UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF PUBLIC HEALTH

ASSESSING IMPLEMENTATION FIDELITY OF COMMUNITY BASED INTEGRATED MASS DRUG ADMINISTRATION FOR NEGLECTED TROPICAL DISEASE CONTROL IN KANO STATE, NIGERIA

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A research report submitted to faculty of health sciences in partial fulfillment of the requirement for the degree of Master of Science in Epidemiology in the field of implementation science

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November, 2017

DECLARATION

I, *Abdu Abdullahi Adamu*, declare that this research report is my own unaided work. It is being submitted in partial fulfillment of the requirement for degree of Master of Science (MSc) in Epidemiology (field of Implementation Science) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

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(Signature of candidate)

Date: 12th day of November 2017

DEDICATION

To my mum for her unending love and steadfast support.

ABSTRACT

Background

There is a dearth of information about how well this intervention is conducted in communities (implementation fidelity) as fidelity data are not included in routine program data. Therefore, this study measured the implementation fidelity of mass drug administration for onchocerciasis, lymphatic filariasis, and soil transmitted helminthiasis control, described factors affecting it, and determined the relationship between identified factors and implementation fidelity.

Methodology

A cross sectional survey was conducted in Nassarawa and Gezawa local government areas of Kano State, Nigeria, where a total 348 community directed distributors were interviewed. Scores were calculated by linearly combining responses obtained using Likert scales. Mean and median of implementation fidelity score were computed. Also, the mean of key determinants were calculated. Adjusted and unadjusted general linear regression models were then fitted to determine the relationship between implementation fidelity and identified determinants.

Results

The mean(SD) implementation fidelity score was 55.39(8.10) and median(IQR) was 56(60 - 49). Minimum implementation fidelity score obtained was 36 and maximum score was 72. The mean(SD) quality of delivery score, intervention complexity score, facilitation strategy score and participant responsiveness score were 16.77(2.74), 11.03(3.04), 8.83(0.99) and 4.62(0.52) respectively. Evidence of association between some factors and implementation fidelity score were found at $p < 0.05$. They include: intervention complexity (Adj Coef: -0.62(-0.93 to -0.30),

facilitation strategies (Adj Coef:-1.68(-3.05 to -0.32), participants responsiveness (Adj Coef: 2.99(1.58 to 4.39), knowledge of NTD (Adj Coef: 0.75(0.36 to 1.13), CDD selection by local government staff (Adj Coef: 7.48(2.85 to 12.11), CDD who volunteered (Adj Coef: 8.38(4.59 to 12.16) CDD with formal training in a health-related field (Adj Coef: 7.34(2.61 to 12.07), and CDD participation in other public health activities (Adj Coef: -6.16(-9.49 to -2.83).

Conclusion

This study demonstrated the feasibility of measuring implementation fidelity of mass drug administration. In addition, key determinants such as intervention complexity and participant responsiveness were found to be important factors affecting implementation fidelity and could be the target of future implementation strategies.

ACKNOWLEDGEMENT

I am grateful to Almighty Allah, the most merciful and beneficence, for giving me the strength and courage to complete this onerous task. Without His grace, this work would not have been possible.

I would like to express my sincere gratitude to my supervisors; Dr Latifat Ibisomi and Prof Zubairu Iliyasu, for their patience and motivation. I appreciate their speedy comments and suggestions which enabled the timely completion of this work.

I would also like to thank all members of my protocol assessor committee: Assoc Prof Nicola Christofides, Assoc Prof Geoff Candy, and Dr Nika Raphaely for their valuable comments and important suggestions at the initial stage of this work.

Special thanks to Prof Jonathan Levin and Dr Eustasius Musenge for their input in the statistical analysis, and Prof Rohit Ramaswamy for his guidance and mentorship all through the project. Dr Rabiu Ibrahim Jalo also assisted greatly with his invaluable experience in navigating the research terrain in Kano State, Nigeria.

Thanks all my classmates, and of course, the class president; Lorraine Molepo, for making the class a wonderful experience - every moment was memorable. And to my best buddies: Elvis, Michael, Desire, and James, it was indeed a great pleasure meeting you guys.

I am immensely grateful to Wits School of Public Health and WHO/TDR for giving me a scholarship which supported my studies, research and stay in Johannesburg throughout the period of this program.

I would like to acknowledge the two teachers who inspired me the most during my stay at Wits School of Public Health; Prof Jonathan Levin and Assoc Prof Nicola Christofides. The passion with which they teach makes is worth emulating.

Last but not the least, I would like to thank my parents, my siblings, as well as my friends; Yasir, Kamal, Yusuf, Murtala, Abubakar Nagoma, Habeeb Kado, Iro, Nura Abubakar, Adamu Haruna and others too numerous to mention for supporting me spiritually while working on this thesis and life in general.

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DEFINITION OF TERMS

Fidelity	Whether an intervention is being delivered as it was designed or written
Adherence	It is simply the bottom line measure of implementation fidelity.
Coverage	Whether those who are supposed to have received an intervention did so.
Dose	This means the amount (content, frequency and duration) of an intervention received by participants
Quality of delivery	It concerns with the way an intervention is delivered in a way to achieve what was intended.
Intervention complexity	It concerns with the description of an intervention.
Facilitation strategies	These are support strategies that are used to optimize and standardize implementation fidelity. They include things like manuals and training etc.
Participant responsiveness	This is how communities respond to an intervention when they consider it as relevant.
Community directed distributors	These are community members assigned to conduct mass drug administration

LIST OF ABBREVIATIONS

APOC	African Program for Onchocerciasis Control
CDD	Community Directed Distributors
CDTI	Community Directed Treatment Intervention
CI	Confidence Interval
DALY	Disability Adjusted Life Years
EVD	Ebola Virus Disease
HHH	Head of Household
HREC	Human Research Ethics Committee
IOF	Implementation Outcome Framework
LGA	Local Government Area
LF	Lymphatic Filariasis
MDA	Mass Drug Administration
NIRN	National Implementation Research Network
NTD	Neglected Tropical Diseases
OCP	Onchocerciasis Control Program
PC-NTD	Preventive Chemotherapy Neglected Tropical Diseases
p	P-value
QALY	Quality Adjusted Life Years
SES	Socioeconomic Status
STH	Soil Transmitted Helminthiasis
SOP	Standard Operative Procedure
SSA	Sub Saharan Africa
USAID	United States Agency for International Development
WITS	University of the Witwatersrand
WHA	World Health Assemble
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.0 INTRODUCTION OF CHAPTER

This chapter gives an overview of neglected tropical diseases, and how mass drug administration is conducted in Nigeria to interrupt the transmission of those neglected tropical diseases amiable to preventive chemotherapy. Then context specific factors that affect mass drug administration exercises across various settings are discussed. The concept of implementation fidelity and its conceptual framework is also discussed. The chapter ends with a conceptualization of fidelity assessment and its possible determinants based on existing literature and an adapted conceptual framework.

1.1 BACKGROUND

Neglected tropical diseases (NTDs) initially consisted of 17 chronic, debilitating infectious diseases as listed by the World Health Organization (1). They include Buruli ulcer, Chagas disease, dengue and chikungunya, guinea worm disease, echinococcosis, foodborne trematodiasis, human African trypanosomiasis, leishmaniasis, leprosy, lymphatic filariasis, onchocerciasis, rabies, schistosomiasis, soil transmitted helminthiasis, taeniasis, trachoma and yaws (1). Additionally, in 2016, mycetoma was recognized as a neglected tropical disease by the World Health Assembly (WHA)(1).

Nigeria contributes the highest burden of soil transmitted helminthiasis, schistosomiasis, and lymphatic filariasis in sub Saharan Africa (2, 3). The country has an estimated 38 million cases of hookworm infection (3). This is only followed by the Democratic Republic of Congo which

has an estimated 31 million infections (3). Also, the estimated number of cases of schistosomiasis is 29 million, and about 106 million people are at risk of lymphatic filariasis (3).

These diseases are most prevalent among people of low socio-economic status (4-6). NTDs have profound effect on health and wellbeing of individuals, as well as economic productivity (5, 7). For example, hookworm (one of the soil transmitted helminths) infection has been associated with anemia especially iron deficiency anemia in pregnant women and children (8, 9). Also, two independent studies in Tanzania and Niger Republic have shown that children with heavy worm infection (soil transmitted helminthiasis) suffer cognitive impairment, stunting and underweight (10, 11). Schistosomiasis has been implicated in painless hematuria, bladder and hepatic cancer (12-15). While, lymphatic filariasis can cause severe limb disability and consequently reduction in mobility which can aggravate poverty among farmers and their families (16)

1.1.1 Control of neglected tropical diseases

In order to mitigate the health and economic consequence of neglected tropical diseases, the WHO (World Health Organization) began spearheading efforts for prevention, control, eradication and elimination (17). Five main strategies for neglected tropical disease prevention and control have been recommended and they are as follows: preventive chemotherapy; safe water sanitation and hygiene, vector control, intensified case management and application of veterinary science in disease control in humans (7, 17, 18).

1.1.2 Mass drug administration

Preventive chemotherapy is the mainstay strategy for control of helminthic diseases such as; soil transmitted helminthiasis, schistosomiasis, onchocerciasis, and lymphatic filariasis, as well as bacterial diseases like trachoma, which are otherwise referred to preventive chemotherapy

neglected tropical diseases (PC-NTD) (19). In order to disseminate this strategy, an intervention known as mass drug administration (MDA) is conducted in communities (19). MDA is a coordinated process where full dose of medicines are administered to all eligible members of a community (without contraindication) within the same period regardless of their disease status (19). This intervention became possible in 1987 when it was demonstrated that annual treatment with the drug; Mectizan (Ivermectin – MSD) (for onchocerciasis), can clear microfilaria from the skin for up to six months (20, 21).

In Nigeria where the prevalence of preventive chemotherapy NTDs are high, mass drug administration is conducted in all 36 states including the federal capital territory in an integrated manner to interrupt transmission of multiple diseases at a time (2, 22). The policy document that directs integration is the national NTD masterplan; which is a context specific, multi-year comprehensive strategic framework developed with the support of World Health Organization (WHO)(22, 23). This masterplan contains the goals and the key performance indicators for the NTD control program in Nigeria (22). These key performance indicators are shown in Table 1.1 and 1.2 (22).

Since all states are endemic for more than one NTD, national masterplan specifies the drug combination to be used (22). The following are accepted for use in Nigeria: ivermectin and albendazole, praziquantel and albendazole or mebendazole (22). Under special condition, triple combination of albendazole, ivermectin and praziquantel may be used(22).

Table 1.1: National goals and Key Performance Indicators (KPI) for neglected tropical diseases

Goals	Objectives	Key Performance Indicators (KPI)
Preventive chemotherapy NTDs: Elimination of lymphatic filariasis, onchocerciasis, soil transmitted helminthiasis, schistosomiasis, and trachoma.	1. To complete mapping of 4 of the NTDs by 2013. 2. To carry out preventive chemotherapy interventions in all endemic LGAs and communities.	1. Number of LGAs completely mapped for these diseases 2. Number of endemic LGAs implemented mass drug administration

Source: Nigeria National NTD Masterplan (22)

The step-by-step field implementation of mass drug administration exercises are guided by a WHO manual titled, "Preventive Chemotherapy in Human Helminths: Coordinated Use of Antihelminthic drugs in control interventions: A manual for health professionals and program managers" (23, 24). The manual specifies dosage of drugs, procedures like weighing or height measurement before drug administration, and eligibility criteria (23, 24).

Mass drug administration are usually large scale interventions; covering diverse geographical areas, and involve complex delivery systems (21, 25). During field implementation, such interventions are prone to multiple context specific factors that can cause variation in quality of implementation across settings despite available evidence that the intervention can reduce morbidity from NTDs in the population (26-31). The contextual factors affecting implementation can be grouped into five and they include; community related factors, provider related factors,

type of innovation, organizational capacity, and training and technical support(31). Several researches have shown that poor quality of implementation causes implementation failure which can in turn leads to poor program outcome (32-34). This can discourage funders from investing further, and communities from accepting the intervention as effective (35).

Table 1.2: Key Performance Indicators for preventive chemotherapy in Nigeria

Disease specific goal	**Key Performance Indicator**
Trachoma elimination	1. Number of LGAs completely mapped for Trachoma 2. Number of trichiasis surgeries in endemic LGAs. 3. Number of communities that have access to surgery 4. Number of persons treated with Azithromycin. 5. Number of Health facilities, LGAs and States reporting timely and monthly using the IDSR 003 Form. 6. Reduction of disease transmission
Soil transmitted helminthiasis elimination	1. Number of LGAs completely mapped for STH 2. Number of school aged children and other at risk population reached with deworming tablets in all endemic LGAs 3. Number of symptomatic cases of STH managed using IMCI Strategy 4. Number of Health facilities, LGAs and States reporting timely and monthly using the IDSR 003 Form
Schistosomiasis elimination	1. Number of LGAs completely mapped for Schistosomiasis. 2.Number of symptomatic cases of Schistosomiasis managed using IMCI Strategy 3. Number of school aged children and other at-risk population reached with deworming tablets in all endemic LGAs 4. Number of Health facilities LGAs and States reporting timely and monthly using the IDSR 003 Form 5.Reduction of disease transmission

Onchocerciasis elimination	1. Number of endemic LGAs attaining a minimum of 80% therapeutic coverage. 2.Number of LGAs with 100% geographical coverage 3.Number of Health facilities, LGAs and States reporting timely and monthly using the IDSR 003 Form 4.Reduction of disease transmission
Lymphatic filariasis elimination	1. Number of LGAs completely mapped for LF 2. Number of endemic LGAs implementing MDA or PCT interventions. 3. Number of hydrocele surgeries in endemic LGAs. 4. Number of Health facilities, LGAs and States reporting timely and monthly using the IDSR 003 Form 5.Reduction of disease transmission 6. Number of LLINS jointly distributed with the Malaria Control Program.

Source: Nigeria National NTD Masterplan (22)

1.1.3 Implementation fidelity

To enable the evaluation of implementation process, 8 conceptually distinct implementation outcomes with their definitions have been outlined (36). For practical reasons, these implementation outcomes are positioned before service and client outcomes to emphasize that implementation outcomes are the proximate determinants of other programmatic outcomes(37). Implementation fidelity is one of the eight implementation outcomes and is defined as "the degree to which an intervention was implemented as it was prescribed in the original protocol or as it was intended by the program developers" (30). Fidelity has its theoretical basis in RE-AIM (Research Effectiveness Adoption Implementation and Maintenance) and can be measured in early to mid-stage of implementation (30, 36).

