Community Acceptance of Reactive Focal Mass Drug Administration and Reactive Focal Vector Control Using Indoor Residual Spraying, a Mixed-Methods Study in Zambezi Region, Namibia

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Research

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Abstract

Background

In Namibia, as in many malaria elimination settings, reactive case detection (RACD), or malaria testing and treatment around index cases, is a standard intervention. Reactive focal mass drug administration (rfMDA), or treatment without testing, and reactive focal vector control (RAVC) in the form of indoor residual spraying, are alternative or adjunctive interventions, but there is limited data regarding their community acceptability.

Methods

A parent trial aimed to compare the effectiveness of rfMDA *versus* RACD, RAVC *versus* RAVC, and rfMDA+RAVC *versus* RACD only. To assess acceptability of these interventions, we conducted a mixed-methods study that included key informant interviews (KIIs) and focus group discussions (FGDs) in three rounds (pre-trial and in years 1 and 2 of the trial), and an endline survey.

Results

In total, 17 KIIs, 49 FGDs were conducted with 449 people over three annual rounds of qualitative data collection. Pre-trial, community members more accurately predicted the level of community acceptability than key stakeholders. Throughout the trial, key participant motivators included: malaria risk perception, access to free community-based healthcare and IRS, and community education by respectful study teams. RACD or rfMDA were offered to 1,372 and 8,948 individuals in Years 1 and 2, respectively and refusal rates were low (<2%). RAVC was offered to few households (n=72) in Year 1. In year 2, RAVC was offered to more households (n=944) and refusal were <1%. In the endline survey, 94.3% of 2,147 respondents said they would participate in the same intervention again.

Conclusions

Communities found both reactive focal interventions and their combination highly acceptable. Engaging communities and centering and incorporating their perspectives and experiences during design, implementation, and evaluation of this community-based intervention was critical for optimizing study engagement.

Background

Successful malaria control efforts have led to declines in malaria transmission worldwide.(1) In Namibia, confirmed malaria cases decreased 97% from 2001 to 2011, from over half a million cases to 14,406, corresponding to a decline in the annual incidence from 422 to 11 cases per 1000 population (2). As part of a national malaria elimination strategy, in 2012, the National Vector-borne Diseases Control Programme (NVDCP) began implementing reactive case detection (RACD), an active case finding strategy whereby teams visit the homes of recent passively-identified malaria index cases and conduct testing

and treatment among household members and neighbors. The rationale for RACD is that asymptomatic infections cluster around index cases and are a reservoir for persistent transmission.(3–6) However, the effectiveness of RACD is limited by its reliance on conventional rapid diagnostic tests (RDTs), which are not able to detect most low-density asymptomatic infections, and because RACD does not tackle the residual reservoir of parasites in the local vector population. In Namibia and other low endemic settings in southern Africa, RACD using RDTs only identifies up to one-third of infections detected by more sensitive molecular methods.(4)(7) The use of these molecular tests to inform treatment in the community is impractical due to long turn-around times and resource requirements.(8)

An alternative to RACD is reactive focal mass drug administration (rfMDA), which eliminates reliance on RDTs by presumptively treating people in active malaria foci. Reactive vector control (RAVC) in the form of indoor residual spraying (IRS) targets the parasite reservoir in the mosquito and prevents transmission by reducing human-mosquito interaction. RAVC may also slow the development of insecticide resistance by using an insecticide from a different chemical class to the one used for pre-season blanket IRS.(9) The effectiveness of rfMDA versus RACD, RAVC versus no RAVC, and rfMDA + RAVC versus RACD only, were compared in a two-by-two factorial design cluster randomized controlled trial conducted in Zambezi region, Namibia.(10) In adjusted analyses, rfMDA and RAVC implemented over a one-year period with over 80% coverage decreased malaria incidence by about 48% and 52%, respectively, with their combination decreasing incidence by 74%. To inform how such strategies could be scaled-up and sustained at high coverage levels in Namibia and other settings, it is critical to understand their community acceptability. By understanding why a community or its members might accept, resist, or refuse an intervention, can inform adjustments to interventions to improve uptake and coverage.

