

Evaluating Context-Specific Evidence-Based Quality Improvement Intervention on Lymphatic Filariasis Mass Drug Administration in Northern Ghana Using the RE-AIM Framework.

Alfred Kwesi Manyeh (✉ alfredmanyeh4u@gmail.com)

University of the Witwatersrand Faculty of Science <https://orcid.org/0000-0002-7005-5707>

Tobias Chirwa

University of the Witwatersrand

Rohit Ramaswamy

University of North Carolina at Chapel Hill Center for Faculty Excellence

Frank Baiden

London School of Hygiene and Tropical Medicine

Latifat Ibisomi

University of the Witwatersrand

Research

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Abstract

Background

Over a decade of implementing a global strategy to eliminate lymphatic filariasis in Ghana through mass drug administration, the disease is still being transmitted in 22 districts out of an initial 98 endemic districts identified in 2000. A context-specific evidence-based quality improvement intervention was implemented in the Bole District of Northern Ghana after an initial needs assessment. This study aimed to evaluate the process and impact of the intervention on implementation of lymphatic filariasis mass drug administration in Bole District of Northern Ghana.

Method

The study used the RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework based on a mixed-methods approach to evaluate the context-specific evidence-based quality improvement intervention.

Results

The findings of the evaluation showed that there was an improvement in social mobilization and sensitization, knowledge about lymphatic filariasis and mass drug administration process, willingness to ingest the medication, and adherence to the directly observe treatment strategy. We observed a 6.3% increase in the district mass drug administration coverage and reduction in self-reported adverse drug reaction. The level of reach, effectiveness and adoption as the district, sub-district and at the individual participants' level suggest that the context-specific evidence-based quality improvement intervention is feasible to implement in LF hotspot districts based on initial context-specific needs assessment.

Conclusion

The study provided the groundwork for future application of the RE-AIM framework to evaluate the implementation of context-specific evidence-based quality improvement intervention to improve mass drug administration towards the elimination of lymphatic filariasis as a public health problem.

Contributions To The Literature

- This study contributed to a growing body of knowledge about the design and implementation of quality improvement interventions and application of RE-AIM framework in public health through a rich mixed-methods research approach.
- We demonstrate the application of implementation science theories, frameworks and multi-component implementation strategies to implement and evaluate a public health intervention towards the elimination of lymphatic filariasis.
- The study provided an avenue to understanding the effect of implementing context-specific evidence-based quality improvement intervention based on an initial needs assessment to improve lymphatic filariasis elimination exercise.
- The findings have a far-reaching significance for lymphatic filariasis mass drug administration in hotspot areas and future implementation of the context-specific evidence-based quality improvement intervention towards the elimination of neglected tropical diseases.

Background

Lymphatic filariasis mass drug administration

Lymphatic filariasis (LF) commonly known as elephantiasis is a mosquito-borne incapacitating and disfiguring disease caused by three species of parasitic worms (*Wuchereria bancrofti*, *Brugia malayi*, and *B. timori*). LF is rarely fatal, but at the clinical stage, it causes lymphedema, elephantiasis, and hydrocele. These conditions cause severe pain and result in permanent disability, social exclusion and loss of productivity [1]. LF has been endemic in Africa, Asia, the Pacific, and the Americas historically [2]. Approximately one billion people from 72 countries were at-risk for LF infection, with nearly 36 million people being affected by LF associated morbidity before the World Health Organization (WHO) established the Global Program to Eliminate Lymphatic Filariasis (GPELF) in 2000 [3]. The goal of the GPELF is to eliminate LF in all disease-endemic areas by 2020.

The main approach recommended by GPELF was based on reduction of microfilaria (mf) prevalence in endemic communities below $< 1\%$ through mass drug administration (MDA) of anti-filarial medicine. The recommended anti-filarial medicine for sub-Saharan Africa is either diethylcarbamazine or ivermectin and albendazole. This strategy is recommended to be implemented for at least five years with effective population treatment coverage of $\geq 65\%$. This is because the life expectancy of an adult worm is from 4 to 6 years. It is therefore expected that the disease transmission should be interrupted after five years of effective treatment coverage.

The main GPELF strategy to interrupt transmission is MDA using combinations of two antifilarial medicines (albendazole plus either diethylcarbamazine or ivermectin) delivered once yearly to entire eligible populations in endemic areas. The recommended regimen in sub-Saharan Africa is either diethylcarbamazine or ivermectin and albendazole for a minimum of 5 years with effective population treatment coverage ($\geq 65\%$).

Ghana became one of the first West African countries to implement MDA intervention through the Ghana Filariasis Elimination Program (GFEP). The implementation of this evidence-based intervention started in 10 endemic districts in 2001 and reached national coverage by 2006.

The GFEP aims to reduce LF prevalence level to below 1% after 4–6 rounds of high-coverage ($> 80\%$) MDA [4, 5].

Over a decade of implementing the MDA intervention in Ghana, the transmission of the disease persists in 22 districts out of an initial 98 endemic districts [6]. These 22 districts have microfilariae prevalence rate above the 1% threshold, there is a need for interruption of the disease transmission and are now termed LF “hotspot” districts [6]. Bole District in Northern Ghana is one of the districts with the highest microfilariae prevalence in Ghana [5]. In 2016, microfilariae prevalence in Bole District was 1.9% with some communities having a prevalence rate as high as 5.9% [5].

The context-specific evidence-based quality improvement intervention

In 2017, TDR, the Special Program for Research and Training in Tropical Diseases funded a project to conduct implementation research (IR) towards the elimination of LF in Bole District of Northern Ghana. An initial needs assessment to identify implementation bottlenecks associated with the LF MDA intervention in the Bole District of Ghana was conducted using a mixed-methods approach. This strategy was used to gain a deeper understanding of the critical issues affecting the implementation of the LF MDA from the perspective of the services providers (health

workers) and frontline workers (community drug distributors), stakeholders (community leaders) and the clients (community members) [5]. The framework connecting all three (3) phases of the study is detailed in Fig. 1.

The results of the pre-intervention phase indicated that the continuous transmission of LF in the Bole District is characterized by refusal to take the drug due to poor knowledge and misconceptions of the disease, poor community mobilization and sensitization, the fear of adverse drug reactions, non-adherence to the directly observed treatment strategy, poor adherence to the MDA protocol and non-participants' responsiveness as detailed elsewhere [5].

