal approach for sanitation promotion, with community health workers (CHWs) playing a central facilitative role across all stages of implementation. TA 1 received a standard CLTS intervention, implemented according to the Malawi National Sanitation and Hygiene Strategy (Malawi Government, 2018). During the pre-triggering phase, CHWs supported community selection through assessment of sanitation coverage, and conducted sensitization meetings with traditional leaders to secure buy-in. The triggering phase was led by CHWs, who facilitated community meetings aimed at stimulating collective realisation of sanitation-related risks through participatory methods such as transect walks, faecal mapping, and demonstrations on the pathways of disease transmission. While a specific number of attendees was not prescribed, the triggering process aims to engage as many community members as possible to ensure a collective emotional and behavioural response that leads to ODF outcomes and sustained sanitation behaviour change. According to the CLTS manual (Kar & Chambers, 2008), triggering sessions, typically one per community, should result in the identification and selection of natural leaders, individuals who emerge organically during a triggering session and assumes responsibility for coordinating and leading household follow up visits to inspire others to adopt and sustain sanitation behaviours, and the development of a community action plan. Finally, CHWs, in collaboration with natural leaders, conducted structured household follow-up visits to monitor implementation progress, promote the construction and sustained use of latrines, and reinforce key sanitation and hygiene practices.

TA 2 received a modified version of the CLTS approach by integrating it with the CG model, referred to as the CLTS + CG group. The CG model structure typically involves one trained promoter supporting several CG volunteers, also referred to as cluster leaders. Each volunteer is responsible for a small group of neighbouring households, known as a cluster. A cluster generally, consists of 10–15 beneficiary households assigned to a single CG volunteer for regular follow-up. These households are often selected based on inclusion criteria such as the presence of pregnant women, children under five, or heightened vulnerability to health and nutrition risks. In addition to this organisational structure, the CG model usually works around a set curriculum or health promotion module. They often talk about things like breastfeeding, complementary feeding, preventing diarrhoea, and other health issues that are important in the area. Promoters train volunteers on a regular basis. After that, the volunteers share what they have learned with others in their community through home visits and small group meetings. The integration of the CG model in this study aimed to broaden the cadre of CLTS facilitators by incorporating CG volunteers alongside CHWs and natural leaders, with CHWs maintaining a supervisory and facilitative role across all CLTS phases. To ensure comprehensive coverage of the W4E intervention, the inclusion criteria included the entire community from the pre-triggering through to the post-triggering phase.

The W4E programme also collaborated with the District Health Office to deliver hygiene promotion campaigns (Fig. 3). These campaigns used standardised sanitation and hygiene messages developed by the Malawian Ministry of Health (MoH). Four rounds of these campaigns were delivered, focusing on public spaces such as marketplaces and villages. To complement this intervention, the W4E project provided soap-making training to CHWs in TA1 and to both CHWs and CG volunteers in TA2, with the aim of improving affordable household soap access. Detailed description of the intervention components and implementation processes are provided by Chidziwisano et al., (2025).

{PLACE FIGURE 2 HERE}

Summary of Intervention Outcomes

The effect of the two interventions on sanitation and hygiene outcomes was assessed after an 11-month period (Chidziwisano et al., 2025) - primary and secondary outcomes have been reported by Chidziwisano et al., (2025) and MacLeod et al., (2025). In brief, two cross-sectional surveys in May and June 2023, and April and May 2024 were used to assess sanitation and hygiene coverage and use in both intervention groups and a concurrently enrolled control group. Direct observations were used to measure frequency of hand hygiene behaviours in a sub-set of households enrolled in the trial (MacLeod, Panulo, et al., 2025). Both intervention groups were associated with large increases in access to private sanitation facilities at endline (31 percentage-point (pp) in CLTS + GC, 38 pp in CLTS) compared to the control group (14 pp)(Chidziwisano et al., 2025). Households classified as having 'no changes' primarily remained reliant on rudimentary sanitation facilities that did not meet internationally recognized standards for safely management sanitation (WHO & UNICEF, n.d.). There was an increase in the proportion of households with a basic handwashing facility and both soap and water in the CLTS + CG group (4% at baseline to 5% at endline) compared to a decline in both the CLTS only group (8% to 4%) and the control group (10% to 4%) (Chidziwisano et al., 2025). In the structured observations, there was no difference in observed handwashing with soap among individuals in either intervention group compared to the control group, but there was a large increase in hand rinsing (handwashing with water only) at pre-defined handwashing opportunities (MacLeod, Panulo, et al., 2025).

Process Evaluation Study Population

The study population included key intervention implementers and community members. Intervention implementers included an Assistant Environmental Health Officer (AEHO) (responsible for supervising CHWs in both intervention groups), CHWs from both intervention groups, locally referred to as Health Surveillance Assistants (HSAs), and CG volunteers from the CLTS + CG intervention group.

Sampling and Data Collection Procedures

Data were collected at two time points. First, prospective data were collected during the implementation of the W4E intervention between July and December 2023 to capture contextual and process-related factors. These data were gathered through qualitative methods, including direct observation of community triggering events, household follow-up visits, and implementation meetings (Table 1). Retrospective data were collected four months following intervention delivery (March–May 2024) using a mixed-methods approach. Data sources comprised interviews, quantitative process evaluation measures embedded within the trial's endline assessment, and secondary data sources, e.g. CLTS triggering forms, project reports, and the intervention log frame. Secondary sources were reviewed to extract information on training delivery, triggering fidelity, household reach, and campaign coverage.

Table 1
Overview of Process Evaluation Methods

Data collection point	Data Source	Purpose	Process evaluation component
Prospective	CLTS triggering events and household visit observations	To understand whether the WASH for Everyone intervention was implemented as intended and record whether any events deviated from the intended process.	Fidelity, Reach, Participant engagement and responses
Retrospective	Questionnaire survey	To assess whether the WASH for Everyone intervention was implemented as intended, assess reach and coverage, measure exposure and engagement with intervention components, and evaluate the acceptability and perceived relevance of the intervention.	Fidelity, Reach, Mechanism of Impact
	In-depth Interviews	To assess implementation fidelity, identify facilitators and barriers, understand adaptations made during delivery, and explore the acceptability and feasibility of the intervention within the local context.	Dose, Fidelity, Adaptation, Reach, mechanism of impact
	Review of project documents	To gather data on planning, programme targeting, training, dose, reach and programmatic adaptation	Dose, Reach, Fidelity

Observations: We observed CLTS triggering events (n = 4) and household follow-up visits (n = 10) as part of the process evaluation. Observations included how triggering sessions were conducted in reference to the CLTS manual and observations on how CHWs and CG volunteers were conducting household follow-up visits to promote uptake of sanitation and hygiene behaviours.

In-depth interviews: We interviewed 28 purposively selected individuals across key stakeholder groups, based on prior experience and the need to capture diverse perspectives on implementation. This included 15 CHWs (8 from TA1 (Standard CLTS) and 7 from TA2 (CLTS + CG), one AEHO who supervised CHWs across both intervention groups, and 12 CG volunteers from TA2).

Document review: To better understand implementation processes and triangulate findings, we examined a variety of project documents. These comprised the project log frame, quarterly progress reports, training reports on capacity-building activities, and CLTS follow-up field reports that included data on sanitation coverage at the household and village levels.

Household survey: Information on intervention fidelity, reach, and community engagement, were included in the household surveys of the associated controlled before-and-after study. Details on survey design and sampling framework are described elsewhere (Chidziwisano et al., 2025). Data were available for 800 households, 400 from each intervention group.