We conducted a study to understand factors that influence acceptability of RACD, rfMDA, and RAVC. (11,12) Key factors of acceptability examined included: community engagement, which can build trust in interventions and the institutions implementing them; human behavior; and attitudes, beliefs and knowledge about malaria, which can influence participation and adherence and therefore, the effectiveness of these interventions. (11,13–18)

Methods

Study site

The study was conducted in the western Zambezi region, Namibia, within 11 contiguous health facility catchment areas with an enumerated population of 33,418. Malaria transmission is seasonal and almost entirely due to *P. falciparum*.(19) From 2010–2015, annual case incidence was <15/1 000 population; incidence then rose starting in 2016, reaching its peak at 40.2/1000 in 2017.(2,20) Community prevalence of infection measured by highly sensitive loop-mediated isothermal amplification (LAMP) was 2.2% in 2015.(21) Routine interventions carried out by the Namibia Ministry of Health and Social Services (MoHSS) include case management, RACD, and annual preseason blanket IRS, at the time with

dichlorodiphenyltrichloroethane (DDT), except for a minority of modern structures, which were sprayed with deltamethrin.(22)

Trial context

The trial aimed to evaluate the effectiveness of reactive focal interventions targeting the human and/or mosquito reservoir of infections using antimalarial drugs (rfMDA), vector control (RAVC), and their combination (rfMDA+RAVC). The design and results of the trial, describing impact on incidence and infection prevalence have been reported elsewhere.(19) Briefly, 56 enumeration areas (EAs) were randomized to receive rfMDA or RACD, with or without RAVC (Table 1). The 2x2 factorial design enabled the assessment of the individual interventions as well as their combination.

Table 1: 2x2 factorial design of parent trial

		Human intervention	
		RACD* (reactive case detection) *28 clusters*	rfMDA† (reactive focal mass drug administration) *28 clusters*
Mosquito intervention	No RAVC (no reactive focal vector control) *28 clusters*	**A** RACD only arm *14 clusters*	**B** rfMDA only arm *14 clusters*
	RAVC‡ (reactive focal vector control) *28 clusters*	**C** RACD + RAVC arm *14 clusters*	**D** rfMDA + RAVC arm *14 clusters*

**RACD (reactive case detection): administering rapid diagnostic tests to people living within a 500 m radius around an index case; treating positives with artemether-lumefantrine and primaquine*

†*rfMDA (reactive focal mass drug administration): presumptively treating individuals living within a 500 m radius around an index case using artemether-lumefantrine, without testing*

‡*RAVC (reactive focal vector control): spraying long-acting insecticide, pirimiphos-methyl, on interior walls of sleeping structures in a 7-household radius around an index case*

Reactive focal interventions were triggered when a malaria case was passively detected at a MOHSS health facility participating in the study and confirmed by RDT (CareStart, AccessBio, USA) or microscopy. If the index case resided in an RACD cluster, the team visited the homes of the case and neighbors and performed RDT-testing and, if positive, treatment with artemether-lumefantrine (AL, Coartem, Novartis Pharmaceuticals, Kempton Park, South Africa, or Komefan 140, Mylan Laboratories Limited, Sinnar, India) and single dose primaquine (Primaquine, Remedica, Cyprus), per national policy. When index cases resided in rfMDA clusters, the team offered the case and neighboring households treatment using AL, without malaria testing. Both interventions aimed to reach ≥25 people within 500m of the index case household, prioritizing those living closest. In clusters assigned to RAVC, the case household and the six closest neighboring households were offered IRS using long-lasting, micro-encapsulated pirimiphos-methyl (Actellic® 300 CS; Syngenta, Basel, Switzerland).

The acceptability study was carried out over three years, 2015 (pre-trial), 2016, and 2017 (Years 1 and 2 of the trial). While data from 2016 were not included in the main trial analysis (10), the qualitative data from both years are included in this study, as the interventions did not change year to year.

Study design

We conducted a mixed-methods study that included key informant interviews (KIIs), focus group discussions (FGDs), and an endline cross-sectional survey, nested within the above described cluster-randomized controlled trial.(19)(10)

Pre-trial assessment focused on understanding health-seeking behavior, potential barriers to participation in community interventions, particularly the novel interventions, rfMDA and RAVC, and community sensitization. The annual qualitative assessments followed Sekhon *et al.*'s theoretical framework of acceptability; FGDs and KIIs examined the six core domains of acceptability: burden (reasons for dropout), ethical consequences (reported adverse events), experience (user perceptions of satisfaction), affective attitude (attitude towards intervention), opportunity costs (influence on adherence and participation), and intention (willingness to participate in the intervention).(23) Quantitative assessment of acceptability involved measuring refusal rates and reasons for refusal during trial implementation. After the conclusion of the trial, an endline cross-sectional survey measured community-level acceptance rates and willingness to participate in future interventions. Participants were eligible for the acceptability study if they were >15 years old, spoke Silozi (the local language) or any other language spoken by study personnel, resided in the study area, and provided informed consent.