Based on the findings of the pre-intervention phase, a context-specific evidence-based quality improvement (CEQI) intervention was designed and implemented using Intervention Mapping (IM), and Plan-Do-Study-Act (PDSA) approaches [5]. The CEQI intervention was based on four (4) key strategies namely: training of community drug distributors (CDDs), social mobilization and sensitization, the involvement of community leaders and other stakeholders and improving the drug distribution process. Each of these strategies was described in terms of seven (7) domains: actor, the action, action targets, temporality, dose, implementation outcomes addressed, and theoretical justification as shown in Table 1 [5].

Table 1

Description of components of the context-specific evidence-based quality improvement intervention

Domain	Strategy: Training of Community Drug Distributors (CDDs)	Strategy: Social Mobilization and Sensitization	Strategy: Involvement of Community Leaders and other Stakeholders	Strategy: Drug Distribution Process
Actor(s)	<ul style="list-style-type: none"> • District Director, Sub-district NTD focal persons, disease control officers and implementation/QI team (District and sub-district NTDs focal persons and heads, DCO, HPO, Assemblymen/women and PI) who have been trained. 	<ul style="list-style-type: none"> • Intervention implementation/QI team (District and sub-district NTDs focal persons, opinion, religious and traditional leaders and PI). 	<ul style="list-style-type: none"> • Intervention implementation/QI team. 	<ul style="list-style-type: none"> • Intervention implementation/QI team and CDDs

Note CDD: Community Drug Distributors, DCO: Disease Control Officer, HPO: Health Promotion Officer, QI: Quality Improvement, DOT: Direct Observed Treatment MDA: Mass Drug Administration [5].

Domain	Strategy: Training of Community Drug Distributors (CDDs)	Strategy: Social Mobilization and Sensitization	Strategy: Involvement of Community Leaders and other Stakeholders	Strategy: Drug Distribution Process
Action(s)	<ul style="list-style-type: none"> • Train drug distributors to have a good understanding of the programme and to be able to instil the same knowledge to the community members. • Train drug distributors to be able to convince every qualified person in the endemic area to participate in the MDA exercise. • Train drug distributors on the inclusion and exclusion criteria of the MDA. • Train drug distributors on the possible adverse drug reactions and be able to explain them to the community members. • Instilling the skills of communication and interaction to the drug distributors and the importance of being patient and tolerant with difficult community members. • Vigorous enforcement of the MDA procedures, in particular, DOT policy during training and supervision. 	<ul style="list-style-type: none"> • An evidence-based, multi-channel communication strategy to result in high levels of awareness among community members, (radio discussions and announcements, announcements in churches, mosques, schools, etc., community durbars and meetings with social groups to explain MDA relevance and public/community announcements). • Focus key messages on cause and mode of transmission of the disease, importance of the MDA and how to identify, what to do and minimize adverse drug reactions. 	<ul style="list-style-type: none"> • Community/Opinion leaders such as Chiefs, Assemblymen/women, religious and traditional leaders should be involved in the MDA exercise. 	<ul style="list-style-type: none"> • An adequate number of days should be dedicated to the distribution exercise (not less than 1 week) • The distribution should reach people in institutions, markets, places, offices and homes. • People with higher-level qualifications and a good knowledge of the MDA should be sent to institutions and offices to distribute the drug. • Strong enforcement of the DOT policy.
Target (s) of the action	<ul style="list-style-type: none"> • Drug distributors in the endemic communities. 	<ul style="list-style-type: none"> • People in the endemic communities. 	<ul style="list-style-type: none"> • Community leaders. 	<ul style="list-style-type: none"> • People in the endemic communities.
Temporality	<ul style="list-style-type: none"> • The drug distribution should start within one week after the training of drug distributors. 	<ul style="list-style-type: none"> • Social mobilization and sensitization should start two weeks before and should continue during the MDA. 	<ul style="list-style-type: none"> • Before, during and after MDA exercise. 	<ul style="list-style-type: none"> • During the drug distribution

Note CDD: Community Drug Distributors, DCO: Disease Control Officer, HPO: Health Promotion Officer, QI: Quality Improvement, DOT: Direct Observed Treatment MDA: Mass Drug Administration [5].

Domain	Strategy: Training of Community Drug Distributors (CDDs)	Strategy: Social Mobilization and Sensitization	Strategy: Involvement of Community Leaders and other Stakeholders	Strategy: Drug Distribution Process
Dose	<ul style="list-style-type: none"> The training of the CCDs should be detailed enough to equip them well for the MDA task, and the training period should not be more than one day to enhance their active participation in the training. 	<ul style="list-style-type: none"> Each endemic community should have at least two social mobilization and sensitization exercises (community durbar, school education, information centre announcement, education at church and mosque, and or radio talk shows etc.) for the start of MDA and at least one during MDA. 	<ul style="list-style-type: none"> Every endemic community must have a community leader representing it. 	<ul style="list-style-type: none"> The distribution exercise should not be less than 1 week in the endemic district. Over 80% of the people in the endemic communities must be covered.
Implementation outcome (s) and effect	<ul style="list-style-type: none"> Increase the level of adherence to LF MDA implementation procedures and participants' responsiveness. 	<ul style="list-style-type: none"> At least 15% increase in MDA coverage and reduction in the number of refusals (increased participant responsiveness). 	<ul style="list-style-type: none"> At least 15% increase in MDA coverage and reduction in the number of refusals (increased participant responsiveness). 	<ul style="list-style-type: none"> At least 15% increase in MDA coverage and reduction in the number of refusals (increased participant responsiveness).
Justification	<ul style="list-style-type: none"> Researchers suggest that drug distributors are the interface between MDA programs and their targeted population; hence their adequate training is crucial to the success of the MDA [7–10]. 	<ul style="list-style-type: none"> It has been shown that evidence-based, context-specific and multi-channel social mobilization and sensitization is required for the LF elimination program to succeed [4, 10, 11]. 	<ul style="list-style-type: none"> Stakeholder engagement and involvement in LF MDA cannot be overemphasized [4, 9, 10]. 	<ul style="list-style-type: none"> The MDA implementation process is crucial for participants' responsiveness to the program [4, 10].
<p>Note CDD: Community Drug Distributors, DCO: Disease Control Officer, HPO: Health Promotion Officer, QI: Quality Improvement, DOT: Direct Observed Treatment MDA: Mass Drug Administration [5].</p>				

As part of the monitoring process and to ensure successful implementation and sustainability of the CEQI, a CEQI implementation team with representation from the district and the sub-districts was formed. The key obligation of the implementation team was to ensure the smooth implementation and sustainability of the CEQI intervention.