Successful interventions have certain core implementation components (also knowns as implementation drivers) that are common to them (38). These core components were described in a framework by Fixsen and his colleagues (38). They include, staff selection, pre- and in-service training, coaching, staff evaluation, program evaluation, facilitative administrative support and system intervention (38). Implementation fidelity provides information about level of implementation success upon the manipulation of these core components in different setting (38).

In practice, fidelity elucidates how frontline providers were committed to the protocol, the amount of the program or sets of activities that were delivered and the quality with which they were delivered (30). Although implementation fidelity is not a new idea its only recently that program implementers had begun to operationalize its measurement in intervention evaluation (35, 39). Measuring implementation fidelity provides more information about the process of implementation – indicating whether an intervention was delivered as planned (36). Indeed, it has since been recommended that program design as well as evaluation frameworks include fidelity documentation as part of its core components (40).

1.2 PROBLEM STATEMENT

Integrated mass administration of two drugs; ivermectin and albendazole, for onchocerciasis, soil transmitted helminthiasis and lymphatic filariasis control is conducted yearly in communities in Kano State in line with the national NTD masterplan and the WHO helminthiasis preventive chemotherapy manual for program managers(23, 24). However, a dearth of knowledge about the fidelity of implementation of this intervention exist, as fidelity data are not routinely collected during monitoring and evaluation (22). In addition, context specific factors that affect implementation fidelity of this intervention in Kano State remains unknown.

Failure to measure implementation fidelity could potentially result in wastage of scarce financial and human resources invested in NTD programs. It could also decelerate the attainment of overall national elimination targets because implementation success or failure are not actively monitored across the various communities where this intervention is being conducted.

1.3 JUSTIFICATION

It is critical to study the implementation fidelity of mass drug administration as it would enable program implementers to objectively assess the quality of its implementation as well as factors that might affect it across different communities.

The current level of political commitment to neglected tropical diseases control and prevention is an opportunity for Nigeria to meet WHO's elimination targets for helminthic NTDs (41). To achieve this, implementation fidelity of mass drug administration needs to be tracked, documented and improved as fidelity is in the pathway between the intervention and program outcome (42).

This research demonstrated the feasibility of measuring implementation fidelity of mass drug administration by adapting an already available conceptual framework which provides constructs within which implementation fidelity can be measured. In addition, the study explored some contextual factors that might affect implementation fidelity, and this can guide microplanning and policies relating NTD control.

The multistage cluster sampling strategy used in this research is not only low cost and easier to implement, but is advantageous in providing information about level of implementation fidelity across various communities thereby highlighting variations in how mass drug administration is conducted.

The tool used for this research can easily be applied in other places where co-endemicity with onchocerciasis, lymphatic filariasis and soil transmitted helminthiasis exist. The research itself can be scaled up the entire state.

1.4 RESEARCH QUESTION, AIM AND OBJECTIVES

RESEARCH QUESTION: What is the implementation fidelity of community-based integrated mass drug administration for onchocerciasis, lymphatic filariasis and soil transmitted helminthiasis control in Kano State, and what factors affect it?

AIM: To assess the implementation fidelity of community-based integrated mass drug administration for onchocerciasis, lymphatic filariasis, and soil transmitted helminthiasis in Nassarawa and Gezawa local government areas of Kano State and to describe the factors that affect it.

OBJECTIVES

1. To measure implementation fidelity of community based mass drug administration for onchocerciasis, lymphatic filariasis and soil transmitted helminthiasis in Kano State, Nigeria
2. To describe factors affecting implementation fidelity of community based mass drug administration for onchocerciasis, lymphatic filariasis, and soil transmitted helminthiasis.
3. To determine the relationship between identified factors and implementation fidelity.

1.5 LITERATURE REVIEW

Database search covering full duration of publications was conducted to identify factors affecting implementation of mass drug administration in low and middle-income countries. The databases searched include; PubMed, Scopus, Web of Science, WHOLIS, and Africa Wide. The PubMed search strategy is attached as Appendix C. No date restrictions were placed on databases, and only articles published in English Language were considered.

1.5.1 Factors affecting implementation of mass drug administration for control of neglected tropical diseases

Several factors affect the implementation success of mass drug administration. The factors identified are grouped into organizational level factors, structural level factors and individual level factors to capture how they affect various implementation outcomes (43).

1.5.1.1 Organizational level factors

These are factors that represent employee morale, implementation culture or climate, and the leadership effectiveness of an institution, which could be a state or local government agency responsible for, or involved in implementing a health intervention such as mass drug administration (43). They include:

a. High attrition: Organizational practices and processes that promote an accommodating work climate reinvigorates employee morale and trust which is necessary for successful implementation (31). Poor organizational practices lead to attrition of community directed distributors (CDD) or community health volunteers and this affects community based mass drug administration (44-48). High attrition rate is usually caused by lack of monetary incentives and inadequate supervision (44, 45, 47). This affects the

sustainability of NTD programs by leading to loss of funds invested in training CDD for mass drug administration exercises (45).

b. Poor management of supply chain and logistics system: Many studies conducted in India, Sierra Leone, Nigeria and Uganda have identified poor drug supply mechanism by national medicines stores as a major factor affecting the implementation of mass drug administration exercises (45, 46, 48, 49). This results in drugs and other equipment like ivermectin rule not being readily available during mass drug administration exercises and this could affect implementation fidelity (43).

c. Poor supervision and monitoring mechanism: Supervision is an important task of organizations responsible for implementation of health intervention especially when necessary resources like front line providers, items like drugs, and finances have been invested (31). Supervision is often inadequate during mass drug administration programs as highlighted by studies conducted in Kenya and India, and this could affect implementation fidelity (44, 47, 49, 50).

d. Poor quality assurance following training: Government institutions responsible for implementing NTD control programs engage in training of health workers or community members assigned as community directed distributors before the mass drug administration exercise, however, there is a lack of quality assurance following these trainings (49). This means that knowledge assessments are not done, and training manuals are not evaluated for clarity, and simplicity (49). This could affect the fidelity with which these trained personnel implement the intervention (43). In addition, long duration between training and implementation of MDA, as well as lack of re-training also affect quality of implementation (49).

1.5.1.2 Structural-level factors

These are factors that reflect the broader community where mass drug administration is being conducted (43). They represent sociopolitical tendencies like misconceptions and sentiments, as well as role of household head and characteristics of the physical environment (43).

a. Community misconception: Misconceptions and conspiracy theories can affect the overall implementation success of mass drug administration which can in turn affect program outcome (31). This was demonstrated in a study conducted during the Ebola virus disease (EVD) epidemic in Liberia where community members believed that the spread of the virus might be linked to mass drug administration (51). In fact, hostilities towards health workers involved in mass drug administration was reported (51). In Western Kenya, conspiracy theories about the motive of MDA has been reported as a key factor reducing compliance (52).
b. Positive sentiments: Positive sentiments toward mass drug administration are important for the implementation process and this can be stimulated through robust community engagement where community members and stakeholders are mobilized to participate in all activities (53, 54). In Fiji, involvement of traditional village forums in a mass drug administration program for lymphatic filariasis control was found to be a positive predictor of adherence in a multivariate analysis (OR=1.78 95%CI (1.04 – 3.05)(55).
c. Characteristics of location: Urban-rural variation affects the quality of implementation of mass drug administration and has been identified as an important determinant of coverage; which is a construct of implementation fidelity, and compliance (56-58). Poor attitude of health workers and inadequate social mobilization were associated with poor coverage and compliance in urban areas (56).

d. Migration: Inter border movement and migration patterns have also been found to impact the implementation of mass drug administration (46, 59). This is because it is often difficult to ascertain the actual number of adults who are resident of an area that have been reached with the medicines (59).

e. Poor household participation: The impact of mass drug administration is reduced when household participation is poor because of there will be high number of untreated people after the exercise (60). Some of the main reasons for this poor household participation include; household head non-participation, increased size of household, higher time to source of water among members of a household and non-inclusion of household head in a previous exercise (60).

f. Health education: Inadequate pre-MDA health education exercises are implicated when fear of drug side-effects continues to determine low compliance or uptake of medicines during mass drug administration campaigns in communities (47, 48, 50, 56, 61, 62). In West Bengal, of the 683 people who were eligible to receive treatment for lymphatic filariasis, although 98.8% of them received the medications, 5% admitted to not taking the drug due to fear of side effects (56). In another 5 year review conducted in India, noncompliance was above 40% in the population covered on account of fear of adverse drug reactions (61).

1.5.1.3 Individual level factors

These represented aspects of the front line provider who implement the intervention (43). They reflect knowledge, skills, attitude and perceptions of the providers (43).

a. Gender dynamics: The gender of a community directed distributor is an important factor in the implementation of mass drug administration programs as a study in Tanzania has

associated it with performance of community health workers participating in mass drug administration exercise (63). It was found that time per interaction in areas with only female workers was higher compared to areas with only male or mixed workers (104.9seconds, 80.1 seconds, and 70.1 seconds respectively) (P=0.01) (63). Furthermore, female workers at sites with only females made more statements per interaction than males at sites with only male community workers (15.9 and 11.4 respectively) (P=0.02) (63). However, at sites where males and females were mixed, males spoke more than women (6.8 and 5.9 statements per interaction respectively) (P=0.01) (63).

b. Relationship between drug distributors and target population: Intervention dissemination by individuals that have good background relationship with community members are more likely to be successful (59, 61). In an attempt to increase coverage rate in an urban area in India, a group of community health workers that have long standing relationship with the community were engaged to conduct mass administration of drugs for lymphatic filariasis control (61). It was found that 33% of people who accepted the medicine did so because they were familiar with the individuals (61).

1.5.2 Implementation fidelity framework

Several frameworks for implementation fidelity such as the Department of Veteran Affairs Quality Enhancement Research Initiative, Behavior Change Consortium Framework for Treatment Fidelity exist (64, 65). However, a more elaborate and recent framework known as the Conceptual Framework for Implementation Fidelity was proposed by Christopher Carroll and his colleagues (66). This framework was developed following a systematic review of literature on implementation fidelity and it encompasses all the components of implementation fidelity and their interrelationship (66)

In this research project, which measured implementation fidelity and examined context specific factors affecting implementation fidelity in Kano State, Nigeria, the contextual framework for implementation fidelity by Carroll was adapted to include some of the factors identified above (66). This framework posits that implementation fidelity is in the pathway between an intervention and program outcome and went further described fidelity in terms of four constructs namely; duration, frequency, coverage and content (66). These four constructs are together referred to as adherence(66). The framework asserts that adherence is the bottom line measure of implementation fidelity and should be considered as a unidimensional variable (66). Therefore if an intervention adheres to the content, frequency, duration, and coverage as indicated in the original manual, model or program design, it is said to be implemented with high fidelity (66).

Content is the "active ingredient" that an intervention seeks to deliver (66). For mass drug administration, content refers to drug combinations used, the drug dosages, eligibility for treatment, and application of exclusion criteria in communities(23, 24). The other three constructs of adherence namely; frequency, coverage and duration are collectively known as dose (66). Dose of a mass drug administration program refers to whether the intervention was delivered for as often as planned, to all eligible members of a community and for as long as was indicated in the original program design or model (66). Nevertheless, a high level of adherence depends on the determinants or moderators of implementation fidelity (66).

Four determinants of implementation fidelity were specified in this framework and they include intervention complexity, facilitation strategies, quality of delivery, and participant responsiveness (66).

Intervention complexity is concerned with the description of the intervention, whether it is simple or complex (66). This is important for mass drug administration exercises which utilizes

manuals to guide community directed distributors in the field (22). If the description of the intervention is simple in those manuals, mass drug administration is more likely to be conducted with high fidelity (66, 67).

Facilitation strategies, is concerned with the type of support strategy which could range from training, provision of manuals and job aids, to logistics and supply chain systems (66). When such support strategies are available during health interventions like mass drug administration, a high implementation fidelity is likely to be attained (24, 68).

Quality of delivery is concerned with how appropriately an intervention is delivered to achieve the desired goal (66). Since administration of drugs such as ivermectin and albendazole require height and weight measurement, availability of instruments such as ivermectin rule for measure height and weighing scale for measuring weight of community members is necessary for implementation of the intervention (24). Also, to ensure quality delivery, the community should be adequately sensitized as indicated in the WHO guideline (24).

Participant responsiveness, is concerned with how cooperative community members were during an intervention which is a function of innovation fit and community sensitization (66). If a community perceives diseases such as helminthiasis, onchocerciasis, or lymphatic filariasis as a major health problem, they are more likely to cooperate with community directed distributors during mass treatment exercises (66).

1.5.3 Implementation fidelity of mass drug administration in Kano State and its determinants

To measure implementation fidelity of mass drug administration in this study, all the 4 constructs of adherence (content, coverage, frequency and dose) in the original conceptual framework were used (24, 66). Content measured the active component of the intervention like use of albendazole and ivermectin in combination, dose of albendazole, height measurement before administering

ivermectin, calculating total doses required with provision for loss and wastage, and eligibility criteria (24). While, coverage, frequency, and duration assessed whether every eligible member of the community was covered, MDAs are conducted yearly, and MDA lasted within the specified numbers of days respectively (24).

Some organizational, structural and individual level factors that could affect mass drug administration as identified from previous studies were combined with the four determinants of implementation fidelity already specified in the conceptual framework for implementation fidelity to give the complete list of determinants considered in this study (43, 66).

The determinants were grouped into key determinants, other determinants and background characteristics. The key determinants were the determinants from the conceptual framework of implementation fidelity (66). The included quality of delivery, intervention complexity, facilitation strategies, and participants responsiveness (66). Facilitation strategies reflected organizational level factors identified from review of previous studies like training, and availability of manuals and other job aids (49). Quality of delivery included assessment of supportive supervision by state and local government authorities as well as adequate supply of drugs and other equipment required for proper implementation (44, 47, 49, 50). These also reflect organizational level factors. Intervention complexity assessed the simplicity or complexity of the manual and process of conducting mass drug administration in the field, while participant responsiveness gauged how cooperative community members were during mass drug administration.

Other determinants included incentives, knowledge of NTDs and how community directed distributors participating in mass drug administration are selected. Incentives was included as a determinant because previous studies had identified it as a cause of CDD attrition (44, 45, 47). It

was deemed important to assess whether it affects implementation fidelity as well. However, knowledge of NTD among CDDs and selection of CDDs were included for conceptual reasons. Although incentives and selection of CDD can be classified as organizational related factors, knowledge is an individual level factor.