A combination of purposive and referral sampling was used to recruit participants for pre-trial KIIs. Key informants (KIs) included malaria stakeholders, such as community leaders, non-governmental organizations (NGOs), and government representatives. After their individual interviews, KIs assisted in referral sampling by suggesting other relevant KIs. Participants in pre-trial FGDs were community members from six randomly chosen health facility catchment areas in the study area. Two to four FGDs were conducted in each health facility catchment area, stratified by gender and three age categories:

youth (15–18 years), young adult (19–35 years), and adult (>35 years). The only exceptions were two mixed-gender FGDs with NGO and MoHSS staff, who were Zambezi region residents.

For KIIs and FGDs during Year 1 and Year 2, all residents of trial clusters where interventions were carried out were eligible, including community members who were absent during the intervention or who had refused to participate. FGDs were conducted in intervention communities, and were segregated age: in Year 1 these age categories were: youth (15–18 years), young adult (19–35 years), and adult (>35 years), in Year 2 these categories were collapsed due to challenges finding young people to participate: youth (15–25) years and adult (>25 years). Youth FGDs were not segregated by gender due to an insufficient number of young males being available for an FGD during the transmission season. This change was suggested and vetted by local staff, who were primarily young Zambezians, who believed that young people of both genders were likely to speak freely together, compared to older generations. KIIs were conducted with community leaders, all of whom were adult males.

For the quantitative acceptability assessment, refusal rates were measured during the trial implementation period and willingness to participate in future interventions was assessed in a representative endline cross-sectional survey in intervention enumeration areas after the interventions ended in 2017. The sampling and methods of this survey have been described previously.(10) The endline cross-sectional survey was powered to detect anticipated differences in trial outcomes. In each of the 56 study clusters, around 25 households were sampled, providing a sample size of 4,440 individuals. Of these individuals, only those who reported having participated in a community level intervention were asked about their willingness to participate in future interventions. Endline survey data were analyzed by the intervention to which they were randomized in 2017, and then restricted to individuals that reported receipt of a study intervention in 2017.

Data Collection

Pre-trial, study staff used semi-structured interview guides to explore malaria knowledge, malaria risk perception, perceptions of and reservations about presumptive treatment, community participation, and adherence optimization. During Years 1 and 2 of the trial, study staff used semi-structured interview guides to explore malaria perceptions and experiences, intervention acceptability compared to MoHSS-delivered RACD, and possible improvements. One staff member led the FGD or KII and another took notes and created an audio recording, both of which were used to create English transcripts, which were reviewed by study coordinators. Quantitative data were collected during trial implementation and the endline survey and recorded in Open Data Kit (ODK version 1.23.3).

Data management and analysis

Pre-trial and Year 1 transcript data were managed using NVivo (Version 11, QSR International, Melbourne) or Microsoft Excel (2016, Microsoft, Redmond, Washington). Year 2 transcripts were imported into and managed in Dedoose (Version 8.0.35, Los Angeles, CA, USA: Sociocultural Research Consultants, LLC).

Quantitative data collected were managed and analyzed in Stata (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC).

Refusal rates for rfMDA were compared to RACD, with or without RAVC. Refusal rates for RAVC could not be compared to no RAVC, but we report on the refusal rates of RAVC with and without rfMDA. Refusal rates were measured at the individual level for rfMDA and RACD, and at the household level for RAVC. Refusal rates across arms were compared using logistic regression, adjusted for clustering.

Results

Enrollment for the pre-trial, Year 1, and Year 2 KIIs and FGDs are shown in Table 2. In total, there were 17 KIIs, 49 FGDs, and 449 participants in the FGDs. Over the study period, enrollment figures fluctuated slightly but were generally similar across years. Pre-trial, KIIs were conducted with Zambezi Region health and political decision-makers and gatekeepers, health extension workers, and NGO field staff. During the trial implementation period, all KIIs were conducted with community leaders, who were male adults. In the FGDs, youth represented about 27% of participants over the study period. KIIs and FGDs by study arm are shown in Table 2. Across the two intervention years, 34 FGDs were conducted with communities enrolled in the interventions: RACD (6), RACD and RAVC (14), rfMDA (5), rfMDA and RAVC (9).