Besides, a WhatsApp group was created to link members of the implementation team. The group platform facilitates the sharing of ideas and resolving of challenges faced during the implementation of the CEQI intervention as shown elsewhere [5]. The WhatsApp platform was also used by the principal investigator (the first author) to review work progress and reinforce compliance with the components of the CEQI.

Reach, Effectiveness, Adoption, Implementation, Maintenance (RE-AIM) framework was used to guide the evaluation of the CEQI intervention implementation. The RE-AIM framework was developed to assess the effects of public health interventions [12].

Reach is defined as the proportion of eligible individuals in the aimed population who partook in an intervention program and the extent to which those individuals represent the target population. *Effectiveness* is the degree to which the intervention program has a positive effect on an outcome(s) of interest. *Adoption* is a measure of the total number of program providers who implement an intervention and the extent to which they represent all potential program providers. *Implementation* is an organizational measure of the quality of the intervention's delivery and its adherence to the essential elements of the research program. *Implementation* is sometimes referred to as *treatment fidelity*. *Maintenance* is the measure of the program's effectiveness in attaining the expected outcome for an extended time. It is also a measure of the sustainability of the intervention and indicates whether the intervention is likely to become an institutional culture [12, 13].

The RE-AIM has been useful in evaluating intervention in diverse fields including behavioural change interventions [14, 15], weight loss studies [16, 17], nutrition projects [18], studies on injury prevention [19, 20] and studies on manual activity [18, 21]. The RE-AIM framework has been applied to assess the effectiveness of a single intervention at employee, community, and patient levels [22]. The framework has also been useful in studying the impact of evidence-based interventions with fidelity and interventions that focus on improving organizational culture and adherence to clinical guideline [23]. It has also been used to assess the impact of single intervention within a context of a broader project [24] and recently to evaluate larger multidimensional interventions [13].

Qualitative, quantitative and the mixed-methods approach to the application of the RE-AIM framework has been demonstrated in evaluating interventions [25]. With awareness of these various options of application of the RE-AIM framework, the primary purpose of this paper is to use the RE-AIM framework to evaluate the effect of CEQI intervention on implementation of LF MDA in the Bole District of Northern Ghana.

Methods

Study design and data source

We used mixed-methods study design which involves the extraction of quantitative secondary MDA data from the neglected tropical diseases database in Bole District Health Administration in Northern Region of Ghana, community survey and qualitative data collection. The post CEQI survey data was collected from randomly selected community members. The selection process of the survey participants is described elsewhere [5]. The survey data includes information on socio-demographic characteristics, knowledge of how LF is acquired, knowledge of signs associated with LF, knowledge of LF prevention, and misconceptions about LF [26].

These variables were measured by correct answers to signs associated with LF, LF prevention methods, and how LF is acquired. The method for measuring these variables and estimating comprehensive knowledge of LF as detailed elsewhere [26].

The quantitative data include information on pre and post CEQI intervention MDA coverage and self-reported adverse drug reaction. We also extracted information from weekly written reports submitted by sub-districts heads of health services during the implementation of the CEQI.

The qualitative data was collected from purposively selected participants through in-depth interviews (IDIs) using semi-structured interview guides. The interview guides were pre-tested in a different rural LF endemic district with similar settings as the study district. The IDIs were conducted with 42 participants, including community leaders, CDDs, and health workers. The health workers include; district and sub-district directors of health services, disease control officers, health information officers, and nurses. The participants for the qualitative arm were purposively selected from six (6) sub-districts to gather enough information for the evaluation of the effect of the intervention. Except for health workers IDIs, all data collection tools were translated into the predominantly spoken local language in the study area.

The data was collected between March - April 2018 by trained graduate research assistants.

All interviews were recorded using digital voice recorders with the consent of the study participants. Detailed field notes and training registers were turned into data documents for analysis.

The interviews with health workers were conducted in English while that of CDDs and community leaders were held in the local languages and translated into English by two independent language experts during transcription.

Measurements

Reach

Reach was assessed at the district, sub-district, CDD, and the individual community member levels.

District level

Reach was measured as the proportion of the members of the district management team who participated in the training before the 2017 drug distribution.

Sub-district level

Proportion of sub-district management team who participated in the training of the CDDs' training before 2017 MDA.

Individual community member level

This was assessed using the number of people who received the drug (coverage) during the 2017 MDA.

Effectiveness

Multiple data source through the mixed methods research approach was used measure the effectiveness of the intervention on the level of knowledge about the LF, understanding of the MDA among the study participants, the involvement of community leaders and the MDA coverage.

Adoption

We assessed the level of adoption as the proportion of sub-districts that implemented each component of the CEQI intervention. Through interviews with the study participants, we assessed their level of knowledge to ascertain

understanding and information given by the interviewers (CDDs, health workers) on the program. If the interviewers determined that the program was not implemented correctly, they were asked what were the impediments during the implementation and how they planned to overcome them.

Implementation

The level of implementation was assessed (i.e., fidelity to delivering the CEQI intervention) with the study participants. This was done through the IDIs to explore the level of information they have been given and to determine how well sub-districts adhered to components of strategies during the implementation. We also assessed the activities carried out during the implementation of the CEQI from the weekly report submitted by the sub-districts heads of health services and from the WhatsApp platform.

Maintenance

The assessment of the district, sub-district and CDD level maintenance of the intervention was used to determine the extent to which the CEQI intervention can become integrated into the routine activities of the LF MDA.

We also determined the extent to which the intervention implementation team could continue and sustain the intervention activities. A review of barriers and possible solutions to enable the successful implementation of the intervention from the perspective of the participants (through the IDIs and from weekly written reports) was carried out.

Results

Reach

Before the commencement of the 2017 MDA, respondents reported that training, which usually lasts between one and three days, were held for CDDs. According to them, the training focused on teaching CDDs how to administer and handle the MDA drugs, filling the forms. They were also trained on sensitization of community members and to convince individuals who were resistant to take the pills. Respondents also indicated they were taught to identify MDA illegible community members and to ensure all houses are visited during the exercise. The participants reported that training was practical; they were provided with material (books and pictures) of the disease to aid with educating community members, which helped in facilitating their work.