Background characteristics like sex was included based on findings from a previous literature that related gender of CDD to level of interaction during mass drug administration exercise (63). Location characteristics was also included because previous studies have demonstrated that rural urban variation affects implementation (56-58). Other background factors were included for conceptual reasons. Location characteristics is a structural level factor while the rest are individual level factors (43).

The conceptual framework of implementation fidelity was chosen for adaptation because it has clearly defined constructs of fidelity and its determinants which eases conceptualization of fidelity and applicability in my research context (66).

The conceptual framework for this study is shown in Figure 1.1

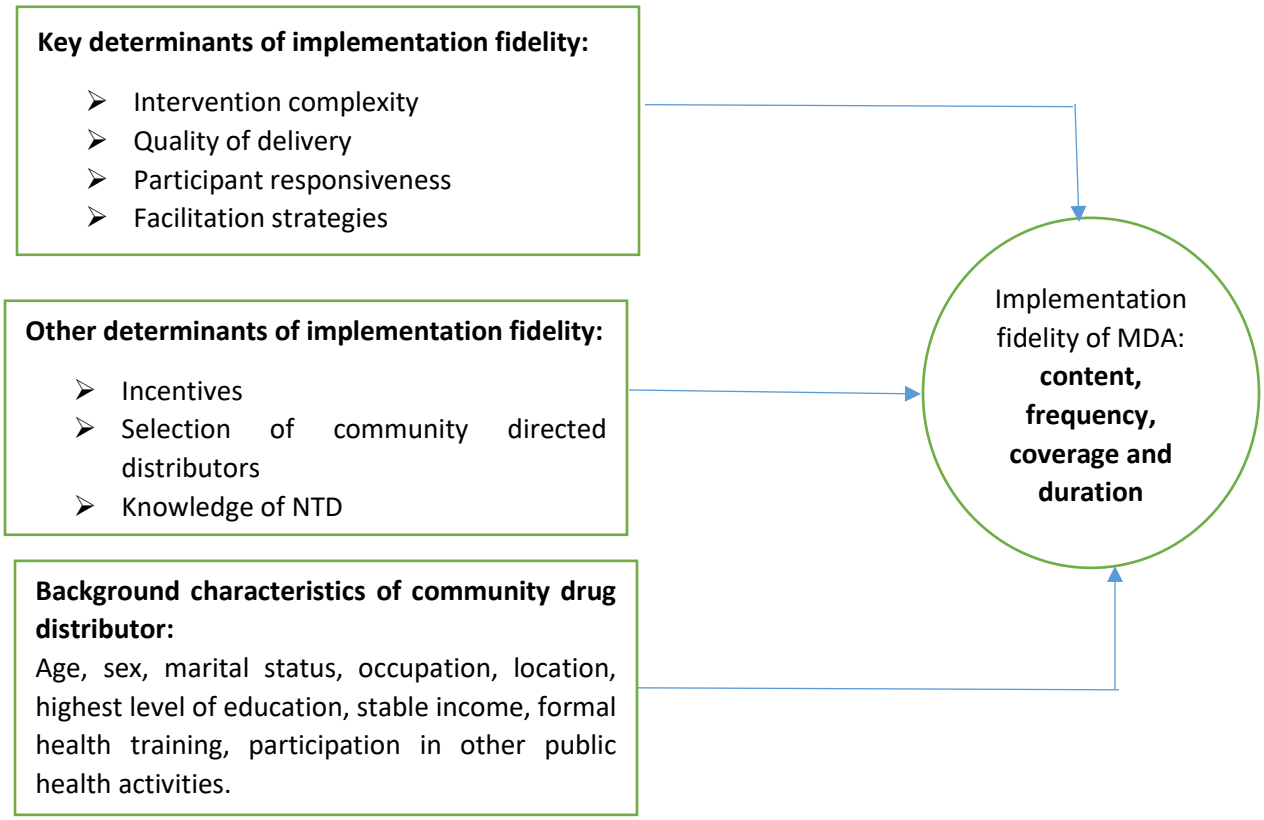

Figure 1.1: Conceptual framework of determinants of implementation fidelity of mass drug administration adapted from Carroll's Framework.

CHAPTER TWO: METHODOLOGY

2.0 INTRODUCTION

In this chapter, the study design, study site and target population are described including justification for choosing the study site. Also, data collection procedure is discussed in detail. Other sections include variables, analysis plan, statistical analysis and ethical consideration.

2.1 STUDY DESIGN

A cross sectional survey design was used to assess implementation fidelity and its determinants (69).

2.2 STUDY SITE

The survey was conducted in 2 local governments areas; Nassarawa (urban) and Gezawa (rural) local government areas of Kano State, located in north west Nigeria (70).

Nassarawa local government is one of the eight urban local governments areas (LGA) in Kano State (located in senatorial district zone A) with an area of 35km^2 (70, 71). According to the 2006 National Population and Housing Census, the population was 596,411 (323740 males and 272671 females) with an annual population growth rate of 3.1% (70).

In this LGA, 7,803 households have access to pipe borne water (70). 26,212 households have access to water closet toilet facility and only 417 use nearby bush (70). Only 18.4% of households do not have access to a telephone (70).

While Gezawa local government is one of the 36 rural local government areas in Kano State (also located in senatorial district zone A) with an area of 355.481km^2 (70, 71). The population

of Gezawa according to the 2006 National Population and Housing Census is 282, 328 (143,380 males and 138,948 females) with an annual population growth rate of 3.1% (70). In this LGA, only 1889 households have access to pipe borne water (70). 2311 have access to water closet toilet facility, and 578 household use nearby bush (70). About 31.6% of households do not have access to a telephone (70).

Each local government is made up of 11 administrative wards each and are all endemic for helminthic neglected tropical diseases (22, 72). A total of 2720 CDDs conduct mass drug administration with Ivermectin and Albendazole in both local government areas.

2.3 STUDY POPULATION

Community directed distributors that have conducted community based, integrated mass drug administration with ivermectin and albendazole in Gezawa and Nassarawa Local Government Areas of Kano State, Nigeria.

2.4 SAMPLING

This comprises of sampling technique and sample size calculation.

2.4.1 Sampling technique

A multistage cluster sampling technique which utilizes an existing structure in the state was used because of its relatively cheaper, easier to conduct, and more time efficient (73, 74). In Nigeria, enabling laws provides for a territorially demarcated local government area to exist within states (75, 76). Within each local government area, there is a further subdivision into units called wards (75).

In this study, these wards were considered as clusters (primary sampling units). Twelve wards were randomly selected from both local government area (six wards each) using a comprehensive and mutually exhaustive list of wards obtained from 2006 National Housing and Population census data as published by the National Population Commission (77). For Gezawa Local Government area, the list of all 11 wards were entered in Microsoft Excel 2016 and numbered accordingly. Then MS Excel random number generation function command; *RANDBETWEEN (1,11)* was used to choose six wards from the local government. The same procedure was then repeated for Nassarawa local government area. The wards selected were as follows: Kaura Goje, Giginyu, Tudun Murtala, Tudun Wada, Gawuna, and Gama for Nassarawa LGA, and Ketawa, Sararin Gezawa, Jogana, Tumbau, Wangara, and Babawa for Gezawa LGA. Secondly, from within each cluster (or primary sampling unit), community directed distributors (CDD) were then randomly selected from a list of CDD in each ward as provided by the local government NTD focal person. A community directed distributor was defined as someone who has participated in a community based mass drug as a frontline provider of preventive chemotherapy to community members.

Inclusion criteria include: CDD resident in the community at time of data collection and must have participated in the 2016 mass administration of Ivermectin and Albendazole.

Exclusion criteria include: CDD who were absent or had relocated from the study site at time of data collection.

2.4.2 Sample size

The minimum sample size for this study was calculated using StatCalc function in Epi Info. An expected frequency of 50% was presumed because there were no previous studies that reported

the prevalence of implementation fidelity of MDA. Design effect was taken into consideration because of cluster sampling technique used. However, a design effect of 1 was used for feasibility and logistical reasons. Given that there are 2720 CDDs in both local government areas, at 95% confidence level, precision of ±5%, and a design effect of 1(one) yielded minimum sample size of 348. Power was set at 80%. Given the selection of n = 12 clusters, we selected m = 29 community directed distributors per cluster.

2.5 DATA COLLECTION

2.5.1 Questionnaire

A data collection tool (questionnaire) was developed in line with the conceptual framework of this study to collect information on background information of community directed distributors, their knowledge of neglected tropical diseases, implementation fidelity of mass drug administration and factors affecting implementation fidelity of mass drug administration. Responses to questions covering knowledge, implementation fidelity and factors affecting implementation fidelity were based on 5-point Likert scale with response ranging from strongly agree to strongly disagree.

The four sections contained in the tool are as follows:

background characteristics of participants which contain questions on demographic, socioeconomic, and past experience of respondent like participation in other public health activities, as well as working as a health worker; **level of knowledge of community drug distributors** which elicited responses to assess knowledge based on participant responses to full meaning of NTD, whether NTD are diseases of public health importance, mass drug administration in schools, and mass drug administration on communities; **implementation of**

mass drug administration by community directed distributors which contained questions on type of medicines used in mass drug administration, dosing of medicines used in mass drug administration, how to administer the medicines, eligibility criteria and contraindications; and **factors affecting implementation fidelity** such as quality of delivery, intervention complexity, facilitation strategies, participant responsiveness, CDD selection, and availability of incentives. The detailed questionnaire is attached as Appendix D.

Validity of this tool was ensured by evaluating drafted questionnaire for fluency, adequacy and clarity in several meetings with my supervisors. Drafts were then corrected and revised again with supervisors until it was deemed appropriate. The tool was then pretested in Tarauni Local Government Area (which is a different location from my study area) to determine the feasibility as well as appropriateness of question format, wording and order from a lay perspective. The participants of the pretest exercise were asked to give their opinions about the questions and to state if they felt any question should be modified. All participants of the pretest said the questions were simple and clear.

2.5.2 REDCap database

Research Electronic Data Capture (REDCap) was used to design the database for this project(78). The online designer function of the web application was used to design the data forms. On each form, fields were added, and field type specified. Field labels were the questions as contained on the questionnaire while variable names were entered manually. Auto naming of variables was disabled to specify more descriptive variable names. Fields like participant ID, age, monthly income were text fields, while a combination of radio and drop down were used for other fields like name of local government, ward name, occupation, level of education, type of health training. Only radio was used for the fields that had Likert scale. Validation was used to

specify that only an integer may be used for age, and minimum age of 18 was specified for ethical reasons. Calculation syntax was used for fields that computed scores. Branching logic was used for questions that appear under certain conditions. For example, a "parent question" which contains "others (please specify)" had a branching logic added so that respondent can specify the answer in a "child/dependent question". Logic builder was used to add the condition to option that will result in appearance of the child question. HTML formatting was added to the forms. Some of the HTML codes used are as follows: <*strong*> <*/strong*> where bold was required, and <*em*> <*/em*> where italics was required.

2.5.3 Advocacy

Advocacy visits were conducted to inform and seek verbal permission of government stakeholders and community gatekeepers before commencing data collection.

At state government level, a visit was paid to the director of public health at the state ministry of health to inform his office of the planned research project. The aim and objective of the research was shared with the director and his team. Also, the state NTD coordinator was briefed on the planned research project.

At local government level, the zonal primary health care director was informed of the research project after which the local government NTD focal persons for Nassarawa and Gezawa LGA were notified of the planned research work.

At community level, traditional leaders are the gatekeepers. They include "*dagachi*" and "*hakimi*" which mean district head and ward head respectively. Advocacy visits were paid to the "*hakimai*" (plural of "*hakimi*") of both local governments to inform them of the research project after which they informed the various "*dagatai*" (plural of "*dagachi*") in their wards. In Gezawa,

the *dagatai* assigned town criers to notify all community directed distributors in the selected wards of the planned data collection exercise. While in Nassarawa, the *dagatai* sent messengers to inform all community directed distributors of the planned activity.

2.5.4 Training of data collectors

Data collectors were trained during a one-day orientation exercise where a discussion on research ethics, data collection tool and use of mobile devices were held. Four data collectors (3 males, 1 female) were recruited for this research and they all participated in the training. They all had a minimum of secondary school leaving certificate and previous experience using mobile devices for data collection.

2.5.5 Field work

Data collection commenced on 1st February and ended on 16th February 2017. The tool used for data collection was a structured, interviewer administered questionnaire on a mobile tablet device. It was translated into Hausa language (local language) when necessary during data collection.

2.6 DATA MANAGEMENT

Since data was collected using REDCap mobile application, quality assurance was done by pre-populating some variables to have default values using key/value pairs. URL encoders were used to convert string to an encoded string. And branching logic were used for questions that need to be concealed until a response is provided for a prior one. After completion of data collection, the data file was exported from REDCap to STATA 14.1 for analysis. A priori, it was decided that

respondents with any missing value in the variables used to compute the outcome variable will be excluded, however, this didn't occur in the research.

2.7 VARIABLES

Outcome variable: Implementation fidelity (continuous variable)

Explanatory variables: The explanatory variables are presented in Table 2.1.

Table 2.1: List of explanatory variables

Variables	Type	Coding
KEY DETERMINANTS OF IMPLEMENTATION FIDELITY		
Quality of delivery	Continuous variable	-
Intervention complexity	Continuous variable	-
Facilitation strategies	Continuous variable	-
Participants responsiveness	Continuous variable	-
OTHER DETERMINANTS OF IMPLEMENTATION FIDELITY		
Knowledge of NTD	Categorical variable	"1" = adequate, "0" = inadequate
Incentives	Categorical variable	"0" = no, "1" = yes
Selection of CDD	Categorical variable	"1" = community, "2" = local government staff, "3" = volunteered
BACKGROUND CHARACTERISTIC OF RESPONDENTS		
Age group	Categorical variable	"1" = less than 25, "2" = 25 – 29, "3" = 30 – 34, and "4" = 35 and above.
Sex	Categorical variable	"1" = male, "2" = female
Marital status	Categorical variable	"0" = never married, and "1" = ever married
Occupation	Categorical variable	"1" = No occupation "2" = student "3" = health work "4" = teaching "5" = farming
Location characteristics	Categorical variable	"1" = rural, "2" = urban
Highest level of education	Categorical variable	"1" = primary education and below, "2" = secondary education and "3" = tertiary education
Stable income	Categorical variable	"1" = yes "0" = no

Formal training in health-related field	Categorical variable	"1" = yes "0" = no
Participation in other public health activities	Categorical variable	"1" = yes "0" = no

2.8 DATA MANAGEMENT

Outcome variable

The scale reliability coefficient (Cronbach's alpha) was computed to assess if the 15 items on the questionnaire provide a reliable measure of the same latent variable; implementation fidelity (79). The correlation between the 15-item scale and all other possible 15-item scales measuring implementation fidelity was 0.79 (i.e. Cronbach's alpha = 0.79). Cronbach's alpha of each of the 15 items were above 0.7 as well (See Table B.2 in the appendix). Since this reliability coefficient is acceptable, implementation fidelity score was obtained by summing up all the responses (*Min = 15, Max = 75*).