Table 2: Numbers of Key Informant Interviews, Focus Group Discussions, and Focus Group Discussion participants over study period, stratified by informant type and age category

	Pre-trial	Year 1	Year 2	All years
	N	N	N	Total
Key informant interviews				
Total interviews held	6	7	4	17
Participants				
Government or NGO	6	-	-	6
Community Leaders	-	7	4	11
Focus group discussions				
Total discussions held	15	16	18	47
Participants	146	127	176	449
Youth	35	24	66	125
Adults	111	103	110	324

NGO, non-governmental organizations

Table 3: Numbers of Key informant interviews (KII), focus group discussions (FGD), and FGD participants by study arm

			Human Intervention					
			RACD (N)			rfMDA (N)		
			Y1	Y2	Total	Y1	Y2	Total
Mosquito Intervention	No RAVC (N)	KII	1	1	2	2	2	4
		FGD	3	3	6	2	3	5
		FGD participants	27	34	61	20	28	48
	RAVC (N)	KII	1	0	1	2	1	3
		FGD	7	7	14	4	5	9
		FGD participants	57	73	130	23	41	64

**Pre-trial excluded – study arms not assigned*

Pre-trial findings

Healthcare-seeking behavior

When asked where community members would go if they suspected malaria, most respondents mentioned public and private health facilities. Many respondents mentioned that elders may visit traditional healers. A male FGD participant explained,

"Older people in their sixties still believe in traditional ways, how they treated malaria before today; it may happen that those are the same people who might still prefer [a traditional healer]."

An MoHSS employee echoed this sentiment in an interview, explaining that a community member's first response to malaria symptoms depends on healthcare access:

…the community prefers going to traditional healers before they come to the [Zambezi regional] hospital… You look at the community that cannot afford to visit the hospital or the clinic because of the distance, they will probably start with the traditional healers, and from there that's when they come to the clinics.

Despite the ongoing use of traditional medicine, a male FGD respondent said that "recently it is evident that the difference between traditional healers and hospital is known… traditional healers cannot cure

malaria disease…" This distinction was seen consistently throughout the FGDs.

Possible barriers to participation

Comments about uncleanliness were made about the local environmental management educational programs that emphasized tidiness around households to prevent malaria.

Second, multiple participants mentioned stigma associated with human immunodeficiency virus (HIV) and the perceived association between HIV testing and malaria testing. According to a female FGD participant,

"Some would not go for [HIV] testing because they are afraid they might be found to have HIV; our people prefers to stay without knowing [un]til they see that they are very sick; that's when they go at the clinic or hospital."

Participants explained that HIV tests have a similar appearance to malaria RDTs and some community members could incorrectly think the malaria tests were for HIV, and therefore would refuse to be tested.

Many respondents anticipated not wanting medication if they did not feel sick or had not tested positive for malaria. One male FGD participant stated,

"It is not all right – medication is supposed to be for those who have been tested."

However, many participants who said they would not take medication without testing offered factors that could make presumptive treatment acceptable, such as education and sensitization. One man explained,

"People nowadays prefer to be tested by a doctor or nurse before accepting malaria dosage, though others may agree on condition that they are properly informed."

All but one key informant said they would encourage members of their household and their neighbors to accept presumptive treatment. However, three out of five key informants who were health professionals said they would refuse to be treated presumptively themselves, despite seeing the value for others.

Some FGD and KII participants expressed concern about medication side effects, including the perception that medications can "trigger other diseases in the body." Respondents anticipated reluctance about completing the full course of medication, explaining that some people will stop treatment once symptoms have diminished, or, alternatively, if symptoms did not subside immediately. Respondents also mentioned that it is common to save medication to treat future illness, given the limited access to care and distance from health facilities. When asked what would help individuals complete the regimen, KII and FGD respondents agreed that community members would appreciate education, supervision, and reminders, especially for the sick, elderly, and those who cannot read.

Possible barriers to IRS were explored during FGDs, with participants sharing feedback primarily based on previous experience with IRS by the MoHSS. Several participants advised the program to include IRS in its

approach, as one adult shared, “Workers go to communities to spray against malaria and distribut[e] mosquito nets [which] needs to continue as the people really appreciate [it]”. However, one woman offered some insight into why some people might decline IRS, saying “Others close their doors to those who spray against mosquitoes, claiming they bring cockroaches”.

Community sensitization

KIs and FGD participants suggested ways to sensitize the community about testing and treatment, presumptive treat, IRS, and means of ongoing engagement. According to an older male FGD participant,

“What I personally notice is that when an employed person tells you, people then listen. Those who went to school and are working tend to be influential. What they say is taken seriously.”

Health extension workers, teachers, and nurses were identified as trusted partners to support community sensitization. Participants agreed that better community understanding of interventions would likely lead to higher acceptance. To educate community members, KII and FGD respondents highlighted the importance of visual aids and forms of media, like radio and dramas, to increase the uptake of health and study information. Participants emphasized the necessity of involving the tribal council of headmen, or *khuta,* for community entry into the study and raising community awareness.

Year 1

Motivation to participate

Participants were motivated to participate in the intervention to receive protection from malaria via testing, treatment, and/or IRS. Watching others in their community suffer from malaria made them fearful of infection. One woman explained,

“After seeing how much elders and kids were complaining of sickness was a reason enough for me to partake.”