Qualitative data was collected by two experienced researchers: one holding a Master’s degree in Environmental Health and the other a Bachelor’s degree in the same field, while 14 enumerators, each holding at least a Bachelor's degree in Environmental or Public Health collected the quantitative data. Prior to data collection, the 16 enumerators underwent a two-day training session to introduce the study, orientate them on research ethics, data collection tips, and the data collection tools, followed by one day of pre-testing.

{PLACE Table 1 HERE}

Data Management

Qualitative interviews were audio-recorded, transcribed, translated to English, and analysed thematically following Braun and Clarke’s (2006) thematic analysis framework, using NVivo qualitative analysis software (NVivo, Release 1.7.2, QSR International). To facilitate integrated coding and thematic analysis, all data sources were imported into NVivo, including program documents, interview transcripts, and typed observation notes. Quantitative data management involved digital data capture via KoboCollect (KoBoToolbox, Harvard Humanitarian Initiative, Cambridge, MA) and daily uploads to a secure server. Data were cleaned in Stata v18 (Stata Corp, College Station, TX) to address missing data, structural inconsistencies, and outliers.

Data Analysis

To analyse the qualitative data (interview transcripts, observation notes, and programme documents), a pre-defined coding framework, based on the study objectives and theoretical constructs, was applied to the transcripts. Transcripts were imported into NVivo, and data were systematically coded according to the established themes (implementation fidelity, reach, dose, adaptation and mechanism of impact). Coding consistency was ensured through regular review and refinement of nodes. Thematic analysis was then conducted to identify patterns, illustrative quotes, and variations within and across participant groups. Where possible Nvivo was used to triangulate the qualitative data with quantitative data.

Household survey data were used to quantify household exposure to intervention activities. We created a composite categorical variable using two self-reported binary indicators: attendance at a CLTS triggering session and receipt of a household follow-up visit. This resulted in a three-level categorical exposure measure: (0) no triggering session attended, and no follow-up visit received, (1) attended triggering session only or received household follow-up visit only, and (2) attended both triggering session and received a household follow-up visit. Intervention exposure outcomes were compared between the two intervention groups. Additional information on household recall of content and engagement in specific intervention activities was also analysed descriptively in each of the intervention arms. Logistic regression models were used to estimate the association between level of participation and two primary sanitation outcomes: sanitation coverage and at least a limited handwashing facility (reported or observed). After controlling for household size, socioeconomic quintile, disability status, and on-plot water availability, logistic regression models were used to investigate relationships between participation and primary outcomes. To take into consideration contextual variation in CLTS implementation, analyses were stratified by treatment areas.

Ethical Considerations

Informed written consent was obtained from all study participants prior to enrolment.

Results

Demographic characteristics of household respondents are reported elsewhere (Chidziwisano et al., 2025). A total of 28 intervention implementers participated in qualitative interviews, including 15 CHWs, 12 CG volunteers, and one AEHO. CHWs had on average, 17 years of work experience (range: 2–29 years), while CG volunteers had an average of four years of work experience (range: 2–5 years). Most CHWs had completed secondary education, with a smaller proportion holding technical training qualifications (Supplementary material B).

The process evaluation of the CLTS implementation using standard CLTS or CLTS + CG gives insight into implementation fidelity, reach, dose, and mechanism of impact of key CLTS components (trainings, CLTS triggering sessions and CLTS household visits) and hygiene promotion campaigns.

Fidelity, dose and reach of CLTS

Pre Triggering

CLTS Delivery Training:

CHW Training: To support the implementation of CLTS across both intervention groups, the project conducted a five-day CLTS training workshop. The workshop involved 46 participants (27 males and 19 females), including 23 CHWs and 23 personnel from related decentralised sectors in local government including Water Monitoring Assistants (WMAs), Social Welfare Officers, and Community Development Assistants (CDAs). All sampled CHWs (n = 15) confirmed their participation in the training, which integrated theoretical instruction with practical demonstrations. The practical component emphasised key aspects of CLTS implementation, including community mapping, illustrating faecal-oral transmission pathways, conducting follow-up visits, and constructing handwashing facilities such as tippy taps.

CG Recruitment and Training: Due to financial constraints, the W4E project deployed a limited version of the CG model rather than adhering to the standard model. In practice, this meant that no distinction was made between a CG promoters/cluster lead and the CG volunteers that they would normally supervise as supervision was provided by the CHW. Also, where CG members were unavailable, the programme recruited them with minimal training on the structure and functional expectations of the model. As such, CG members found it difficult to understand their role in the delivery of the CLTS programme based on previous experience in the group. Three out of the 12 interviewed CG volunteers reported having no prior experience with CG activities, indicating that they were newly introduced to both the structure and functional expectations of the model.

“No, this is my first time in a Care Group. I was selected to replace members who had withdrawn from the project” (KII, CG volunteer)

Since no distinction was made between the identified CG members (i.e. promoter/lead versus volunteer), they all received a joint five-day training aimed at strengthening their capacity to implement CLTS and equipping them with the necessary knowledge and skills for their roles. Ten of the 12 interviewed CG volunteers participated in this CLTS training. Some CG volunteers who had previously served as promoters/leads under the traditional CG model expressed concerns that the joint CLTS training was insufficient and ineffective, noting that the joint training and lack of differentiation in roles limited supervision-specific content, which they considered essential to the CG model.

Soap Making Training:

In addition to the CLTS training, intervention reports indicated that training on soap production was provided to both CHWs and CG volunteers. However, the project documentation did not clearly specify the intended cadre or targeted participants. Participation in the soap making training was limited, with only two senior-level CHWs and two CG volunteers attending. Four of the 10 CG volunteers, who did not attend the soap-making training, reported receiving informal briefings on the soap-making process from those who did receive the training.

Two newly recruited CG volunteers reported that they had not received training in either CLTS or soap-making, which they felt limited their capacity to conduct household follow-ups and complete the required documentation.

“I am new, and I did not attend any training, so I did not know exactly what to do. Although I learned from others as we went along, I found it hard to collect and accurately document the data” (KII, CG volunteer).

The CHWs and CG volunteers who were trained on soap making to promote hand hygiene behaviour were unable to produce soap due to the limited accessibility of caustic soda, one of the key ingredients in soap making.

Triggering Sessions

Of the 800 surveyed community members, 60% (n = 478) reported attending the triggering sessions (59% (n = 233) in the standard CLTS and 61% (n = 245) in the CLTS + CG group).

Programme documents indicate that, on average, 37% of the population across villages participated in the triggering sessions. The triggering sessions were conducted as usual, primarily facilitated by CHWs, with traditional leaders given the opportunity to address the community and encourage the adoption of improved sanitation practices. Although CG volunteers were expected to support mobilizing communities for triggering activities, interviews indicate limited participation by CG volunteers in triggering sessions.

A review of triggering forms, intervention reports, and interviews with CHWs indicate that in both groups, most facilitators adhered to standard CLTS methodologies, including the walk of shame, community mapping, food-faeces contamination, water-faeces contamination and community action plan during triggering sessions. However, observational data and household surveys, suggested that some activities that required physical demonstrations were delivered in a descriptive way.

Among 478 participants that attended the CLTS triggering sessions, 43% (n = 206) reported that the water-related activity and 53% (n = 253) the food-related activity was delivered through demonstration. Among those who did not report water-related demonstration (n = 254) and food-related demonstrations (n = 217), most indicated that the activities were delivered verbally

(72% (n = 183) for water-related and 80% (n = 173) for food-related activities). A small proportion of participants reported that they did not know if these activities were delivered (Table 2).