Explanatory variables

Key determinants: Quality of delivery score, intervention complexity score, facilitation strategies score and participant responsiveness score had five (5), three (3), two (2) and one (1) items respectively. Responses were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale reliability coefficient (Cronbach's alpha) for quality of delivery and intervention complexity was found to be 0.40 and 0.74 respectively. To prevent underestimation of true reliability, the Cronbach's alpha of facilitation strategy, and participant responsiveness were not calculated because they were 2-item scale and 1-item scale respectively (80).

Scores were calculated by summing responses (quality of delivery score (*Min = 5, Max = 25*), intervention complexity score (*Min = 3, Max = 15*), facilitation strategies score (*Min = 2, Max = 10*) and participant responsiveness score *(Min = 1, Max = 5*)).

Other determinants: Incentives and selection of community directed distributors were used as collected. Knowledge was assessed using 4 – item questions with responses based on 5 – point Likert scale. Knowledge score was then computed by adding the responses obtained.

Background characteristics: Age which was collected in years and was converted into a categorical variable; age groups. Age groups include: less than 25, 25 – 29, 30 – 34, and 35 and above. Marital status was further re-categorized into 2 groups (never married, and ever married) because none of the respondents were separated or divorced and only 11 participants were widowed. Level of education was also re-categorized into 3 groups (primary education and below, secondary education and tertiary education) because only 13 respondents had no formal education and 19 had primary education. For regression analysis, occupation was re-categorized into 2 groups (non-health workers and health workers). All other background characteristics variables were used for analysis as collected.

2.9 STATISTICAL ANALYSIS

All statistical analysis for this research project was done using STATA Statistics/Data Analysis Software version 14.1(STATACorp, Lakeway Drive, College Station, TX, USA). None of the respondents were excluded from analysis.

In order to obtain robust estimates which accounted for the multistage cluster sampling used in this research, *svyset* command with probability weight, and finite population correction (FPC) at

every stage of sampling was specified (81, 82). Then, *svy* command was used as the prefix for all descriptive, univariate and multivariate analysis (81, 82).

Objective One: To measure implementation fidelity of community based mass drug administration for onchocerciasis, lymphatic filariasis and soil transmitted helminthiasis

The measurement of Implementation fidelity was operationalized according to the constructs (content, coverage, frequency and duration) specified in the conceptual framework. All four constructs were covered in a 15-item questionnaire. Rating of the items were based on 5-point Likert scale ranging from (1) strongly disagree to (5) strongly agree with higher scores signifying increasing fidelity.

Composite score of implementation fidelity was obtained for each respondent. The mean and standard deviation as well as the median and interquartile range were calculated. In addition, implementation fidelity score was ordered and divided into three parts to produce tertiles. First tertile represented low score, second tertile represented moderate score, while the third tertile represented high score. The mean implementation fidelity score for each tertile was calculated. Box plots of the overall implementation fidelity score and the implementation fidelity score for each tertile was drawn.

Factor score (latent score) of implementation fidelity was obtained using exploratory factor analysis (83). Since the Kaiser-Meyer-Olkin Measure of Sampling Adequacy of 0.83 was obtained, a correlation matrix was fitted (84). The output of this correlation was used to perform factor analysis (84). Kaiser rule and Scree plot was used to support the decision to retain factors with eigen value greater than one (85). The retained factors were rotated using a varimax

orthogonal rotation to produce uncorrelated factors, which were then used to obtain factor scores. Output of exploratory factor analysis is attached in the Appendix (Table B.3 – 10).

Objective two: To describe factors affecting implementation fidelity of community based mass drug administration for onchocerciasis, lymphatic filariasis, and soil transmitted helminthiasis.

For key determinants: Mean and standard deviation of quality of delivery score, intervention complexity score, facilitation strategies score, and participants responsiveness score were calculated.

For other determinants: The frequencies and percentages of other determinants (incentives, selection of CDD, and knowledge) were calculated. In addition, the implementation fidelity score for each of their categories was calculated.

For background characteristics: Age, sex, marital status, occupation, highest level of education, stable income, formal training in health-related field and participation in other public health activities were summarized using frequency and percentages. The mean (and standard deviation) of implementation fidelity score for each of the categories of these variables were then calculated. The results were presented using tables.

Objective three: To determine the relationship between identified factors and implementation fidelity.

Adjusted and unadjusted coefficients of two models were computed. For Model 1, unadjusted coefficients (with their 95% confidence intervals) were obtained by fitting survey linear

regression to determine whether each of the key determinants; quality of delivery score, intervention complexity score, facilitation strategy score and participants responsiveness score predicted implementation fidelity score. The following linear regression equation was used $y = \beta_0 + \beta_1 x_i + \varepsilon_i$ (β_0 and β_1 were model parameter and ε_i was error term). Statistical significance was at $p < 0.05$. Scatter plots were used to demonstrate linearity. Then adjusted coefficients (with their 95% confidence intervals) were obtained by fitting survey linear regression with all the sets of key determinants (quality of delivery score, intervention complexity score, facilitation strategy score, and participants responsiveness score) included in the model. The decision to include all variables in this model was for conceptual reasons. The following linear regression equation was used $y = \beta_0 + \beta_1 x_i + \ldots. + \beta_k x_{ki} + \varepsilon_i$ (β_0, β_1, β_1 were model parameter and ε_i was error term). Statistical significance was at $p < 0.05$. The multiple correlation coefficient of determination (R^2) of the model was reported. Multicollinearity of the predictor variables (quality of delivery score, intervention complexity score, facilitation strategy score, and participants responsiveness score) were assessed using survey correlation before fitting the model. For sensitivity analysis, a univariate ordered logistic regression model was fitted using implementation fidelity categorized into tertiles and key determinants.

Similarly, for Model 2, unadjusted coefficients (with their 95% confidence intervals) were obtained by fitting survey linear regression to determine whether each of the explanatory variables; quality of delivery score, intervention complexity score, facilitation strategy score, participants responsiveness score, knowledge score, incentives, selection of community directed distributors, age group, sex, marital status, occupation, location characteristics, highest level of education, stable income, formal training in health-related field, and participation in other public health activities predicted implementation fidelity. Subsequently, adjusted coefficients (with

their 95% confidence intervals) were obtained by fitting survey linear regression with only the explanatory variables that were significant at $p < 0.05$, while holding all the key determinants (quality of delivery score, intervention complexity score, facilitation strategy score, and participants responsiveness score) and location characteristics constant in the model. The multiple correlation coefficient of determination (R^2) of the model was reported. Multicollinearity of all explanatory variables (quality of delivery score, intervention complexity score, facilitation strategy score, participants responsiveness score, knowledge score, selection of CDD, occupation, training in a health-related field, participation in other public health activities, and location characteristics) included in the multiple regression model were assessed using survey correlation before including them in the fitted model.

2.10 ETHICAL CONSIDERATION

The study was conducted in line with current research ethical guidelines(86, 87). The study protocol was submitted to both Wits Human Research Ethics Committee (HREC - Medical) and the ethics committee of Kano State Ministry of Health for approval. Kano State Ministry of Health gave ethical approval in a letter dated 14th November 2016 with reference number MOH/Off/797/T.I/218 (attached as Appendix H). While Wits HREC (Medical) gave unconditional approval on 13th January 2017 with clearance certificate no: M1611117 (attached as Appendix I).

To minimize risk during data collection, an information sheet (attached as Appendix E) and informed consent form (attached as Appendix F) were given to all study participants. The information sheet was read and explained to all study participants as well as the consent form. Participants then signed and returned the consent form to the field data collector. All participants

were clearly informed that they can leave the study at any point or choose not to answer any question if they so wish. Participants were also reassured that if they choose to leave the study or decide not to answer any of the questions, their responsibility as community directed distributors would not be affected. No identifying variable like name was collected to maintain anonymity of respondents. The study posed minimal risk to participants. All data were safely stored on Wits University database and only the principal investigator had access to it.

2.11: LIMITATIONS OF THE STUDY METHODOLOGY

1. Small sample size: A design effect of 1 was used to calculate the minimum sample size for logistical reasons. This relatively small sample size affected the number of variables that were included in the model.

2. Generalizability and applicability: The extent to which the results of this present research can be generalized to the entire state is limited as data was only collected in 2 of the 44 local government areas in Kano State.

Nassarawa is one of the most cosmopolitan local government areas in the state. There is also high turnover of CDDs in this local government, as previously trained CDDs often move to other places. Also, the traditional leadership institution in this local government is not as established as Gezawa which is a more rural area. These contextual features have effect on measurement.

Also, care should be taken when applying the tools used in this study in other settings. It is advisable to validate this tool before use.

2.12 DISSEMINATION

This study was presented at Bayero University Kano, Kano State, Nigeria during a research seminar forum. The audience was postgraduate students and faculty members from the Center for Infectious Disease Research (CIDR) and Community Medicine Department of the university. Findings from this study were also presented to the director of public health at the Ministry of Health in Kano State during a dissemination meeting. In addition, the study was presented during a workshop organized by the special program for research and training in tropical diseases (WHO/TDR) in Geneva, Switzerland. Manuscripts will be developed and submitted for peer review publications. The compiled research report will be submitted to the library of University of the Witwatersrand, Johannesburg for public use.

CHAPTER THREE: RESULTS

The results of statistical analysis conducted using data obtained from 348 community directed distributors are presented here. The presentation of findings follows each of the research objectives. Tables and graphs are used to illustrate findings.

3.1 MEASURING IMPLEMENTATION FIDELITY OF COMMUNITY BASED MASS DRUG ADMINISTRATION FOR NTD CONTROL

Composite score: The minimum implementation fidelity score is 36 (48%), while the maximum score is 72 (96%). The mean implementation fidelity score for all study participants is 55.39 with standard deviation of 8.10. The distribution of the scores are normal since the mean and median are close (median is 56). CDDs in the first tertile have a lower mean implementation fidelity score compared to those in the second and third tertiles. Other descriptive features are presented in Table 3.1.

Table 3.1: Descriptive statistics of implementation fidelity score of mass drug administration by community directed distributors in Kano State, Nigeria.

Variable	Range	Number of observations	Mean (SD)	Median(IQR)
Overall Implementation fidelity score	**36 - 72**	**348**	**55.39(8.10)**	**56(49 - 60)**
Tertile 1	36 - 52	118	46.12(3.79)	47(44 - 49)
Tertile 2	53 - 59	121	56.46(1.96)	57(55 - 58)
Tertile 3	60 - 72	109	64.24(4.12)	63(61 - 68)

The box plot presented in Figure 3.2 shows that the size of the boxes varies according to tertile as the range of score within each tertile differ from each other.

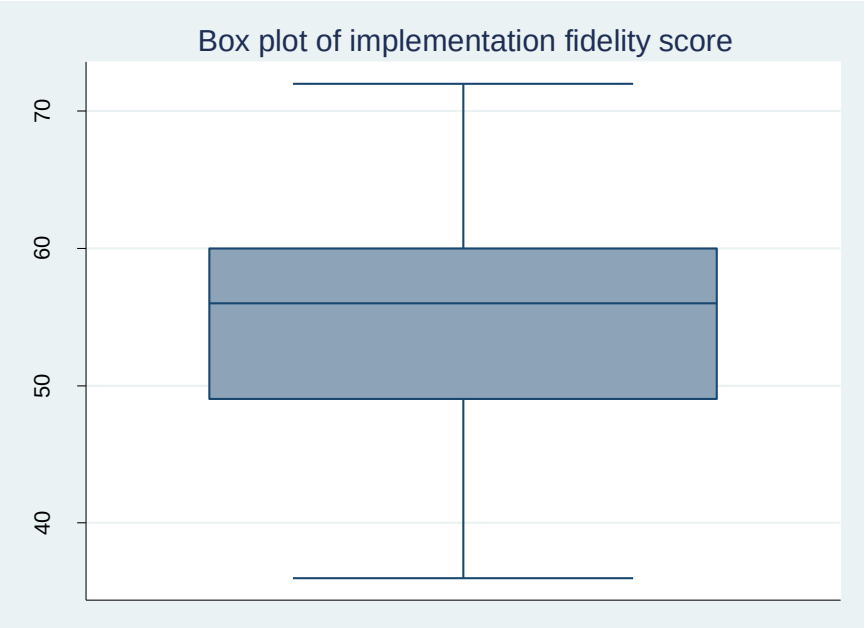

Figure 3.1: Box plot of implementation fidelity score

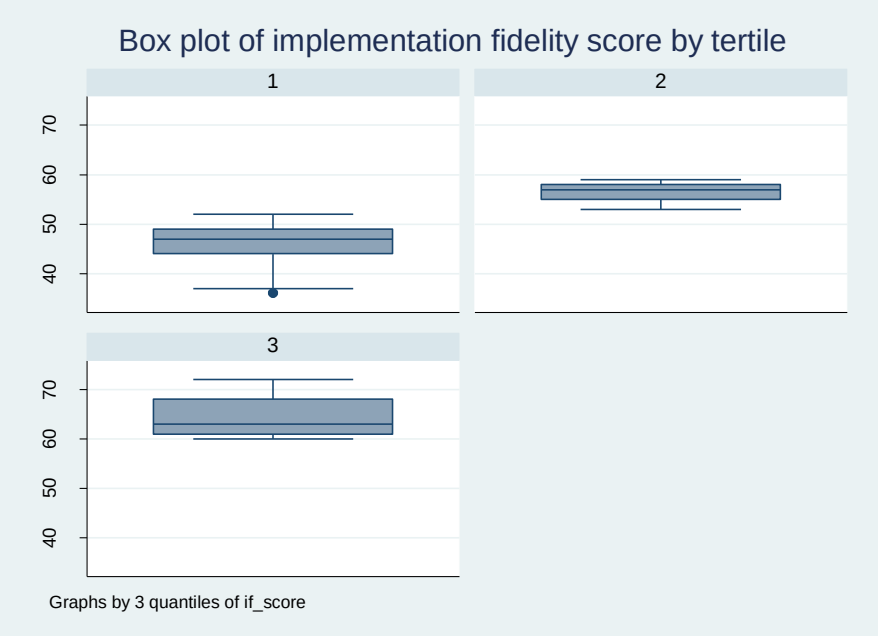

Figure 3.2: Box plot of implementation fidelity score by tertile

Factor score: Eight items loaded on factor 2 as shown on Table B.8. The mean and standard deviation of the latent score obtained for factor 2 is 8.68 and 2.68 respectively. Descriptive statistics of other factors are presented in Table 3.2.