Community engagement and sensitization efforts before and during the intervention were noted as important factors that influenced participation.

Perceptions of and attitudes towards reactive focal interventions

Reactions were overwhelmingly positive towards the interventions. Participants said that they valued the interventions provided by the study, and were particularly appreciative that the teams “*come in villages.”* The behavior and professionalism of the study team and the respect shown for participants and local traditions were reported to be critical elements of successful implementation. One man explained,

“Most people are talking here that they have never seen people dedicated to their work like you showed us, you did not mind if the people were dirty or clean. You have treated them all equal… it’s the elders and the community leaders that are praising the most.”

Suggestions for improved delivery of the interventions, both medical and vector control, included providing additional notices in advance of the visit date, arriving earlier in the day, and quicker processing of participants and houses.

Criticisms included the lack of IRS in communities not receiving RAVC, no distribution of long-lasting insecticide treated bednets (LLINs), the need to remove all furniture from the household to receive RAVC (especially when advance notice of IRS was not given), and a desire to also receive additional medical interventions like testing and treatment for tuberculosis and HIV. With regards to the project being a time-limited research study, participants expressed concern that the interventions were not a long-term strategy. FGD participants also reported that a neighboring community felt jealous that they did not receive the same interventions, because they had been assigned to a different study arm. In another community, rumors reportedly circulated about the misuse of participant blood. One man explained,

"Some people even said the blood you are collecting is for satanic [purposes] and you are going to hand it to the people to use in a satanic way."

Such fears can spread, and being aware of them as they arise presents the opportunity to confront misinformation with education.

Influences on participation and adherence

When participants were asked why they chose to participate in a given intervention, whether RACD, rfMDA, or RAVC, they generally chose to participate because they were sick, a relative was sick, or because they knew people who had contracted malaria recently.

It's was my grandkids that had malaria and I received a call… I was told some people were coming to visit me the following day and I should prepare my house to get sprayed because all four of my grandkids had malaria. It looked as though mosquitos with malaria were in my house."

Here it is clear that a perception that her family was at risk as well as advance notice about when the team would come and how to prepare her house positively influence RAVC participation. Rationale for participation in RACD and rfMDA were similar, with participants naming their own or their contacts recent illness and wanting to learn more about malaria as motivators.

FGD participants were asked about their experience taking the malaria medication, whether they received it in the rfMDA intervention arm or after a positive malaria RDT in the RACD intervention arm. Most participants described positive experiences, such as this FGD participant:

"There was no problem with the time of taking the prescribed dosage by the nurse, people drank or finished the medicine very well."

FGD participants reported that negative medication experiences did not affect intervention participation or the ability or willingness to finish the medication course. A few participants in three of the 16 FGDs

raised concerns about treatment without testing. One FGD participant explained,

"Some people were concerned, why are they giving us treatment? Do they think we are sick of [with] malaria?"

However, this concern was held by the minority of participants; most FGD participants did not feel that treatment without testing was an issue and no FGD participant said they refused an intervention because they disliked the strategy. For example, one woman said,

"There is nothing wrong [with treatment without testing], just continue with what you are helping the communities with, it is your team which is helping people here.

Continued willingness to participate

All FGDs were concluded by asking participants whether they would be willing to participate in the same intervention in the future. Only two of 127 FGD participants said they would not participate, both referring to medical interventions. One rfMDA participant said,

"At least we should be tested first and only give medications to those who are found positive."

The other, from an RACD intervention, said he would decline because he did not need further intervention,

"I was already tested and I was negative, I don't feel any sign of malaria."

The overwhelming majority of participants found the interventions acceptable and reason for future participation included: desire to protect their families from the ongoing risk of malaria, whether via testing, treatment, or IRS, a desire to know if they are sick, and medication effectiveness. Regarding RAVC, participants specifically referenced the effectiveness of the IRS. As one participant explained, "… the spraying that you did, that was very nice. After you sprayed both flies and mosquito were no longer a lot and one could sleep even without a mosquito net." This visible change in mosquito presence was referenced as proof that RAVC was effective and acceptable to community members, despite challenges removing furniture so IRS could take place.

Year 2

Motivation to participate

In Year 2, the perceived level of malaria risk and convenience of free community-based care and IRS continued to heavily influence decisions to participate in the trial interventions. In one FGD, a woman commented, "The disease is affecting us so much that is why we have decided to participate," which is particularly noteworthy given the malaria outbreak the year prior (in 2016). Furthermore, one FGD participant remarked on the accessibility of the services,

"When you go to the clinic you will pay ten [Namibian] dollars going and coming back, even pay something again at the clinic, also you will find queues at the clinic, but the malaria team would come in the village to test and treat without you paying anything.".