Table 2

Reported Participation in Water–Faeces and Food–Faeces Demonstrations During CLTS Triggering Sessions (n = 478)

Mode of delivery	**Response**	**Water with faeces activity (n = 478)**	**Food with faeces activity (n = 478)**
Delivered through demonstration	Yes	206 (43%)	253 (53%)
	No	254 (53%)	217 (45%)
	Don't know	18 (4%)	8 (2%)
Delivered verbally	**Response**	**Water with faeces activity (n = 254)**	**Food with faeces activity (n = 217)**
	Yes	183 (72%)	173 (80%)
	No	63 (25%)	41 (19%)
	Don't know	8 (3%)	3 (1%)

Note. Denominator for verbal delivery is restricted to participants who reported that the activity was not delivered through demonstration (water: n = 254; food: n = 217).

{PLACE Table 2 HERE}

Ninety-five percent (n = 455) of respondents reported that a community action plan to end open defaecation was agreed at the triggering session and 317 (70%) of these reported personally participating in the development of these community plans. Across both treatment groups, the majority (93%) of respondents reported that a natural leader was identified during triggering session to support household follow up visits during CLTS post triggering phase.

Household Follow-Up Visits

While the initial project plan included four rounds of visits, an adaptation was employed to increase the number to six visits to better support the achievement of ODF status. In total, 91% (724/800) of household survey participants indicated receiving a follow-up household visit (93% (370/400) in the standard CLTS group; 89% (354/400) in the CLTS + CG). Overall, 65% (n = 467) of respondents reported a household visit from CHWs (61% (n = 226) in the standard CLTS; 68% (n = 241) in CLTS + CG). Additionally, across both treatment groups, 45% of households reported being visited by a natural leader (53% in the standard CLTS, 38% in CLTS + CG).

In the CLTS + CG group, 72% (n = 288) of household survey respondents indicated there was a W4E project CG in their village, but only 44% (n = 126) of these reported that they were part of the CG model during the W4E intervention period. Among these, 67% (n = 84) were CG cluster households, 28% were CG volunteers, and 5% reported other roles. Among CG cluster households, the majority (83%) reported being visited by a CG volunteer, most often on a monthly (50%) basis. In contrast, CG volunteers more frequently described conducting visits on a biweekly (32%) or weekly (27%) schedule, with smaller proportions reporting monthly (24%) or inconsistent (18%) patterns (Table 3). In-depth interviews with CG volunteers revealed that there was a decline in the frequency of household engagement over time, shifting from proactive to reactive visitation, primarily occurring only when the implementing NGO told the CG volunteers to do the visits.

Table 3
Respondent Roles and Reported Frequency of Care Group Volunteer Household Visits

Category	n	%
Respondent role (n = 126)		
Care Group cluster household	84	66.6
Care Group volunteer	36	28.6
Other	6	4.8
Household reports (n = 84)		
Received visit by CG volunteer	70	83.3
Visit frequency		
Weekly	9	12.9
Biweekly	20	28.6
Monthly	35	50
Annually	6	8.5
Volunteer self-reports (n = 36)		
Visit frequency		
Weekly	9	26.5
Biweekly	11	32.3
Monthly	8	23.5
Inconsistent	6	17.7

{PLACE Table 3 HERE}

Among participants in the CLTS + CG group who received a household visit by CG volunteers, 79% (n = 137) reported that the purpose of the visit was regarding sanitation, 63% (n = 110) hygiene, and 46% (n = 80) nutrition. However, process evaluation observations found that these interactions largely reflected observational checks or brief inquiries rather than structured behaviour change communication. CG volunteers reported that this was partly because they were not provided with behaviour change support materials such as flipcharts, which are commonly used in programmes, for example nutrition, to guide messaging and facilitate consistent delivery.

“In nutrition programmes, we get books and flipcharts to promote behaviours, but for this project, we only received notebooks, pens, and reporting forms” *(*KII, CG volunteers).

According to one of the intervention implementation reports, each CG volunteer was expected to routinely monitor and collect data on latrine and handwashing facility coverage in 10 to 12 households. However, only 5 of 12 CG volunteers interviewed reported that they were assigned a specific number of households, with these typically ranging from 12 to 17. Allocation of households was less useful among CG volunteers who conducted collectively as a group and on a rotational basis. There was no systematic, peer- to -peer type of follow-ups as done in a typical CG model.

“The large number of CG volunteers made it challenging to involve all members in follow-up visits and project meetings. To address this, a rotation system was implemented, allowing volunteers to alternate during household visits, ensuring that all had an opportunity to participate by the end of the intervention” (KII, CHW)

To enhance the promotion of handwashing behaviour in both treatment groups, the project modified the CLTS household follow-up visit form to include an assessment of handwashing facilities (HWFs). However, observational data revealed that the

assessment in both treatment groups was limited to verifying the presence of a tippy tap (a simple, low-cost handwashing device that provides a hands-free way to wash hands using minimal water, allowing users to avoid touching a shared container or tap, and is especially appropriate for rural areas where there is no running water) and water availability, rather than evaluating the functionality of the HWF. Follow-up teams neither checked for, nor inquired about, the presence of soap at handwashing stations. In the CLTS + CG group, in cases where household members were absent and a latrine was either missing or incomplete, the CG volunteers recorded the household's details and assigned some CG volunteers to conduct another follow-up visit later that same day to ensure contact. In contrast, similar follow-up procedures were not applied when households lacked a handwashing facility, suggesting a lower prioritization of this component during monitoring activities.

By the end of intervention delivery, nearly all respondents (96%) participated in CLTS activities to some degree. A higher percentage, 58% (n = 453), indicated full participation, whereas 37% (n = 291) reported partial participation (Table 4).

Table 4
Distribution of household participation in CLTS intervention by treatment group

Participation level	CLTS (n = 386)	CLTS + CG (n = 392)	Total (n = 778)
No participation[0]	12 (3.1%)	22 (5.6%)	34 (4.4%)
Partial participation[1]	149 (38.6%)	142 (36.2%)	291 (37.4%)
Full participation[2]	225 (58.3%)	228 (58.2%)	453 (58.2%)
Total	386 (100%)	392 (100%)	778 (100%)
Note. Participants who respondent "don't know" to either question (n = 22) were excluded.			
[0] No participation = no triggering and no follow-up			
[1] Partial participation = yes trigger and no follow-up or no triggering and yes follow-up			
[2] Full participation = yes triggering and yes follow-up)			

{PLACE Table 4 HERE}

Fidelity, dose and reach of hygiene campaigns

The District Health Promotion Office delivered all four rounds of hygiene campaigns in both treatment groups by the end of intervention delivery. In total, just under half (n = 378) of household survey participants reported having heard sanitation and hygiene promotion messages through a mobile van during the intervention delivery period (Table 5). Most households in both treatment groups heard the messages either once or twice, with fewer households reporting hearing them three times or more.

Table 5
Frequency and percentage of households indicating exposure to hygiene campaigns (n = 378).

Number of times messages heard	CLTS (n, %)	CLTS + CG (n, %)	Total (n, %)
One	42 (27.1%)	65 (29.1%)	107 (28.3%)
Two	50 (32.3%)	77 (34.5%)	127 (33.6%)
Three	27 (17.4%)	38 (17.0%)	65 (17.2%)
More than three	36 (23.2%)	43 (19.2%)	79 (20.9%)
Total	**155 (100%)**	**223 (100%)**	**378 (100%)**

{PLACE Table 5 HERE}

Participants reported exposure to a range of health promotion messages, with broader health-related issues (32%) and handwashing with soap (20%) as the most recalled topics (Table 6).

Table 6
Message topics recalled from health and hygiene campaigns (n = 378).