Table 3.2: Descriptive statistics of latent score of implementation fidelity of mass drug administration by community directed distributors in Kano State, Nigeria.

Factors	Frequency	Mean(SD)
Factor 1	348	3.16(1.49)
Factor 2	348	8.68(2.68)
Factor 3	348	-1.04(3.18)

3.2 DESCRIPTION OF FACTORS AFFECTING IMPLEMENTATION FIDELITY OF COMMUNITY BASED MASS DRUG ADMINISTRATION IN KANO STATE

3.2.1 Description of key determinants affecting implementation fidelity of community based mass drug administration in Kano State, Nigeria

Although the maximum quality of delivery score obtained is 22 (out of 25), the mean quality of delivery score is 16.77 (with standard deviation of 2.74). Similarly, a maximum score of 15 (out of 15) for intervention complexity with mean score of 11.03 (standard deviation of 3.04) was obtained. The distribution of the scores obtained are normal as their means and medians are almost equal. The descriptive statistics for other key determinants are presented in Table 3.3.

Table 3.3: Descriptive statistics of key determinants of implementation fidelity of mass drug administration in Kano State, Nigeria

Variables	CDD (348)	Percentage	Min/Max Score	Mean(SD)	Median (IQR)
Quality of delivery score	348	100	10 - 22	16.77(2.74)	17(15 - 18)
Intervention Complexity	348	100	3 - 15	11.03(3.04)	12(9 - 14)
Facilitation strategies	348	100	5 - 10	8.83(0.99)	9(8 - 10)
Participants Responsiveness	348	100	3 - 5	4.62(0.52)	5(4 - 5)

IF = Implementation fidelity, SD = Standard Deviation, CDD = Community directed distributor

3.2.2 Description of other determinants and background characteristics affecting implementation fidelity of community based mass drug administration in Kano State, Nigeria

Of the 348 CDDs interviewed, only 37% have adequate knowledge of NTD. Among those with inadequate knowledge, their mean implementation fidelity score is 53.66 while those with adequate knowledge have a mean implementation fidelity score of 58.22. Over 80% of the CDDs interviewed were selected by their community members as oppose to only about 5% that were selected by a local government staff. However, the mean implementation fidelity score among those CDD selected by community members is 53.38 while those selected by local government staffs have a mean implementation fidelity score of 65.65.

Among those aged 25 – 29, their mean implementation fidelity score is 56.58, while those aged above 35 years have a mean implementation fidelity score of 54.29. Although majority of CDDs are males, the mean implementation fidelity score for males and females are 55.32 and 55.64 respectively. Only 12% of CDDs have formal training in a health-related field however their

mean implementation fidelity score is 65.56 as oppose to 53.93 for those who do not have any background health training. In rural areas, implementation fidelity score is 56.36, while in urban areas the score is 54.43. The descriptive statistics for other key determinants are presented in Table 3.4.

Table 3.4: Description of other determinants and background characteristics affecting implementation fidelity of mass drug administration in Kano State, Nigeria

Variables	Community Directed Distributors (348)	Percentage	IF Mean (SD)	Median (IQR)
Overall implementation fidelity	348	100	55.39(8.10)	56(49 - 60)
OTHER DETERMINANTS				
Knowledge of NTD				
Inadequate	216	62.07	53.66(7.66)	56(47 - 59)
Adequate	132	37.93	58.22(8.04)	58(52 - 64)
Incentive				
No	286	82.18	55.59(6.80)	56(50 - 60)
Yes	62	17.82	54.47(12.51)	49(43 - 67)
Selection of CDD				
By community members	290	83.33	53.38(6.91)	55(48 - 59)
By local government staff	20	5.75	65.65(6.35)	67(61 - 72)
Volunteered	38	10.92	65.34(5.62)	67(63 – 70)
BACKGROUND CHARACTERISTICS				
Age group				
<25	91	26.15	54.96(8.23)	55(48 - 60)
25 - 29	106	30.46	56.58(8.53)	58(50 - 62)
30 - 34	60	17.24	55.62(7.12)	57(51 - 60)
35 and above	91	26.15	54.29(8.01)	56(48 - 59)
Sex				
Male	270	77.59	55.32(8.42)	57(48 - 61)
Female	78	22.41	55.64(6.93)	55(51- 60)
Marital status				
Never married	162	46.55	54.48(7.32)	55(48 - 60)
Ever married	186	53.45	56.19(8.67)	58(49 - 61)

Variables	Community Directed Distributors (348)	Percentage	IF Mean (SD)	Median (IQR)
Overall implementation fidelity	348	100	55.39(8.10)	56(49 - 60)
Occupation				
Unemployed	30	8.62	54.80(4.94)	55(52 - 58)
Student	144	41.38	54.97(7.27)	56(46 - 60)
Health work	21	6.03	65.43(5.99)	67(62 - 69)
Teaching	27	7.76	56.67(10.56)	59(49 - 67)
Trading	46	13.22	56.54(8.84)	58(47 - 63)
Farming	80	22.99	52.64(7.58)	54(46 - 59)
Highest level of education				
Primary education and below	32	9.20	55.50(5.59)	57(54 - 59)
Secondary education	224	64.37	54.52(8.19)	55(47 - 60)
Tertiary education	92	26.44	57.47(8.31)	58(53 - 62)
Stable income				
No	122	35.06	54.38(6.63)	55(49 - 60)
Yes	226	64.94	55.94(8.76)	57(48 - 61)
Formal training in a health-related field				
No	305	87.64	53.96(7.22)	55(48 - 59)
Yes	43	12.36	65.56(6.71)	68(62 - 70)
Participation in other public health activities				
No	65	18.68	59.91(5.10)	59(58 - 61)
Yes	283	81.32	54.35(8.31)	55(48 - 60)
Location characteristics				
Rural	174	50	56.36(9.86)	58(47 - 63)
Urban	174	50	54.43(5.72)	55(50 - 59)

SD = Standard Deviation, IQR = Inter Quartile Range, NTD = Neglected Tropical Diseases and CDD = Community Directed Distributors

3.3 FACTORS ASSOCIATED WITH IMPLEMENTATION FIDELITY SCORE

Model 1 (Only the four key determinants are modelled)

In the unadjusted analysis (as shown in the second column of Table 3.4), only quality of delivery score is significantly associated with implementation fidelity. For every unit increase in quality of delivery score, implementation fidelity score increased by 1.32 (95% CI: 0.40 – 2.25). This is similar to the result of the sensitivity analysis using an ordinal logistic regression as shown on Table B.14.

In the multivariable model quality of delivery score and facilitation strategies score, are significant at $p < 0.05$ (as shown in the third column of Table 3.4). The adjusted coefficient of quality of delivery score is positive as in the unadjusted model while the coefficient for facilitation strategy score is negative indicating that for every unit increase in facilitation strategy, implementation fidelity score decreases by 1.40(95%CI: -2.58 - -0.23). The survey correlation matrix of the 4 explanatory variables is presented in Table B.12 (Appendix B).

Model 2 (all determinants modelled including the four key determinants)

In the unadjusted analysis (as shown in the fourth column of Table 3.4), six determinants; quality of delivery score, knowledge of NTD, selection of CDD, occupation of CDD, formal training in health-related field, and participation in other public health activities, are significantly associated with implementation fidelity. In the multivariable model (as shown in the fifth column of Table 3.4), 7 predictors; intervention complexity, facilitation strategy, participant responsiveness, knowledge of NTD, selection of CDD, formal training in health-related field and participation in

other public health activities are significantly associated with implementation fidelity. The adjusted coefficients for all predictors in the model are presented in Table 3.5.

Table 3.5: Unadjusted and adjusted coefficients of factors affecting implementation fidelity of mass drug administration for neglected tropical diseases control in Kano State, Nigeria

	MODEL 1		MODEL 2	
Variables	**Unadjusted Coef. Coefficient(95%CI)**	**Adjusted Coef. Coefficient(95%CI)**	**Unadjusted Coef. Coefficient(95%CI)**	**Adjusted Coef. Coefficient(95%CI)**
KEY DETERMINANTS				
Quality of delivery	1.32(0.40 - 2.25) *	1.54(0.72 - 2.36) *	1.32(0.40 - 2.25) *	0.47(-0.08 - 1.03)
Intervention complexity	0.26(-0.43 - 0.95)	-0.23 (-0.66 - 0.21)	0.26(-0.43 - 0.95)	-0.62(-0.93 - -0.30) *
Facilitation strategies	0.45(-1.34 - 2.24)	-1.40(-2.58- -0.23) *	0.45(-1.34 - 2.24)	-1.68(-3.05 - -0.32) *
Participants responsiveness	2.07(-1.17 - 5.31)	2.33(-0.20 - 4.85)	2.07(-1.17 - 5.31)	2.99(1.58 - 4.39) *
OTHER DETERMINANTS				
Knowledge of NTD			1.04(0.04 - 2.04) *	0.75(0.36 - 1.13) *
Incentive				
No			REF	
Yes			-1.12(-10.91 - 8.66)	
Selection of CDD				
By community members			REF	
By local government staff			12.27(8.68 - 15.87) **	7.48(2.85 - 12.11) *
Volunteered			11.96(8.46 - 15.47) **	8.38(4.59 - 12.16) **
BACKGROUND CHARACTERISTICS				
Age group				
<25			REF	
25 - 29			1.63(-1.16 - 4.42)	
30 - 34			0.66(-2.85 - 4.18)	
>35			-0.67(-4.37 - 3.029)	
Sex				
Male				
Female			0.32(-2.85 - 3.49)	

Variables	MODEL 1 **Unadjusted Coef. Coefficient(95%CI)**	**Adjusted Coef. Coefficient(95%CI)**	MODEL 2 **Unadjusted Coef. Coefficient(95%CI)**	**Adjusted Coef. Coefficient(95%CI)**
Marital status				
Never married			REF	
Ever married			1.71(-1.71 - 5.13)	
Occupation				
Non-health work			REF	
Health work			10.68(7.15 - 14.22) **	-1.64(-5.52 - 2.23)
Highest level of education				
Primary education and below			REF	
Secondary education			-0.98(-3.95 - 1.99)	
Tertiary education			1.97(-1.61 - 5.54)	
Stable income				
No			REF	
Yes			1.56(-2.06 - 5.18)	
Formal training in a health-related field				
No			REF	
Yes			11.60(8.51 - 14.70) **	7.34(2.61 - 12.07) *
Participation in other public health activities				
No			REF	
Yes			-5.55(-8.94 - -2.17) *	-6.16(-9.49 - -2.83) *
Location characteristics				
Rural			REF	
Urban			-1.93(-8.25 - 4.39)	2.16(-2.51 - 6.82)

*significant at P<0.05, **significant at P<0.0001 R^2 for model 1 = 0.2354, R^2 for model 2 = 0.5330

CHAPTER FOUR: DISCUSSION

The present study assessed the level of implementation fidelity among community directed distributors in two local governments areas (a rural and an urban setting) in Kano State. In addition, the factors affecting implementation fidelity of mass drug administration for community based onchocerciasis, lymphatic filariasis, and soil transmitted helminthiasis control was assessed. Both assessments were based on the adapted conceptual model for implementation fidelity (66).

Using a 15-item questionnaire based on 5-point Likert scale to measure implementation fidelity, it was found that the overall mean implementation fidelity score in both local government areas was 55.39 with standard deviation of 8.10. Predictors of implementation fidelity score identified in the present study included intervention complexity score, facilitation strategy score, participants responsiveness score, knowledge of NTD, selection of CDD, formal training in a health-related field and participation in other public health activities.

In this chapter, the findings presented in the result section is discussed as well as the limitations of the research.

4.1 LIMITATIONS OF THIS STUDY

1. This study relied on self-reported information from community directed distributors. Although this was cheaper and easier to implement, it is important to take note of the shortcomings of self-reported data which include: social desirability bias; where community directed distributors may respond to the questions in a way that will appear favorable to the interviewers, difficulty in ascertaining data accuracy, selective memory, exaggeration and telescoping.

2. No prior research studies on implementation fidelity of mass drug administration for neglected tropical diseases were found. This therefore limited the depth at which the findings from this research was discussed.

4.2 MEASURING IMPLEMENTATION FIDELITY

Current perspectives in implementation science advocates the use of adherence as a bottom-line measure of implementation fidelity because how an intervention adheres to frequency, dose, content and duration prescribed in a manual determines it (66). This current study contributes to the understanding of this concept. Measuring adherence to the WHO preventive chemotherapy manual in this study gave a clear insight into whether the implementation process of mass drug administration in the 2 local governments reflected what was prescribed.

The overall implementation fidelity score in this study was found to be moderate. This average score is about 70% of the maximum obtainable score which implies that some prescribed components of the manual are not been implemented as indicated.

Poor performance in adherence to content (one of the fidelity constructs) contributed to a significant lowering of the score. In particular, the extent to which community directed distributors adhered to drug dosages and eligibility criteria specified in the WHO was suboptimal (24). It was found that many CDDs did not administer 400 mg of albendazole to children above 2 years while some administered the medications to infants. This is in contrast with the WHO recommend dose of 400mg of albendazole for all preschool aged children (above 2 years) and adults as far as the community meet the threshold for implementing mass drug administration using preventive chemotherapy (24). In addition, the guideline only recommend treatment for children above 12 months, as those aged 12 - 23 months are treated with 200 mg of albendazole

(24). Estimating dose of ivermectin based on the height of an individual is preferred over observation of physical appearance without any measurement (88). It is the method recommended by the WHO, and is widely practiced in both local governments (24, 89). However, some administered ivermectin to children less than 90 centimeters in height which is in contrast to what had been specified in the manual (24). This scenario may be attributed to the demand to treat household members by caregivers and other community members during mass drug administration exercises. In this study, there were a high proportion of CDD who did not adhere to the eligibility criteria and this has implications. To ensure safe and event-free implementation of mass drug administration, the WHO in its manual for preventive chemotherapy recommended that seriously ill people, those who have suffered a previous adverse reaction, pregnant and lactating women (in case of treatment with ivermectin) should be excluded (24). Also, it recommended that scored tablets should be broken into smaller pieces before administrating to children to prevent asphyxiation (90). Despite these clear recommendations, many CDDs interviewed reported administering medications to people who have previously suffered an adverse reaction, or those that were severely ill during the exercise, and even to pregnant or lactating women. Even though the drugs used in mass drug administration have very good safety records, severe reactions have been reported in some people thus necessitating attention during mass treatment (91, 92). Other aspects of content like drug delivery practices is optimal among CDDs. In this study, nearly all CDD calculated the dose required for each round of mass drug administration with provision for loss as recommended by WHO.