All four community leaders interviewed (key informants) confirmed that people appreciated no-cost, community-based interventions. FGD participants expressed their gratitude that the study teams visited communities twice to ensure everyone had the opportunity to participate in RACD or rfMDA, and RAVC where applicable. The education offered by trial teams was also important to participants. One participant explained, "…always the nurse would explain the dose and the signs of malaria to the community; for the past six years we thought malaria is a headache so now we know the difference".

Perceptions of and attitudes towards reactive focal interventions

Most participants responded positively to rfMDA, based on the belief that rfMDA protects people from illness. There was a continued emphasis on the importance of community members' understanding of malaria and the rationale for presumptive treatment, with both FGD participants and headmen requesting ongoing education. When participants were asked whether rfMDA or RACD was preferable, based on their experience with one intervention and a description of the other, the majority preferred rfMDA. Concerns around RACD included: blood being used for satanic purposes or for HIV testing, and the perception that non-positive individuals miss the protective benefit of the medication, since only RDT-positive individuals are given medication. Headmen were more neutral regarding intervention preference, stating that their main objective for participation was to improve the health of their community, and therefore were pleased with all community-based interventions.

RAVC was generally perceived as a useful tool for malaria prevention. Participants in study arms that did and did not receive RAVC expressed a desire to have their houses sprayed against mosquitoes. Actellic CS was generally perceived to be "stronger" and more effective than DDT or Deltamethrin, the insecticides used by MOHSS at the time of the study. However, some participants noted strong smell, coughing, difficulty breathing, itchy eyes, and felt the chemical was too strong. A few participants reported seeing mosquitoes right after RAVC and questioned its effectiveness.

Influences on adherence and participation

Suggestions for improvement aligned with Year 1 findings, where residents and headmen asked that visits by trial teams be better timed and communicated in advance, and requested additional interventions such as mosquito repellants or LLINs. The majority of those who did not participate said they were unavailable at the time of the intervention. However, some non-participants expressed a low malaria risk-perception, as one person said,

"[It was] my will not to participate because I am always exercising, so I will not get malaria."
As in Year 1, a few community members described refusing because they disagreed with presumptive treatment. During an interview, a community leader emphasized that the main reason for refusal was

likely a lack of knowledge about malaria risk. He said, “Some people were misinformed or did not get the right information of what exactly was happening in the malaria program.”

Continued willingness to participate

All but one FGD participant expressed willingness to participate in the same intervention again in the future. All community leaders said they would welcome the intervention teams again. The lone dissenter, a male participant, had participated in rfMDA + RAVC and said,

“At least we should be tested first and only give medication to those who are found positive.”

Furthermore, some participants said they preferred vector-based interventions over those involving testing and/or treatment. As one woman explained, “I don’t like tablets, maybe [I would participate again] to have my house sprayed only, I don’t get healed when I drink tablets.” A few other respondents agreed that combining medical and vector-based approaches, or delivering vector-based approaches only, were important to protect all members of the community.

Refusal during trial implementation – Years 1 and 2

RACD or rfMDA was offered to 1,372 and 8,994 individuals during years 1 and 2 of the trial, respectively. Refusal rates (Table 3) were higher for rfMDA compared to RACD both years, though low for both interventions in both years (<2%). The refusal rate for RAVC was high at 13.9% in year 1. As indicated in FGDs, refusals were due to lack of notification before arrival, and reluctance of community members to move furniture at short notice. Of note, few households (n=72) were offered RAVC in year 1 due to staffing limitations (10). In year 2, when <1% refused, more households were offered RAVC (n=923) and advance notification was provided. RAVC could not be compared to no RAVC. RACD, which was offered at the individual level, could not be compared to rfMDA+RAVC which was offered individual and household levels, respectively. All interventions were able to meet or exceed the goal of 80% acceptance of the intervention among those offered the intervention.

Table 3. Refusal rates for RACD versus rfMDA among participants, and for RAVC among households

	Year 1			Year 2		
	N	Refused	p-value	N	Refused	p-value
RACD	894	3 (0.34%)	0.05	4711	10 (0.21%)	<0.001
rfMDA	478	8 (1.7%)		4283	36 (0.84%)	
RAVC	72	10 (13.9%)	-	923	2 (0.22%)	-

Willingness to participate in future interventions

2,147 people participated in the acceptability portion of a cross sectional endline survey that was conducted in 2017, after most study interventions were implemented. Almost all respondents (94.3%, n=2024) said they would participate in the same intervention if offered again. Of respondents residing in clusters assigned to RACD, 95.5% (1,546/1,619) said they would participate in a future round of RACD (Table 4). The most common reason for accepting RACD in the future was to know whether they were ill. The most common reason for not accepting RACD in the future was that they tested negative for malaria recently. Of respondents residing in clusters assigned to rfMDA, 90.5% (478/528) said they would participate in a future round. The most common reasons for accepting rfMDA in the future were because it is free and because they wanted to prevent and treat malaria. The most common reason for not accepting in rfMDA in the future was concern about medication side effects. Of participants residing in clusters assigned to RAVC, 98.7% (616/624), said they would participate again. The most common reason cited for future participation was to keep mosquitoes and bugs away.