“We were trained for three days, and the training was very good. We were taught a lot about LF and drug distribution. We were also taught how to sensitize our community members to participate in the drug administration” (CDD, Tinga).

District level

The district director of health service, district disease control officer, district public health officer, and district public health nurse participated in the training sessions. This participation represents 100% reach for the district level officials who superintends the MDAs in the district.

Sub-district level

The heads of each of the five (5) sub-districts and their disease control officers participated in the training. Thus 10 (100%) representation of the sub-districts officials who oversee the implementation of the MDA at the sub-district

level. Five (5) nurses from the sub-districts also participated in the training to help with supervision of the CDDs during the MDA.

Community drug distributor level

A total of 152 CDDs were trained representing 98% of the total CDDs identified for the MDA in the study district. Three (3) were absent due to ill health, but arrangement was made for them to be trained at the sub-district level before the commencement of the 2017 MDA.

Individual community member level

A total of 66623 (83.4%) eligible community members received the LF medication in the study district during the 2017 MDA.

Community leader level

Two (2) key community leaders from each sub-district (a total of 10) participated in the CDD's training. The community leaders were also involved in the social mobilization and sensitization activities in their various communities in the sub-districts.

The post-intervention phase shows that there is a 38.9% increase in the overall MDA coverage at sub-district level during the post-intervention. This represents 8,715 more individuals who ingested the drug after the implementation of CEQI intervention in 2017. Although there is a reduction of 3.2% in MDA coverage in Bole sub-district after the intervention as shown in Table 2, all other sub-districts recorded an increase in coverage ranging from 0.1 to 12.3% after the implementation of the intervention.

Table 2
Distribution of pre and post intervention MDA coverage in subdistricts in Bole

Sub-districts	Pre-intervention % (N = 57908)	Post intervention % (N = 66623)	Difference in Coverage %
Mandari	70.0	79.8	9.8
Tinga	70.4	82.7	12.3
Bole	83.7	80.5	(3.2)
Mankuma	68.0	86.0	18.0
Bamboi	98.9	99.0	0.1
Jama	96.9	98.8	1.9
Overall improvement in coverage at Sub-district level			38.9
Overall coverage District coverage	82.0	83.4	
Self-reported adverse drug reaction*	0.13	0.02	
* This is per the number of people who ingested the drug.			

Effectiveness

Knowledge of lymphatic filariasis

Most of the respondents in the qualitative study were able to describe lymphatic filariasis (LF) based on the signs and symptoms exhibited by patients. Others also relied on the causes of the disease in explaining what the disease is. The following are some responses to the question of what LF is:

"...it is a disease that affects the human body and allows some fungi to grow on the affected part, and at a point, you will see the affected area growing to an abnormal position. Sometimes if it is the foot, you will see that foot is extraordinary fatter than the other foot, if it is the hand too, the same thing. But most people I have seen being affected by this disease have it on foot and hardly have I seen somebody being affected by the arm" (Community leader, Mankuma).

"It is a disease that when a mosquito bites a person who is not immunized and comes to bite you, then you also become infected" (CDD, Mandari).

"...it is a disease that affects the lymph system which is mostly caused by mosquito. Mostly when it does happen, it is characterized by swelling, and the body parts it affects are the extremities and the scrotum and other parts of the body" (Health worker, Tinga).

Knowledge on lymphatic filariasis

The survey result presented in Table 3 shows that there is a significant difference in knowledge about LF among the study participants during the two phases of the study. The comprehensive knowledge of LF among the participants in during the post-intervention phase of the study is higher compared to that of the pre-intervention phase.

Table 3
Knowledge about lymphatic filariasis before and after intervention in Bole District

	Pre-intervention Phase		Post intervention		P-Value
	Frequency	Percentage	Frequency	Percentage	
Have correct knowledge of how LF is acquired					< 0.001
Yes	75	33.9	200	89.2	
No	147	66.1	24	10.8	
Have correct knowledge of signs associated with LF					< 0.001
Yes	127	57.1	217	96.9	
No	95	42.9	7	3.2	
Have correct knowledge of LF prevention					< 0.001
Yes	82	37.1	146	65.3	
No	140	63.0	78	34.7	
Misconception about how LF is acquired					< 0.001
Yes	131	59.2	35	15.5	
No	91	40.8	189	84.5	
Comprehensive knowledge of LF					< 0.001
Yes	70	31.5	178	79.7	
No	152	68.5	46	20.3	

Knowledge of lymphatic filariasis mass drug administration

Similar results were seen in the quantitative arm of the study as shown in Table 4. There is difference in the level of knowledge about the MDA between the study participants during the pre and post CEQI intervention phases. Participants in the post intervention phase showed a high level of knowledge and participation in the MDA as compared to pre-intervention phase. Adherence to the direct observation treatment (DOT) is significantly higher in post intervention phase compared to the pre intervention phase. Fear of adverse drug reaction as the reason for the refusal to swallow the medicine was higher in pre-intervention phase than in the post-intervention phase.

Table 4
 Knowledge of lymphatic filariasis mass drug administration pre and post intervention in Bole District

Variables	Pre-intervention Phase		Post intervention Phase		P-value
	Frequency	Percentage	Frequency	Percentage	
Awareness of LF MDA					< 0.001
Yes	102	46.0	173	77.2	
No	120	54.1	51	22.8	
Source of MDA information					< 0.001*
Radio	2	2.3	2	1.3	
Health workers	6	5.4	58	33.5	
Posters	0	0.00	12	6.7	
Family members	7	6.7	2	0.9	
Church/mosque	18	18.0	23	13.4	
Community volunteers	37	36.5	39	22.3	
Gong-gong	14	13.5	35	20.5	
Neighbors/friends	18	17.6	2	1.3	
Was there any public education before MDA					< 0.001*
Yes	40	39.6	154	89.0	
No	51	50.0	18	10.4	
Don't know	11	10.4	1	0.6	
Have you ever taken the LF drug					< 0.001*
Yes	98	44.1	210	93.8	
No	82	36.9	10	4.5	
Can't remember	42	18.9	4	1.8	
How was the drug administered					< 0.001*
Direct observation treatment	140	63.1	221	98.7	
Given to beneficiary to take at his/her convenience	82	36.9	3	1.3	
Why some community 'members' Refusal to ingest drug					< 0.001*