Constructs like coverage, frequency and duration were consistently high among all community directed distributors.

4.3 FACTORS ASSOCIATED WITH IMPLEMENTATION FIDELITY

This study found seven predictors of implementation fidelity and they include, intervention complexity, facilitation strategy, participant responsiveness, knowledge of NTD, selection of CDD, formal training in a health-related field and participation in other public health activities. The proportion of variability of implementation fidelity score predicted by these factors is significant (about 53%). Surprisingly, provision of incentives didn't predict implementation fidelity of MDA in Nassarawa and Gezawa local government areas.

Lack of provision of monetary incentives have been associated with higher CDD attrition in previous studies, and this is expectedly so because monetary incentives have been found to be a strong extrinsic motivator (45, 93, 94). In fact, when individuals are provided incentives performance is seen to be highest(93). However, this does not seem to influence implementation fidelity in this study. The fact that incentives didn't predict implementation fidelity suggests that other forms of motivation especially intrinsic motivation might play a role (95).

The identified predictors are grouped into three as follows:

4.2.1 Key determinants

Participants responsiveness: This predictor was found to have a strong positive association with implementation fidelity score of mass drug administration. As expected, when community members view an intervention as relevant, they're more likely to accept it. This high acceptability of the intervention results in high coverage which invariably improves implementation fidelity (66). This finding is consistent with previous evidence from a community based study in Tanzania which showed that positive sentiments about usefulness of the drugs used for lymphatic filariasis control improves coverage (54).

Intervention complexity: This study found that as the complexity of mass drug administration increases, the implementation fidelity score decreases. Intervention complexity was based on the ease, comprehensiveness and description of mass drug administration process in the manual. The finding therefore imply that these properties influences how community directed distributors adhere to all the prescribed components of the manual. In other implementation science literature, it has already been established that complex interventions are more prone to modification during implementation thus resulting in poor fidelity (96-98).

Facilitation strategies: Before implementation of interventions like mass drug administration, support strategies like training of community directed distributors and provision of job aids like manuals are instituted to ensure that frontline providers implement the intervention uniformly and as prescribed (49, 68). However, this study found a negative relationship between facilitation strategy and implementation fidelity score even though majority of CDD received training and intervention manuals. This finding contrasts a common assertion that support strategies optimize implementation fidelity (98). However, it is important to bear in mind that no empirical implementation study are yet to demonstrated that support strategies is positively related to implementation fidelity (99).

4.2.2 Other determinants

Knowledge of NTD: The presented study showed that knowledge of neglected tropical diseases has a strong moderating effect on implementation fidelity. This is in agreement with a previous study (31). Knowledge determines self-efficacy and self-proficiency which are important individual level characteristics required for attaining high level of implementation fidelity (31).

Selection of CDD: Within the principle of community directed treatment intervention (CDTI), which is currently the mainstay strategy employed by NTD control programs, community members are responsible for organizing and conducting mass drug administration (100, 101). This include selection of community directed distributors (CDDs) that implement the intervention in the field (100). Interestingly, this study found that community directed distributors (CDDs) selected by local government staffs and those who volunteered to conducted mass drug administration implement with higher implementation fidelity compared to those selected by community members. Possible explanations might be that those selected by local government officials or those that volunteered have previous experience with MDA or other public health programs, are more motivated or have participated in additional trainings. The advantage of this is regardless of selection method, all CDDs are residents of their communities as such the core principle of CDTI is kept for program sustainability.

4.2.3 Background characteristics

Formal training in health-related field: It was found that CDDs with formal training in a health-related field had higher implementation fidelity score. This is expected as training improve skill proficiency.

Participation in other public health activities: In this study, participation in other public health activities is associated with a decrease in implementation fidelity score of mass drug administration. Although this is inconsistent with a previous study which found that CDD participation in other health and development activities didn't affect the coverage of ivermectin distribution, it is important to note that coverage is only one of the four constructs of implementation fidelity (66, 102).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Although implementation fidelity is not a new concept, it is seldom measured by program managers and designers of public health programs like mass drug administration. It is now well established that implementing with quality is a prerequisite for achieving set program objectives. However, without fidelity assessment, the quality with which mass drug administration is conducted cannot be ascertained. Therefore, the current study attempted to measure implementation fidelity and identify factors that affect it.

Objective one: This study demonstrated the feasibility of measuring implementation fidelity of mass drug administration programs using an easy and time efficient methodology. This has policy application both at state and national level as it could serve as an advocacy tool to solicit for inclusion of fidelity assessment in the monitor and evaluation. If the revised national NTD masterplan features fidelity assessment, the NTD program at all level will be better positioned to not only monitor program outcome but also the implementation process. Moreover, the method used in this research is scalable because it can easily be modified to suit different communities.

Objective two and three: Several factors affecting implementation fidelity were identified in this research. But of interest are intervention complexity and participants responsiveness, as they could be the target of future implementation strategies. Quality improvement can be used to reduce the complexity of the intervention or increase community engagement during mass drug administration exercises.

In this current study, the relationship between facilitation strategies and implementation fidelity was reversed which is not in agreement with the current literature. Going forward, there will be a need to conduct more research to ascertain this relationship.

Lastly, from implementation research perspective, it is important to study the process of implementation to ensure that programs are implemented as prescribed in the original design. This must be established before an intervention can be said to have led to a program outcome. Therefore, this current research makes important contribution to the field.

5.2 RECOMMENDATIONS

Based on findings from this study, the following recommendations are suggested:

1. There is a need for more capacity building interventions like trainings on the core component of the WHO manual for helminthiasis control especially drug dosage and eligibility criteria. Lack of adherence to what was specified in these areas accounted for most of the reduction in implementation fidelity score observed in this research.
2. There is a need to strengthen monitoring and supervision system during mass drug administration exercises as gaps were identified in the quality of delivery of the intervention.
3. National and state NTD programs should consider routine fidelity assessment as part of monitoring and evaluation data as implementation fidelity data can provide valuable information about how CDDs are conducting mass drug administration in the field, as well as, important contextual factors that affect fidelity across different settings. These implementation data can be used to improve policy, microplanning, and even tailor supportive supervision during mass drug administration exercise.

4. There is a need for more research on implementation fidelity of mass drug administration to generate a strong body of evidence on the dimensions of fidelity relevant to NTD control efforts in communities as well as establish factors that affects it.
5. Lastly, further research is required to investigate the relationship between implementation fidelity and facilitation strategies for neglected tropical diseases control programs.

5.3 FUNDING ACKNOWLEDGEMENT

The principal investigator was a recipient of a full Master's degree scholarship awarded by the *Division of Epidemiology and Biostatistics, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa*. The award was supported by a postgraduate training scheme from the *TDR, the Special Programme for Research and Training in Tropical Diseases* hosted at the World Health Organization (WHO) in Geneva, Switzerland. The content is of this research report is solely the responsibility of the authors and does not necessarily represent the official views of the TDR or WHO.

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APPENDICES

APPENDIX A: PLAGIARISM DECLARATION

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Abdu Adamu (Student number: 815633) am a student

registered for the degree of Master of Science in Epidemiology (field of Implementation Science) in the academic year 2017.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature: Date: 26th of July 2017

26/04/2015
1

APPENDIX B: ADDITIONAL TABLES AND FIGURES

Table B.1: Characteristics of 15-item questionnaire used to assess implementation fidelity

Items	1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%
Ivermectin and Albendazole were the drugs used in combination during the last community based mass drug administration.	0	0	210	60.34	3	0.86	21	6.03	114	32.76
The doses of drugs required for the round of mass drug administration in my community is usually calculated with provision for loss and wastage of medicines during exercise.	0	0	1	0.29	3	0.86	180	51.72	164	47.13
All members of the community including preschool aged children are given similar doses of ivermectin and albendazole during mass drug administration exercise.	88	25.29	175	50.29	9	2.59	42	12.07	34	9.77
Ivermectin and albendazole cannot be administered to infants during mass drug administration exercise.	55	15.8	25	7.18	10	2.87	151	43.39	107	30.75
The dose of Albendazole administered to children above 2 years and adults during the mass drug administration exercise is 400 milligrams.	25	7.18	151	43.39	16	4.6	93	26.72	63	18.1
The dosage of ivermectin depends on the height of the individual.	0	0	0	0	2	0.57	162	46.55	184	52.87
Before administering Ivermectin, height must be measured using an IVM tablet-pole.	1	0.29	0	0	6	1.72	165	47.41	176	50.57
Children less than 90 centimeters in height are ineligible for mass drug administration with Ivermectin and Albendazole.	71	20.4	55	15.8	14	4.02	147	42.24	61	17.53
Pregnant and lactating women within one week after delivery are ineligible for mass drug administration with ivermectin and albendazole.	95	27.3	50	14.37	2	0.57	89	25.57	112	32.18
People who have previously suffered serious adverse reaction to the drugs are excluded during mass drug administration.	87	25	53	15.23	24	6.9	105	30.17	79	22.7
Severely ill individuals are excluded from large scale mass drug administration exercise for helminthic NTDS.	92	26.44	46	13.22	27	7.76	92	26.44	91	26.15
When drugs are given to younger children, scored tablets are broken into smaller pieces and crushed before administration.	49	14.08	53	15.23	55	15.8	140	40.23	51	14.66
Every eligible member of the community was given Albendazole and Ivermectin during the mass drug administration exercise.	0	0	1	0.29	1	0.29	89	25.57	257	73.85
Mass drug administration with combined ivermectin and albendazole is conducted yearly.	0	0	0	0	13	3.74	110	31.61	225	64.66
I conducted mass drug administration exercise in my community within the specified number of days.	4	1.15	7	2.01	8	2.3	103	29.66	226	64.94

Table B.2: Cronbach alpha of each of the 15-items for assessing implementation fidelity

Item	Observation	Sign	Item-test correlation	Item-rest correlation	Average interitem covariance	alpha
Ivermectin and Albendazole were the drugs used in combination during the last community based mass drug administration.	348	-	0.51	0.37	0.27	0.7798
The doses of drugs required for the round of mass drug administration in my community is usually calculated with provision for loss and wastage of medicines during exercise.	348	-	0.24	0.18	0.3	0.7895
All members of the community including preschool aged children are given similar doses of ivermectin and albendazole during mass drug administration exercise.	348	+	0.69	0.6	0.25	0.759
Ivermectin and albendazole cannot be administered to infants during mass drug administration exercise.	348	+	0.43	0.28	0.28	0.7881
The dose of Albendazole administered to children above 2 years and adults during the mass drug administration exercise is 400 milligrams.	348	+	0.2	0.05	0.31	0.8069
The dosage of ivermectin depends on the height of the individual.	348	-	0.08	0.02	0.31	0.7948
Before administering Ivermectin, height must be measured using an IVM tablet-pole.	348	-	0.16	0.09	0.31	0.7927
Children less than 90 centimeters in height are ineligible for mass drug administration with Ivermectin and Albendazole.	348	+	0.81	0.74	0.22	0.7418
Pregnant and lactating women within one week after delivery are ineligible for mass drug administration with ivermectin and albendazole.	348	+	0.83	0.76	0.21	0.7365
People who have previously suffered serious adverse reaction to the drugs are excluded during mass drug administration.	348	+	0.85	0.8	0.21	0.7336
Severely ill individuals are excluded from large scale mass drug administration exercise for helminthic NTDS.	348	+	0.85	0.78	0.21	0.7345
When drugs are given to younger children, scored tablets are broken into smaller pieces and crushed before administration.	348	+	0.62	0.52	0.25	0.7658
Every eligible member of the community was given Albendazole and Ivermectin during the mass drug administration exercise.	348	+	-0.02	-0.07	0.32	0.7971

Item	Observation	Sign	Item-test correlation	Item-rest correlation	Average interitem covariance	alpha
Mass drug administration with combined ivermectin and albendazole is conducted yearly.	348	-	0.12	0.05	0.31	0.7941
I conducted mass drug administration exercise in my community within the specified number of days.	348	+	0.12	0.04	0.31	0.7967
Test scale					**0.27**	**0.7887**

Table B.3: Bartlett test and KMO Measure of sampling adequacy of the 15-items

Bartlett test of sphericity	
Chi-square	2512.433
Degrees of freedom	105
p-value	< 0.001
H0: variables are not intercorrelated	

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	
KMO	0.827

Table B.4: Polychoric correlation matrix of 15-items for assessing implementation fidelity

	drug combination	dose calculation	dose similarity	ivermectin and albendazole	albendazole dose	ivermectin dose	administer ivermectin	ineligible1	ineligible2	ineligible3	ineligible4	drugs child	Coverage	Frequency	Duration
drug combination	1.00														
dose calculation	0.65	1.00													
dose similarity	-0.58	-0.14	1.00												
ivermectin and albendazole	-0.18	0.08	0.26	1.00											
albendazole dosage	-0.24	0.20	0.33	0.45	1.00										
ivermectin dosage	0.45	0.52	-0.17	0.24	0.16	1.00									
administer ivermectin	0.48	0.43	-0.22	0.18	0.14	0.62	1.00								
ineligible1	-0.40	-0.12	0.67	0.23	0.10	0.05	0.00	1.00							
ineligible2	-0.25	-0.20	0.58	0.14	-0.06	0.00	-0.11	0.80	1.00						
ineligible3	-0.48	-0.28	0.61	0.19	0.02	0.03	-0.08	0.76	0.87	1.00					
ineligible4	-0.43	-0.23	0.58	0.18	0.02	0.09	-0.05	0.76	0.89	0.90	1.00				
drugs child	-0.08	0.17	0.46	0.19	0.17	0.25	0.11	0.58	0.56	0.59	0.64	1.00			
coverage	0.65	0.33	-0.22	0.00	-0.04	0.48	0.55	0.03	0.14	0.03	0.03	0.25	1.00		
Frequency	0.21	0.24	-0.23	0.08	0.11	0.55	0.44	-0.01	-0.11	-0.11	-0.04	0.13	0.46	1.00	
Duration	0.29	0.25	-0.08	0.09	-0.03	0.45	0.43	0.16	0.11	0.08	0.18	0.28	0.49	0.52	1