Table 4. Primary reasons for willingness or unwillingness to participate in future interventions as assessed in an endline survey.

	N	Willing	Unwilling	Don't know/No response
RACD	1619	1,546 (95.5%)	28 (1.7%)	45 (2.8%)
		Reasons:	Reasons:	
		714 (46.2%) To know whether they were ill	17 (60.7%) Tested negative for malaria recently	
		380 (24.6%) To know whether their children were ill	4 (14.3%) Afraid of needles	
		286 (18.5%) Care was free		
rfMDA	528	478 (90.5%)	31 (5.9%)	19 (3.6%)
		Reasons:	Reasons:	
		153 (32.0%) It is free	26 (83.9%) Worried about medication side effects	
		147 (30.8%) To both prevent and treat malaria	14 (45.2%) Do not want to take medication when not ill	
		105 (22.0%) Like to have their children treated		
RAVC	624	616 (98.7%)	7 (1.1%)	1 (0.16%)
		Reasons:	Reasons:	
		522 (84.7%) To keep mosquitoes and bugs away	2 (28.6%) No mosquitoes in area	
		89 (14.4%) Structures were sprayed well during the previous visit		

Note: Some participants provided multiple reasons.

Of 528 participants who reported receipt of rfMDA, 77.5% (n=409) rated rfMDA as equally or more acceptable than MoHSS RACD. Of 624 participants who reported receipt of RAVC, 97.4% (n=608) found RAVC equally or more acceptable than MoHSS-delivered pre-season IRS.

Discussion

In this study examining acceptability of reactive focal interventions, we found that rfMDA, RAVC, and their combination were at least as acceptable as RACD, the standard of care. In total, 17 KIIs, 49 FGDs were conducted with 449 people over three annual rounds of qualitative data collection. Pre-trial, community members predicted the level of community acceptability more accurately than key stakeholders, who were more doubtful that communities would accept study interventions, particularly rfMDA. Throughout the trial, participant motivators included: malaria risk perception, access to free community-based healthcare and IRS, and community education by respectful study teams. RACD or rfMDA were offered to 1,372 and 8,948 individuals in Years 1 and 2, respectively and refusal rates were low (< 2%). RAVC was offered to few households (n = 72) in Year 1. In year 2, RAVC was offered to more households (n = 944) and refusal was < 1%. In the endline survey, 94.3% of 2,147 respondents said they would participate in the same intervention again. Furthermore, according to Sekhon et al's theoretical framework to evaluate acceptability of healthcare interventions, communities found the packages of interventions highly acceptable. [24] Refusal rates were low and participant attitude regarding the interventions was largely positive. Community members understood the interventions and their purpose, and while they had suggestions for improvement, there was no indication that community members would discontinue them or refuse in the future.

Ongoing community engagement and education was a crucial element of achieving and maintaining community acceptability. However, findings suggest the need for an even stronger approach to community engagement, as exemplified in the confusion between malaria and HIV testing, or interpretation of environmental management guidance as meaning that homes with malaria cases are "unclean".(24) By providing malaria education during every visit, trial teams ensured that community members were informed about malaria and how the intervention could reduce risk and contribute to elimination, and the visits build trust between communities and the trial team. Nevertheless, some community members had misconceptions about malaria transmission and risk, which could be addressed with robust education about malaria and the trial. Spending more time explaining why rfMDA is needed is crucial, because the strategy contradicted MoHSS messaging and policy about testing and treatment. Intervention teams can play a critical role in communicating these messages and answering questions to address any doubts before and during the study, as community engagement must be ongoing and iterative.(24) This work can be time and resource intensive, but soliciting community feedback through community meetings and ongoing community education were critical to acceptability and understanding of the interventions, and should be implemented prior to the rollout of a large-scale, community-based trial.