Message Type	Frequency (n)	Percentage (%)
Sanitation facility promotion	55	14.6%
Handwashing infrastructure promotion	25	6.6%
Handwashing with soap	74	19.6%
Broader health-related topics (e.g., cervical cancer, vaccination)	122	32.3%
Other unspecified health topics	102	26.9%

{PLACE Table 6 HERE}

Intervention's mechanism of impact

Review of project reports and interviews with CHWs revealed several interrelated mechanisms of impact that contributed to changes in sanitation and hygiene behaviours. CHWs from both treatment groups reported that CLTS training increased both their competence and credibility. Triggering sessions emerged as a powerful tool in catalysing behavioural awareness and emotional commitment. They described how these sessions confronted communities with the realities of OD, prompting behavioural intentions.

"Triggering sessions helped people a lot to change their behaviour... now you cannot find faeces in the bush" (KII, CHW)

Both CHWs and CG volunteers indicated that household follow-up visits functioned as crucial mechanisms for achieving and sustaining behavioural change. They indicated that their regular presence as intervention implementers ensured accountability and ongoing support.

To assess how the intervention may have influenced sanitation and hygiene outcomes in both treatment groups we used regression models. These models estimated the adjusted effects of CLTS intervention exposure, defined as participation in triggering sessions and household follow-up visits, on sanitation coverage and at least having a limited handwashing facility.

At the final survey, 78% (n = 623) of respondents had a sanitation facility. Adjusting for confounding factors such household size, socioeconomic quintile, disability status, and on-plot water availability, logistic regression showed that full participation was significantly associated with higher odds of latrine availability in both intervention arms (aOR = 13.17, 95% CI [3.46–50.18], P = 0.000) (Table 7). Partial participation was only significant in the CLTS group (aOR = 4.96, 95% CI [1.32–18.63], p = 0.018). Participation in hygiene campaigns, measured through exposure to mobile van messages, was not significantly associated with sanitation coverage across intervention groups.

Table 7
Logistic regression estimates for sanitation coverage and availability of a limited handwashing facility by exposure to CLTS and hygiene.

Respondent participation	**Sanitation**						**Hygiene**					
	CLTS (n = 384)			**CLTS + CG (n = 388)**			**CLTS (n = 386)**			**CLTS + CG (n = 392)**		
aOR	**95% CI**	**p-value**	**aOR**	**95% CI**	**p-value**	**aOR**	**95% CI**	**p-value**	**aOR**	**95% CI**	**p-value**	
CLTS Participation (ref = No)												
Partial participation	4.96	[1.32, 18.63]	**0.018**	2.03	[0.78, 5.26]	0.145	0.43	[0.14, 1.63]	0.197	1.78	[0.70, 4.54]	0.226
Full participation	13.17	[3.46, 50.18]	**< 0.001**	3.05	[1.20, 7.76]	**0.019**	0.39	[0.11, 1.38]	0.146	1.28	[0.51, 3.18]	0.601
	CLTS (n = 396)			**CLTS + CG (n = 398)**			**CLTS (n = 396)**			**CLTS + CG (n = 398)**		
Hygiene campaigns participation (ref = No)												
Participation	1	[0.99, 1.00]	0.791	1	[1.00, 1.00]	0.993	1	[0.99, 1.00]	0.714	1	[1.00, 1.00]	0.993
Note. Unadjusted logistic regression is presented in Supplementary material C												

Less than half (46.8%, n = 374) of respondents had at least a limited handwashing facility at the final survey. Neither participation in CLTS components or hygiene campaigns was significantly associated with the availability of having at least a limited handwashing facilities in either intervention groups (Table 7).

{PLACE Table 7 HERE}

Discussion

This process evaluation examined the implementation of standard CLTS and a modified CLTS intervention integrating the CG model (CLTS + CG) in rural Malawi. The findings highlight how intervention design, delivery fidelity, and contextual dynamics influence sanitation and hygiene outcomes.

Although CHWs received comprehensive training, implementation fidelity was affected by a training-to-practice gap, where knowledge gained during training did not fully translate into programme delivery during implementation (Means et al., 2016; Smith & Wilkins, 2018). In many triggering sessions, visual participatory methods were replaced by verbal explanations, reducing the emotional intensity intended by the CLTS model. Improper programme implementation (fidelity) is a challenge in CLTS rollouts (Abebe & Tucho, 2020). The quality and consistency of implementing CLTS activities can impact the achievement of desired outcomes like becoming and maintaining ODF (Kennedy & Meek, 2013). While post-training coaching and real-time supervision are widely recommended in implementation science (Gunderson et al., 2018), the CLTS manual itself does not provide explicit guidance on supervisory presence or performance monitoring during triggering sessions. This absence may contribute to inconsistent facilitation quality. Strengthening supervisory structures, by moving beyond mere training attendance to include direct observation and structured feedback when the CHWs conduct triggering, could help bridge this training-to-practice gap.

These implementation challenges also point to broader considerations regarding how interventions are embedded within community systems. Investing time in adapting interventions to existing community structures and ensuring that delivery mechanisms are locally understood and accepted may support more consistent implementation. Embedding sanitation and hygiene promotion within established and ongoing community platforms, such as CGs, may offer a pathway towards more sustainable behaviour change by fostering local ownership and continuity beyond the lifespan of externally funded programmes. Such integration may also strengthen community capacity to respond to external shocks, including climate-related events (MacLeod, Sidira, et al., 2025), by maintaining ongoing support systems and reinforcing adaptive behaviours. These findings

align with implementation literature highlighting the importance of co-design and participatory implementation approaches. By working through existing community structures and engaging local actors in intervention delivery, programmes may improve acceptability, ownership, and sustainability. However, meaningful integration requires sufficient time and resources to adapt interventions to local contexts rather than simply layering new activities onto existing systems.

The integration of CG volunteers in the CLTS + CG group created new pathways for household engagement, opening an existing cadre of health sector volunteers to support implementation and monitoring. Our findings show that a diluted version of the CG model, which lacked clear role differentiation and systematic household assignments, undermined the intended peer-to-peer structure and diminished the effectiveness of intervention delivery and did not translate to greater frequency of household follow-ups. These challenges echo findings from other studies that emphasize the importance of role clarity and structured supervision in volunteer-led health promotion (Perry et al., 2015; Wilner et al., 2017). Although peer-based models can be effective in promoting the adoption of health-related behaviours (Freeman et al., 2020; Matsungo et al., 2023; Morse et al., 2020), their success depends heavily on adequate training, intervention fidelity and support (Food Security and Nutrition Network Social and Behavioral Change Task Force, 2014; Panulo et al., 2022; Wilner et al., 2017).

From an implementation science perspective, these findings highlight the tension between intervention adaptation and implementation fidelity. Adaptations are often necessary to accommodate contextual and resource constraints; however, when core functions of an intervention are modified, programme effectiveness may be compromised. In this study, the removal of role differentiation, structured supervision, and household allocation altered several core features of the Care Group model, potentially limiting its ability to function as intended. Similar tensions between adaptation and fidelity have been widely documented in implementation research, where maintaining the core functions of an intervention is considered critical for achieving intended outcomes (Perez Jolles et al., 2019; Stirman et al., 2013). The findings indicate a significant policy implication that the successful integration of the CG model into WASH systems necessitates more than adoption in name; it requires institutional mechanisms to ensure adherence to the model.