Table B.5: Unrotated Factor Score

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	4.81	1.20	0.40	0.40
Factor 2	3.61	2.25	0.30	0.70
Factor 3	1.36	0.51	0.11	0.81
Factor 4	0.85	0.44	0.07	0.89
Factor 5	0.41	0.04	0.03	0.92
Factor 6	0.37	0.13	0.03	0.95
Factor 7	0.24	0.06	0.02	0.97
Factor 8	0.18	0.08	0.02	0.99
Factor 9	0.10	0.03	0.01	0.99
Factor 10	0.07	0.01	0.01	1.00
Factor 11	0.06	0.02	0.00	1.01
Factor 12	0.04	0.04	0.00	1.01
Factor 13	0.00	0.04	0.00	1.01
Factor 14	-0.04	0.01	0.00	1.00
Factor 15	-0.06	.	0.00	1.00

Chi2 = 4770.30 p= <0.0001

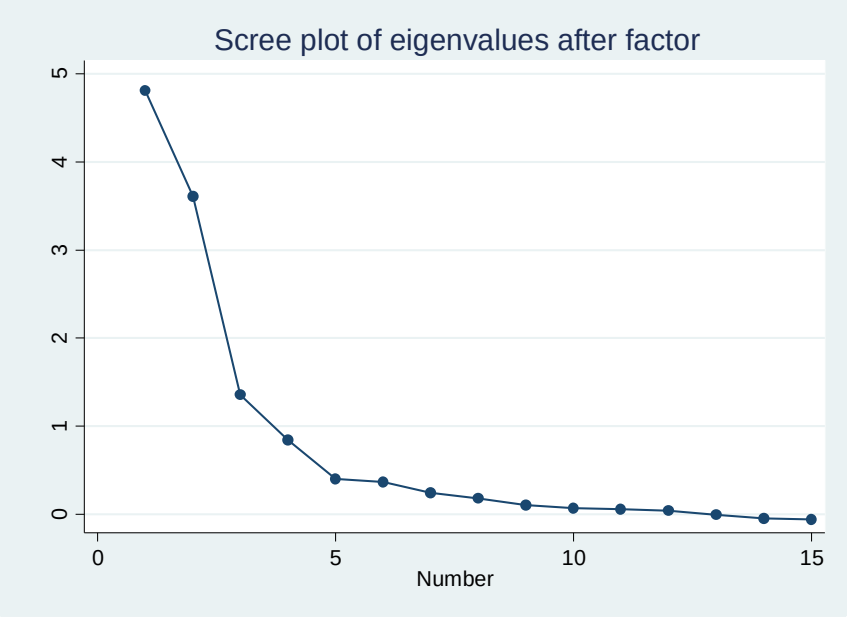

Figure B.1: Scree plot of eigen values

Table B.6: Rotated factors

Variable	Factor 1	Factor 2	Factor 3	Uniqueness
drug combination	-0.6594	0.5423	-0.3353	0.1586
dose calculation	-0.3616	0.5702	0.2428	0.4851
dose similarity	0.7784	-0.05	0.302	0.3004
ivermectin and albendazole	0.2265	0.2108	0.4712	0.6822
albendazole dosage	0.1305	0.1378	0.7605	0.3856
ivermectin dosage	-0.1546	0.7878	0.1604	0.3298
administer ivermectin	-0.2523	0.7048	0.1167	0.4259
ineligible1	0.833	0.2622	-0.0107	0.2373
ineligible2	0.8657	0.246	-0.3135	0.0917
ineligible3	0.9102	0.1848	-0.1502	0.1148
ineligible4	0.8966	0.2599	-0.1667	0.1007
drugs child	0.5767	0.4773	0.0272	0.4389
coverage	-0.1755	0.7579	-0.2884	0.3116
Frequency	-0.2072	0.6131	0.1045	0.5703
Duration	-0.0176	0.6311	-0.098	0.5918

Table B.7: Varimax orthogonal rotation of factors

Factor	Variance	Difference	Proportion	Cummulative
Factor1	4.57430	0.86142	0.3813	0.3813
Factor2	3.71289	2.22492	0.3095	0.6908
Factor3	1.48797	.	0.124	0.8148

Table B.8: Pattern of rotated factor loading matrix and uniqueness variance

Variable	Factor 1	Factor 2	Factor 3	Uniqueness
drug combination	-0.39	0.74	-0.37	0.16
dose calculation		0.64		0.49
dose similarity	0.65	-0.31	0.42	0.30
ivermectin and albendazole			0.52	0.68
albendazole dosage			0.78	0.39
ivermectin dosage		0.78		0.33
administer ivermectin		0.74		0.43
ineligible1	0.86			0.24
ineligible2	0.94			0.09
ineligible3	0.94			0.11

Variable	Factor 1	Factor 2	Factor 3	Uniqueness
ineligible4	0.95			0.10
drugs child	0.67			0.44
coverage		0.79		0.31
Frequency		0.64		0.57
Duration		0.61		0.59

Blanks represents absolute loading < 0.3

Table B.9: Factor rotation matrix

	Factor 1	Factor 2	Factor 3
Factor 1	0.9367	-0.3066	0.1689
Factor 2	0.2887	0.9495	0.1226
Factor 3	-0.198	-0.0661	0.978

Table B.10: Scoring coefficient of varimax rotated factors using regression method

Variables	Factor 1	Factor 2	Factor 3
drug combination	-0.21	2.20	-2.74
dose calculation	0.02	-0.40	0.93
dose similarity	0.03	0.33	-0.21
ivermectin and albendazole	-0.02	0.13	0.03
albendazole dosage	-0.05	0.27	0.08
ivermectin dosage	0.03	-0.19	0.65
administer ivermectin	0.03	-0.17	0.48
ineligible1	0.11	0.59	-0.56
ineligible2	0.44	-1.73	1.73
ineligible3	0.14	0.96	-1.22
ineligible4	0.18	1.04	-1.15
drugs child	0.10	-0.22	0.37
coverage	0.10	-0.28	0.56
Frequency	-0.02	0.66	-0.52
Duration	0.04	-0.07	0.14

Table B.11: Characteristics of items of key determinants of implementation fidelity

	1		2		3		4		5	
Variables	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Quality of Delivery										
There was good supportive supervision from local and state government officials during the mass drug administration exercise.	63	18.1	241	69.25	1	0.29	16	4.6	27	7.76
The drugs (ivermectin and albendazole) were available to me for distribution to community members on the scheduled day.	2	0.57	2	0.57	1	0.29	137	39.37	206	59.2
Adequate number of IVM tablet-pole were available for use during the mass drug administration exercise.	4	1.15	24	6.9	20	5.75	168	48.28	132	37.93
Adequate number of weighing scales were available for use during the mass drug administration exercise.	223	64.08	57	16.38	5	1.44	31	8.91	32	9.2
The community was adequately sensitized through community mobilization activities before the commencement of mass drug administration exercise	11	3.16	30	8.62	13	3.74	155	44.54	139	39.94
Intervention complexity										
How would you rate the ease of the current process of conducting mass drug administration?	100	28.74	57	16.38	10	2.87	92	26.44	89	25.57
How would you rate the description of responsibility in the manual provided?	21	6.03	41	11.78	28	8.05	140	40.23	118	33.91
How would you rate the information provided in the manual?	14	4.02	5	1.44	17	4.89	192	55.17	120	34.48
Facilitation strategies										
I was properly training on community based mass drug administration with ivermectin and albendazole	0	0	0	0	3	0.86	185	53.16	160	45.98
I received a training manual and other job aids on mass drug administration	1	0.29	2	0.57	12	3.45	185	53.16	148	42.53
Participants responsiveness										
Community members were cooperative during the mass drug administration exercise	0	0	0	0	6	1.72	119	34.2	223	64.08

Table B.12: Survey correlation matric of predictors of implementation fidelity

Variables	QD score	IC score	FS score	PR score	Knowledge	Selection	Occupation	Training	Participate PH	Location xtics
QD score	1									
IC score	0.42	1								
FS score	0.35	0.31	1							
PR score	0.15	0.12	0.5	1						
Knowledge	0.47	0.42	0.44	0.23	1					
Selection	0.47	0.41	0.1	-0.09	0.28	1				
Occupation	0.37	0.24	0.09	-0.002	0.18	0.43	1			
Training	0.43	0.35	0.13	0.003	0.22	0.61	0.49	1		
Participate PH	0.12	0.14	0.09	0.02	0.21	-0.17	-0.09	0.09	1	
Location xtics	0.11	-0.03	0.28	0.25	0.39	-0.38	-0.25	-0.34	0.41	1

Table B.13: Survey correlation matrix of key determinants of implementation fidelity

Variables	QD score	IC score	FS score	PR score
QD score	1			
IC score	0.42	1		
FS score	0.35	0.31	1	
PR score	0.15	0.12	0.5	1

Table B.14: Unadjusted odds ratio of key factors affecting implementation fidelity of mass drug administration for neglected tropical diseases control in Kano State, Nigeria

Variables	Unadjusted OR (95% CI)	p-Value
KEY DETERMINANTS		
Quality of delivery	1.29(1.02 - 1.64)	0.039
Intervention complexity	1.02(0.89 - 1.19)	0.719
Facilitation strategies	0.94(0.62 - 1.42)	0.739
Participants responsiveness	1.40(0.64 - 3.06)	0.367

APPENDIX C: PUBMED SEARCH STRATEGY

	Query
#1	"mass drug administration" OR “preventive chemotherapy” [MeSH Terms]
#2	“community based” OR “community” OR “rural”
#3	#1 AND #2
#4	“lymphatic filariasis” OR “onchocerciasis” OR “soil transmitted helminthiasis” OR “schistosomiasis” OR “buruli ulcer” OR “chagas disease” OR “dengue” OR “chikungunya” OR “dracunculiasis” OR “echinococcosis” OR “foodborne trematodiases” OR “human African trypanosomiasis” OR “leishmaniasis” OR “leprosy” OR “rabies” OR “trachoma” OR “yaws” OR “taeniasis” OR “cysticercosis” OR “guinea worm disease” OR “sleeping sickness” OR “hansen’s disease” OR “river blindness” OR “endemic treponematoses” OR “yaws” OR “taeniasis”
#5	“neglected tropical diseases” OR "neglected diseases" OR "tropical diseases" OR “neglected tropical disease” OR "neglected disease" OR "tropical disease" [MeSH Terms]
#6	#4 OR #5
#7	#3 AND #6
#8	(Afghanistan OR Islamic Republic of Afghanistan OR Bangladesh OR People's Republic of Bangladesh OR Benin OR Dahomey OR Republic of Benin OR Burkina Faso OR Burkina OR Republic of Upper Volta OR Burundi OR Republic of Burundi OR Cambodia OR Kingdom of Cambodia OR Central African Republic OR Chad OR Republic of Chad OR Comoros OR Union of the Comoros OR Democratic Republic of the Congo OR DR Congo OR Congo-Kinshasa OR DRC OR Zaire OR Eritrea OR State of Eritrea OR Ethiopia OR Federal Democratic Republic of Ethiopia OR The Gambia OR Republic of the Gambia OR Guinea OR Republic of Guinea OR Guinea-Conakry OR Guinea-Bissau OR Republic of Guinea-Bissau OR Haiti OR Republic of Haiti OR Kenya OR Republic of Kenya OR North Korea OR Democratic People's Republic of Korea OR Kyrgyz Republic OR Kyrgyzstan OR Liberia OR Republic of Liberia OR

	Madagascar OR Republic of Madagascar OR Malawi OR Republic of Malawi OR The Warm Heart of Africa OR Mali OR Republic of Mali OR Mozambique OR Republic of Mozambique OR Myanmar OR Burma OR Republic of the Union of Myanmar OR Nepal OR Democratic Republic of Nepal OR Niger OR Republic of Niger OR Rwanda OR Republic of Rwanda OR Sierra Leone OR Republic of Sierra Leone OR Somalia OR Federal Republic of Somalia OR South Sudan OR Republic of South Sudan OR Tajikistan OR Republic of Tajikistan OR Tanzania OR United Republic of Tanzania OR Republic of Tanganyika and Zanzibar OR Togo OR Togolese Republic OR Uganda OR Republic of Uganda OR Zimbabwe OR Republic of Zimbabwe OR Rhodesia)
#9	(Armenia OR armenia OR Bhutan OR Kingdom of Bhutan OR Bolivia OR Plurinational State of Bolivia OR Cameroon OR Republic of Cameroon OR Republic of Cameroun OR Cape Verde OR Republic of Cape Verde OR Cote D'ivoire OR Ivory Coast OR Republic of Cote D'ivoire OR Djibouti OR Republic of Djibouti OR Arab Republic of Egypt OR Egypt OR El Salvador OR Georgia OR Ghana OR Republic of Ghana OR Guatemala OR Republic of Guatemala OR Guyana OR Co-operative Republic of Guyana OR Honduras OR Republic of Honduras OR Spanish Honduras OR Republic of Indonesia OR Indonesia OR India OR Republic of India OR Kiribati OR Republic of Kiribati OR Kosovo OR Kosovo and Metohija OR Laos OR Lao Lao People's Democratic Republic OR Lesotho OR Kingdom of Lesotho OR Mauritania OR Islamic Republic of Mauritania OR Micronesia, Fed. Sts. OR Federated States of Micronesia OR FSM OR Moldova OR Republic of Moldova OR Mongolia OR Morocco OR Kingdom of Morocco OR Nicaragua OR Republic of Nicaragua OR Nigeria OR Federal Republic of Nigeria OR Pakistan OR Islamic Republic of Pakistan OR Papua New Guinea OR Independent State of Papua New Guinea OR Paraguay OR Republic of Paraguay OR Philippines OR Republic of the Philippines OR Samoa OR Independent State of Samoa OR Sao Tome and Principe OR Democratic Republic of Sao Tome and Principe OR Senegal OR Republic of Senegal OR Solomon Islands OR Sri Lanka OR Democratic Socialist Republic of Sri Lanka OR Sudan OR Republic of the Sudan OR North Sudan OR Swaziland OR Kingdom of