* Fisher's exact test

Variables	Pre-intervention Phase		Post intervention Phase		P-value
	Frequency	Percentage	Frequency	Percentage	
Fear of side effects	143	64.4	140	62.5	
Level of knowledge of the disease	20	9.0	10	4.5	
'Don't think they will get the disease	17	7.7	9	4.0	
Think only sick people should take the drugs	15	6.8	6	2.7	
Too many drugs	18	8.1	16	7.1	
Religious beliefs/superstition that oppose medication	6	2.7	3	1.3	
Taking other medication	2	0.9	19	8.5	
Have taken the drugs far too many times	1	0.5	21	9.4	
* Fisher's exact test					

Perception of the respondents on the cause of LF

Most respondents mentioned being bitten by a mosquito as a cause of the disease. Two respondents (a drug distributor and community leader) however said they had no idea about what causes the disease. There were speculations by one respondent that the disease is caused by witchcraft.

"I don't know what causes the disease, but some said it is caused by witches" (Community leader, Jama).

With regards to preventive methods available for treating LF, most of the respondents indicated that taking the MDA drugs help in preventing the disease.

"...health staffs have made us aware that if you take the drugs consistently, then you can prevent it" (CDD, Jama).

"...the only thing is to be taking the drugs always" (CDD, Mandari).

"...if you know you don't have elephantiasis, and they are sharing the medicine, and you refuse to take them, it can't prevent it unless you have taken the drug" Community leader, Bole).

The study participants were knowledgeable about the signs and symptoms of the disease. The commonest sign mentioned by respondents was swollen limbs or legs. Others were itchiness, rashes, headaches, frequent diarrhoea, dizziness, fever, fear of light, enlargement of the testes, reddish eyes, body pains and weakness in the body.

"...you see one of the legs bigger than the other or very big testicles" (CDD, Jama).

"...sometimes I see the fellow having reddish eye and itchy body" (Community leader, Mankuma).

Broad understanding of the MDA

According to respondents, the MDA is the distribution or administration of drugs to all community members (both LF patients and non-patients), to prevent and eradicate lymphatic filariasis. This is usually done using volunteers from the communities with supervision and monitoring from health workers.

"We do the exercise because we don't want anyone to get the disease in addition to those who already have it. It is an attempt to eradicate the disease" (CDD, Bamboi).

"...it has to do with we giving people drugs in our communities so that they are protected from getting the disease... mostly it happens once in a year... we go around to distribute the drugs... mostly we use the volunteers then the health workers do the monitoring and supervision" (Health worker, Tinga).

Although all the respondents agreed that drugs given during the MDA are to prevent LF, some CDDs were also of the view that the drugs are capable of curing blindness and other diseases. It is worth noting that some community members were usually eager to ingest the drug because the drug enhances their sexual performance.

"The medicine makes you active in whatever you are doing. Some community member said they could have sex with their wives and husbands very well" (CDD, Mandari).

Adoption and implementation

We learnt from the respondents that other activities undertaken before the 2017 MDA included informing the communities about the MDA via a town criers, sensitization in churches, mosques, community information centres and sometimes on local radio stations. On a few occasions, durbars were held to educate community members on the LF disease and the importance of MDA. The endemic communities were also educated on reasons for the MDA and possible side effects of the drugs. Some respondents also reported that they used door to door approach to announce dates and to sensitize households. The reasons given for the announcement by drug distributors were to ensure that people make themselves available on distribution days as most communities' members were farmers who sometimes spent nights on their farms.

"...we pre-inform the people. This is because sometimes, some people go to spend the whole day and nights on the farm. Sometimes we even go to churches to make announcements with regards to the exercise so that the people are overly aware of the exercise" (CDD, Jama).

It is important to note that most drug distributors disclosed that the focus was usually on announcements of dates and not on sensitization. Very few of them mentioned sensitization on the disease, possible side effects and how to handle such as activities they undertook before the commencement of the MDA. Health workers who participated in the study, on the other hand, emphasized community mobilization through durbars and meetings with stakeholders for sensitization as one of the primary activities undertaken before the MDA began. This clearly shows that social mobilization and sensitization before and during the MDA is the responsibility of the health workers. There is an indication that community leaders were involved in the last MDA exercise as shown in the quotes.

"We do what we call social mobilization and we get the stakeholders to involve. We have a meeting with the stakeholders and we discuss what we about to do and we let them know the reason for carrying the exercise because without the stakeholders we can't get the community to participate in the exercise... we have the volunteers involved in the meeting. We orientate them... we then send the information across to enforce the community sensitization after the meeting" (Health worker, Tinga).

"The last time we were informed about the exercise, we beat the 'gong-gong' in the community to inform everyone about the exercise and when it will take place. We then advise them to make sure they avail themselves to take the medication. We also advise and encourage them to stay away from alcohol on the day of the exercise to avoid any complications" (Community leader, Mankuma).

According to the participants, the drug distribution lasted between one and two weeks. Alcoholics, pregnant women, under-heights, lactating mothers, and people who were seriously sick were excluded from the exercise. In cases where household members were unavailable to take the drugs or were unable to ingest the medicine for one reason or the other (sometimes because they were drunk), the house or structure was noted and revisited. Height of household members was measured to determine the dosage of medicine to be given.

"...we have the measuring stick we use to check their height so when we establish that the person can take the drug, we make sure the person takes the drug in our presence...we don't give it to you to take later" (CDD, Tinga).

There is a strong indication that the Directly Observe Treatment (DOT) strategy was adhered to by the CDDs, as indicated in the following quotes:

"...for some of them I fetch water, and they swallow the medicine there... especially those who didn't take for the previous years... so they take it on the spot before I leave the house" (CDD, Tinga).

"...we make sure they take medicine in front of us so that they don't go and throw the drugs away" (CDD, Bole).

The participants revealed that there were several differences which made the most recent exercise more effective compared to previous ones. Some of the differences mentioned include detailed training for CDDs, increase in incentive for CDDs, supportive supervision, assurance of free treatment of adverse drug effects by health service, a higher level of participation and community sensitization.