The results of the pre-trial KIIs and FGDs informed the pre-trial community sensitization, and community entry and engagement strategies. For example, pre-trial FGDs and KIIs identified community leaders and frontline health workers as important information sources, so the study team focused on these individuals as “trial champions” to help educate the community members and facilitate community entry. The educational messages delivered to communities prior to the intervention were tailored to address the gaps in malaria knowledge identified during the pre-trial FGDs and KIIs. The prediction by KIIs in the pre-trial phase that medication adherence could be a struggle informed the degree of education, time, and emphasis placed on community adherence. The qualitative data collection process overall served as an ongoing monitoring mechanism, both formally through FGDs and KIIs, and informally through discussions between community members and trial staff, enabling the study team to address issues before they could impact enrollment and erode trust.

Compared to the Year 1 results, the round of FGDs after implementation of Year 2 of the trial reflected a somewhat higher level of inquiry among community members about the rationale and processes for treatment without testing. That rfMDA refusal rates were lower in Year 2 compared to Year 1 suggests that these questions were not connected to refusals, however, we cannot rule out the possibility that such comments were early signs of intervention fatigue. It is possible that increased familiarity with the intervention enabled them to ask more questions. rfMDA participants emphasized the importance of malaria prevention, increased access to treatment, and avoiding a blood draw, reflecting comprehension of study messages.

There were limitations of this acceptability study. In 2016 and 2017 there was a malaria outbreak, so communities likely had an increased awareness of malaria and desire for services, possibly affecting intervention acceptance. Coverage of interventions in 2016 was low, particularly for RAVC, which limited the assessment of this intervention in year 1. The lack of consistency in segmentation of FGD groups is another limitation, as the age ranges and gender segregation varied between years, making it more difficult to compare results. Finally, the perceptions of those who refused to participate in the trial, declined the refuser questionnaire, and did not participate in the FGDs were not captured, but they constituted a small proportion of the total target population for these assessments.

Strengths of the study included repeated acceptability data collection and immediate integration of acceptability results into trial study procedures. Strategies to improve acceptability during this trial demonstrate that focusing on community acceptability can benefit both an ongoing trial and the communities it is intended to serve.

The findings of this study are relevant for public health intervention generally, including research and program intervention by Ministries of Health or other organizations planning to implement similar approaches, as well as for researchers implementing community-based operational research studies. High community acceptability and intervention uptake are crucial for impact; integrating the findings of this study, particularly engaging the community at all stages of the intervention to provide feedback on past and planned interventions, engagement rather than just sensitization, and to provide ongoing

education to ensure the most pressing community needs are prioritized and the interventions are highly acceptable.

Looking forward, more work can be done to understand how community health workers and other community leaders can be engaged to improve access to malaria education, interventions, support medication adherence, and contribute to sustainability. Additional evidence of how centering community perspectives and experiences in the design, implementation, and evaluation contributes to more robust community-based research and programmatic interventions is also needed. Finally, future pre-intervention evaluations should be aware that asking experts to predict the acceptability of community interventions may be less valuable or accurate than soliciting perspectives directly from community members.

Abbreviations

AL – artemether lumefantrine

CRCT – cluster-randomized controlled trial

DDT - Dichlorodiphenyltrichloroethane

EA – enumeration area

FGD – focus group discussion

HIV – human immunodeficiency virus

IRS – indoor residual spraying

KI – key informant

KII – key informant interview

LLIN – long-lasting insecticide-treated net

MoHSS – Ministry of Health and Social Services

NGO – Non-governmental organization

RACD – reactive case detection

RAVC – reactive focal indoor residual spraying

rfMDA – reactive focal mass drug administration

RDT – rapid diagnostic test

Declarations

Ethical approval and consent to participate

The University of California, San Francisco (UCSF) (148728 and 15-17422), The London School of Hygiene and Tropical Medicine (10411), the University of Namibia (MRC/259/2017), and the Namibia Ministry of Health and Social Services (17/3/3) approved this study. The University of Texas, Southwestern relied on the UCSF approval. Consent for participation and to audio-record in KIIs and FGDs was received verbally from all participants. Written informed consent was obtained to collect quantitative data.

Consent for publication

Not applicable

Availability of data and material

All data analyzed for this article are co-owned by the Namibian Ministry of Health and Social Services and the University of Namibia. The de-identified data are available from the corresponding author upon reasonable request.

Competing interests

The authors declare no competing interests.

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Authors' Contributions

K.R. led study design, implementation, analysis. C.S.G. and K.B. co-led analysis and K.B. co-led study design. K.R. led, and C.S.G. and M.S.H supported the manuscript writing. P.M. and A.M supported implementation and analysis. B.W. supported analysis of quantitative data. P.U., D.M., and I.M. contributed to study design and oversight. R.G. and M.S.H. conceptualized the study. M.S.H. provided oversight. All authors read and approved the final manuscript.

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