Our findings also reflect broader challenges associated with the “projectisation” of WASH interventions, whereby externally driven programmes are implemented within fixed timelines and delivery targets, often prioritising rapid implementation over contextual integration. In this study, the limited time and support allocated to embedding the CG model within CLTS may have contributed to unclear roles, inconsistent application of the model, and reduced effectiveness of community-based delivery mechanisms. Similar concerns have been raised by Barrington et al., (2025), who highlight how short-term, project-based approaches can undermine meaningful community engagement and limit the sustainability of sanitation interventions.

Our study findings emphasise that full participation was a significant determinant of sanitation coverage in both intervention groups. This result is consistent with a previous study carried out during the first year of the W4E programme, which showed a strong correlation between owning a sanitation facility and exposure to both CLTS triggering and household visits (Panulo et al., 2026). Additionally, this findings is consistent with existing implementation research indicating that follow-up visits are significantly correlated with increased sanitation coverage, underscoring the critical importance of the post-triggering phase in attaining sanitation outcomes (Harter et al., 2019). Evaluations of CLTS sustainability highlight that outcomes are typically more long-lasting when an enabling environment, particularly sufficient follow-up, is present (Crocker et al., 2017). Behaviour change theory within the CLTS framework also highlights the significance of post-triggering follow-up, to sustain community mobilization, monitor progress, and offer encouragement (Sigler et al., 2015). Our findings highlight the importance of participation in triggering activities and follow-up visits in achieving sanitation coverage within the study context.

Participation did not translate into improvements in hand hygiene infrastructure. This reflects a long-standing challenge in CLTS programming, where the emphasis on latrine construction and use often overshadows investments in handwashing facilities. Previous studies similarly report that while CLTS can facilitate rapid improvements in sanitation coverage, its impact on hand hygiene outcomes remains inconsistent or limited (Venkataramanan et al., 2018; Whaley & Webster, 2011). One possible explanation is that households may perceive handwashing infrastructure as a lower priority investment, as it is not as strongly embedded in the triggering and follow-up processes as latrine construction. The CG model has previously been effective in promoting hand hygiene practices among mothers and caregivers (Panulo et al., 2022; Wilner et al., 2017). However, the broader targeting strategy employed in this intervention, which included all community members rather than focusing on a specific group

such as pregnant and lactating women, may have reduced the perceived relevance of CG volunteers for some households, given their traditional association with maternal and child health. As suggested by Pieterse et al. (2023), engaging community volunteers in WASH interventions can foster a more inclusive environment and encourage broader participation, though this may require more robust integration models.

Just over half of study participants were reached with both CLTS triggering and household follow-up, representing a marked improvement of the W4E intervention compared to the process evaluation carried out in the first year of the programme where only 37% received both components of the intervention (Panulo et al., 2026). This progress followed an intentional feedback loop between researchers and implementers, in which early findings were shared to inform mid-course adjustments. The observed increase in coverage suggests that this collaborative exchange supported operational improvements and enhanced implementation consistency. These findings highlight the value of embedding routine monitoring and active researcher–implementer collaboration within phased implementation models to strengthen intervention reach and adaptability over time.

In our study, a notably higher proportion of households reported receiving household follow-up visits by a natural leader in the standard CLTS compared to the CLTS + CG group (53% vs. 38%). This pattern may reflect a shift in community mobilization dynamics, whereby the introduction of CG volunteers in the CLTS + CG group may have unintentionally reduced the visibility or perceived role of natural leaders. It is possible that the addition of CG volunteers created overlap or uncertainty in responsibilities, leading to less engagement from natural leaders or a diffusion of accountability. However, our study did not explore in depth the underlying reasons for this pattern or how natural leaders perceived the involvement of CG volunteers. Future research is therefore needed to better understand these dynamics and to explore how role clarity and collaboration between different community agents can be optimized in multi-component interventions.

Although CHWs and CG volunteers were trained in soap making, access to key ingredients, particularly caustic soda, remained limited. This highlights a critical gap between behaviour change messaging and the availability of enabling products. Our findings highlight the need for WASH interventions to address not only behavioural drivers, but also supply-side constraints. Future programs should explore the promotion of locally produced, culturally acceptable soaps that are both affordable and effective. In addition, the establishment of WASH Business Centres (WBCs), one-stop hubs for the production and distribution of WASH-related goods and services (Tafesse & Tidwell, 2023), could be explored in similar settings, with a focus on improving community-level access to affordable hygiene products

Conclusion

This process evaluation shows that the success of sanitation and hygiene interventions depends not only on programme reach, but also on how interventions are implemented in practice. Across both intervention groups, participation in triggering activities and household follow-up visits emerged as important implementation mechanisms associated with sanitation uptake. However, hygiene-related outcomes remained limited, highlighting challenges in translating behaviour change messaging into sustained infrastructure and practice.

The findings demonstrate that integrating community-based models does not automatically strengthen programme delivery. Without clear role definitions, adequate training, structured supervision, and strong implementation fidelity, combining approaches may dilute rather than reinforce intended programme mechanisms. The study also highlights the importance of addressing supply-side constraints alongside behaviour change strategies, as limited access to essential resources such as soap can undermine hygiene promotion efforts.

These findings have several implications for future WASH programming. Training approaches should be tailored to the specific roles of different implementers, rather than combining multiple cadres in a single training format. Programmes should also institutionalise strong supervisory and post-triggering follow-up systems to support sustained engagement at the household level. In addition, monitoring frameworks should move beyond measuring infrastructure presence to assess actual use and functionality of hygiene facilities.

Finally, while the Care Group model offers potential for strengthening community engagement in WASH programmes, further research is needed to understand how it can be effectively integrated within sanitation interventions. Achieving this will require

deliberate investments in implementation capacity, role clarity, and supportive systems to ensure that community-based delivery models operate as intended and contribute to sustained sanitation and hygiene improvements.

Declarations

Author Contribution

Conceptualization, M.P., K.C., C.M., R.D.,T.B, and T.M; data curation, M.P., K.C., and B.W; formal analysis, M.P.; funding acquisition, R.D.; methodology, M.P., K.C., R.D.,T.B, and T.M.; resources, R.D.; software, M.P; validation, M.P.,B.W., G.S., K.C., C.M., T.K., R.D.,T.B, and T.M.; visualization, M.P., K.C., C.M., R.D.,T.B and T.M.; writing—original draft, M.P.; writing—review and editing, M.P., B.W., K.C., C.M., G.S., R.D.,T.B, and T.M.;.;. All authors have read and agreed to the published version of the manuscript.

Data Availability

All data underpinning this publication are openly available from the University of Strathclyde KnowledgeBase at https://doi.org/10.15129/d44c1f7a-4e0c-4b9a-a06c-160016334de6

References

1. Abebe, T. A., & Tucho, G. T. (2020). Open defecation-free slippage and its associated factors in Ethiopia: A systematic review. *Systematic Reviews*, *9*, 1–15. https://doi.org/https://doi.org/10.1186/s13643-020-01511-6
2. Barrington, D. J., Sindall, R. C., Chinyama, A., Morse, T., Sule, M. N., Beale, J., Kativhu, T., Krishnan, S., Luwe, K., & Malolo, D., R (2025). The persistence of failure in water, sanitation and hygiene programming: A qualitative study. *BMJ Global Health*, *10*(2), e016354.
3. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/https://doi.org/10.1191/1478088706qp063oa
4. Bushen, G., Merga, H., & Tessema, F. (2022). Effects of community-led total sanitation and hygiene implementation on diarrheal diseases prevention in children less than five years of age in South Western Ethiopia: A quasi-experimental study. *PloS One*, *17*(4), e0265804. https://doi.org/https://doi.org/10.1191/1478088706qp063oa
5. Cha, S., Jung, S., Bizuneh, D. B., Abera, T., Doh, Y. A., Seong, J., & Schmidt, W. P. (2021). Effect of a community-led total sanitation intervention on the incidence and prevalence of diarrhea in children in rural Ethiopia: A cluster-randomized controlled trial. *The American Journal of Tropical Medicine and Hygiene*, *105*(2), 532. https://doi.org/10.4269/ajtmh.20-0014
6. Chidziwisano, K., Panulo, M., MacLeod, C., Vigneri, M., White, B., Wells, J., Ross, I., Morse, T., & Dreibelbis, R. (2025). Water, Sanitation, and Hygiene for Everyone Intervention Study: Protocol for a Controlled Before-and-After Trial. *JMIR Research Protocols*, *14*(1), e68280. https://doi.org/10.2196/68280
7. Chidziwisano, K. R., MacLeod, C., Panulo, M. F., White, B., Wells, J., Ross, I., Morse, T., & Dreibelbis, R. (2025). The effect of two community-based interventions on sanitation and hygiene outcomes in rural Malawi: A controlled before-and-after (CBA) trial. *medRxiv*, 2025–09.
8. Clarke, N. E., Dyer, C. E. F., Amaral, S., Tan, G., & Nery, V., S (2021). Improving Uptake and Sustainability of Sanitation Interventions in Timor-Leste: A Case Study. *International Journal of Environmental Research and Public Health*, *18*(3). https://doi.org/10.3390/ijerph18031013
9. Crocker, J., Abodoo, E., Asamani, D., Domapielle, W., Gyapong, B., & Bartram, J. (2016). Impact evaluation of training natural leaders during a community-led total sanitation intervention: A cluster-randomized field trial in Ghana. *Environmental Science & Technology*, *50*(16), 8867–8875. https://doi.org/https://doi.org/10.1021/acs.est.6b01557
10. Crocker, J., Saywell, D., & Bartram, J. (2017). Sustainability of community-led total sanitation outcomes: Evidence from Ethiopia and Ghana. *International Journal of Hygiene and Environmental Health*, *220*(3), 551–557. https://doi.org/https://doi.org/10.1016/j.ijheh.2017.02.011

11. *Care Groups: A Training Manual for Program Design and Implementation*. Washington, DC: Food Security and Nutrition Network Social and Behavioral Change Task Force, & Technical (2014). and Operational Performance Support Program. https://coregroup.org/resource-library/care-groups-a-training-manual-for-program-design-and-implementation/Care%20Group_manual_final_508.pdf?utm
12. Freeman, M. C., Ellis, A. S., Ogutu, E. A., Caruso, B. A., Linabarger, M., Micek, K., Muga, R., Girard, A. W., Wodnik, B. K., & Arriola, K. J. (2020). Impact of a demand-side integrated WASH and nutrition community-based care group intervention on behavioural change: A randomised controlled trial in western Kenya. *BMJ Global Health*, *5*(11), e002806. https://doi.org/https://doi.org/10.1136/bmjgh-2020-002806
13. Gunderson, L. M., Willging, C. E., Trott Jaramillo, E. M., Green, A. E., Fettes, D. L., Hecht, D. B., & Aarons, G. A. (2018). The good coach: Implementation and sustainment factors that affect coaching as evidence-based intervention fidelity support. *Journal of Children's Services*, *13*(1), 1–17.
14. Hanchett, S., Khan, M. H., Krieger, L., & Kullmann, C. (2011). Sustainability of sanitation in rural Bangladesh. *Loughborough University*. https://doi.org/https://hdl.handle.net/2134/30351
15. Harter, M. (2018). *Understanding mechanisms and effectiveness of community-led total sanitation (CLTS) in promoting the use of safe sanitation services* [Doctoral dissertation, University of Zurich]. https://doi.org/10.5167/uzh-169279
16. Harter, M., Inauen, J., & Mosler, H. J. (2020). How does Community-Led Total Sanitation (CLTS) promote latrine construction, and can it be improved? A cluster-randomized controlled trial in Ghana. *Social Science & Medicine*, *245*, 112705. https://doi.org/https://doi.org/10.1016/j.socscimed.2019.112705
17. Harter, M., Lilje, J., & Mosler, H. J. (2019). Role of implementation factors for the success of community-led total sanitation on latrine coverage. A case study from rural Ghana. *Environmental Science & Technology*, *53*(9), 5466–5472.
18. Hinton, R. G. K., Tremblay-Levesque, L. C., Macleod, C., Troldborg, M., Kanjaye, M., & Kalin, R. (2024). Progress and slippage of sanitation and hygiene targets in Malawi: Is SDG6.2 achievable? In *Journal of Water Sanitation and Hygiene for Development*. *IWA PUBLISHING*, *14*, 633–644. https://doi.org/10.2166/washdev.2024.263
19. Kar, K., & Chambers, R. (2008). *Handbook on community-led total sanitation*. https://doi.org/https://bloodwater.org/content/uploads/2023/10/rc314.pdf
20. Kennedy, M., & Meek, A. (2013). Extension agent reorganization into a 'block'system for CLTS implementation and monitoring in Salima and Zomba Districts, Malawi. *Toronto, ON, Canada: Engineers Without Borders*. Https://Www.Ircwash.Org/Sites/Default/Files/Kennedy_and_meek_block_system_for_clts_implementation_and_monitoring. *Pdf [Accessed 15 December 2015]*.
21. Kouassi, H. A. A., Andrianisa, H. A., Traoré, M. B., Sossou, S. K., Nguematio, R. M., Ymélé, S. S. S., & Ahossouhe, M. S. (2023). Review of the slippage factors from open defecation-free (ODF) status towards open defecation (OD) after the Community-Led Total Sanitation (CLTS) approach implementation. *International Journal of Hygiene and Environmental Health*, *250*, 114160. https://doi.org/https://doi.org/10.1016/j.ijheh.2023.114160
22. MacLeod, C., Panulo, M. F., Wells, J., White, B., Ross, I., Morse, T., Dreibelbis, R., & Chidziwisano, K. (2025). The effect of community-based behaviour change interventions on observed handwashing and child faeces disposal in rural Malawi: A controlled before-and-after (CBA) trial. *medRxiv*, 2025–06.
23. MacLeod, C., Sidira, G., Kapazga, T., Njolomole, P., Panulo, M., Vigneri, M., Morse, T., Dreibelbis, R., & Chidziwisano, K. (2025). Household sanitation access before and after an extreme weather event: Tropical Cyclone Freddy in rural Malawi. *PLOS Climate*, *4*(10), 1–12. https://doi.org/10.1371/journal.pclm.0000721
24. Malawi Government (2018). *National Sanitation and Hygiene Strategy 2018–2024*. Malawi Government. https://www.wesnetwork.org/wp-content/uploads/2020/03/National-Sanitation-and-Hygiene-Strategy.pdf
25. Matsungo, T. M., Kamazizwa, F., Mavhudzi, T., Makota, S., Kamunda, B., Matsinde, C., Chagwena, D., Mukudoka, K., & Chopera, P. (2023). Influence of care group participation on infant and young child feeding, dietary diversity, WASH behaviours and nutrition outcomes in rural Zimbabwe. *BMJ Nutrition Prevention & Health*, *6*(2), 164. https://doi.org/10.1136/bmjnph-2023-000627
26. Means, A. R., Phillips, D. E., Lurton, G., Njoroge, A., Furere, S. M., Liu, R., Hassan, W. M., Dai, X., Augusto, O., Cherutich, P., Ikilezi, G., Soi, C., Xu, D., Roman, & Kemp, C. G. (2016). The role of implementation science training in global health: From the

perspective of graduates of the field's first dedicated doctoral program. *Global Health Action*, *9*(1), 31899. https://doi.org/10.3402/gha.v9.31899

27. Moore, G., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W., Moore, L., O'Cathain, A., Tinati, T., & Wight, D. E. (2015). Process evaluation of complex interventions: A summary of Medical Research Council guidance. In *Complex Interventions in Health* (pp. 222–231). Routledge. https://pmc.ncbi.nlm.nih.gov/articles/PMC4366184/
28. Morse, T., Tilley, E., Chidziwisano, K., Malolo, R., & Musaya, J. (2020). Health Outcomes of an Integrated Behaviour-Centred Water, Sanitation, Hygiene and Food Safety Intervention–A Randomised before and after Trial. *International Journal of Environmental Research and Public Health*, *17*(8). https://doi.org/10.3390/ijerph17082648
29. National Statistical Office (2019). *2018 Malawi Population and Housing Census Main Report*. NSO Malawi. https://www.elibrary.macoha.mw/uploads/resources/1676540136_716070317.pdf
30. Nilsen, P. (2020). Making sense of implementation theories, models, and frameworks. *Implementation Science 3.0* (pp. 53–79). Springer.
31. Novotný, J., Hasman, J., Lepič, M., & Bořil, V. (2018). PROTOCOL: Community-led total sanitation in rural areas of low-and middle-income countries: A systematic review of evidence on effects and influencing factors. *Campbell Systematic Reviews*, *14*(1), 1.
32. Panulo, M., Chidziwisano, K., Beattie, T. K., Tilley, E., Kambala, C., & Morse, T. (2022). Process Evaluation of The Hygienic Family Intervention: A Community-Based Water, Sanitation, and Hygiene Project in Rural Malawi. *International Journal of Environmental Research and Public Health*, *19*(11), 6771. https://doi.org/10.3390/ijerph19116771
33. Panulo, M., Chidziwisano, K., MacLeod, C., Kapazga, T., Dreibelbis, R., Beattie, T. K., & Morse, T. (2026). Community-Led Total Sanitation implementation in Malawi: Process evaluation of a sanitation and hygiene intervention. *Global Public Health*, *21*(1), 2638018.
34. Pasteur, K. (2017). *Keeping track: CLTS monitoring, certification and verification*. https://doi.org/https://hdl.handle.net/20.500.12413/12728
35. Perez Jolles, M., Lengnick-Hall, R., & Mittman, B. S. (2019). Core functions and forms of complex health interventions: A patient-centered medical home illustration. *Journal of General Internal Medicine*, *34*(6), 1032–1038.
36. Perry, H., Morrow, M., Borger, S., Weiss, J., DeCoster, M., Davis, T., & Ernst, P. (2015). Care groups I: an innovative community-based strategy for improving maternal, neonatal, and child health in resource-constrained settings. *Global Health: Science and Practice*, *3*(3), 358–369. https://doi.org/https://doi.org/10.9745/GHSP-D-15-00051
37. Pieterse, P., Matthews, A., Walsh, A., & Chirwa, E. (2020). Exploring how and why Care Groups work to improve infant feeding practices in low- and middle-income countries: A realist review protocol. In *Systematic Reviews* (Vol. 9, Issue 1). BMC. https://doi.org/10.1186/s13643-020-01497-1
38. Pieterse, P., Walsh, A., Chirwa, E., & Matthews, A. (2023). *What is the'secret'sauce of successful Care Group implementation: Realist synthesis findings on creating an enabling environment for behaviour change adaptation*.
39. Sigler, R., Mahmoudi, L., & Graham, J. P. (2015). Analysis of behavioral change techniques in community-led total sanitation programs. *Health Promotion International*, *30*(1), 16–28. https://doi.org/https://doi.org/10.1093/heapro/dau073
40. Smith, L. S., & Wilkins, N. (2018). Mind the gap: Approaches to addressing the research-to-practice, practice-to-research chasm. *Journal of Public Health Management and Practice*, *24*, S6–S11.
41. Snyder, J. S., Canda, E., O'Brien, L. A., Reardon, E. E., Ogutu, E. A., Hoffman, S., Bagtas, P., Santos, F., & Freeman, M. C. (2026). Conducting process evaluations of WASH interventions: A scoping review of design approaches and indicators in low- and middle-income countries. *Implementation Science Communications*, *7*(1), 51. https://doi.org/10.1186/s43058-026-00872-8
42. Stirman, S. W., Miller, C. J., Toder, K., & Calloway, A. (2013). Development of a framework and coding system for modifications and adaptations of evidence-based interventions. *Implementation Science*, *8*(1), 65.
43. Tafesse, A., & Tidwell, J. B. (2023). *Water, Sanitation, and Hygiene (WASH) Business Centers Promote Better Household and Community WASH Services*. World Vision. https://www.wvi.org/publications/water-sanitation-and-hygiene/technical-brief-wash-business-centres

44. USAID (2018). *An Examination of CLTS's Contributions toward Universal Sanitation*. https://archive.ids.ac.uk/clts/sites/communityledtotalsanitation.org/files/WASHPaLS%202018_CLTS%20desk%20review.pdf
45. Venkataramanan, V., Crocker, J., Karon, A., & Bartram, J. (2018). Community-led total sanitation: A mixed-methods systematic review of evidence and its quality. *Environmental Health Perspectives*, *126*(2), 026001. https://pmc.ncbi.nlm.nih.gov/articles/PMC6066338/
46. Weiss, J., Makonnen, R., & Sula, D. (2015). Shifting management of a community volunteer system for improved child health outcomes: Results from an operations research study in Burundi. In *BMC Health Services Research* (Vol. 15, Issue 1). BIOMED CENTRAL LTD. https://doi.org/10.1186/1472-6963-15-S1-S2
47. Whaley, L., & Webster, J. (2011). The effectiveness and sustainability of two demand-driven sanitation and hygiene approaches in Zimbabwe. *Journal of Water Sanitation and Hygiene for Development*, *1*(1), 20–36. https://doi.org/10.2166/washdev.2011.015
48. WHO, & UNICEF (n.d.). *JMP Topics: Sanitation*. Retrieved https://washdata.org/topics/sanitation
49. WHO/UNICEF. (2022). *Sanitation | JMP*. JMP / WASH. https://washdata.org/topics/sanitation
50. Wilner, L., Suri, D. J., Langlois, B. K., Walton, S. M., & Rogers, B. L. (2017). Effective delivery of social and behavior change communication through a Care Group model in a supplementary feeding program. *Journal of Health Population and Nutrition*, *36*, 1–9. https://doi.org/https://doi.org/10.1186/s41043-017-0111-3
51. Zuin, V., Delaire, C., Peletz, R., Cock-Esteb, A., Khush, R., & Albert, J. (2019). Policy diffusion in the rural sanitation sector: Lessons from community-led total sanitation (CLTS). *World Development*, *124*, 104643. https://doi.org/https://doi.org/10.1016/j.worlddev.2019.104643

Figures

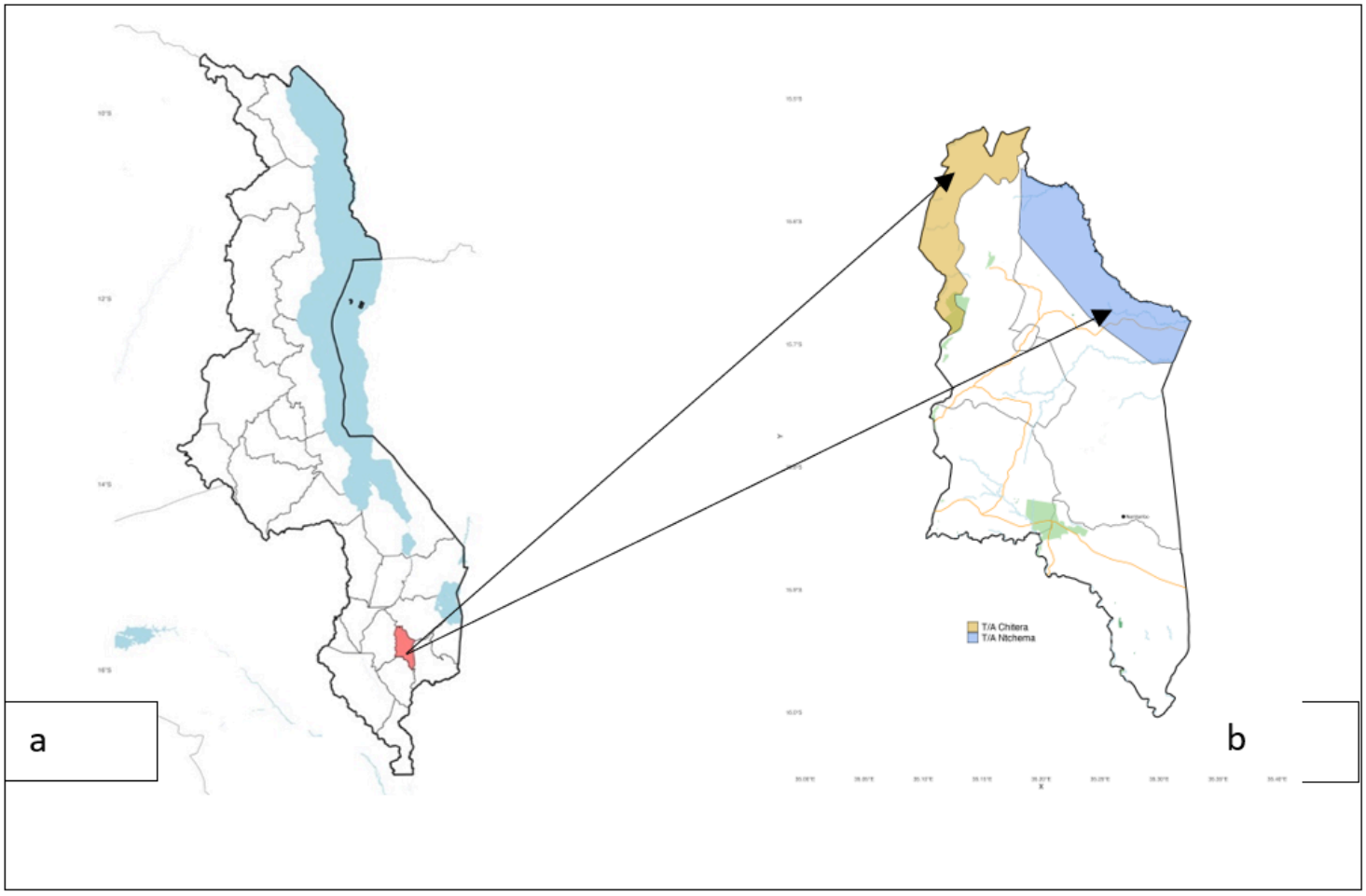


Figure 1

a) Map of Malawi with Chiradzulu District highlighted in red; (b)-Map of-Chiradzulu District, Malawi, with intervention areas; TA Chitera highlighted in beige and TA Ntchema highlighted in blue.

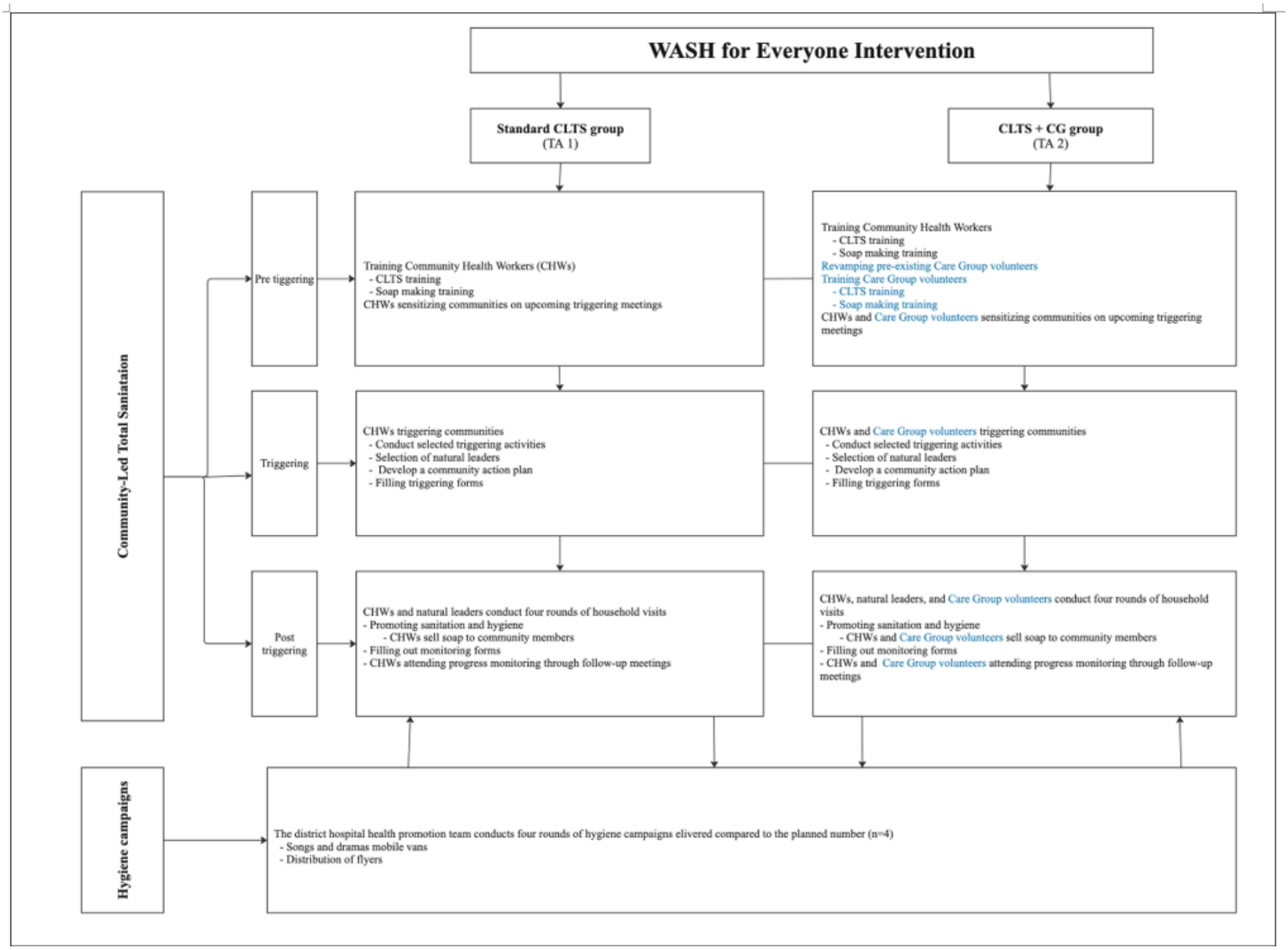


Figure 2

Intended intervention components of the W4E programme

Note: Blue text indicates components that extend beyond the standard CLTS framework

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SUPPLEMENTARYMATERIAL.docx