The respondents indicated that many community members agreed to ingest the medication in the most recent (2017) MDA exercise compared to previous ones. They mentioned that in previous exercises, they had to work hard in convincing community members to ingest the drugs, and it was a different case in the most recent MDA program. We were informed that on some occasions, community members went to the homes of the drug distributors or asked about the drugs even before the commencement of the MDA program. Some drug distributors also mentioned that they faced a minimal challenge in getting community members to comply on distribution day as they were eager and ready to participate in the MDA exercise.

"Formerly they will say they don't know you, but now they say you have not come to my house to give me the medicine" (CDD, Mandari).

"One major improvement is that we were given the assurance that if anyone faces any adverse effect after taking the drugs, they can report at the health facility, and they would be treated for free, and this boosted the confidence of the people in the drugs" (Bole, Tinga).

"Previously, people used to reject the drug and will never take it no matter what you say or do... but during the last distribution, people were in their houses waiting for me to bring the drug" (CDD, Mankuma).

"As I said earlier, the willingness of community members to ingest the medicine was very high in the last exercise...those who used to complain of drug reactions have now seen the benefits because we always convince them that the drug reactions they experience are because the organisms that cause the disease is already in their body, and so the drug is working on it, and so they need to continue taking the drugs to completely kill the organisms...previously, people used to reject the drug and will never take it no matter what you say or do" (CDD Tinga).

A higher level of compliance in the new exercise, according to some CDDs was due to the claims that the MDA drugs make one more physically active and enhance sexual performance. There was also an indication that community members understood the importance of MDA exercise and so were willing to participate in the activity, which made work easy for CDDs. Pictorial evidence was shown to community members on the signs and symptoms of LF also influenced compliance as it induced some fear and insight about the reality of the disease into community members who were likely to reject the drugs.

“they say when you take it (the medicine), it makes you active in whatever you are doing and some also say they can sleep with their wives and husbands very well” (CDD, Mandari).

“The compliance was better now because they understood the exercise and so they were willing to swallow the drugs... sometimes those who were absent even trace me to come for theirs when they return” (CDD, Bamboi).

“During the previous drug distribution they were not willing to swallow, but last year they were willing due to the photos that we were holding” (CDD, Tinga).

Another difference between the recent MDA and previous ones was the intense training volunteers received before the distribution exercise. Because of this training, respondents reported that they were able to better engage community members and in instances where refusals were imminent, they were able to convince community members to take the drugs.

“...now what we do is that when the fellow wants to refuse to take the drugs, we explain the benefit of the drugs to them. But formerly, if the person doesn't want to take the drug, we leave” (CDD, Mandari).

“...but now because of the intensive training, we take our time to explain to them, so most of them agreed” (CDD, Tinga).

Even though respondents said, they used different channels (religious centres, gong-gong beating, door-to-door approach) to sensitize community members and announce distribution dates, the introduction of some new channels such as the use of community information centres and radios were new additions. These new additions were able to reach a wider population compared with the traditional channel of the house-to-house announcement and gong-gong beating. A CDD had this to say:

“We used to go from house to house to inform people, but now there are information centres around that we were encouraged to use... you can just go there and make the announcements and people hear it from their homes” (CDD, Jama).

Unlike in previous exercises where drugs were just administered without measures in place for treating adverse side effects, respondents felt that provisions that were made in the recent exercise for free treatment of adverse reactions helped. Community members were informed on where to seek free health care should they have any adverse drug reaction And that motivated community members to ingest the drugs. As shown in the following quote:

“One other improvement is that we were given the assurance that if anyone faces any adverse effect after taking the drugs, they can report at the health facility, and they would be treated for free, and that boosted the confidence of the people in the drugs” (CDD, Jama).

Respondents also mentioned that an increase in allowances for volunteers and supervision in the most recent exercise compared to previous MDA exercises. These motivated drug distributors to give their best.

"...well, the money we were given in the last MDA exercise was an increment from the previous ones" (CDD, Bamboi).

"In fact, before God and man, there was a slight increment in the allowances that are given to the volunteers in this last MDA exercise, and this encouraged us to work harder" (CDD, Tinga).

"During the last exercise, the MDA officers were around to supervise us, so when you are going astray, they will correct you this helped us a lot" (CDD, Mandari).

Some distributors revealed that coverage in some communities in the recent MDA program was affected by the migration of community members to other parts of the country and so were not accessible. The results also show that the timing of the MDA being Islamic fasting period also contributed to the low participation in some communities.

"I realized that the number of people covered in the previous drug distribution was more than in the recent exercise because many of the people who had written their names in some of the houses were nowhere to be found because most of them had either moved out or travelled" (CDD, Bole).

"...you know Bole is a Muslim community, and the drug was distributed at the time of Ramadan so the people fasting could not take part" (Health Worker, Bole).

The fight against 'galamsey' (Illegal mining of gold) caused a lot of out-migration in some communities hence resulting in several community members not available.

"For my community, the coverage was low because previously, there were a lot of galamsey workers around and so the number of people was very high. But now that the galamsey has been stopped, all those people have moved away, and so it has caused a decrease in the number of people" (CDD, Bole).

"One challenge is that, since this is a galamsey area, you go and register a lot of people, but during the drug distribution they tell you they have moved out" (Health worker, Bole).

There were reports by CDDs that they were unable to complete or cover the areas assigned to them within the stipulated time of the MDA. This was partly because of the increase in compliance or acceptance, which meant more people to attend. Some of the areas within the district had seen some development and population increase. Thus, some households were left out of the exercise.

Other community members rejected MDA drugs due to misconception, fear of side effects and the unwillingness of some health facilities to treat such cases for free. The distance to the nearest health facility to report adverse drug reaction was also assigned as reasons for refusal of the drug. CDDs outlined these as challenges encountered during the last MDA exercise.

"Because a lot of people including some visitors were ready to take the drug, I spent more time attending to people in some houses, and I was not able to visit all the houses in my area." (CDD, Mankuma).

"...some of the community people said when they ingest the drug, their legs become swollen and I tell them if it has swollen they should come to the health centre, and they will give them drugs and they said when they go to the health facility, the nurses will not attend to them" (CDD, Tinga).

Some community members refused the drugs because they did not trust the volunteers, accusing volunteers of accepting bribes to administer deadly drugs to them.

"There were even people who would refuse to take the drugs and then ask you to leave their house... they say you have been given money to come and give them drugs for which they may even die after taking" (CDD, Mankuma).

Lack of logistics such as transportation and Protective boots to enable drug distributor access remote areas were among the challenges encountered.

"One thing they can do to help us is provided wellington boots and raincoats for us to be able to reach the communities that have muddy access and when it rains on the way" (CDD, Bamboi).

Community members also had unrealistic demands, demanded incentives such as mosquito nets which were not part of the program.

"Everywhere we go they talk about mosquito nets. They said we always talk about LF and oncho, but we don't give them mosquito nets so they will not take the drugs" (CDD, Tinga).

Maintenance

Due to the short duration of the CEQI intervention, detailed evaluation of maintenance was difficult to assess and to determine the sustainability of the intervention. However, we reviewed barriers and possible solutions to enable successful implementation and sustainability of the intervention from the perspective of the study participants.

Because of the challenges encountered during the last MDA exercise, respondents suggested that the MDA exercise should be conducted during the dry season when there will be no farming activities as that will ensure accessibility to communities and availability of individual household members. The interval between MDA exercises was reported to be too long, and some CDDs suggested that the interval should be shortened.

"My suggestion is the interval between the MDAs is too long because people continue asking when is the tablet coming" (CDD, Jama).

To ensure the sustainability of the intervention, the CCDs suggested that more knowledgeable people (health worker) should accompany them during to authenticate their credibility during the drug distribution. According to some CDDs, community members knowing volunteers are not medical personnel hence disregard information they give and consider it as inaccurate and incredible.

"We need more help to encourage us to do the job because if it only we the volunteers when we are talking to them, they won't listen to us. They will say you have never been to school, and you are coming to give medicine to us" (CDD, Bole).

CDDs also recommended better remuneration, provision of incentives and motivation for community members.

"I think providing us with bicycles and increasing the allowance will help us reach the very far communities easily... and distributing bed-nets to the community members will also help" (CDD, Bamboi).

Some CDDs reported that they were unable to complete or cover the areas assigned to them within the stipulated time of the MDA. This was partly because of the increase in compliance or acceptance, which meant more people to

attend. Some of the areas within the district had seen some development and population increase. Thus, some households were left out of the exercise.

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One major threat to the sustainability of the CEQI intervention observed is the frequent transfer of health staff within the district. Between 2017 to December 2018, key health worker (senior disease control officers and district director) has been transferred. These health workers were vital members of the CEQI implementation team and management members of the district health administration.

Discussion

The study aimed to assess the effect of implementing CEQI intervention on implementation of LF MDA in the Bole District of Northern Ghana using RE-AIM. The RE-AIM framework provided a structure to evaluate the impact of the CEQI towards the elimination of the LF as a public health problem in hotspot districts in Ghana.

The findings of the evaluation showed that there was an improvement in social mobilization and sensitization, knowledge about LF and MDA process, willingness to ingest the medication, and adherence to the DOT Strategy. We observed a 6.3% increase in the district MDA coverage and 0.03% reduction in self-reported adverse drug reaction.

However, the interventions did not have the desired effects on MDA coverage in Bole sub-district. This was due to the timing of the MDA and peri-urban nature of the sub-district. Bole Sub-district being Muslim dominated population, administering drugs to the people around the Muslim fasting period made it difficult for most people to ingest the medicine, causing the decline in the MDA coverage. Secondly, social mobilization and sensitization strategy, which works well in rural areas did not work in Bole sub-district due to the semi-urban nature of the sub-district.

These observations reveal the contextual complexities of working in semi-urban/urban communities (as demonstrated in Bole sub-district), and that health workers at the local level understand their system and difficulties on the ground much better than the national level team.

The evaluation revealed a substantial improvement in knowledge, risk perceptions and understanding of LF and the MDA. Comparable observations have been made elsewhere [4, 27, 28], and reflect the need for the creation of awareness, through social mobilization and sensitization using evidence-based context-specific strategies and involvement of community leaders and other key stakeholders in deciding on the strategies and methods to be used to improve MDA activities towards LF control based on initial needs assessment [5, 11, 29].

Intensive training and motivation for CDDs was also a particularly important factor that determines the success of the ongoing LF MDA in the study district, as shown elsewhere [4, 30].

The nature of contextual complexities and dynamics of populations in LF endemic areas may require that MDA activities are designed taking into consideration contextual factors based on WHO-recommended strategies [4, 5, 31]. The use of social mobilization and sensitization materials and strategy should focus on the local context, need-based, social and culture structures [4, 32]. This study also revealed that the involvement of community leaders, intensive training of CDDs and employing context-specific evidence-based social mobilization and sensitization strategies led to an improvement in the knowledge, attitude and practices relating to the disease, reduction in misconception regarding LF and MDA activities and willingness to ingest the LF medicine in the study area.

The fear of adverse drug reaction associated with the LF medication was an important factor that influenced the decision to take the MDA drugs and has been identified in several studies elsewhere [9, 33] and the study area [5]. In this study, the fear of adverse reactions improved after the implementation of QI intervention, indicating that the challenge of fear of adverse drug reaction in control of LF can be eradicated through the implementation of context-specific educational strategies, building confidence in the populace, the outlining of the reasons for the occurrence of drug reactions, and what to do when they occur as indicated in this study. While misconception about the drug (enhances sexual performance) still exist in some areas, continuous appropriate education and advocacy may help overcome this challenge to avoid abuse of the drug.

This study has reinforced the importance of application of the RE-AIM framework for evaluation of public health intervention using a mixed-methods approach.

The increasing advocate for public health studies to apply both qualitative and mixed methods in health services delivery research has been demonstrated in other studies [34–38]. Guidance is scarce in the literature on how to apply qualitative methods in the RE-AIM framework [39]. Therefore, the inclusion of qualitative approaches in this study is a vital contribution to the full application of the RE-AIM model in assessing public health interventions [15, 40]. The combination of qualitative and quantitative methods helped to evaluate the CEQI intervention when very complex and unbiased quantitative data are not available or feasible [39].

Although the qualitative methods may not represent the entire study population, it added depth and meaning to facilitate understanding [39]. The methods in this study have also enriched the understanding and conclusion of the evaluation of the CEQI intervention. This approach can guard against the wrong assumption that an intervention or method did not work when it was an implementation failure [41, 42]. Finally, the approaches used in this study has offered insight into how to guard against implementation failures in the future application of the CEQI intervention. Mixed methods can both enhance and advance the effective application of the RE-AIM [39].

Limitations

This study has some limitations. Social desirability bias could be a limitation to the study as some study participants might have withheld what they thought to be harmful practices during the implementation of the CEQI from the researchers. The duration of the intervention (one round of implementation) does not provide knowledge of the long-term effect and difficulties within the setting and with participants to be fully studied.

Due to the pilot nature of the CEQI intervention, detailed evaluation of maintenance was difficult to assess and to determine the sustainability of the intervention.

The CEQI intervention has been implemented for only one round of MDA. The intervention was limited to only one district in Northern Ghana; hence, limits the generalizability of the findings.

Conclusion

The findings of this study at the district and sub-district level, coupled with reach, effectiveness and adoption at the participant level, suggest that the CEQI intervention is feasible to implement in LF hotspot districts based on initial context-specific needs assessment.

Although there is an improvement in coverage, compliance, knowledge about the disease and MDA activities in the study area, the study further emphasized the need to improved context-specific social mobilization and sensitization focusing on the safety of medicines and the importance of MDA before and during the drug distribution exercises.

Abbreviations

CDDs

community drug distributors

DOT

Directly Observe Treatment

GFEP

Ghana Filariasis Elimination Program.

GPELF

Global Program to Eliminate Lymphatic Filariasis

IDIs

in-depth interviews

IM

Intervention Mapping

IR

Implementation research

LF

Lymphatic filariasis

MDA

Mass Drug Administration

PDSA

Plan-Do-Study-Act

RE-AIM

Declarations

Ethics approval and consent to participate

Ethical approval numbers: M170219 and GHS-ERC: 04/02/2017 were obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg, South Africa and the Ghana Health Service Ethics Review Committee respectively before the commencement of the study. Written informed consent was sought from all research participants. All study participants were adults aged > 18years.). Permission was obtained from Neglected Tropical Diseases (NTDs) program of the Ghana Health Services and the District Health Administration of Bole.

Consent for publication

Not applicable.

Availability of data and materials

The dataset supporting the conclusions of this article is included in the article.

Competing interest

The authors declare that they have no competing interests.

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Authors' Contribution

AKM conceptualized and designed the study. He conducted the data extraction, analysis, interpretation and led the writing of the paper. FB and RR contributed to the intellectual content and writing review and editing of the manuscript. LI and TC refined the initial study design and critically reviewed the manuscript. All authors read and approved the manuscript.

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Figures

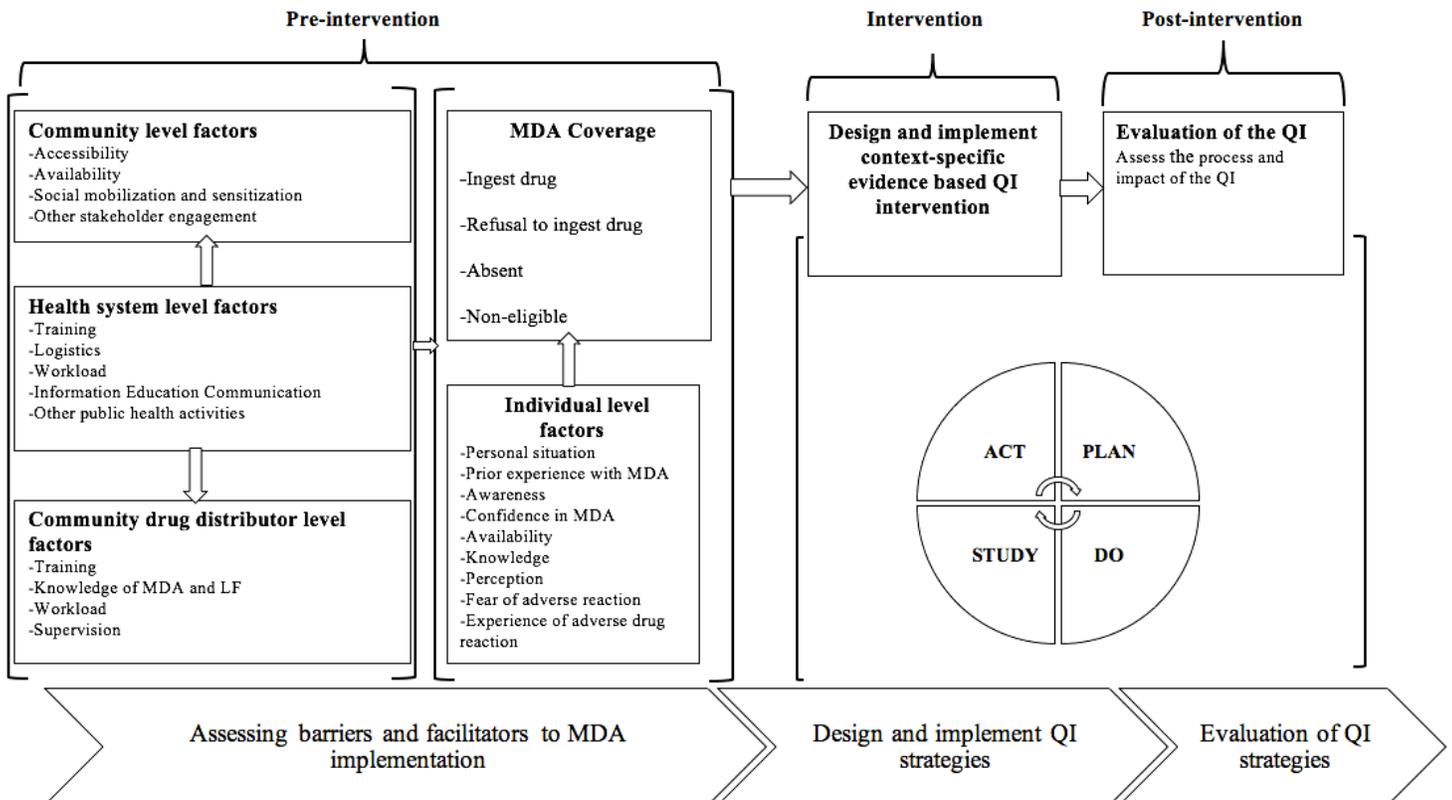


Figure 1

Conceptual framework showing the connection between the study phases.