	Swaziland OR Ngwane OR Yuwatini OR Syrian Arab Republic OR Syria OR East Timor OR Timor-Leste OR Democratic Republic of Timor-Leste OR Ukraine OR Uzbekistan OR Republic of Uzbekistan OR Vanuatu OR Republic of Vanuatu OR Vietnam OR the Socialist Republic of Vietnam OR West Bank and Gaza OR Yemen OR Yemeni Republic OR Zambia OR Republic of Zambia.)
#10	(Angola OR Republic of Angola OR Albania OR Republic of Albania OR Algeria OR The People's Democratic Republic of Algeria OR American Samoa OR Argentina OR Azerbaijan OR Belarus OR Belize OR Bosnia and Herzegovina OR Bosnia-Herzegovina OR Bosnia OR Botswana OR Brazil OR Federative Republic of Brazil OR Bulgaria OR China OR People's Republic of China OR Colombia OR Costa Rica OR Fiji OR Gabon OR Gabonese Republic OR Grenada OR Hungary OR Islamic Republic of Iran OR Persia OR Iran OR Iraq OR Jamaica OR Jordan OR Hashemite Kingdom of Jordan OR Kazakhstan OR Lebanon OR Lebanese Republic OR Libya OR State of Libya OR Macedonia OR Republic of Macedonia OR Malaysia OR Maldives OR Republic of the Maldives OR Maldives Islands OR Marshall Islands OR Republic of the Marshall Islands OR Palau OR Republic of Palau OR Panama OR Republic of Panama OR Peru OR Romania OR Serbia, OR the Republic of Serbia OR Seychelles OR the Republic of Seychelles OR South Africa OR Saint Lucia OR Saint Vincent and the Grenadines OR Suriname OR Thailand OR Kingdom of Thailand OR Tonga OR Kingdom of Tonga OR Tunisia OR Turkey OR Turkmenistan OR Turkmenia OR Cuba OR Dominica OR Commonwealth of Dominica OR The Dominican Republic OR Ecuador OR Mauritius OR Mexico OR United Mexican States OR Montenegro OR Namibia OR Tuvalu OR Ellice Islands OR Venezuela OR the Bolivarian Republic of Venezuela)
#11	(Low-income country OR lower-income country OR third-world country OR middle-income country)
#12	developing countries [MeSH Terms]
#13	#8 OR #9 OR #10 OR #11 OR #12
#10	#7 AND #13

APPENDIX D: QUESTIONNAIRE

QUESTIONNAIRE

QUESTIONNAIRE ID: ……

NAME OF LOCAL GOVERNMENT: ____ NAME OF WARD (CLUSTER): _____

CLUSTER NUMBER: _____ CHARACTERISTICS OF LOCATION: RURAL/URBAN

SECTION A: BACKGROUND DEMOGRAPHICS AND SOCIOECONOMIC DATA

1. Age _____
2. Sex 1] Male 2] Female
3. Marital status 1] Never married 2] Married 3] Separated 4] Divorced 5] Widowed
4. Occupation 1] No occupation 2] Student 3] Health worker 4] Teacher 5] Petty Trader 6] Other (specify) ----------
5. Do you currently have a stable source of income? 1] Yes 2] No
6. What is your monthly income? _____
7. What is your highest level of educational? 1] No formal education 2] Primary education 3] Secondary education 4] Tertiary education
8. Do you have any formal training in a health-related field? 1] Yes 2] No
9. If yes, which health related field have you received training in? 1] Community Health 3] Environmental Health 4] Nursing 5] Medicine 6] Others (specify) ----------
10. Do you participate in other public health activities apart from mass drug administration exercise in your community? 1] Yes 2] No
11. If yes, which other public health activity have you participated in, in the last 12 months? 1] Immunization campaigns 2] Nutritional campaigns 3] Community Tuberculosis Campaign 4] Others (Specify) ----------

SECTION B: LEVEL OF KNOWLEDGE OF COMMUNITY DRUG DISTRIBUTORS

1. The full meaning of NTD is Neglected Tropical Disease. 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree

2. NTDs are considered diseases of public health importance. 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree
3. Mass drug administration for control of schistosomiasis is school based in Kano State. 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree
4. Mass drug administration for control of lymphatic filariasis, soil transmitted helminthiasis and onchocerciasis is community based in Kano State. 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree

SECTION C: IMPLEMENTATION OF MASS DRUG ADMINISTRATION BY COMMUNITY DRUG DISTRIBUTORS

CONTENT

1. Ivermectin and Albendazole were the drugs used in combination during the last community based mass drug administration.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree
2. The doses of drugs required for the round of mass drug administration in my community is usually calculated with provision for loss and wastage of medicines during exercise.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree
3. All members of the community including preschool aged children were given similar doses of albendazole during mass drug administration exercise.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree
5. Ivermectin and albendazole can be administered to infants during mass drug administration exercise.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree
6. The dose of Albendazole administered to children above 2 years and adults during the mass drug administration exercise is 400 milligrams.

1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
5) Strongly agree

7. The dosage of ivermectin depends on the height of the individual.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree
8. Before administering Ivermectin, height must be measured using an IVM tablet-pole.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree
9. Children less than 90 centimeters in height are ineligible for mass drug administration with Ivermectin and Albendazole.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree
10. Pregnant and lactating women within one week after delivery are ineligible for mass drug administration with ivermectin and albendazole.
    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
    5) Strongly agree
11. People who have previously suffered serious adverse reaction to the drugs are excluded during mass drug administration. 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly agree
12. Severely ill individuals are excluded from large scale mass drug administration exercise for helminthic NTDS.
    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
    5) Strongly agree
13. When drugs are given to younger children, scored tablets are broken into smaller pieces and crushed before administration.
    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
    5) Strongly agree

COVERAGE

14. Every eligible member of the community was given Albendazole and Ivermectin during the mass drug administration exercise.

    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree

    5) Strongly agree

15. If strongly disagree, please specify reasons why they were not reached. _____

FREQUENCY

16. Mass drug administration with combined ivermectin and albendazole is conducted yearly.

    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree

    5) Strongly agree

DURATION

17. I conducted mass drug administration exercise in my community within the specified number of days.

    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree

    5) Strongly agree

SECTION D: FACTORS AFFECTING IMPLEMENTATION FIDELITY

QUALITY OF DELIVERY

1. There was good supportive supervision from local and state government official during the mass drug administration exercises.

    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree

    5) Strongly agree

2. The drugs (Ivermectin and Albendazole) were available to me for distribution to community members on the scheduled day.

    1) Strongly disagree 2) Disagree 3) Neutral 4) Agree

    5) Strongly agree

3. Adequate number of IVM tablet-pole were available for use during the mass drug administration exercise.

1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
5) Strongly agree

4. Adequate number of weighing scales were available for use during the mass drug administration exercise.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree
5. The community was adequately sensitized through community mobilization activities before the commencement of mass drug administration exercise.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree

INTERVENTION COMPLEXITY

1. How would you rate the ease of the current process of conducting mass drug administration?
   1] Very complex 2] Somewhat complex 3] Neither 4] Somewhat simple 5] Very simple
2. How would you rate the information provided in the manual?
   1] Very vague 2] Somewhat vague 3] Neither 4] Detailed 5] Very detailed
3. How would you rate the description of responsibility in the manual provided?
   1] Very complex 2] Somewhat complex 3] Neither 4] Somewhat simple
   5] Very simple

FACILITATION STRATEGIES

4. I was properly trained on community based mass drug administration with Ivermectin and Albendazole.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree
5. I receive a training manual or job aids on mass drug administration.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree

PARTICIPANT RESPONSIVENESS

6. Community members were cooperative during the mass drug administration exercise.
   1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
   5) Strongly agree

CDD SELECTION PROCESS

7. How were you selected to become a community directed distributor in your locality? 1] Selected by community members 2] Selected by local government authority 3] Volunteered 4] Others (please specify) _____

AVAILABILITY OF INCENTIVES

8. Do you receive any incentive for conducting mass drug administration in your community? 1) Yes 2) No
9. If yes, who provided incentives? 1] State Government 2) Local Government
   3] Community members
10. I am satisfied with the incentives I received for conducting mass drug administration in my community. 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree
    5) Strongly agree
11. What kind of incentives did you receive while conducting mass drug administration in your community?
12. 1] Monetary incentives 2] Food items 3] Others (please specify)
    _____

APPENDIX E: INFORMATION SHEET

PARTICIPANTS' INFORMATION SHEET

Good Day

My name is Abdu Adamu and I am a Masters student in the Division of Epidemiology and Biostatistics, School of Public Health at the University of the Witwatersrand, Johannesburg, South Africa. I am conducting a study to know how well community-based mass drug administration for onchocerciasis, lymphatic filariasis, and soil transmitted helminthiasis is done in Kano State.

The reason why I am conducting this study is because these neglected tropical diseases are a major cause of morbidity and with high economic consequences too. Data collected will be compiled in a thesis report, and may be shared in publications or presentations.

As a community directed distributor that have been involved in conducting mass drug administration, I would like to invite you to participate in this study because your response is important. Before you decide to take part, you need to understand why the research is being conducted and what would be required of you. Therefore, take your time to read this information sheet carefully. Please ask any question if anything you have read is not clear or would like further information.

The entire survey will take about 30 minutes and it will be conducted in Hausa Language. The survey is confidential and anonymous. This is guaranteed by not needing to indicate your name on questionnaire. If you decide to take part in this study, be assured that your participation is voluntary and you are free to withdraw at any time without giving any reason. There are no risk, penalty or loss of benefits whether you participate or not.

If you have any concerns or questions regarding any aspect of this study or wish to obtain a copy of the results of the survey, please kindly contact me on;

Name: Abdu Adamu Tel: (+234)8065459980

Email: 815633@students.wits.ac.za and abdu.adamu@gmail.com

For questions regarding participants' rights and ethical conduct of research, please contact:

Hamza Ahmad
Director Planning Research and Statistics
Kano State Ministry of Health Research Ethics Committee
Tel: +23464634233

Peter Cleaton-Jones
Wits Human Research Ethics Committee (Medical)
University of the Witwatersrand, Johannesburg
Email: peter.cleaton-jones1@wits.ac.za

APPENDIX F: INFORMED CONSENT FORM

INFORMED CONSENT FORM

I, _____ consent and volunteer to participate in a research looking at how well community based integrated mass drug administration for onchocerciasis, lymphatic filariasis and soil transmitted helminthiasis control in Kano State is being done. The study is being conducted by Abdu Adamu; a Master's student from University of the Witwatersrand, Johannesburg, South Africa.

I confirm that:

1. I was provided with an information sheet that explained what the study is about I have read and understood the information about the study as provided in the information sheet.
2. I have been given the opportunity to ask questions about the project and my participation.
3. I understand that I will not be paid for participating in the study.
4. I understand that I can withdraw at any time without giving reasons and there are will be no risks or penalty for withdrawing
5. It has been clearly explained to me that the research is confidential and anonymous. i.e. and what I say will not be linked to me as a person and that the information will only be used for this research purpose and not shared with other people that are not part of this research team.
6. It has been clearly explained to me that information from this research may be used in a thesis report, publications or presentations.
7. I understand that mobile tablet devices will be used in the collection of data.

Participant

_____	_____	_____
Name	Signature	Place and date

APPENDIX G: FIELD DATA COLLECTORS 'CONFIDENTIALITY AGREEMENT

Field Data Collectors' Confidentiality Agreement

This study; *assessing implementation fidelity of community based integrated mass drug administration for neglected tropical disease control in Kano State, Nigeria*, is being undertaken by Dr Abdu Adamu, a postgraduate student at Wits School of Public Health, University of the Witwatersrand, Johannesburg, South Africa.

I, _____, agree to:

1. Keep all the research information shared with me confidential by not discussing or sharing the research information in any form or format with anyone other than the Principal Investigator;
2. Keep all research information in any form or format secure while it is in my possession;
3. Return all research information in any form or format to the Principal Investigator when I have completed the research tasks.

Field Data Collector:

_____ _____ _____

(print name) (signature) (date)

Principal Investigator:

_____ _____ _____

(print name) (signature) (date)

APPENDIX H: ETHICS APPROVAL LETTER FROM KANO STATE MINISTRY OF HEALTH

KANO STATE OF NIGERIA
MINISTRY OF HEALTH

Ref: MOH/Off/797/T.I/218

Date: 14th November 2016

Abdu Adamu
Division of Epidemiology & Biostatistics
Wits School of Public Health
University of the Witwatersrand, Johannesburg
South Africa.

RE: APPLICATION FOR ETHICAL CLEARANCE FOR MY MASTERS RESEARCH

Reference to your letter dated 31st October 2016 on the above request addressed to the Chairman Ethics Sub-Committee of Health Operational Research Unit of the Ministry requesting for ethical approval to carry out research at Nassarawa and Gezawa Local Government areas respectively.

2. The research titled *"Assessing Implementation Fidelity of Community Based Integrated Mass Drug Administration for Neglected Tropical Disease Control in Kano State, Nigeria"*, is for the award of Master of Science Degree in Epidemiology (M.Sc Epidemiology).

3. In view of the foregoing, I wish to convey the Ministry's approval for you to conduct research at the above mentioned local government areas in Kano State.

4. You are also requested to share your findings with the Ministry of Health, Kano.

5. Best Regards

Hamza Ahmad
DPRS
Secretary (ORAC)
For: Honourable Commissioner

2nd & 3rd Floor, Post Office Road, P.M.B. 3066, Kano.
Tel: 064-634233, 634426, 635640, 633482, 632535, 647922, 634983, 635616
Cables of Telegram: COMMHEALTH KANO

APPENDIX I: WITS HUMAN RESEARCH ETHIC COMMITTEE (HREC) CLEARANCE CERTIFICATE

R14/49 Dr Abdu Adamu

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M1611117

NAME: (Principal Investigator)	Dr Abdu Adamu
DEPARTMENT:	Epidemiology and Biostatistics School of Public Health Nassarawa and Gazawa Local Government Areas of Kano State, Nigeria
PROJECT TITLE:	Assessing Implementation Fidelity of Community Based Integrated Mass Drug Administration for Neglected Tropical Disease Control in Kano State, Nigeria
DATE CONSIDERED:	25/11/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Latifat Ibisomi and Prof Zubairu Iliyasu
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	13/01/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in November and will therefore be due in the month of November each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES