Prevention and control of cholera in complex emergencies in Sub-Saharan Africa: evaluating the effectiveness of water, sanitation and hygiene interventions used by Médecins Sans Frontières

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Thesis submitted in accordance with the requirements for the degree of Doctor of Philosophy of the University of London, October 2021

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Declaration

I, Lauren D'Mello-Guyett, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Date	1/10/21

Abstract

Across Sub-Saharan Africa, an estimated 430 million people are at risk of cholera. Cholera will continue to challenge health systems in affected regions until access to safely managed water, sanitation and hygiene (WASH) services is expanded. Populations in many African countries experience concurrent humanitarian crises including natural disasters, civil conflict or war, malnutrition and food insecurity and economic crises or chronic poverty that further exacerbates the risk of both transmission and case-fatality of cholera.

Efforts to control cholera across Sub-Saharan Africa have almost exclusively been reactive. Although essential, the variation in intervention strategies between epidemics and reliance on operational memory to implement emergency responses is not sufficient to guarantee success of a control programme. Controlling cholera comes with several disease-specific challenges due to its diverse transmission dynamics, the lack of specific symptoms and the insufficiency of any single intervention to sustainably control cholera. Case-area targeted interventions (CATI) are gaining traction on the premise that fast, localised response could significantly reduce transmission and control epidemics. Generation of evidence supporting the choice of interventions to include in CATI responses, and on interventions that could be systematically used by organisations for cholera preparedness and control in hotspots, is required.

By integrating quantitative and qualitative methods for evaluating public health interventions, this thesis provides evidence on the effectiveness and implementation of a case-targeted WASH response to cholera in the Democratic Republic of Congo, working alongside Médecins Sans Frontières, UNICEF and the Ministry of Health, and reviews both normative guidelines for and previous experience of implementing cholera response programmes. After estimating the effect of a hygiene kit and health promotion distributed to cholera-case households, this thesis demonstrates how measuring and valuing the populations' response to and the challenges among implementation bring new insights to the effectiveness and delivery of emergency, case-targeted cholera responses.

Acknowledgements

I would not have been able to undertake and continue this PhD journey without the support of my friends and family. Their patience, encouragement and humour during this process has been invaluable. Thanks, Mama, for all you did. A daughter with a PhD is not bad for the immigrant single parent mother statistics. To the rest of FamJam, thanks for your love and support especially all the holidays, meals, and mockery. Thank you to my favourite people in the world- to Laaarveley, Ladies of London, LGS, The Disease Controllers, and Scotland, I couldn't ask for a better group of pals around me when things get tough and when I need to laugh at life or laugh at myself. Thanks to some old and new friends not included in the above groups, in particular– to Sarah, Rachelle, Sian, Ailie, Jackie, Karin, Vicki, Faith, Marie, Rachael, Caroline, Rich, Mike, Ziz, Ben, Chris, Helen, Jack, Eric, Corey, Dan and Rob. And anyone else I've forgotten to mention.

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Thank you to my colleagues at Médecins Sans Frontières (MSF), particular in DRC, for their dedicated collaboration and putting up with my ridiculous French. I have been incredibly fortunate to be supported by Peter Maes, Rob D'hondt and Rafael Van Den Bergh since day one. Their belief in this project and in me is irreplaceable and I honestly think we wouldn't have been able to pull this off without Peter's tenacity or Rob's stamina for yet another meeting. Thank you to my team in DRC. An exceptional group of individuals who supported the research although they weren't always sure. Thank you to Brunnette Nakoka, Jeannette Luthala, Gaspard Tapo, Denis Lungi, Kalume Kalumwendo, Noel Mufumbele, Rollin Ndombe, Noè Kanyinda, Ali Luyeye,

Paul Mukendi, Dieu Donne Kashala, Emmanuel Kayembe, Benoit Kabeya and Yvonne Tshibwaya and our fleet of 20 motorcycle drivers in Kasaï-Oriental. And last but by no means least, I thank the participants and communities of Kasansa, Kasaï-Oriental, DRC for their support for this study. The funding for the PHD and fieldwork costs from MSF are also gratefully acknowledged.

To my supervisor, Francesco Checchi. First, thank you for agreeing to be my supervisor and supporting me through every step of the planning and analysis. You walked me through the chaos and supported me to figure out what on earth to do with my data. I'm not sure if you knew what you'd be getting into, or how many times I would cry in your office but thanks for sticking with me. Second, you have exceptional taste in comedy YouTube videos, and I would not have known about What We Do In the Shadows if it wasn't for my cohort study analysis and all the tears. My analytical skills are substantially improved after this relentless journey of the PhD, and you helped me bridge the world of academic and practice research. I was a pleasure to be your student for the last five years.

To Oliver Cumming, well, what can I say. My writing and analytical brain are both unrecognisable after all your advice, critique, and gentle nudging in the right direction. You took a chance with me and for that I'll forever be thankful. You have been the rudder to this work from before day one. A constant when everything was chaos. It would be impossible to imagine what this PhD would have been without your support. I probably owe you at least five kegs of beer by now and a bonus one this year. But for now, all I can say is thank you. From the words of the great Mushashi, passed on to me by Ollie on the day I enrolled onto the PhD, "*you must understand that there is more than one path to the top of the mountain*". I should have known that this wouldn't have been an easy journey when he followed up with "*Meditation on inevitable death should be performed daily. Every day when one's body and mind are at peace, one should meditate upon being ripped apart by arrows, rifles, spears, and swords, being carried away by surging waves, being thrown into the midst of a great fire, being struck by lightning, being shaken to death by a great earthquake, falling from thousand-foot cliffs, dying of disease, or committing seppuku at the death of one's master. And every day without fail one should consider himself as dead*." I think the last part of that quotation sums up my PhD experience perfectly. Thank you.

In memoriam

This thesis thanks Dr Jeroen Ensink, my mentor and Senior Lecturer of the Environmental Health Group at LSHTM, who tragically died before I started both my job at LSHTM and this PhD. A phone call and a beer in the pub with Jeroen convinced me of this project, without which I would not have embarked on this journey. And thanks to Ollie, as always, who picked up the pieces in January 2016 and said yes over an espresso, a mint tea and some tears.

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Table of Abbreviations

ACF	Action Contre la Faim
CATI	Case Area Targeted Interventions
CFR	Case Fatality Rate
COREQ	Consolidated Criteria for Reporting Qualitative Research
CMR	Crude Mortality Rate
CT	Cholera Toxin
CTC	Cholera Treatment Centre
CTU	Cholera Treatment Unit
DRC	Democratic Republic of Congo
GTFCC	Global Task Force on Cholera Control
HCF	Health Care Facility
ICDDR'B	International Centre for Diarrhoeal Disease Research Bangladesh
IFRC	International Federation of Red Cross and Red Crescent Societies
IV	Intravenous Solution
LMIC	Low- and Middle-Income Countries
LSHTM	London School of Hygiene and Tropical Medicine
MSF	Médecins Sans Frontières
NGO	Non-Governmental Organisation
NPO	Non-Profit Organisation
OCV	Oral Cholera Vaccination
ORS	Oral Rehydration Solution
PRISMA-ScR	Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews
RCT	Randomised Controlled Trials
RDT	Rapid Diagnostic Test
SDG	Sustainable Development Goal
SIR	Susceptible-Infected-Recovered Model
STROBE	Strengthening Reporting of Observational studies in Epidemiology
UN	United Nations
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Structure of the thesis

This thesis by research paper is structured in three parts.

Part One consists of an introduction incorporating a brief literature review as background to the four chapters included as papers and provides a description of the research questions addressed in this thesis. Table 1 summarises the four journal articles that form part of this thesis, and Table 2 summarises the ongoing dissemination activities being undertaken to engage policy and practice actors in the sector.

Part Two contains the three peer-reviewed published journal articles and one submitted journal article, one of which is the required systematic literature review component of the thesis.

Part Three draws together the research findings across the four papers and provides a summative discussion of implications and recommendations for future research.

Part One

Introduction

Cholera: the disease and the disease burden

Epidemic cholera is a major global health challenge affecting many parts of the world and cholera epidemics often coincide with armed conflict and humanitarian crises (1), including those in the Democratic Republic of Congo (DRC) (2), South Sudan (3, 4) and across other sub-Saharan African countries (5-8). Cholera is one of the oldest known documented infectious diseases (9). Originating in South Asia, cholera spread beyond the Ganges delta in 1817 and six pandemics of cholera emerged from the Bay of Bengal between 1817-1923 (10, 11). The ongoing seventh pandemic began in 1961 and has persisted for 60 years (7, 12).

Caused by the toxigenic bacteria *Vibrio cholerae* O1 and O139 and its secreted cholera toxin (CT), cholera is a disease transmitted by the faecal-oral route and is characterised by rapid onset, profuse watery diarrhoea with fluid loss of up to 20 litres per day (10-12). With appropriate case management (including oral rehydration solution (ORS), rehydration through intravenous solutions (IV), oral antibiotics and food), mortality can be kept below 1% but without treatment case fatality ratios (CFR) can be as high as 50-60% (11, 13). Incubation periods for cholera can be between a few hours to five days, and most cases (60-80%) are asymptomatic (14). Symptomatic individuals with cholera can excrete up to 1,000,000 bacterial cells per ml of stool and asymptomatic individuals can excrete 100-100,000 cells/ml for up to 14 days post-infection (15, 16). Cholera infection can last from 3 to 14 days (17).

Annually, there are an estimated 2.9 million (1.3-4.0 million uncertainty range) cases of cholera worldwide resulting in 95,000 deaths (21,000-143,000 uncertainty range) (18). The disease is estimated to be substantially underreported, particularly from South Asia where much of the burden originates (19). In 2019, the World Health Organization (WHO) reported 923,037 cases of cholera across 55 countries, 1911 deaths and an overall 0.2% CFR (20). Cases were reported from all WHO regions, the African region accounting for 88.9% of the reported burden. Across Sub-Saharan Africa, an estimated 430 million people are at risk of cholera (18). Depending on the

incidence rate each year, the economic burden of cholera can be between $68 million and $2.4 billion inclusive of hospital or facility costs, diagnosis, medicines, costs borne by patients and households, productivity losses and other losses such a loss in tourism income or export revenues (21, 22). Cases in Africa typically cluster in the lacustrine areas of the African Great Lakes and the Chad River Basin (6, 7, 23). Genomic insights have demonstrated that toxigenic *V. cholerae* can be reintroduced into the population, and DRC (24), for months or years (25-28).

Transmission and risk factors

In 1855, John Snow is credited with first demonstrating the transmission of cholera by drinking water (29). Since then, many studies have explored other potential transmission routes and risk factors for cholera infection. Today, we understand that infection with *V. cholerae* can originate from a susceptible person ingesting the bacteria directly from environmental point sources (e.g. contaminated water in lakes and rivers, or a faecal-contaminated environment) (30-35) or horizontally, through human-to-human transmission between infected and susceptible individuals and consuming food or water that has been contaminated by a cholera case or through caring for cases (36-38) (Figure 1).

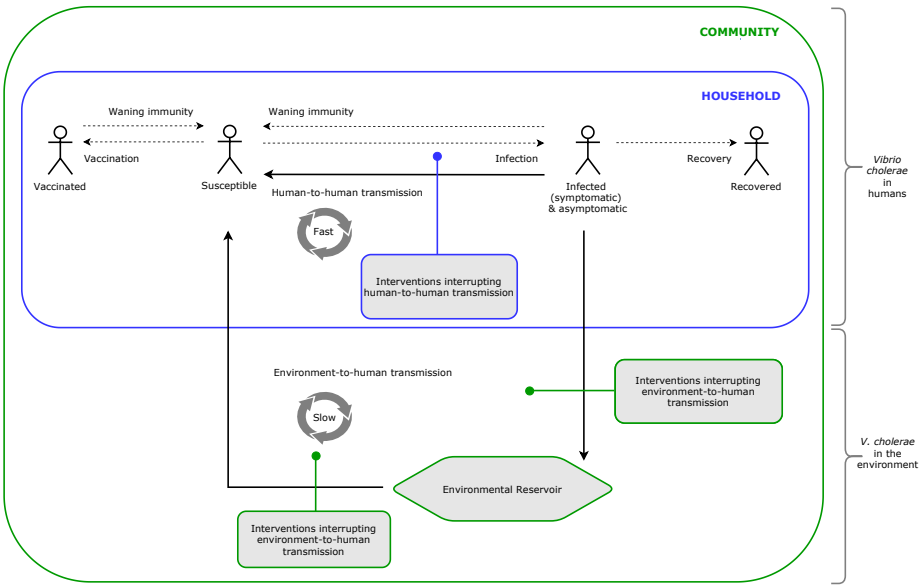

Figure 1. Pictorial representation of cholera transmission within the household and at the community-level, incorporating the human-to-human and environment-to-human pathways of transmission

Transmission models that only feature environment-to-human transmission struggle to explain the steep rise in case numbers usually seen in epidemics (33, 39, 40). Several studies have found that household contacts of cholera cases are at 100 times higher risk of becoming infected than the general population (41-44), particularly during the first 7-10 days after a cholera case becomes symptomatic or after seeking care at a health care facility (HCF) (16, 41, 42). This intrahousehold transmission is due to the prolific shedding of *V. cholerae* by symptomatic and asymptomatic cases (11, 45, 46), and to the multiple transmission routes available within household settings (36). Research on the genomics of cholera transmission has also demonstrated strong phylogenetic similarities among cases from the same household and 80% of transmission is said to occur within the household (38, 47, 48). Beyond the household, significant clustering of cases has been observed to within 200m of case-households during the first five days after a case becomes symptomatic (49-52).

Prevention and control

In the aftermath of a large cholera epidemic among refugees in Goma, Zaire in 1994 (53, 54), the international community mobilised to develop guidelines and standards for humanitarian assistance and cholera prevention and control. Though such normative efforts date back at least to the 1980s, the creation of the Sphere Project in 1997 helped to set globally applicable evidence-based minimum standards for humanitarian responses that were largely accepted by the international community (55). These standards have now been incorporated into the manuals and guidelines of other organisations for both general humanitarian response and specifically in cholera prevention and control (56-62).

Cholera epidemics continue to challenge and overwhelm health systems in low-and middle-income countries (LMICs) and are viewed as a serious threat for crisis-affected populations. As with the Soho epidemic studied by John Snow (29), these settings experience epidemics with regularity because of inadequate water, sanitation and hygiene (WASH) services and practices (36, 63), and CFRs are often high due to poor nutritional status (64), other comorbidities (65) and limited access to adequate case

management. Coordinated responses to epidemics, particularly in crisis-affected contexts where recurrent or large epidemics have occurred (4, 52, 66-74), are required to prevent serious loss of life and considered critical to achieving the objectives of the WHO-led Global Task Force on Cholera Control (GTFCC).

In 2017, 20 years on from the Sphere Project, the GTFCC launched an international plan for the elimination of cholera entitled, "*Ending Cholera: A Global Roadmap to 2030*" (75). It proposed to strengthen health systems, WASH and coordination strategies for cholera control in LMICs. By 2030, the GTFCC aims to reduce cholera mortality by 90% and eliminate the disease in 20 of the 47-cholera affected countries. The renewed focus on cholera provides a framework for synchronising the efforts of countries, donors, implementing agencies and support coordinated multisectoral implementation of cholera control measures (76). The strategy has three axes: 1) to focus on cholera hotspots in endemic countries with well targeted interventions; 2) to reinforce early detection and response to contain epidemics quickly; and 3) to provide an effective mechanism for coordinated technical support, financing and resources at the global and country level (77).

Case-targeted prevention and control

Strategies to tackle cholera in endemic and epidemic settings have commonly entailed mass-delivered, population-wide interventions targeting large areas at risk from infection. While it is accepted that investments in WASH services and practices would lead to the elimination of cholera, as typified by the elimination of the disease in Europe and the Americas (76, 78, 79), there is a paucity of evidence to support which WASH interventions are most effective to reduce incidence of cholera and how those interventions can be delivered most effectively and efficiently (80-102). Of the published evaluations of the effect of WASH interventions on cholera incidence (**Table 1**), reductions in cholera incidence have varied between 25-75%. Studies have have been of variable study quality and predominantly evaluate community-wide interventions (80, 83-85, 88) rather than case-targeted strategies for effective disease reduction (81, 86).

Although sustainable access to safe WASH remains the foundation for sustainable cholera control, case-targeted WASH interventions that rapidly contain and control cholera may have an important role. Case-targeted approaches can take advantage of the natural spatiotemporal clustering of cases in households and surrounding areas to curb transmission in the short term. In 2017, the GTFCC proposed control strategies which emphasise the use of rapid response teams to deliver case-area targeted interventions (CATI) in a radius around detected cases. A recent review of CATI responses found that delayed detection, confirmation and response can considerably dampen the impact of CATI-like approaches, with delays of >2 weeks expected to result in spill-over beyond the initial epidemic cluster (74). Interventions falling under the CATI approach seek to contain epidemics before they propagate widely, include case-based or localised distribution of WASH interventions, oral cholera vaccination (OCV) (103-105) or antibiotic prophylaxis (106), and are particularly dependent on early response, as is case management of cholera cases (54, 107).

Table 1. Summary of published studies evaluating the effect of WASH interventions on cholera incidence					
Study	**Study setting**	**Intervention strategy**	**Intervention**	**Study design and sample size**	**Reported effect on cholera incidence**
Azurin & Alvero (1974)	Philippines, endemic, non-crisis	Community targeted prevention and control	Improved water supply and sanitation facilities	Non-randomised controlled trial: 4 communities in Bacolod city	Improved sanitation compared to control observed a 68% reduction in cholera incidence. Improved water supply compared to control observed a 73% reduction. Improved water supply and sanitation observed 65% reduction. No statistical analysis was provided
Deb et al (1986)	India, endemic, non-crisis	Case-targeted prevention and control	Safe water storage containers	Non-randomised controlled trial: 91 families of index cases residing in Calcutta slums	Use of the safe storage containers compared to controls saw a 75% reduction in cholera incidence ($p<0.001$). Chlorination compared to controls observed a 58% reduction ($p<0.01$)
Conroy et al (2001)	Kenya, epidemic, non-crisis	Community targeted prevention and control	Solar disinfection bottles (POU water treatment)	Randomised controlled trial (RCT): 155 and 144 Maasai children <6yrs randomised to solar disinfection (67 households) or control (64 households)	Solar disinfection saw a reduction in cholera incidence compared to controls: adults RR1.2 (95%CI 0.59-2.5); children aged 6-15yrs RR1.09 (95%CI 0.58-2.05); and children <5yrs RR0.12 (95%CI 0.02-0.65).

Table 1. Continued					
Colwell et al (2003)	Bangladesh, endemic, non-crisis	Community targeted prevention and control	Sari and nylon (POU water treatment)	Non-randomised controlled trial: 133,000 people in rural Matlab to intervention groups: sari (27 villages), nylon (25 villages) or control (13 villages)	Sari households compared to control households saw a 48% reduction in cholera incidence ($p < 0.001$). Nylon households compared to control observed a 41% reduction ($p < 0.02$).
Huq et al (2010)	Bangladesh, endemic, non-crisis	Community targeted prevention and control	Sari filtration and filters (POU water treatment)	Cross-sectional study: 7,470 rural women in Matlab	Filters compared to controls saw a 25% reduction in cholera incidence (not statistically significant)
George et al (2016)	Bangladesh, endemic, non-crisis	Case-targeted prevention and control	Hygiene kits: chlorine tablets (POU water treatment) and safe water storage, cholera IEC, soap, soap bottles and hand washing stand	RCT: 168 cholera patients; 168 households with 445 household contacts in Dhaka	Intervention arm saw 47% reduction of symptomatic and asymptomatic cholera incidence in household contacts (OR0.5, 95%CI 0.21-1.18) compared to controls ($p<0.001$)

Table 1. Continued					
Najnin et al (2017)	Bangladesh, endemic, non-crisis	Community targeted prevention and control	Handwashing stand, soap, soapy bottles and liquid cholerine (POU water treatment), and oral cholera vaccination (OCV)	RCT: 90 neighbourhood clusters; 149,839 people in the OCV group, 147,222 OCV and WASH, and 145,821 controls	Hospitalisation rates were similar across the study areas [events/1000 person-years, 95% confidence interval (CI), cholera-vaccine-only: 9.4 (95% CI: 8.3–10.6); vaccine-plus-behaviour-change: 9.6 (95% CI: 8.3–11.1); control: 9.7 (95% CI: 8.3–11.6)]. There was no effect of OCV or WASH on diarrhoea-associated or cholera-associated hospitalisation.

Rationale for the PhD

Despite a wide body of evidence evaluating the effectiveness of WASH interventions on endemic diarrhoeal diseases (63), there are few studies investigating the impact of WASH interventions on endemic or epidemic cholera. Additionally, whilst work has sought to either define packages of care for CATI (8, 81, 108) or to investigate the speed or area at which interventions should be delivered (50, 74, 108-112), there is currently no agreed standard of which WASH interventions to include for cholera control and the need for further research on effective WASH interventions for CATI and other response approaches has been signalled as priority (113, 114).

Many of the published studies on WASH interventions for cholera control have methodological limitations, including insufficiently defined health or behavioural outcomes, and do not provide a strong evidence base to guide WASH policy and practice. To a large extent, this is a result of the difficulties associated with conducting research in epidemics and crisis contexts (115-121) but also reflects a reliance on operational experience rather than independent evaluation (122). Research published on WASH and cholera is dominated by studies on household point of use (POU) water treatment, with little exploration of the health and social impacts of other WASH interventions (80-102). Broadly speaking, the current practices and policies for cholera response are not supported by a high-quality evidence base and the current evidence base particularly does not support swift decision making on which WASH interventions to deploy in case-targeted responses to cholera epidemics.

The rationale for this thesis was to develop evidence on which interventions would be appropriate and effective to include in case-targeted cholera responses by quantifying the effectiveness of selected WASH interventions for cholera control. Specifically, this thesis focussed on the distribution of a hygiene kit, containing a 20 L water container, POU water treatment, soap and a handwashing device coupled with health promotion messaging, which were both designed to address multiple routes of cholera transmission. MSF has utilised the kit since 2017 but there is no evidence on its effectiveness for cholera control. This thesis also addresses overall challenges within cholera responses, such as timeliness and coverage of interventions and the lack of

consistent and rigorous evaluations in humanitarian practice, and how intervention effectiveness will be mediated by the context in which programmes are delivered.

Thesis aim

The overall aim of this thesis was to evaluate the effectiveness against cholera of a case-targeted hygiene kit currently used by Médecins Sans Frontières (MSF) in crisis contexts and to make recommendations to improve cholera response programmes in subsequent humanitarian crises in light of the current normative landscape and operational constraints to cholera epidemic responses.

Thesis research questions

Specifically, this thesis research sought to address the following research questions:

1. Are current international WASH guidelines for cholera prevention and control consistent and reflect recent evidence on cholera transmission?

2. What is the effectiveness of a case-targeted WASH intervention delivered by MSF in response to a cholera outbreak in DRC?

3. What factors affect the implementation of a case-targeted WASH intervention delivered by MSF in response to a cholera outbreak in DRC?

4. What factors affect the timeliness of cholera responses and implementation of WASH and other health interventions by MSF during responses to cholera outbreaks?

Collaborating organisations and funding

This thesis was part of a collaboration between the London School of Hygiene and Tropical Medicine (LSHTM) and MSF, and is inscribed within a wider strategy in the WASH sector to expand the evidence-base for interventions delivered in humanitarian crises. The project was funded by MSF between 2016-2020. Other in-country collaborators of the work included UNICEF and the Ministry of Health in DRC who oversaw data collection in DRC and assisted with the disssemination of the research findings by sharing project reports, contributing to peer-reviewed publications and hosting in-country meetings to discuss study implications.

I led all elements of the research in this thesis, with the support and advice of my supervisors, advisory committee and colleagues at MSF and LSHTM.

Ethical approval

All study procedures were approved by the Research Ethics Committee of LSHTM (No. 14425 and 17994), the Kinshasa School of Public Health at the University of Kinshasa, DRC and the Comité National d'Ethique de la Santé, DRC (No. 67/CNES/BN/PMMF/2018) and the international ethics board of MSF (No. 1805b, 1805c including a letter of exemption for Research Paper 4). All participants of the studies provided written informed consent to participate. All personal identifiers were removed from datasets and deleted. All audio recordings were deleted after verification of transcripts. All participant information sheets and informed consent forms for the study procedures are attached in Appendix E. All ethical approval certificates are attached in Appendix F.

Dissemination

Between 2016-2021, I have made various efforts to disseminate and present the research from this PhD. Table 2 describes the activities undertaken.

Table 2. Studies included as part of this PhD submission								
#	Study title	Study design	Study site	Collaborating organisations	Year published/ submitted	Journal	Citation	Publication Link
1	Prevention and control of cholera with household and community water, sanitation and hygiene (WASH) interventions: a scoping review of current international guidelines	Scoping review	n/a	World Health Organization (WHO), UNICEF, MSF and LSHTM	2020	PLOS ONE	(123)	Link
2	Effectiveness of hygiene kit distribution to reduce cholera transmission in Kasaï-Oriental, Democratic Republic of Congo: a prospective cohort study	Prospective cohort study	Democratic Republic of Congo (DRC)	Ministry of Health (DRC), UNICEF, MSF and LSHTM	2021	BMJ Open	(124)	Link
3	Distribution of hygiene kits during a cholera outbreak in Kasai-Oriental, Democratic Republic of Congo: a process evaluation	Process evaluation	Democratic Republic of Congo (DRC)	MSF and LSHTM	2020	Conflict and Health	(125)	Link
4	Identifying transferable lessons from cholera epidemic responses by Médecins Sans Frontières in Mozambique, Malawi and the Democratic Republic of Congo, 2015-2018: a scoping review	Scoping review	Democratic Republic of Congo (DRC), Malawi and Mozambique	Ministry of Health (DRC), UNICEF, MSF and LSHTM	2021	BMJ Global Health	n/a	Submitted

Table 3. Dissemination activities undertaken in the cholera, humanitarian, and WASH sectors as part of the PhD programme			
#	**Study title**	**Organisation / Event**	**Audience**
1	Prevention and control of cholera with household and community water, sanitation and hygiene (WASH) interventions: a scoping review of current international guidelines	Emergency Environmental Health Forum, 2019	Academic, Non-governmental organisations (NGO), United Nations (UN) and donor agencies
		Global Task Force on Cholera Control, 2020	
2	Effectiveness of hygiene kit distribution to reduce cholera transmission in Kasaï-Oriental, Democratic Republic of Congo: a prospective cohort study	Emergency Environmental Health Forum, 2018	Academic, NGO, UN and donor agencies
		Emergency Environmental Health Forum, 2021	
		Global Task Force on Cholera Control, 2021	
		Médecins Sans Frontières, Belgium, 2021	NGO
		Médecins Sans Frontières, DRC, 2021	NGO
		International Federation of the Red Cross and Red Crescent Societies (IFRC), Switzerland and UK, 2021	NGO
3	Distribution of hygiene kits during a cholera outbreak in Kasai-Oriental, Democratic Republic of Congo: a process evaluation.	Emergency Environmental Health Forum, 2019	Academic, NGO, UN and donor agencies
		Médecins Sans Frontières, Belgium, 2020	NGO
		Global Task Force on Cholera Control, 2020	Academic, NGO, UN and donor agencies
		Médecins Sans Frontières, Belgium, 2021	NGO
		Médecins Sans Frontières, DRC, 2021	NGO
		IFRC, Switzerland and UK, 2021	NGO
4	Identifying transferable lessons from cholera epidemic responses by Médecins Sans Frontières in Mozambique, Malawi and the Democratic Republic of Congo, 2015-2018: a scoping review	n/a	n/a

Part Two

Research Paper 1: Prevention and control of cholera with household and community water, sanitation and hygiene (WASH) interventions: a scoping review of current international guidelines

This scoping review highlights the limited concordance across international guidelines for cholera prevention and control. It summarises the full list of recommended WASH interventions from the current eight international guidelines, and concludes that future editions of guidelines should reflect on the inclusion of evidence-based approaches and the growing evidence on cholera transmission.

This chapter is supplemented by Appendix A summarising the full list of recommendations extracted across guidelines, search strategy, search terms, excluded guidelines and the results according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).

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RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed <u>for each</u> research paper included within a thesis.

<u>SECTION A – Student Details</u>

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RESEARCH ARTICLE

Prevention and control of cholera with household and community water, sanitation and hygiene (WASH) interventions: A scoping review of current international guidelines

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Abstract

Introduction

Cholera remains a frequent cause of outbreaks globally, particularly in areas with inadequate water, sanitation and hygiene (WASH) services. Cholera is spread through faecal-oral routes, and studies demonstrate that ingestion of *Vibrio cholerae* occurs from consuming contaminated food and water, contact with cholera cases and transmission from contaminated environmental point sources. WASH guidelines recommending interventions for the prevention and control of cholera are numerous and vary considerably in their recommendations. To date, there has been no review of practice guidelines used in cholera prevention and control programmes.

Methods

We systematically searched international agency websites to identify WASH intervention guidelines used in cholera programmes in endemic and epidemic settings. Recommendations listed in the guidelines were extracted, categorised and analysed. Analysis was based on consistency, concordance and recommendations were classified on the basis of whether the interventions targeted within-household or community-level transmission.

Results

Eight international guidelines were included in this review: three by non-governmental organisations (NGOs), one from a non-profit organisation (NPO), three from multilateral organisations and one from a research institution. There were 95 distinct recommendations identified, and concordance among guidelines was poor to fair. All categories of WASH interventions were

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featured in the guidelines. The majority of recommendations targeted community-level transmission (45%), 35% targeted within-household transmission and 20% both.

Conclusions

Recent evidence suggests that interventions for effective cholera control and response to epidemics should focus on case-centred approaches and within-household transmission. Guidelines did consistently propose interventions targeting transmission within households. However, the majority of recommendations listed in guidelines targeted community-level transmission and tended to be more focused on preventing contamination of the environment by cases or recurrent outbreaks, and the level of service required to interrupt community-level transmission was often not specified. The guidelines in current use were varied and interpretation may be difficult when conflicting recommendations are provided. Future editions of guidelines should reflect on the inclusion of evidence-based approaches, cholera transmission models and resource-efficient strategies.

Introduction

Cholera remains a major public health threat in many parts of the world [1], particularly in areas facing complex emergencies [2–4]. Cholera outbreaks generally occur when water, sanitation and hygiene (WASH) services are inadequate or compromised [3, 5–14], and cholera remains a leading cause of disease outbreaks globally [15–17], with an increasing rate and intensity [18]. Originating in the Indian Subcontinent, cholera spread beyond the Ganges delta in 1817, and the current and ongoing seventh pandemic of *Vibrio cholerae* El Tor began in 1961 [19]. Adjusting for incomplete reporting, some 2.9 million cholera cases (1.3–4.0 million uncertainty range) and 95,000 deaths (21,000–143,000 uncertainty range) are estimated to occur across 69 cholera-endemic countries annually [20]. Sub-Saharan Africa and South Asia account for the largest proportion of global cholera morbidity and mortality [18, 21], with many cities acting as transmission hotspots [21–24].

Diarrhoeal diseases such as cholera are transmitted through the faecal-oral route. Infection with *V*. *cholerae* can originate from a susceptible person ingesting the bacteria from environmental point sources (e.g. contaminated water in lakes and rivers, or a faecal-contaminated environment) [25]: this is known as the environment-to-human transmission pathway [26, 27]. Infection with *V*. *cholerae* can also occur between infected and susceptible individuals [28, 29], from consuming contaminated food [30–37] or water at the point of use (POU) [37–43] that has been contaminated by a cholera case or through caring for existing cholera cases, particularly among household contacts of a case [28]: this is known as the human-to-human transmission pathway. During outbreaks, recurrent environment-to-human reinfection of the population may also occur through ingestion of *V*. *cholerae* through contaminated environmental point sources, due to sustained contamination of the environment by symptomatic and asymptomatic cholera cases [25, 44, 45]. Both transmission pathways occur through the faecal-oral routes of diarrhoeal disease transmission commonly known as the F-diagram [46].

Transmission models that only include ingestion of *V*. *cholerae* through environmental point sources, or environment-to-human transmission, cannot explain the steep rise in case numbers usually seen in outbreaks [27, 45, 47]. Spatiotemporal analyses of cholera in endemic and epidemic settings have instead demonstrated clusters of cases within 200m distances of case-households during the first five days after index cases present with symptoms [48–50],

and a 100-fold higher risk of household contacts of cases to contract the disease compared to those outside the household [43, 51–54]. Research on the genomics of cholera transmission has also demonstrated strong phylogenetic similarities among same-household cases [43, 55–58], and a recent paper found 80% of transmission occurs between people who share a household [55]. Accordingly, faecal-oral transmission of cholera within the household, predominantly through the human-to-human transmission pathway, may far better explain the propagated and explosive nature of cholera outbreaks than community-level transmission from exposure to environmental point sources and environment-to-human transmission [27, 29, 45, 59–62].

These relatively recent findings suggest that efforts to prevent and control cholera could benefit from focusing on the domains of transmission: within-household and community-level. Typically, cholera response measures for prevention and control have included a mix of WASH interventions, Oral Cholera Vaccination (OCV) and, in some cases, prophylactic antibiotics. Strategies that seek to control and contain cholera outbreaks in epidemic and endemic settings could implement these measures to the household–delivered through case-centred strategies (i.e. delivery of interventions to cases and their households or close contacts) or case area targeted interventions (CATIs) (i.e. delivery of interventions to a defined area surrounding cases) [47]–and take advantage of the natural clustering of cases within a given distance and effectively reduce within-household transmission [44, 49, 63]. Whereas strategies that seek to prevent cholera could implement community-level measures–potentially aligning resources with longer term WASH-related disease control efforts [64]–and effectively reduce environment-to-human transmission during outbreaks [65, 66] and prevent disease among populations deemed to be at an elevated risk of recurrent cholera [21]. Targeted approaches would also be efficient across resource-limited contexts, as part of a phased approach or in contrast to mass intervention campaigns [67].

There is currently global momentum to tackle cholera and an internationally agreed road map to eliminate the disease by 2030 [68]. While it is accepted that large scale investment in water and sanitation infrastructure in Europe and the Americas led to the elimination of cholera and a reduction in other diarrhoeal diseases [63, 66, 69–89], there is a paucity of evidence to support which WASH interventions are most relevant for cholera prevention and control in currently cholera-affected populations [70, 90]. Multiple WASH guidelines exist for cholera prevention and control in both endemic and epidemic settings. However, the guidelines used in low- and middle-income countries (LMICs) vary considerably between and within international organisations and it is unclear to what extent these guideline recommendations are predicated upon experience rather than published evidence. Whilst appropriate cholera responses will always be specific to the geographical and social context, it is important that these responses are informed by the best possible evidence and updated models of cholera transmission or, in the absence of rigorous evidence, a combination of theoretical reasoning, best operational judgement and documented practice, even if unpublished [91–93].

Given the above, we conducted a scoping review of current, international and accessible WASH guidelines for cholera prevention and control to analyse consistency and concordance among recommended interventions, and to assess how guidelines seek to prevent and control cholera whilst aligning with current conceptual models of cholera transmission, in order to make recommendations for their improvement.

Methods

Search strategy

The search strategy sought to identify all relevant international guidelines (published and in press) and was limited to English and French languages. The review is reported according to

the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines [94]. The review was not pre-registered prior to publication.

The websites of organisations who typically respond to cholera were searched, including the Global WASH Cluster (GWC), World Health Organization (WHO), United Nations Children's Fund (UNICEF), United Nations High Commissioner for Refugees (UNHCR), International Organization of Migration (IOM), Médecins Sans Frontières (MSF), Oxfam, International Committee for the Red Cross and Red Crescent (ICRC), International Federation of the Red Cross and Red Crescent Societies (IFRC), Action Contre la Faim (ACF), Care International, Save The Children, Norwegian Refugee Council, the Sphere Project, United States Centers for Disease Control and Prevention (CDC) and International Centre for Diarrhoeal Disease Research Bangladesh (ICDDR'B).

Reference sections of guidelines were hand-searched for any additional relevant guidelines. Journal articles did not meet the inclusion criteria for this review and reference databases were not searched for guidelines. A full list of websites searched can be found in S1 Appendix. Prior to searching organisations' websites for available guidelines, a research librarian assisted in the development of search terms and, in collaboration with the authors, provided advice on organisations where guidelines could be found. Search terms have been provided in S2 Appendix.

Inclusion and exclusion criteria

Guidelines were eligible for inclusion if they were available after 1999 and up to and including January 2019, and recommended interventions for cholera prevention and control. Only household- and community-level WASH interventions were included. Any guideline in which interventions were proposed for high-, middle- or low-income countries was included in the review.

Guidelines for infection prevention and control (IPC) or WASH in Cholera Treatment Centres or Units (CTCs or CTUs) or Health Care Facilities (HCFs) were excluded as these will be addressed in a separate review. Guidelines published in languages other than English or French, guidelines for non-human subjects or for other water-related or outbreak-prone diseases were excluded. Historical versions of guidelines that have been subsequently updated, and have been assumed by the authors to be no longer in use, and country-specific guidelines were also excluded from the review.

Data extraction and analysis

All retrieved documents were transferred to Endnote X9 (Clarivate Analytics, Boston, USA) and de-duplicated. Records were screened according to the inclusion criteria described. Data were extracted by two reviewers (LDG and KG) and cross-checked for accuracy. Any disagreement between reviewers was resolved through discussion and consensus. Data were extracted into an MS Excel (Microsoft, Redmond, VA, USA) sheet for each of the guidelines on the following: agency/author and year of publication, overall content of the guideline and whether the guideline proposed interventions for urban, rural, endemic and/or epidemic contexts.

Moving through the guidelines chronologically, the evidence synthesis consisted of four stages:

i. extracting all recommendations from the different guidelines and classifying them according to 11 categories of WASH interventions, consistent with definitions used in previous systematic reviews of WASH interventions [95, 96], listed in Table 1;

ii. measuring concordance among guidelines, whereby all recommendations within each WASH intervention category were analysed through a Fleiss' Kappa Statistic (κ) for interrater agreement on a scale from <0 to 1 for perfect agreement [97, 98];

Table 1. Categories and definitions of water, sanitation and hygiene (WASH) interventions included in the review.

WASH intervention category	Definition
Improving the access to water sources and/or quantity of water	Any intervention to provide a new and/or improved water supply or distribution system, or both, i.e. to reduce direct and indirect exposure with contaminated water (e.g. installation of piped water supply, hand pumps, boreholes; installation or extension of distribution networks; water trucking or tankers; and, protection of water sources)
Improving the quality of water: water treatment at source	Any intervention to improve the microbiological quality of drinking water at the source, including: - assessment and monitoring of water quality i.e. microbiological, chemical and physical quality - removing or inactivating microbiological pathogens (e.g. water source level water treatment systems, filtration, sedimentation, chemical treatment, heat treatment, ultraviolet (UV) radiation or flocculation)
Improving the quality of water: point of use (POU) and safe storage	Any intervention to expand use of or improve the microbiological quality of drinking water at the point of use (POU), including: - assessment and monitoring of water quality i.e. microbiological, chemical and physical quality - protecting the microbiological quality of water prior to consumption (e.g. chemical treatment, filtration, heat treatment, flocculation, UV radiation, residual disinfection, protected distribution, improved storage)
Improving the access to and use of sanitation facilities and reducing exposure to faeces	Any intervention to introduce, improve or expand the coverage of facilities for the safe management, disposal and treatment of excreta, i.e. to reduce direct and indirect contact with human faeces (e.g. latrine construction, pour flush, composting or water sealed flush toilet, piped sewer system, septic tank, simple pit latrines, VIP latrine, defecation trenches or use of a potty or scoop for the disposal of child faeces)
Behaviour change interventions to improve personal, domestic and food hygiene practices	Any intervention to improve hygiene, including: - promotion of hygiene behaviours, norms or practices surrounding personal, food and hand hygiene - assessment and monitoring of hygiene behaviours, norms or practices, including adaptation of activities - any named method of delivery of hygiene promotion (e.g. interpersonal channels, house-to-house visits, community meetings, mass and social media, targeted areas or information, education and communication (IEC) materials, or other hygiene promotion activities) - any named theory, framework or technique for hygiene promotion (e.g. behaviour change communication (BCC), community engagement, social marketing and demand creation, integrated hardware)
Distribution of hygiene materials or non-food items (NFIs)	Any intervention that provides hygiene materials or use of hygiene materials (e.g. soap, hygiene kits, handwashing stands, sinks and other facilities)
Promotion or distribution of disinfection and cleaning of households and community spaces and/or materials	Any intervention that provides or distributes disinfection materials (e.g. chlorine spraying, disinfection of clothes, disinfectants, disinfection of bedding or vehicles) or promotes household cleaning (e.g. safe laundry practices, cleaning of floors and furniture)
Improving dead body management and safe funeral practices	Any intervention to improve safe funeral practices, funeral gatherings and management of corpses in the community

(*Continued*)

Table 1. (Continued)

WASH intervention category	Definition
Improving the management of wastewater and faecal sludge	Any intervention to improve management of wastewater and faecal sludge
Provision of interventions that improve solid waste disposal	Any intervention to improve solid waste disposal, particularly in public places
Use of vector control interventions to reduce flies	Any intervention to improve fly control and/or other vectors
Other WASH interventions	*As applicable*

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iii. identifying consistent recommendations, whereby each recommendation was classified as "Recommended" when it featured in the guideline, "Not Recommended" if the guideline clearly stated that the intervention was not recommended by the authors/agency or "Recommendation not listed" if otherwise, see examples in Table 2;

iv. categorising recommendations on the basis of whether they would interrupt within-household or community-level transmission. The conceptual framework also incorporates key transmission pathways within the two domains of transmission, based on recent models describing human-to-human and environment-to-human transmission of cholera [27, 43, 61, 99], described in Fig 1.

The details of each recommendation, including mode and frequency of intervention delivery, duration of the intervention and any other factors deemed relevant were also noted. A quality assessment for risk of bias among guidelines was not performed. A narrative summary of data extraction and analysis was developed by one investigator (LDG) and then reviewed by all authors.

Results

Search results and characteristics of included guidelines

Searches were finalised on 14th February 2019. The search strategy identified a total of 48 records. After de-duplication and screening, eight guidelines met the inclusion criteria for review and are included in this scoping review. The guidelines were published between 2004 to 2019; three were authored by international non-governmental organisations (NGOs)–Médecins Sans Frontières (MSF) [100], Oxfam [101], Action Contre la Faim (ACF) [102]; one from a non-profit organisation (NPO)–the Sphere Project [103]; three by multilateral organisations–United Nation's Children Fund (UNICEF) [104], the World Health Organization (WHO)

Table 2. Classifying recommendations, definitions and examples.

Recommendation classification	Definition	Examples of the terminology	Example from the guidelines
"Recommended"	"Recommended" interventions were those that were listed in the guideline unless there is rationale not to.	"strongly recommended", "should", "offer", "provide"	"At least 20 litres of potable water should be provided per person and per day for drinking and hygiene (personal and domestic)" MSF 2017
"Not recommended"	"Not recommended" interventions applied when there was a strong statement in the guideline of no benefit and/or harms outweighing benefits.	"do not recommend", "do not provide", "not appropriate", "should not", "will not"	"Oxfam GB will not implement, advocate for or support the following as an appropriate response to cholera control: spraying to reduce the number of flies" Oxfam 2012
"Recommendation not listed"	"Recommendation not listed" applied when there was no recommendation listed for or against a practice.	n/a	n/a

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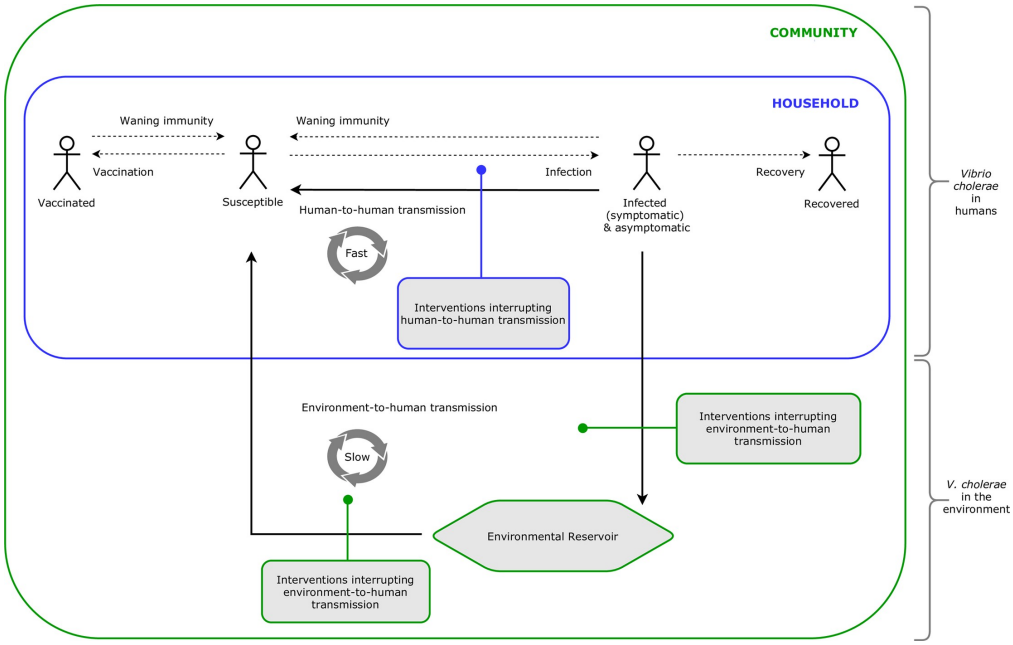

Fig 1. Conceptual framework of cholera transmission within the household and at the community-level: incorporating the human-to-human and environment-to-human pathways of transmission (adapted from recent models [27, 43, 45, 61]).

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[105] and the Global Task Force on Cholera Control (GTFCC) [106]; and one by a research institution–the International Centre for Diarrhoeal Disease Research Bangladesh (ICDDR'B) [107]. The guidelines were published in English (n = 7) and French (n = 1). No guidelines were excluded based on language. All excluded records are listed in S3 Appendix, with reasons for exclusion. The guideline selection process is outlined in Fig 2 and reported according to the PRISMA-ScR checklist [94] in S4 Appendix.

Guidelines were not restricted to specific contexts (epidemic/endemic, urban/rural), except one guideline that was specific for cholera outbreaks in crisis contexts such as conflict settings, natural disasters, refugee camps, and among internally displaced populations or populations on the move [103].

A total of 95 recommendations were extracted. UNICEF (2013) listed the most recommendations (n = 66) [104], followed by ACF (2013) [102], MSF (2017) [100], Sphere (2018) [103] and Oxfam (2012) [101] who all had a similar number of recommendations (n = 54, 53, 53, 51, respectively). Guidelines published by WHO (2004) [105], ICDDR'B (2018) [107] and GTFCC (2019) [106] had the fewest recommendations (n = 26, 34 and 42, respectively).

Classifying recommendations by WASH intervention categories

Recommendations were classified across 11 categories of WASH interventions (Table 3). Among the 95 recommendations, 32 (34% combined) focused on improving the quantity,

access and quality of water, at both source and point of use (POU) and 13 (14%) on improving sanitation access and use. Interventions to improve personal, domestic and food hygiene, such as behaviour change or distribution of non-food items (NFIs), also featured heavily (n = 18 and n = 8, 27% combined). Other, more specific interventions, such as disinfection of

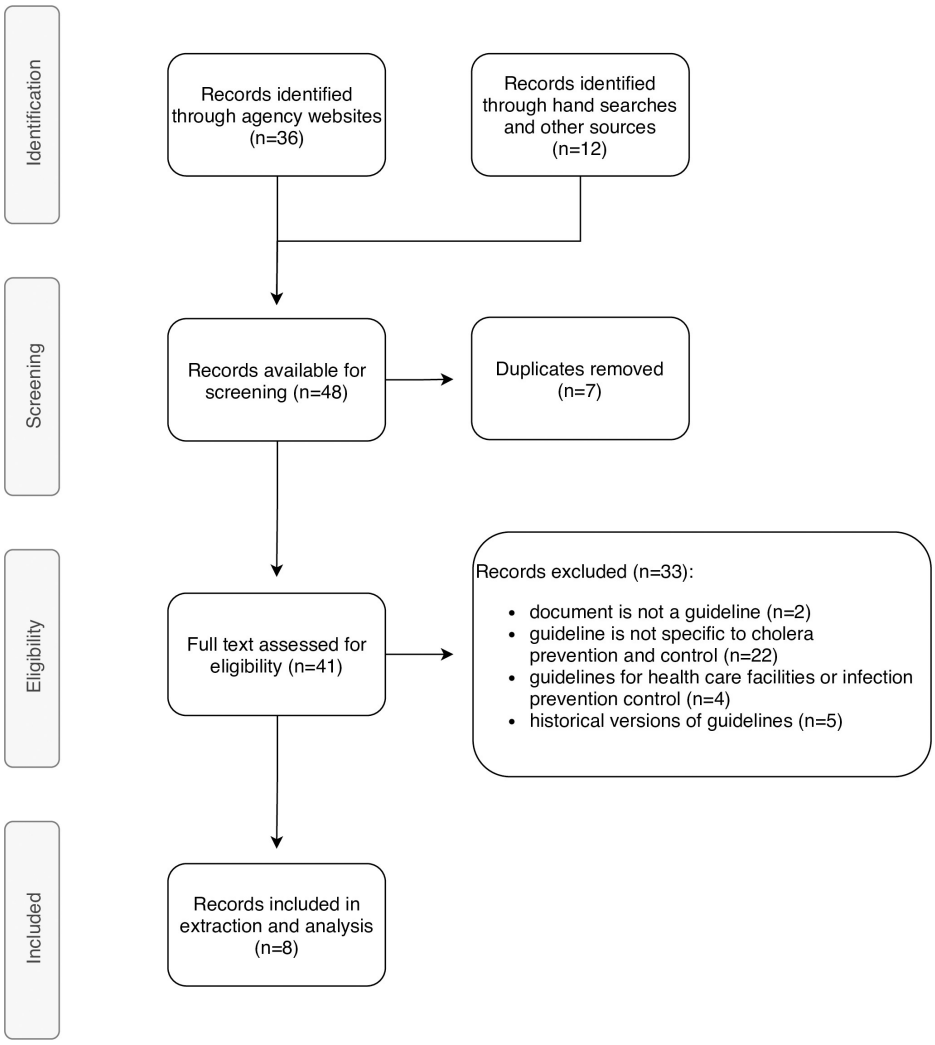

Fig 2. Overview of the search strategy and selection: PRISMA-ScR diagram.

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households and community spaces or dead body management, featured less frequently (n = 10 and n = 7, or 11% and 7% respectively). Interventions such as management of wastewater and faecal sludge, solid waste disposal and fly control, were infrequently mentioned (n = 3, n = 3 and n = 1, 7% combined).

Measuring concordance among guidelines

The interrater agreement among guidelines, as to which WASH interventions they proposed, ranged from -0.14 to 0.36 (Fleiss' Kappa Statistic (κ)), indicating a poor to fair level of agreement among guidelines (Table 3). The mean interrater agreement was slight at 0.14 and overall concordance among guidelines was fair at 0.25.

Identifying consistently recommended WASH interventions

Twenty consistent recommendations (defined as those mentioned by at least seven of the eight guidelines) were identified (Table 4). These interventions fell under seven of the 11 categories

Table 3. Number of recommendations listed by each guideline, classified by WASH intervention category and analysed for concordance among guidelines.

Categories of water, sanitation and hygiene (WASH) interventions	Total (n)	WHO, 2004	Oxfam, 2012	ACF, 2013	UNICEF, 2013	MSF, 2017	Sphere, 2018	ICDDR'B, 2018	GTFCC, 2019	Fleiss Kappa Statistic (κ) for interrater agreement among guidelines		Key to Fig 3.
Improving the access to water sources and/or quantity of water	9	3	4	6	6	6	7	4	2	0.19	Slight	1–9
Improving the quality of water: water treatment at source	12	3	5	9	4/1NR	7/1NR	6	5	4	0.30	Fair	10–21
Improving the quality of water: point of use (POU) and safe storage	11	3	6	9	6	7	8	6	7	0.36	Fair	22–32
Improving the access to and use of sanitation facilities and reducing exposure to faeces	13	4	4	3	10	6	10	3	5	0.09	Slight	33–45
Behaviour change interventions to improve personal, domestic and food hygiene practices	18	8	13	12	17	8	11	8	12	0.23	Fair	46–63
Distribution of hygiene materials or non-food items (NFIs)	8	0	6	4	6	4	5	2	2	0.25	Fair	64–71
Promotion or distribution of disinfection and cleaning of households and community spaces and/or distribution of materials	7	1	3NR	2/2NR	4/2NR	4/2NR	1	1	1	0.24	Fair	72–78
Improving dead body management and safe funeral practices	10	4	5/1NR	6	7	8	0	5	8	0.08	Slight	79–88
Improving the management of wastewater and faecal sludge	3	0	2	1	1	0	2	0	1	0.01	Slight	89–91
Provision of interventions that improve solid waste disposal	3	0	1	0	2	0	3	0	0	-0.07	Poor	92–94
Use of vector control interventions to reduce flies	1	0	1NR	0	0	0	0	0	0	-0.14	Poor	95
Total number of recommendations listed in each guideline (n)	**95**	**26**	**51**	**54**	**66**	**53**	**53**	**34**	**42**	**0.25**	**Fair**	-

NR- Not Recommended by a guideline; "Key to Fig 3." provides the numbered recommendations to be used with Fig 3; WHO- World Health Organization, MSF- Médecins Sans Frontières, ICDDR'B- International Centre for Diarrhoeal Disease Research Bangladesh, ACF- Action Contre la Faim, UNICEF- United Nations Children's Fund, GTFCC- Global Task Force on Cholera Control

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Table 4. Twenty consistently recommended WASH interventions for cholera prevention and control.

Recommendation	Total (n)	WHO, 2004	Oxfam, 2012	ACF, 2013	UNICEF, 2013	MSF, 2017	Sphere, 2018	ICDDR'B, 2018	GTFCC, 2019	Transmission domain
Improving the access to water sources and/or quantity of water										
Assessment and mapping of existing water sources (i.e. availability, types, access, quantity of water, risks of contamination)	8	✓	✓	✓	✓	✓	✓	✓	✓	Household/ Community
Installation or repair of temporary or permanent improved water sources (e.g. boreholes, protected wells, protected hand pumps, protected springs, water tankers, water distribution systems including taps to households or public spaces and/or protection of the water source)	7	✓	✓	✓	✓	✓	✓	×	✓	Household/ Community
Improving the quality of water: water treatment at source										
A free residual chlorine (FRC) concentration of >0.5mg/l measured at source	8	✓	✓	✓	✓	✓	✓	✓	✓	Community
Highly turbid water, at source, should not be chlorinated and filtration, coagulation-flocculation or other pre-treatments should be used to reduce turbidity before treatment	7	✓	✓	✓	×	✓	✓	✓	✓	Community
Bulk or batch chlorination of water sources (e.g. in-line chlorination of water distribution systems, temporary bladders, water tanks and trucking), with dosage determined by jar tests	7	✓	✓	✓	✓	✓	✓	✓	×	Community
Improving the quality of water: point of use (POU) and safe storage										
Promotion of household water treatment products/ technologies	8	✓	✓	✓	✓	✓	✓	✓	✓	Household
Distribution of household water treatment products/ technologies	7	×	✓	✓	✓	✓	✓	✓	✓	Household
Promotion of cleaning, coverage and/disinfection of safe water storage containers	7	✓	✓	✓	✓	✓	✓	×	✓	Household
Highly turbid water, at point of use, should not be chlorinated and filtration, coagulation-flocculation or other pre-treatments should be used to reduce turbidity before treatment	7	✓	✓	✓	×	✓	✓	✓	✓	Household
Monitoring of water quality at the household	7	×	✓	✓	✓	✓	✓	✓	✓	Household
Behaviour change interventions to improve personal, domestic and food hygiene practices										
Promotion of handwashing after defecation, before eating, before preparing food, before feeding a child, after cleaning a child's faeces and after contact with a cholera case	8	✓	✓	✓	✓	✓	✓	✓	✓	Household
Promotion of safe water collection, treatment and storage (e.g. for drinking and cooking)	7	✓	✓	✓	✓	✓	✓	×	✓	Household
Promotion of safe food preparation, cooking and storage (e.g. covering food to avoid flies and contamination, promotion of breastfeeding)	7	✓	✓	×	✓	✓	✓	✓	✓	Household
Promotion of safe defecation practices (e.g. no open defecation, use of latrines, cleaning of latrines, safe disposal of child faeces)	7	✓	✓	×	✓	✓	✓	✓	✓	Household/ Community
Hygiene promotion through house-to-house visits or community meetings	7	×	✓	✓	✓	✓	✓	✓	✓	Household/ Community
Hygiene promotion and cholera awareness using mass media (e.g. radio, television, SMS, social media)	8	✓	✓	✓	✓	✓	✓	✓	✓	Household/ Community
Distribution of hygiene materials or non-food items (NFIs)										
Distribution of soap to households	7	×	✓	✓	✓	✓	✓	✓	✓	Household

(*Continued*)

Table 4. (Continued)

Recommendation	Total (n)	WHO, 2004	Oxfam, 2012	ACF, 2013	UNICEF, 2013	MSF, 2017	Sphere, 2018	ICDDR'B, 2018	GTFCC, 2019	Transmission domain
Installation of handwashing points in public places (e.g. markets, schools, public toilets)	7	×	✓	✓	✓	✓	✓	✓	✓	Household/ Community
Promotion and distribution of disinfection and cleaning of households and community spaces and/or distribution of materials										
Promotion of safe laundry practices, including disinfection of clothes and bedding of cholera cases with chlorine, boiling for 5 minutes or drying in the sun; alternatively burn or bury with the deceased	7	✓	×	✓	✓	✓	✓	✓	✓	Household
Improving dead body management and safe funeral practices										
Disinfection of corpses with chlorine, and fill mouth and anus with cotton wool soaked in chlorine	7	✓	✓	✓	✓	✓	×	✓	✓	Household/ Community

✓ - Present in guideline; × - Not found in guideline; "Household" and "Community" denote the two levels of cholera transmission and where WASH interventions would be implemented and used; WHO- World Health Organization, MSF- Médecins Sans Frontières, ICDDR'B- International Centre for Diarrhoeal Disease Research Bangladesh, ACF- Action Contre la Faim, UNICEF- United Nations Children's Fund, GTFCC- Global Task Force on Cholera Control

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of WASH, and included: improving the access to water sources and/or quantity of water (n = 2); improving the quality of water at source (n = 3); improving the quality of water at point of use (POU) and safe storage (n = 5); behaviour change interventions to improve personal, domestic and food hygiene practices (n = 6); distribution of hygiene materials and non-food items (NFIs) (n = 2); promotion of disinfection or cleaning of households, community spaces and/or distribution of materials (n = 1); and, improving dead body management and safe funeral practices (n = 1). The majority of the consistently recommended interventions (n = 10, 50%) targeted within-household transmission, three targeted community-level transmission (35%) and another seven recommendations targeted both (15%). Additionally, all guidelines recommended that interventions and messages should be adapted to the local context and cultural practices of the population.

Six interventions were explicitly described as not recommended for cholera prevention and control by four organisations [100–102, 104] and all involved the use of chemical products (Table 5). There was clear disagreement and contradictions between the organisations, some of which were based on the lack of available evidence to support interventions, including the provision of disinfection products, chlorine spraying and use of insecticides to control fly populations.

Categorising recommendations to conceptual models of cholera transmission

From the 95 recommendations found across guidelines, 33 (35%) would target within-household transmission, 43 (45%) community-level and 19 (20%) would affect both domains (Table 6). Table 6 also describes how many recommendations each guideline made for within-household or community-level interventions.

A full list of the 95 recommendations, concordance among guidelines and whether an intervention was categorised to target within-household or community-level transmission, is provided in the supplementary materials (S1 Table). Each of the 95 recommendations listed in S1 Table has been mapped to the conceptual framework of cholera transmission in Fig 3 (with the numbers in Table 3 acting as a key to the recommendations), including the theoretical interruption of human-to-human or environment-to-human cholera transmission.

Table 5. WASH interventions not recommended for cholera prevention and control by one or more guidelines.

Recommendation	Total (n)	WHO, 2004	Oxfam, 2012	ACF, 2013	UNICEF, 2013	MSF, 2017	Sphere, 2018	ICDDR'B, 2018	GTFCC, 2019	Transmission domain
Improving the quality of water: water treatment at source										
Chlorination of unimproved water sources (e.g. unprotected wells, unlined wells)	2NR	×	×	×	NR	NR	×	×	×	Community
Promotion and distribution of disinfection and cleaning of households and community spaces and/or distribution of materials										
Disinfection of households with chlorine spraying (especially vomit and faeces)	4NR	×	NR	NR	NR	NR	×	×	×	Household
Disinfection of non-households with chlorine spraying (e.g. in vehicles, marketplaces)	4NR	×	NR	NR	NR	NR	×	×	×	Community
Provision of disinfection materials to households for household cleaning and disinfection (e.g. detergents, 0.5–2% chlorine solution)	1NR	×	NR	✓	✓	✓	×	×	×	Household
Improving dead body management and safe funeral practices										
Promotion or provision of hygiene materials to households for safe and hygienic corpse preparation (e.g. detergents, 0.5–2% chlorine solution, body bags)	1NR	✓	NR	✓	✓	✓	×	×	×	Household
Use of vector control interventions to reduce flies										
Reduction of fly populations through insecticide spraying in breeding areas	1NR	×	NR	×	×	×	×	×	×	Community

✓ - Present in guideline; × - Not found in guideline; NR—Not recommended; "Household" and "Community" denote the two levels of cholera transmission and where WASH interventions would be implemented and used; WHO- World Health Organization, MSF- Médecins Sans Frontières, ICDDR'B- International Centre for Diarrhoeal Disease Research Bangladesh, ACF- Action Contre la Faim, UNICEF- United Nations Children's Fund, GTFCC- Global Task Force on Cholera Control

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Discussion

Our scoping review of current international guidelines found that guidelines generally recommend all categories of WASH interventions for cholera prevention and control, with 95 distinct recommendations extracted from the eight included guidelines. The guidelines had poor to fair concordance, and some had considerably fewer recommendations than others. Among the 95 recommendations identified, 20 recommendations were consistently recommended by seven or more guidelines. Overall, the guidelines proposed a balance between interventions

Table 6. Categorisation of WASH recommendations, by each of the eight included guidelines, according to domains of cholera transmission.

Domain of transmission targeted by WASH interventions	Total (n/%)	WHO, 2004 (n/%)	Oxfam, 2012 (n/%)	ACF, 2013 (n/%)	UNICEF, 2013 (n/%)	MSF, 2017 (n/%)	Sphere, 2018 (n/%)	ICDDR'B, 2018 (n/%)	GTFCC, 2019 (n/%)
Within-household	33 (35)	11 (42)	19 (37)	21 (39)	23 (35)	21 (21)	18 (34)	13 (38)	15 (36)
Community-level	43 (45)	7 (27)	19 (37)	21 (39)	27 (41)	20 (38)	24 (45)	10 (30)	13 (31)
Within-household and community-level	19 (20)	8 (31)	13 (25)	12 (22)	16 (24)	12 (23)	11 (21)	11 (32)	14 (33)
Total recommendations	**95**	**26**	**51**	**54**	**66**	**53**	**53**	**34**	**42**

WHO- World Health Organization, MSF- Médecins Sans Frontières, ICDDR'B- International Centre for Diarrhoeal Disease Research Bangladesh, ACF- Action Contre la Faim
UNICEF- United Nations Children's Fund, GTFCC- Global Task Force on Cholera Control

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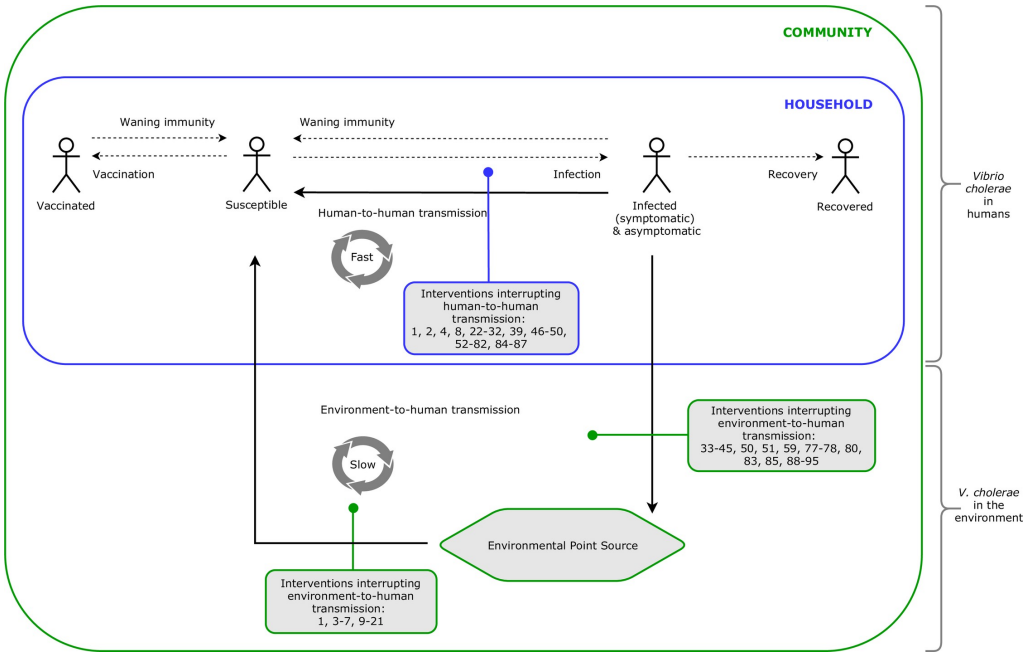

Fig 3. 95 recommended WASH interventions found across eight current international guidelines mapped to the conceptual framework of cholera transmission within the household and at the community-level.

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addressing within-household and community-level transmission of cholera, however, the majority of guidelines focused on community-level interventions. We anticipate that undertaking this scoping review of WASH guidelines for cholera prevention and control has the potential to be a useful tool for both implementing organisations and national governments to further develop and guide response strategies. Particularly as our findings suggest that guidelines, notably those written by multilateral agencies and informing national policy, require more structured alignment, and, in terms of WASH interventions, should consider how interventions effectively reduce transmission pathways, as well as economic and feasibility criteria, when making recommendations for the prevention and control of cholera.

Improvements to personal, domestic and food hygiene, water quantity and quality were the most consistently recommended interventions, many of which targeted within-household transmission of cholera. Accordingly, all, or some subset of, the 20 consistently recommended WASH interventions could be considered as the "minimum standard" interventions that organisations have proposed for effective cholera response programmes. Neither hygiene nor water improvements are new to public health nor to cholera control [1, 70, 108–110], but in addition to controlling cholera outbreaks, these interventions could prevent recurrent epidemics in endemic areas. Additionally, if governments and organisations move away from disease-specific efforts and towards systems strengthening, these interventions may be viewed in terms of their broader effects on WASH-related diseases and other health outcomes [111, 112].

A high number of recommendations does not necessarily render guidelines more useful or more likely to be used. Fewer, more focused recommendations may mitigate the potential for confusion at an operational level and incentivise uptake. To an extent, the low concordance among guidelines observed in this review could indicate the potential difficulty of using the available guidelines, by practitioners and policy makers, to decide which interventions to propose or which guidelines to follow. It may also disincentivise uptake or confuse the prioritisation of interventions among implementers. Only half of the included guidelines explicitly discouraged specific interventions, which in practice may be helpful to concentrate efforts and reduce the range of options considered. On the other hand, interventions that have not been recommended may point to mixed, inconclusive or low-quality evidence. During this review, we did not assess which of the interventions were based on concrete or published evidence. There is a lack of evidence regarding the effectiveness of the interventions across the guidelines, as well as concerns around timeliness, prioritisation of other interventions, cost-effectiveness and potential stigmatisation of the beneficiaries [101, 104]. All of which implies evidence to support the recommendations listed are an area requiring further work.

Effective interventions to reduce within-household transmission

Considering recent evidence on the heightened risk of intra- and interhousehold transmission of cholera, reactive interventions to control and contain cholera outbreaks should take advantage of this clustering by targeting cases, their households and the associated human-to-human transmission pathway [28, 67]. Most recommendations in the included guidelines did address this pathway (35% targeting within-household and 20% targeting both within-household and community-level transmission), and generally reflected new evidence of effective transmission reduction through household-level interventions [44, 47, 49, 63]. However, effective delivery strategies or modalities for implementation of household-level interventions, such as recently introduced case-centred models for the delivery of interventions (i.e. CATIs) or HCF-based strategies for delivery of interventions, were rarely discussed. Limited attention was given to the importance of responding rapidly [44, 113], particularly due to the hyper infective nature of newly shed *V*. *cholerae* from cholera cases [114] and lower infective dose required for transmission from cases in the first days of bacterial shedding [60], or repeated delivery of interventions [115, 116], which are all important considerations for effective disease reduction.

Behaviour change interventions were among the only recommendations for which the modality of delivery was specified, e.g. "*Hygiene promotion through house-to-house visits or community meetings*" and "*Hygiene promotion and cholera awareness using mass media (e.g. radio*, *television*, *SMS and social media)*". Whilst there is some evidence to support radio as a preferred or trusted communication means in cholera outbreaks [110], guidelines would benefit from more explicitly incorporating the evidence base on the other delivery modalities and platforms available. Behaviour change interventions that were recommended across the guidelines should also consider the limited effect of health education and messaging alone [117–119], and incorporate activities to improve the role of collective or community engagement in response activities [111, 120]. Recommendations should rely on the available evidence base to design context-specific behaviour change interventions, including evidence from non-outbreak settings, that facilitate WASH intervention uptake [121], with an emphasis placed on assessing practices in the population before proposing set strategies, and allowing programmes to adapt and change according to needs.

Available evidence also suggests that case-centred strategies or CATIs, which require targeting fewer people per case averted and delivery of interventions centred to cases, are more cost-

effective and resource-efficient for delivery of interventions [1, 44, 49, 67, 122, 123]. For example, hygiene and health promotion and the distribution of hygiene kits at the point of care have been observed as an effective delivery channel in cholera control [63, 78, 113], and in other disease reduction efforts [124–126], yet recommendations on the location of intervention delivery was either omitted or limited in all eight of the guidelines. Prepositioning of supplies for distribution has also been noted as an important consideration to allow for timely response in case-centred and mass-delivered strategies [110].

Effective interventions to reduce community-level transmission

Cholera affects communities already burdened with a lack of infrastructure, poor health systems and affected by crises. Any global map of poor water and sanitation services, and high levels of poverty and insecurity, is essentially the same as the map of cholera burden [1, 21]. Although models have highlighted within-household and human-to-human transmission as the catalyst in epidemics, interventions that target community-level transmission and the environment-to-human transmission pathways remain important for cholera prevention. Regional resurgences of cholera are a contributing factor to the burden of disease globally [21, 23, 24, 127], with notable high incidence of disease and recurrent outbreaks in the lacustrine areas of East and Central Africa [128–130]. Community-level or mass population strategies in areas such as this may limit the reliance on active case finding or attendance at HCFs required by case-centred approaches, and provide interventions that also target the estimated 40 to 80% of cholera cases which are asymptomatic [19, 131]. Ultimately, the elimination of cholera can only happen by limiting exposure to or reinfection from a contaminated environment for the entire population [1, 64, 108, 132].

Historically, improvements to WASH infrastructure at a population level such as the community-level interventions listed across the included guidelines, have reduced the incidence of cholera, and other diarrhoeal diseases [111, 120, 133–137], and eliminated the disease since the time of John Snow [108, 109, 138]. However, guidelines reviewed offered little specificity on the standards that should be attained for these WASH interventions. For example, water quality at source is reliant on meeting minimum quality standards such as "*A free residual chlorine concentration of >0.5 mg/l measured at source*" and "*A turbidity less than 5 NTU at the water source, up to 20 NTU acceptable*" [139]. However, guidelines did not consistently state specific corresponding standards for other WASH interventions such as water availability. Given evidence that limited hours of water availability during the day [140], distance and time needed to fetch water [111, 141] all affect health and water-use practices negatively, standards for water availability, and other WASH interventions, should be further specified across their included recommendations. By contrast, levels and standards of WASH service provision (e.g. 'limited', 'basic', 'safely managed') are more explicitly stated in the SDG indicators and targets [142–146]. The current recommendations in the guidelines to reduce community-level transmission may be more aligned to the first phases of an outbreak whereas the SDG-type standards for these interventions would be required for the longer-term strategy for prevention of outbreaks. Regardless, all recommendations for both community-level and within-household interventions for the prevention or control of cholera require further alignment to national and international targets for WASH service delivery.

Limitations

Our review only included current, international and accessible guidelines for the prevention and control of cholera. This may have affected how many recommendations were found and the review will have excluded any context specific or more detailed interventions from national

guidelines and other sources. The review also does not systematically address the level of evidence supporting the different recommendations, and does not factor in which interventions would be more effective at reducing transmission than others.

In this review, we have considered the risk of transmission within two domains: within-household and at the community-level. Although the separation of household and community is potentially more intuitive for practitioners and policymakers to understand and use, the conceptual cholera transmission framework may diminish the observed overlap of household and community-level transmission and the associated human-to-human and environment-to-human transmission pathways. Neither domains nor pathways of transmission are dichotomous and, aside from interpersonal contact, there is a close association of the risk factors among levels. Human-to-human transmission, or interpersonal contact between infected and susceptible cases, will also occur outside of the household (e.g. in mass gatherings, community places) [28]. Additionally, regular cholera outbreaks in endemic settings may be associated with seasonal climatic patterns (e.g. temperature and humidity) [147, 148], and epidemic cholera is often triggered by weather conditions [149], such that it changes households' behaviours (e.g. water collection practices) and interaction with the aquatic environment which in turn increases the risk of community-level environment-to-human transmission [25].

Concordance or consistency of recommendations is not necessarily a measure of guideline quality, but rather of how much agreement there is among guidelines. Concordance scores may simply reflect a lack of detail or prioritisation of certain service areas, rather than explicit decisions to include specific interventions. Nevertheless, the less agreement, the more potential there is for inappropriate interventions or conflicted decision-making among national governments and responding organisations, and the more likely it is that evidence has not been considered systematically when developing guidelines [93, 150], suggesting a need for greater scientific and policy collaboration among organisations.

None of the guidelines explicitly stated their process for guideline development such as using the GRADE system [151, 152] or other recommended methods [93, 150, 153, 154] to determine the quality of evidence for each recommendation. Any new development of guidelines should either use and adhere to these recommended processes to strengthen their quality and use, or clearly describe their methods. Additionally, as the objectives of this review did not include an assessment of guideline quality, readers may come away not understanding guideline quality or which, if any, of these guidelines should be considered in cholera programmes. However, the review was not intended to make this decision as we are unable to take into account the specific mission or mandate of each author organisation, which may affect the priority given to different types of intervention or indeed WASH as a whole.

Conclusions and recommendations

The Global Roadmap for Cholera Elimination by 2030 has focused attention on current efforts to prevent and control cholera [68], and highlighted the need for clear, consistent and evidence-based guidelines. A number of international guidelines for cholera prevention and control are in current use; however, the concordance among the WASH recommendations in these guidelines was relatively low. Overall, the guidelines did propose a balance of interventions to reduce within-household and community-level transmission. Interventions to reduce within-household transmission were consistently proposed and could be a minimum package of interventions to address outbreak control. Interventions to reduce community-level transmission tended to interrupt transmission between a contaminated environment and susceptible individuals or contamination of the environment by cases, but did not often specify the level of service that should be provided to reduce transmission. Guidelines should more

explicitly consider strength of evidence, efficiency and feasibility criteria when recommending different candidate WASH interventions.

No single guideline included all recommendations or collated all available guidance. Interpretation of the guidelines may be difficult particularly where recommendations are omitted or contradict one another. Based on this review, we make five recommendations to strengthen the development of future guidelines for cholera prevention and control:

- Considering the different phases of cholera outbreaks, WASH interventions should target human-to-human transmission within the household and at the community-level for outbreak control, and environment-to-human transmission at a community-level for cholera prevention in recurrent settings and areas where reinfection during outbreaks is likely;
- Limiting the number of guidelines available and compiling fewer, more focused recommendations in guidelines so as to mitigate the potential for confusion at an operational level and incentivise uptake;
- Providing greater specificity in the language used in recommendations, e.g. specifying the timing of response, coverage required, minimum levels of service and modality of delivery (e.g. location, population group);
- Publishing or improving access to programme evaluations and practice literature to strengthen the evidence base for guideline development, and to support national cholera control plans as part of the Global Roadmap for Cholera Elimination by 2030;
- Standardising approaches in guideline development to consider the evidence base, from studies, programme evaluations or models, when deciding which interventions to recommend.

Supporting information

S1 Table. All recommendations found across guidelines.
(DOCX)

S1 Appendix. Search strategy and resources searched.
(DOCX)

S2 Appendix. Search terms.
(DOCX)

S3 Appendix. Excluded guidelines.
(DOCX)

S4 Appendix. PRISMA-ScR checklist.
(DOCX)

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Research Paper 2: Effectiveness of hygiene kit distribution to reduce cholera transmission in Kasaï-Oriental, Democratic Republic of Congo: a prospective cohort study

This cohort study evaluates the effectiveness of hygiene kit distribution to reduce the incidence of suspected cholera among household contacts of admitted suspected cholera patients. It details the inclusion of a case-targeted WASH strategy into the care of patients and their households and assesses both the effect of the intervention on disease outcomes and contamination of food and water. The evaluation sought to validate the choice of this intervention for use in epidemic cholera and crises contexts in future responses.

This chapter is supplemented by Appendix B summarising the data collection tools used during the study, causal framework for cholera incidence, additional tables of results and the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement for cohort studies.

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Primary Supervisor	Dr Francesco Checchi		

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Effectiveness of hygiene kit distribution to reduce cholera transmission in Kasaï-Oriental, Democratic Republic of Congo, 2018: a prospective cohort study

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ABSTRACT

Introduction Household contacts of cholera cases are at a greater risk of *Vibrio cholerae* infection than the general population. There is currently no agreed standard of care for household contacts, despite their high risk of infection, in cholera response strategies. In 2018, hygiene kit distribution and health promotion was recommended by Médecins Sans Frontières for admitted patients and accompanying household members on admission to a cholera treatment unit in the Democratic Republic of Congo.

Methods To investigate the effectiveness of the intervention and risk factors for cholera infection, we conducted a prospective cohort study and followed household contacts for 7 days after patient admission. Clinical surveillance among household contacts was based on self-reported symptoms of cholera and diarrhoea, and environmental surveillance through the collection and analysis of food and water samples.

Results From 94 eligible households, 469 household contacts were enrolled and 444 completed follow-up. Multivariate analysis suggested evidence of a dose-response relationship with increased kit use associated with decreased relative risk of suspected cholera: household contacts in the high kit-use group had a 66% lower incidence of suspected cholera (adjusted risk ratio (aRR) 0.34, 95% CI 0.11 to 1.03, p=0.055), the mid-use group had a 53% lower incidence (aRR 0.47, 95% CI 0.17 to 1.29, p=1.44) and low-use group had 22% lower incidence (aRR 0.78, 95% CI 0.24 to 2.53, p=0.684), compared with household contacts without a kit. Drinking water contamination was significantly reduced among households in receipt of a kit. There was no significant effect on self-reported diarrhoea or food contamination.

Conclusion The integration of a hygiene kit intervention to case-households may be effective in reducing cholera transmission among household contacts and environmental contamination within the household. Further work is required to evaluate whether other proactive localised distribution among patients and case-households or to households surrounding cholera cases can be used in future cholera response programmes in emergency contexts.

Strengths and limitations of this study

- This study is one of few published evaluations on the effectiveness of water, sanitation and hygiene interventions for cholera control from an emergency context, and within the confines of a rapid response to an outbreak.
- This study was conducted outside of controlled study conditions and among challenges of an ongoing humanitarian crisis and reflects potential study designs that can be used in complex settings.
- Randomisation was not logistically feasible in this setting and the acute phase of an emergency response and our study thus relies on a comparison group who did not receive the intervention due to implementation failures rather than deliberate study design.
- Unfortunately, we had originally aimed to enrol 250 cholera cases and their households, expected to be at least 985 household contacts, but due to political tensions in the region less than half (n=94) were enrolled and only 444 household contacts had complete data.
- Information on developing cholera or diarrhoea was self-reported and may have resulted in recall bias. Additionally, the ascertainment of our primary outcome by self-report may lead to misclassification of our outcomes.

INTRODUCTION

Annually, there are an estimated 1.3–4.0 million cases of cholera worldwide resulting in between 21 000 and 143 000 deaths.[1] The Democratic Republic of Congo (DRC) accounts for 5%–14% of the global cholera burden annually,[2] with >56 000 cholera cases and 1190 deaths in 2017 alone.[3] DRC has been experiencing outbreaks of cholera annually since the 1970s[2] while also experiencing multiple humanitarian crises

across the country that in turn exacerbate the risk of cholera epidemics.[2 4–7]

Risk factors for infection with *Vibrio cholerae* include the consumption of contaminated water and food, not washing hands with soap prior to eating and living in the same household as a cholera case.[8] Several studies have found that household contacts of cholera cases are at 100 times higher risk of becoming infected than the general population,[9–11] particularly during the first 7–10 days after a cholera case becomes symptomatic and seeks care at a healthcare facility (HCF).[9 10 12] This is due to the prolific shedding of *V. cholerae* by symptomatic and asymptomatic cases which can last up to 14 days after onset of symptoms.[13–15] Up to 80% of *V. cholerae* transmission can occur within households,[16 17] and cases have been observed to cluster within 200m of case-households during the first 5 days after the case becomes symptomatic.[18–20] These high secondary transmission rates suggest an important role for human-to-human transmission at the household level via contamination of shared stored drinking water and/or food, and inadequate hygiene practices such as handwashing with soap.[8 21]

For patients with suspected cholera admitted to HCFs, the standard package of care includes case management with oral rehydration solution (ORS) or intravenous fluids and infection prevention and control (IPC) to prevent transmission from the patient to staff or within the cholera treatment unit (CTU) or centre (CTC).[13 22–26] Guidelines to limit cholera transmission have historically directed attention to community-wide interventions rather than being targeted to case-areas or case-households.[22–30] While work has sought to either define packages of care for household contacts[31 32] or to calculate the speed or area at which interventions should be delivered, that is, through case-area targeted interventions (CATI),[19 33–38] there is currently no agreed standard of care for household contacts or households surrounding case-households, despite their high risk of infection.

Since 2017, hygiene kit distribution combined with health promotion has been recommended in guidelines by the international non-governmental organisation (NGO), Médecins Sans Frontières (MSF), as a rapid and localised intervention for patients and their accompanying household members on admission to a CTU/CTC.[22] The hygiene kit is intended to be used at the household-level and typically includes a container (eg, 10– L) for water collection and storage, bars or bags of soap, point of use (POU) water treatment product/s (eg, chlorine, filters and/or flocculant disinfectants) and a handwashing device (eg, a 10 L bucket with tap).[22] Health promotion and contact with the patient and their accompanying household member when seeking treatment in the HCF provides an opportunity for intervention delivery, particularly as the perceived severity of disease and the perceived benefits of the intervention are likely to be highest.[39–42] Hygiene kit distribution combined with health promotion has been part of MSF's response strategy and accompanies case management, community-wide health promotion, support to the healthcare system and enhanced surveillance for the duration of the outbreak.[43]

The CHOBI7 RCT in Dhaka, Bangladesh, which demonstrated a 50% reduction in symptomatic and asymptomatic cholera infection among household contacts from a similar yet more intensive intervention strategy,[31] and other work in Haiti[35] and Yemen,[44] has supported this change to the MSF guidelines and concentration on CATI or CATI-like responses in emergencies. In addition, there are a few other published studies on water, sanitation and hygiene (WASH) interventions to support guidelines and practice, but while the studies did report reductions in cholera incidence between 25% and 75%, they are of variable study quality and predominantly community-wide interventions.[45–50] To date, which WASH interventions to include for cholera control as part of CATI or targeted to case-households in other response formats have not been extensively evaluated in humanitarian settings or outside of controlled study conditions.[32 34 45 51–54]

METHODS

Study design

In this prospective cohort study, we investigated the effectiveness of hygiene kit distribution combined with health promotion to reduce suspected cholera and self-reported diarrhoea among household contacts of patients with suspected cholera admitted to MSF-supported CTUs in Kasaï-Oriental province, DRC. Patient-household sets were enrolled consecutively during the study period irrespective of whether they received the MSF hygiene kit. This was an observational study and the intervention was not allocated to particular groups. Households were revisited after 7 days, and data were analysed for the association between hygiene kit use and disease outcomes as well as the evolution of water and food contamination from enrolment to 7-day follow-up. We have separately published a process evaluation conducted in parallel to this study which evaluates the implementation and population response to the distribution of hygiene kits during an emergency response to a cholera outbreak in DRC.[43]

Study site and period

The Programme National d'Elimination du Choléra et de lutte contre les autres Maladies Diarrhéiques (PNECHOL-MD) issued a country-wide alert of a laboratory confirmed cholera case in Kasansa district, Kasaï-Oriental province, DRC, on 9 August 2018 (Epidemiological Week 28 (W28)).[55] A second alert and call for assistance came from the PNECHOL-MD on 22 August 2018 (W34).[56–58] The cholera response in Kasansa was led by the Ministry of Health (MoH) and supported by MSF over a 5-week period between 22 October and 23 November 2018 (W43–47). Between W28 and W42, there were 443 suspected cholera cases and 29 deaths across Kasansa. A further 224 suspected cholera cases and 3

deaths occurred during the MSF response between W43 and W47. The overall case fatality ratio (CFR) was 5% and the attack rate (AR) of suspected symptomatic cases in the population was 0.28% between W28 and W47.[55 57–64]

During the outbreak, MSF supported seven government HCFs, two CTUs and five Oral Rehydration Points (ORPs) with case management, essential medicine supply, enhanced surveillance, community-level health promotion and infrastructure improvements. A total of 196 suspected cholera cases (75% of total reported suspected cases) were treated across all seven MSF-supported HCFs (121 in CTUs and 75 in ORPs) between W43 and W47. This study was conducted in the only two HCFs in the district, both of which were supported by MSF. Data were collected for this study between 22 October and 4 December 2018 (W43 and W49).

Study intervention

In this cholera response, the MSF hygiene kits distributed included a 20 L container for water collection and storage, 1 kg of bar soap, a 2-month supply of POU water treatment products (Aquatabs disinfectant and/or P&G Purifier of Water combined flocculant/disinfectant) and a 10 L bucket with tap as a handwashing device. One hygiene kit per household, accompanied by standard WASH-related health promotion messages, was delivered by community health workers (CHWs) to the household contacts of patients on the day of the patient's admission at either of the two MSF-supported CTUs. The WASH-related health promotion messages included the following components: cholera transmission (e.g., F-diagram); encouraging case-seeking behaviours at HCFs; treatment at MSF facilities is free of charge; increase in water stored in the household (by using the water container provided to you); boil or treat drinking water; limit open defecation; practice safe corpse preparation; wash hands at key times (before eating, before food preparation, after toilet, after changing a baby's nappy, after caring for the ill/ contact with a cholera case).[43] The hygiene kit was intended to be delivered to the households of all patients, regardless of their participation in the study. However, due to implementation challenges described in a parallel process evaluation published elsewhere,[43] there were delays in receiving the hygiene kits to the project site and the initial households seeking care and later enrolled into the study had not received a hygiene kit or health promotion at the HCF. Only accompanying household contacts of the admitted patient received the health promotion messages.

Study participants

All suspected cholera cases, defined as patients admitted with acute watery diarrhoea (three or more loose stools over a 24-hour period) and/or moderate to severe dehydration, using the WHO definitions,[22 30] were eligible for enrolment into the study. Patients were not selected randomly and were enrolled through a convenience sample as they were admitted to the CTU. We excluded any patients aged <2 years old and/or who had a household contact previously or currently enrolled in the study. All patients were tested for the presence of *V. cholerae* on rectal swab samples using the SD Bioline Rapid Diagnostic Test (RDT).[65 66] All rectal swab samples were transferred to Cary-Blair media and enriched in alkaline peptone water (APW) for 24 hours at room temperature (approximately 25–27°C)[67–69] prior to testing by RDT. Patients and patient-household sets were retained in the study regardless of their RDT result.

Household contacts were defined as individuals sleeping under the same roof and sharing a cooking pot with the suspected cholera case during at least the previous 5 days. Eligible household contacts present at the CTU at the time of patient enrolment were invited to participate in the study, and a household visit was made within 48 hours of patient enrolment to recruit the remaining household contacts. To be eligible for the study, household contacts had to plan to reside in the house for the following 2 weeks. Follow-up visits were conducted at households 7 days after the case presented at the CTUs.

Data collection

Exposure to the intervention

Measures of intervention compliance within households which received a hygiene kit were prespecified, based on standard WHO or WHO/UNICEF Joint Monitoring Programme indicators[70 71] and included: availability of a 20 L drinking water container distributed as part of the intervention; presence of water in the 20 L container; presence of Aquatabs or P&G Purifier of Water, specifically distributed as part of the intervention; a recommended cut-off value of 0.5 mg/L free residual chlorine (FRC) for household drinking water;[71 72] availability of soap, specifically distributed as part of the intervention; presence of soap within 2 m of the toilet; presence of soap within 1 m of the kitchen area and availability of the 10 L handwashing bucket with tap including the presence of water and soap.

To assess the association between presence of the intervention, intervention compliance and our outcomes of interest, we established four subgroups: no kit, low use of kit, medium use of kit and high use of kit. Receipt of the kit by the household was confirmed at the CTU and verified by observation at the household. All groups came from the same study population. Households in the no kit group were not randomly allocated at the CTU and the reason they did not receive a kit was due to delayed implementation.[43] For the other three subgroups, intervention compliance was not random but based on assessing by first estimating the percentage of physical kit components used by the household and then categorising households and the individuals residing in the house as high (71%–100%), medium (31%–70%) or low (0%–30%) users. These equally sized categories were selected owing to the limited evidence on the relative effect of individual kit components.[53]

Clinical outcomes

The occurrence during the ensuing 7-day follow-up period of syndromes consistent with cholera (hereafter referred to as 'suspected cholera') as well as self-reported diarrhoea, were ascertained among household contacts based on verbal report. A 7-day follow-up period was selected based on the 7–10-day high risk period for transmission following admission to a HCF, as noted in other work,[9 10 12] and feasibility for follow-up. Each household contact reported their own symptom history, with caregivers reporting disease for children. Suspected cholera was defined as diarrhoea (three or more loose stools over a 24-hour period), vomiting and/or attending a HCF with suspected cholera in the past 5 days.[13 22] Self-reported diarrhoea was defined as three or more loose stools over a 24 hours period, with or without the presence of blood, in the past 5 days.[73] We were unable to confirm cholera through RDT or by culture among household contacts during this study.

Environmental outcomes

Stored water samples were collected at enrolment and 7-day follow-up whereas source water was collected only at enrolment. Food samples were collected when prepared food was available at both visits. Environmental samples were collected in 100 mL Whirl-Pak bags (Nasco, Fort Atkinson, Wisconsin, USA) and transported with ice packs in cooler bags to the purpose-built laboratory at the CTU.

Water samples were tested for the presence of *Enterococcus* spp (coliform forming units per 100 mL (CFU/100 mL)),a thermotolerant faecal indicator bacteria,[74–76] by culture on *Enterococcus* indoxyl-β-D-glucoside (mEI) selective medium through standard membrane filtration techniques.[77] FRC concentrations (mg/L) were measured with using a pool tester. The recommended thresholds for chemical and physical characteristics of water samples included 1.0 mg/L FRC for water sources 0.5 mg/L FRC for stored drinking water and 5 NTU for both source and stored water.[72]

Enterococci were also enumerated in food samples, of which a 5 g aliquot was diluted in 50 mL of sterile water, homogenised by shaking and allowed to settle. The 5 mL volumes of supernatant were filtered through sterile membranes with 50 mL of sterile water.

All environmental samples were processed for incubation at 41°C for 24 hours in a Wagtech Potatest 2 incubator (Palintest, Tyne & Wear, UK) within 6 hours of collection. Method blanks and positive controls were analysed in each batch of samples. The number of CFU/100 mL was counted and microbiological contamination of water and food samples was defined as >10 CFU/100 mL of detectable *Enterococcus* spp according to previously published work.[22 72 74–76]

Data collection procedures

Household data were collected through structured questionnaires written in English, translated to French and then back translated to confirm wording. The French translations were required for training of the enumerators and while the study site was still being determined as it was dependent on where the next cholera outbreak would be in DRC. Once the study site was confirmed as the Tshiluba-speaking Kasaï-Oriental, Tshiluba translations of the questions were checked during training of the local enumerators and all enumerators were asked to come to consensus on how to ask particular questions. Questionnaires were administered in the local language (Tshiluba) by two-person teams of Congolese enumerators speaking French and Tshiluba. Survey data were entered directly onto tablets through KOBO Toolbox platform (Harvard Humanitarian Initiative, Cambridge, Massachusetts, USA). Questionnaires were administered to all available household contacts at enrolment and 7-day follow-up. Individual and household characteristics that may have confounded the association between the intervention and the outcomes of interest were measured. A separate questionnaire administered to the head of each household was used to assess access to, and use of, WASH interventions, in accordance to global standard definitions by the WHO/UNICEF Joint Monitoring Programme.[70] The individual and household questionnaires can be found in online supplemental file 1.

Sample size

We wished to detect a reduction of at least 50% (relative risk ≤0.5) in suspected cholera risk among household contacts with high kit use, compared with those with no use of the hygiene kit, with 5% significance and 80% power. We assumed a 20% risk of suspected cholera in the unexposed (no use of the kit) group,[11 21] yielding a sample size of 197 people per group. Further assuming that the high-use and no use kit groups were each ≥20% of the study population, a total of 985 individual household contacts were needed. Assuming a mean household size of five people (average household sizes are 5.3 across DRC[78]) for each case, and a loss to follow-up of 25%, we aimed to enrol 250 cholera cases and their households in the study.

Due to ongoing political instability in the country[4] and upcoming elections in December 2018,[79] the study was stopped mid-way and did not reach the intended sample size.

Statistical analysis

All statistical analyses were conducted in Stata V.16 (Stata, College Station, Texas, USA).

For clinical outcomes, log generalised linear models (GLM) with a binomial distributional assumption were fitted to estimate the relative risk (risk ratio, RR) of household contacts developing suspected cholera and self-reported diarrhoea between enrolment and 7-day follow-up, with robust standard errors to account for household clustering. The association of exposure to the intervention, no kit, low-use, mid-use and high-use, with the outcomes was tested univariately and adjusted for potential confounders or effect modifiers, including

socioeconomic status (SES), environmental conditions (water source, sanitation type), handwashing and water and food storage practices, selected based on an *a priori* causal framework (online supplemental file 2) and Theory of Change previously published for this intervention.[43] All variables were converted to categorical variables according to appropriate thresholds. Variables with a *p* value of 0.1 in univariate analysis, as well as those variables that were related to the outcome in our causal framework, were considered for inclusion in the multivariable model. Each such variable was included into the model in turn, and likelihood ratio tests (LRT) were used to compare the base model with each new model. This process was repeated until no variables left improved model fit. Variables included in the final multivariable model were also checked for interaction and collinearity.

For environmental outcomes, censored tobit linear regression models (selected because of right-censoring in the outcomes: CFU levels were only quantified up to 1000/100 mL) were used to assess the change in coliform density counts of *Enterococcus* spp (CFU/100 mL) in water and food samples between enrolment and 7-day follow-up. As data were longitudinal, we treated households as a random effect. Because of low sample size for this analysis, we considered receipt of the kit as the exposure, irrespective of use. Exposure to the intervention and risk factors were tested in univariate models with a *p* value of 0.1. The multivariable model was built forward iteratively comparing the new model to the base model where the LRT and Akaike Information Criterion (AIC) statistic were included in the same model and minimised. Regression diagnostic plots of the residuals were visualised to test linear regression assumptions such as normality, linearity and homogeneity of variance.

Patient and public involvement

Research questions and outcome measures were developed and informed by the lack of an agreed standard of care for patient-households and the patient experience in cholera outbreaks, and the global research agendas for cholera prevention and control[80] and emergency WASH interventions.[81] Patients and the public were first involved in the research at the point of enrolment when admitted to the CTU and were recruited to the study during admission to the HCF. Patients and the public were not involved in the design of the study. All participants were informed about the study objectives and time required to participate in the research. Results of the study have been provisionally shared with all research partners nationally and internationally and will be further disseminated to district level partners and the population through community meetings and a lay summary report of the findings.

RESULTS

Description of patients with suspected cholera

Of the 101 suspected cholera cases screened for eligibility before the study was stopped, four were excluded as household contacts of enrolled cases, one person declined to participate and two cases died during treatment and these households were disenrolled on request by the households (figure 1). There were no cases <2 years of age. A total of 94 suspected cholera cases were therefore enrolled and defined as patients with cholera, based on syndromic diagnosis, of which 52.1% (n=49) tested positive for *V. cholerae* by SD Bioline RDT. The average age of admitted patients with cholera was 30.6 years with an even gender ratio. Prior to, or during the study, 36.1% of patients had taken antibiotics in the past 5 days. Most patients had no to moderate dehydration (table 1).

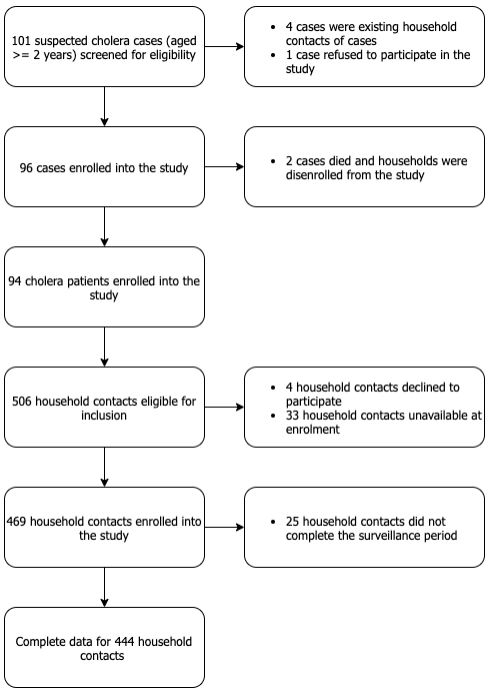

Figure 1 Flowchart of study participation in a prospective cohort study of hygiene kit distribution to patients with suspected cholera, Kasaï-Oriental, DRC, October–December 2018.

Description of household contacts

All identified household contacts of enrolled patients were invited to participate in the study. Of the 506 eligible household contacts, four declined to participate and 33 were unavailable at the time of the enrolment visit. Of the 469 enrolled household contacts, 25 (5.3%) did not complete 7-day follow-up (figure 1). Of the 444 who completed 7-day follow-up, the mean age was 19.0 years and approximately half were female (51.1%). Most participants had received primary level or above

Table 1 Characteristics of the enrolled patients with suspected cholera in Kasaï-Oriental, DRC, 2018

	% (n)
Number of patients with suspected cholera	94
Age of patient with suspected cholera, mean (x)±SD (min–max)	30.6±18.3 (2–81)
2–5 years	9.6 (9)
5–15 years	14.9 (14)
>15 years	75.5 (71)
Gender of patient with suspected cholera	
Female	51.1 (48)
Male	48.9 (46)
Individual taken antibiotics in the last 5 days	36.1 (34)
No vaccination with OCV	100 (94)
Cholera treatment plan of patient with suspected cholera	
Plan A (no dehydration)	39.4 (37)
Plan B (some dehydration)	39.4 (37)
Plan C (severe dehydration)	21.3 (20)
Cholera diagnosis of suspected patient confirmed by RDT	52.1 (49)

OCV, oral cholera vaccine; RDT, rapid diagnostic test.

education and the majority were employed. No patient or household contact had received oral cholera vaccination (OCV). Some (18.7%) household contacts reported caring responsibilities for patients with cholera, while most contacts only reported sharing food and water with patients. During the surveillance period, 91.4% reported eating or drinking outside of the household and 35.8% had contact with another suspected cholera case outside of the household (table 2). All household contacts confirmed that they had resided in the household for the entirety of the 7-day follow-up period.

Description of households

Household sizes averaged 8.4 persons, which was greater than the average reported by recent surveys,[78] and 73.4% of households were categorised in the lowest category of SES based on principal component analysis (PCA) weightings.[82 83] The small sample size dictated that we reduce the typical five SES categories to a binary variable. Unimproved sources or surface water were used by 86.2% of households, and average time to walk to and back from water sources was 66.3±56.0 min. The average volume of water stored at the time of visit was 50.3±36.4 L. Water source samples were collected for all households and >10 CFU/100 mL *Enterococcus* spp was found in 42.6% of source water samples and chlorine concentrations were all <1.0 mg/L FRC. Unimproved sanitation, as defined by the WHO/UNICEF JMP,[70] was found in 84.0% of households, and a further 4.3% of households practiced open defecation (table 3).

Effect of the intervention on suspected cholera risk

At enrolment of household contacts, a total of 175 (39.4%) household contacts reported suspected cholera in the previous 5 days. At 7-day follow-up, 25 (5.6%) household contacts reported suspected cholera in the previous 5 days. Univariate associations are shown in online supplemental table 1. Multivariate analysis suggested evidence of a dose-response relationship with increased kit use associated with decreased risk of suspected cholera: household contacts in the high kit-use group had a 66% lower incidence of suspected cholera (adjusted risk ratio (aRR) 0.34, 95% CI0.11 to 1.03, p=0.055), the mid-use group had a 53% lower incidence (aRR 0.47, 95% CI 0.17 to 1.29, p=1.44) and low-use group had 22% lower incidence (aRR 0.78, 95% CI 0.24 to 2.53, p=0.684), compared with household contacts who had not received a hygiene kit (table 4). Overall, there was a 56% lower incidence of suspected cholera among household contacts with a hygiene kit than those without (aRR 0.44, 95% CI 0.20 to 0.99, p=0.046). aRR associations were adjusted for confounders including age, gender, education, employment, types of contact with index cases and sanitation coverage (online supplemental table 2). There were no systematic differences between the hygiene kit user groups noted in our analysis.

Effect of the intervention on self-reported diarrhoea risk

At enrolment, a total of 155 (34.9%) household contacts had self-reported diarrhoea in the previous 5 days. At 7-day follow-up, 16 (3.6%) household contacts had self-reported diarrhoea in the previous 5 days. Univariate associations are shown in online supplemental table 3. A similar dose-response relationship was observed between increased kit use and decreased risk of self-reported diarrhoea; the high kit-use group had a 45% lower incidence of self-reported diarrhoea (aRR 0.55, 95% CI0.15 to 2.00, p=0.366), the mid-use group had a 35% lower incidence (aRR 0.65, 95% CI 0.18 to 2.21, p=0.487) and low-use group had 20% lower incidence (aRR 0.80, 95% CI 0.16 to 4.00, p=0.786), compared with household contacts who had not received a hygiene kit. Overall, there was a 45% lower incidence in self-reported diarrhoea among household contacts with a hygiene kit than those without (aRR 0.55, 95% CI 0.18 to 1.69, p=0.296). However, there results were not statistically significant (table 5). aRR associations were adjusted for confounders including age, types of contact with index case and cholera treatment plan (online supplemental table 4).

Effect of the intervention on contamination of drinking water and food

At enrolment, 46.8% of stored drinking water samples were contaminated (>10 *Enterococcus* spp CFU/100 mL)

Table 2 Sociodemographic characteristics of enrolled household contacts and clinical surveillance in Kasaï-Oriental, DRC, 2018

	Total	Enrolment % (n)	7-day follow-up % (n)
Number of household contacts	444		
Age of household contact, mean (x)±SD (min–max)		19.0±16.7 (2–81)	
2–5 years		17.3 (77)	
5–15 years		39.6 (176)	
>15 years		43.0 (191)	
Gender of household contact			
Male	444	47.3 (210)	
Female	444	52.7 (234)	
Education			
None	444	27.5 (122)	
Any education	444	72.5 (322)	
Ability to read	444	31.1 (139)	
Ability to write	444	30.9 (137)	
Currently employed	444	78.4 (348)	
No vaccination with Oral Cholera Vaccine (OCV)	444	100 (444)	
Types of contact with patient with suspected cholera in the last 5 days			
Shared food, water and caring responsibilities	444	18.7 (83)	
Shared food and water	444	81.3 (361)	
Individuals reported eating or drinking outside of the household during the surveillance period	444	91.4 (406)	
Individuals reported contact with another suspected cholera case during the surveillance period	444	35.8 (159)	
Clinical surveillance			
Number of household contacts with suspected cholera (any diarrhoea, vomit and cholera) in the last 5 days	444	39.4 (175)	5.6 (25)
Number of household contacts with symptoms of cholera in the last 5 days			
Diarrhoea (three or more loose stools in 24 hours)	444	34.9 (155)	3.6 (16)
Vomiting	444	14.9 (66)	3.4 (15)
Cholera (determined by attendance at a HCF and clinical diagnosis)	444	4.1 (18)	0.9 (4)

HCF, healthcare facility.

and 80.7% of samples reported chlorine concentrations <0.5 mg/L FRC. At 7-day follow-up, 31.9% drinking water samples were contaminated (>10 *Enterococcus* spp CFU/100 mL) and 71.3% of samples reported chlorine concentrations <0.5 mg/L FRC (table 3). Univariate associations are shown in online supplemental table 5. Multivariate analysis showed that there was statistically significant reduction in drinking water contamination observed among all groups receiving the kit (adjusted effect estimates −224.1, 95% CI −365.9 to −82.3, p=0.002) (table 6). Effect estimate adjusted for confounders including SES and availability of a handwashing facility at enrolment (online supplemental table 6).

Of the 77 households with food prepared at enrolment, 53.3% covered the food at the time of visit and 63.6% of food samples collected were contaminated (>10 *Enterococcus* spp CFU/100 mL). At 7-day follow-up, 57.1% of households covered the food and 74.0% of food samples collected were contaminated (>10 *Enterococcus* spp CFU/100 mL) (table 3). Univariate associations are shown in online supplemental table 7. There was no statistically significant reduction in food contamination (adjusted effect estimates −114.4, 95% CI −417.4 to 188.5, p=0.459) (table 7). Effect estimate adjusted for confounders including SES (online supplemental table 8).

Table 3 Sociodemographic and WASH characteristics of households in Kasaï-Oriental, DRC, 2018

	Total	Enrolment % (n)	7-day follow-up % (n)
Number of households	94		
Household size, x±SD (min–max)		8.4±4.1 (2–23)	
Average number of adults, x±SD		3.3±1.8	
Average number of children (5–18 years), x±SD		3.8±2.5	
Average number of infants (0–5 years), x±SD		1.37±1.3	
Socioeconomic status			
Lowest	94	73.4 (69)	
Highest	94	26.6 (25)	
Water source coverage and access			
Improved: basic (improved, <30 min) and limited (improved, >30 min)	94	13.8 (13)	
Unimproved: unimproved and surface water (rivers, unprotected springs)	94	86.2 (81)	
Average time to and back from water source (in minutes), x±SD (min–max)		66.3±56.0 (0–240)	
Volume of water stored in household (L), x±SD (min–max)		50.3±36.4 (1–200)	
Source water with a median chlorine concentration <1.0 mg/L FRC	94	100 (94)	
Source water with >10 *Enterococcus* spp (CFU/100 mL)	94	42.6 (40)	
Sanitation coverage			
Limited (improved, shared >2 households)	94	11.7 (11)	
Unimproved	94	84.0 (79)	
Open defecation	94	4.3 (4)	
Water storage and treatment practices			
Any safe water storage available	94	79.8 (75)	96.8 (91)
Safe water storage distributed to households (20 L container)	94	0 (0)	96.8 (91)
Water present in any safe water storage	94	91.5 (86)	91.5 (86)
Water present in distributed safe water storage (20 L container)	94	0 (0)	86.2 (81)
Decant or drink water from water storage container with glass or cup	94	95.7 (90)	95.7 (90)
Water treatment options available (Aquatabs or P&G Purifier of Water)	94	0 (0)	75.5 (71)
Soap availability			
Any soap available	94	81.9 (77)	73.4 (69)
Soap distributed to households (1 kg of bar soap)	94	0 (0)	73.4 (69)
Soap observed within 1 m of kitchen	94	8.5 (8)	18.1 (17)
Soap observed within 2 m of latrine	94	4.3 (4)	1.1 (1)
Handwashing facility			
Basic facility (facility, water and soap)	94	20.2 (19)	24.5 (23)
Limited facility (facility and water)	94	36.2 (34)	46.8 (44)
No handwashing facility	94	43.6 (41)	28.7 (27)
Food storage practices			
Food covered	77	66.7 (36)	79.3 (42)
Receipt of a hygiene kit during the surveillance period	94	0 (0)	80.8 (76)
Environmental surveillance			
Stored drinking water with median chlorine concentration <0.5 mg/L FRC	94	80.7 (75)	71.3 (67)
Stored drinking water with >10 *Enterococcus* spp (CFU/100 mL)	94	46.8 (44)	31.9 (30)
Food samples with >10 *Enterococcus* spp (CFU/100 mL)	77	63.6 (49)	74.0 (57)

WASH, water, sanitation and hygiene.

Table 4 Multivariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period in Kasaï-Oriental, DRC, 2018

	Contacts (n)	Suspected cholera (% (n))	Univariate (RR)	Multivariate (aRR)	Lower 95% CI	Upper 95% CI	P value
Suspected cholera among household contacts	444	5.6 (25)					
Receipt of a hygiene kit during surveillance period							
No (reference)	99	36.0 (9)	(ref.)	(ref.)			
Yes	345	64.0 (16)	0.51	0.44	0.20	0.99	0.046
Receipt of a hygiene kit and intervention compliance during surveillance period							
Did not receive the hygiene kit (reference)	99	36 (9)	(ref.)				
Received a hygiene kit with low use	54	16 (4)	0.81	0.78	0.24	2.53	0.684
Received a hygiene kit with mid-use	149	28 (7)	0.52	0.47	0.17	1.29	0.144
Received a hygiene kit with high use	142	20 (5)	0.39	0.34	0.11	1.03	0.055

Log GLM with a binomial distributional assumption were fitted and aRR associations were adjusted for confounders including age, gender, education, employment, types of contact with index cases and sanitation coverage.
aRR, adjusted risk ratio; GLM, generalised linear models.

DISCUSSION

The distribution of hygiene kits combined with health promotion, by MSF in Kasaï-Oriental, DRC, reduced the incidence of suspected cholera among household contacts of admitted patients with cholera by 22%–66% during the intervention period. This was highest, and statistically significant, among individuals with high use of the hygiene kits compared with households without a kit. A similar relationship was observed in the reduction of self-reported diarrhoea among household contacts; however, this association was not statistically significant. Overall, these findings indicate that the distribution of hygiene kits and health promotion may be effective in reducing suspected cholera and the relative risk of diarrhoeal disease during the high-risk period for household contacts of patients with suspected cholera. Furthermore, these results suggest that the impact of these kits is greatest when compliance is highest. The observed dose-response associations support a causal link between kits and reduced disease risk.

Consistent with these findings, kit receipt was associated with a reduction in drinking water, though not food, contamination. We potentially attribute this success and failure to the components of the hygiene kit and contents of the health promotion messages. The hygiene kit incorporated two components designed to treat or store water safely and seems to have been both effective in making people use the water treatment and safe storage when previously they did not, as previously reported in a parallel process evaluation.[43] However, the kit contained no components to limit food contamination, improve food storage or health promotion for food-related behaviours and thus failed to have any effect on food contamination other than potentially through improving the presence of handwashing facilities. It may also be that the measurement of food contamination in this study was too variable to capture changes which may occur between different times of day, types of food, storage practices or other factors.[76 84 85] Lastly, health promotion messages were only addressed to the accompanying household contacts at the CTU and diffusion of messages to the other household contacts may be limited or ineffectual.

Identified risk factors for suspected cholera and self-reported diarrhoea among household contacts included the type of contact with patients and age of household contacts. Although not statistically significant, we found that individuals without direct caring responsibilities for the patient with cholera had a reduced relative risk of disease outcomes compared with other household contacts. This is consistent with previous studies which have identified caring responsibilities as a risk factor for intrahousehold transmission.[8] However, further analyses

Table 5 Multivariate analysis for self-reported diarrhoea during the surveillance period in Kasaï-Oriental, DRC, 2018

	Contacts (n)	Self-reported diarrhoea (% (n))	Univariate (RR)	Multivariate (aRR)	Lower 95% CI	Upper 95% CI	P value
Self-reported diarrhoea among household contacts	444	3.6 (16)					
Receipt of a hygiene kit during surveillance period							
No (reference)	99	43.8 (7)	(ref.)	(ref.)			
Yes	345	56.2 (9)	0.63	0.55	0.18	1.69	0.296
Receipt of a hygiene kit and intervention compliance during surveillance period							
Did not receive the hygiene kit (reference)	99	31.2 (5)	(ref.)	(ref.)			
Received a hygiene kit with low use	54	12.5 (2)	0.73	0.80	0.16	4.00	0.786
Received a hygiene kit with mid-use	149	31.3 (5)	0.66	0.65	0.18	2.21	0.487
Received a hygiene kit with high use	142	25.0 (4)	0.56	0.55	0.15	2.00	0.366

Log GLM with a binomial distributional assumption were fitted and aRR associations were adjusted for confounders including age, types of contact with index case and cholera treatment plan.
aRR, adjusted risk ratio; GLM, generalised linear models.

would be required to understand the relative difference between those with and without caring responsibilities in the household-high-risk environment. Household contacts >5 years of age had a reduced risk of both suspected cholera and diarrhoea which is consistent with previous studies.[8 86] Key WASH practices, such as individuals practicing open defecation, increased the relative risk of suspected cholera which is consistent with a number of previous studies.[8]

Our findings are broadly consistent with the 25%–75% reductions in cholera incidence reported in previous evaluations of WASH interventions[31 46–50] and echoes the CHOBI7 RCT intervention in Bangladesh, which included distribution of a hygiene kit to patients and their household contacts and both point-of-care and household hygiene promotion, which reported a 50% reduction in symptomatic and asymptomatic incidence of cholera.[31] Thus, our study contributes to a growing body of evidence demonstrating that targeted WASH interventions delivered through CATI or targeted to case-households during cholera outbreaks may be an effective approach to reduce household transmission and to control the epidemic.[19 32–37 44]

The reported reduction in household transmission of cholera may be attributed to three notable factors. First, the intervention was delivered to households at the point-of-care allowing for early adoption of the intervention. Admitted patients with cholera typically attended HCFs within 1 day of the onset of symptoms, and kits were taken to their respective dwellings within 1–3 days of receipt and used within the 7-day high risk period.[43] Second, there was high user acceptance of the intervention reported among households which may have led to increased uptake of the intervention,[43] as found in other

Table 6 Multivariate analysis for change in *Enterococcus* spp coliform density counts in drinking water samples during the surveillance period in Kasaï-Oriental, DRC, 2018

	Households (n)	%	Effect estimate	Lower 95% CI	Upper 95% CI	P value
Receipt of a hygiene kit during surveillance period						
No (reference)	18	19.2	(ref.)			
Yes	76	80.8	−224.1	−365.9	−82.3	0.002

Censored tobit linear regression models were fitted and effect estimates adjusted for confounders including socioeconomic status and availability of a handwashing facility at enrolment.

Table 7 Multivariate analysis for change in *Enterococcus* spp coliform density counts in food samples during the surveillance period in Kasaï-Oriental, DRC, 2018

	Households (n)	%	Effect estimate	Lower 95% CI	Upper 95% CI	P value
Receipt of a hygiene kit during surveillance period						
No (reference)	18	19.2	(ref.)			
Yes	76	80.8	−114.4	−417.4	188.5	0.459

Censored tobit linear regression models were fitted and effect estimates adjusted for confounders including socioeconomic status.

WASH studies.[52 87 88] Third, the uptake of the intervention may have been enhanced due to the severe illness and perceived risk of diarrhoeal disease at the moment of delivery, as observed in other studies of WASH interventions.[39–42]

Nevertheless, and despite the reduction in suspected cholera incidence, a high proportion of household contacts reported symptoms of cholera in the previous 5 days before enrolment: our enrolled patients were thus not necessarily the primary cases in their households, many of whom could have been mild or asymptomatic, and did not require hospitalisation. This implies that much of intrahousehold transmission may have occurred before households received the kit and potentially when the outbreak was already dissipating, meaning that the first generation of intrahousehold transmission may not have been mitigated. Another difference between exposure groups may be at what stage of the outbreak did households receive a kit. This was not explored in this study and may have affected the reported outcomes. The overall potential for impact of the intervention, therefore, may be considerably less than this study's finds. Further, the 16-week delay between outbreak confirmation and intervention delivery would need to be greatly shortened,[33 43] coverage of interventions would need to be greater[89 90] and surveillance would need to be more timely and heightened[33 91 92] if this intervention were to have an impact on early epidemic propagation.

Limitations

Implementing research in the context of an ongoing cholera outbreak is complex and often compounded by the broader instability which characterises settings where cholera outbreaks occur.[93 94] Challenges with implementation, compounded by the ongoing conflict in DRC,[4] led to a delayed response and low coverage of the intervention.[43] Second, there may not have been a clear division between the evaluators and healthcare providers during the outbreak. Both sets of staff were employed and worked wearing MSF-branded clothing and both were present in the community at similar times. There may be challenges in the reflexivity of the evaluators and potential bias introduced to data collected. For example, social desirability bias may have been introduced when households reported symptoms, intervention uptake and use especially as they were in receipt of hygiene kits distributed by MSF. The participants may be more likely to recall a positive health outcome, or forget a negative experience, to the MSF-related evaluators. Third, the enumerators were aware of whether the household had received the intervention and the outcome variables. This brings potential risk to how questions were asked by the study team. Last, this evaluation was not independent of MSF the organisation and although this work contributes to increasing the quantity of operational research evaluations and meaningful partnerships in the humanitarian sector, it brings risk to independence. We hope to have addressed this through being open and transparent throughout the evaluation, and MSF has no say in the decision to publish the results.

Randomisation was not logistically feasible in the acute phase of an emergency response and our study thus relies on a comparison group who did not receive the intervention due to implementation failures rather than deliberate study design.[93 95] The no kit group was not randomly selected, and the observed associations may be subject to residual unobserved confounding due to their plausibly different baseline circumstances (eg, other factors related to poverty or lower access to care, beyond those we adjusted for). Additionally, and as noted earlier in the paper, due to political instability in the country[4] and upcoming elections in December 2018,[79] we did not reach the required sample size for this study and our power to detect an association was reduced. If we had been able to enrol our target sample size, we may have had power to observe associations more precisely.

Another limitation of our study is the use of suspected symptomatic cholera as an outcome measure among household contacts compared with collection of rectal swab samples for case ascertainment, a decision that was made by MSF and outside of the influence or control of the study team. The ascertainment of our primary outcome was therefore based on self-reported symptoms and may lead to misclassification of our outcomes, as other studies have found.[96] It may have also led to an inflation of suspected cholera at enrolment, as the case definition may have been too broad and captured any cause diarrhoea. We were unable to test suspected cholera diagnoses among our study population by RDT or culture. Other studies have been able to test the stool or rectal swab samples of household contacts,[21 31] and this would have strengthened outcome ascertainment. It is unlikely that misclassification would have been differential by hygiene kit use: as such, the most likely effect of this bias is underestimation of effect sizes. Additionally, we used a

5-day recall of diarrhoea rather than 7-day recall, which could lead to reporting of more outcome events and may have further reduced study power.

Our study also only examined faecal indicator bacteria counts for *Enterococcus* spp in food and water. We were unable to conduct microbiological analysis of *V. cholerae* in environmental samples or extend the microbiological analysis to other samples such as hand rinses[97] or surfaces within the household which have been found to be heavily contaminated with *V. cholerae* in other studies.[98] These additional measures would be useful in future studies to understand the effect on overall cholera transmission within the household.

Last, in this study, our measurement of intervention exposure was based on uptake and use of the intervention. We assigned equal weight to each kit component due to lack of evidence to the contrary[53] and also because the intervention was delivered as a package: the study thus does not shed light on which components are more effective, are preferred or should be included in future kit compositions. Due to the arbitrary nature of the thresholds and number of assumptions needed, we also chose not to conduct sensitivity analysis and robust estimates could differ if other cut-off values had been selected. Moreover, our measures serve only as proxies for the use of the intervention. For example, availability of soap anywhere in the dwelling, that is, within 1 m of the kitchen area or 2 m of a latrine, indicates that the intervention is in the household[99] but not whether soap was used consistently. Similarly, soap and water availability at the handwashing device does not necessarily mean that people wash hands.[100] Positive behaviours such as handwashing are often overreported.[101 102]

CONCLUSION

Hygiene kit distribution is a promising intervention for cholera control. The integration of a WASH intervention at the point of admission of suspected cases is new in cholera control efforts, particularly in outbreaks and complex emergencies. This study has shown that the distribution of hygiene kits accompanied by health promotion may be effective in reducing cholera transmission among household contacts and a may be an important component of CATI responses.

Further evaluations of hygiene kit distribution are still warranted, with a more established and rigorous counterfactual or control group, to assess if the intervention may be as effective as this study found. Further, studies should evaluate hygiene kit distribution to hospitalised patients and their households at the HCF and also in a CATI response where there is proactive localised delivery to vulnerable households surrounding a case who are at an increased risk of interhousehold transmission.[18 19 34 35 89 103] Additionally, postdistribution evaluation should extend beyond 1 week to establish the sustainability of intervention compliance and use by the household and other advantages such as the cost-effectiveness of case-centred delivery, should this intervention be adopted and adapted in future responses.

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Contributors LDG is the guarantor for the study and accepts full responsibility for the finished work and/or the conduct of the study, had access to the data, and controlled the decision to publish. LDG conceived the study and designed the study with input from OC, RD, RVdB, PM and FC. SB contributed to the collection of data during the intervention implementation. BN conducted the microbiological analysis of environmental samples. LDG, SB, AG, DV, POW and MM oversaw all data collection. LDG analysed the data with input from FC and OC. LDG drafted the manuscript and all coauthors contributed revisions to the manuscript. All authors read and approved the final manuscript.

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Research Paper 3: Distribution of hygiene kits during a cholera outbreak in Kasai-Oriental, Democratic Republic of Congo: a process evaluation.

This process evaluation ran concurrently to the previous cohort study and aimed to evaluate the implementation of a case-targeted WASH intervention, population response to the intervention and the context that mediated this relationship. It summarises the barriers faced during implementation in this context and the successes of intervention delivery and receipt by the population. The evaluation acts as a guide for humanitarian actors on how to collect and use programmatic data to evaluate programme implementation. It also makes recommendations on what to improve in future cholera responses.

This chapter is supplemented by Appendix C summarising the data collection tools used during the study, and the Consolidated criteria for Reporting Qualitative research (COREQ) checklist for qualitative studies.

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Surname/Family Name	D'Mello-Guyett		
Thesis Title	Prevention and control of cholera in complex emergencies in Sub-Saharan Africa: evaluating the effectiveness of water, sanitation and hygiene interventions used by Médecins Sans Frontières		
Primary Supervisor	Dr Francesco Checchi		

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Conflict and Health

RESEARCH Open Access

Distribution of hygiene kits during a cholera outbreak in Kasaï-Oriental, Democratic Republic of Congo: a process evaluation

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Abstract

Background: Cholera remains a leading cause of infectious disease outbreaks globally, and a major public health threat in complex emergencies. Hygiene kits distributed to cholera case-households have previously shown an effect in reducing cholera incidence and are recommended by Médecins Sans Frontières (MSF) for distribution to admitted patients and accompanying household members upon admission to health care facilities (HCFs).

Methods: This process evaluation documented the implementation, participant response and context of hygiene kit distribution by MSF during a 2018 cholera outbreak in Kasaï-Oriental, Democratic Republic of Congo (DRC). The study population comprised key informant interviews with seven MSF staff, 17 staff from other organisations and a random sample of 27 hygiene kit recipients. Structured observations were conducted of hygiene kit demonstrations and health promotion, and programme reports were analysed to triangulate data.

Results and conclusions: Between Week (W) 28–48 of the 2018 cholera outbreak in Kasaï-Oriental, there were 667 suspected cholera cases with a 5% case fatality rate (CFR). Across seven HCFs supported by MSF, 196 patients were admitted with suspected cholera between W43-W47 and hygiene kit were provided to patients upon admission and health promotion at the HCF was conducted to accompanying household contacts 5–6 times per day. Distribution of hygiene kits was limited and only 52% of admitted suspected cholera cases received a hygiene kit. The delay of the overall response, delayed supply and insufficient quantities of hygiene kits available limited the coverage and utility of the hygiene kits, and may have diminished the effectiveness of the intervention. The integration of a WASH intervention for cholera control at the point of patient admission is a growing trend and promising intervention for case-targeted cholera responses. However, the barriers identified in this study warrant consideration in subsequent cholera responses and further research is required to identify ways to improve implementation and delivery of this intervention.

Keywords: Cholera, Outbreaks, Emergency, Water, Sanitation, Hygiene, Process evaluation

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Introduction

Cholera is a diarrhoeal disease transmitted through faecal-oral routes and caused by the pathogenic bacteria *Vibrio cholerae* O1 and O139. It remains a leading cause of infectious disease outbreaks globally [1, 2], and a major public health threat in complex emergencies [3, 4]. The Democratic Republic of Congo (DRC) contributes an estimated 189,000 (5–14%) of the annual estimated 1.3–4.0 million cholera cases worldwide [4] and is considered a hotspot for cholera transmission regionally [5–7]. Cholera has been endemic in DRC since 1978 [8], and repeated complex emergencies have contributed to regular outbreaks [8–10]. In 2018 alone, 28,332 cholera cases and 890 deaths were recorded [11].

Spatiotemporal analyses suggest that transmission is localised to the households of cholera cases and household contacts of cases have up to a 100-fold greater risk of infection than those outside of the household [12–14], with risk greatest during the first 7 days after onset of a case's symptoms [15–17]. Evidence demonstrates that within-household transmission (i.e. human-to-human transmission) of cholera occurs through shared drinking water [18], contaminated food [19] and caring for the ill, due to prolific shedding from symptomatic and asymptomatic cases which can continue up to 14 days after onset of symptoms [20]. Models also show that within-household transmission contributes more to the explosive nature of epidemics than transmission through in the community such as environment-to-human transmission from contaminated water sources [12, 21–23]. Household-level water, sanitation and hygiene (WASH) interventions targeting within-household may thus be important in combatting cholera outbreaks [24–26], and can align with case-centred strategies for effective disease control [27–29].

"Hygiene kits" are a household-level WASH intervention recommended for use during cholera outbreak responses and in other crises contexts [30–33]. Selection of hygiene kit contents differs between organisations but they typically include a jerrycan (e.g. 10 to 20 litres (L)) for water collection and storage, soap, point of use (POU) water treatment product/s (e.g. chlorine, filters and/or flocculant disinfectants) and a handwashing device (e.g. a 10-L bucket with tap). Some guidelines specify that hygiene kits should contain components in sufficient quantities for one month's use by an "average sized" household [31, 32], whereas others recommend the inclusion of other components (e.g. toothbrushes, menstrual hygiene management materials) appropriate for populations affected by other types of crises [33, 34]. Distribution of a hygiene kit to a cholera cases when they are admitted to a Cholera Treatment Centre (CTC) or Cholera Treatment Unit (CTU) has been recommended in the Médecins Sans Frontières (MSF) guidelines "*Management of a Cholera Epidemic*" since 2017 [30]. This is based on previous research which found that the distribution of hygiene kits, or their component parts [24, 35], were effective in reducing cholera transmission in Bangladesh [25] and Haiti [36], and the burden of other diarrhoeal diseases [37–39]. However, hygiene kit distribution in outbreak response has not been widely published and is not common in cholera outbreaks [24, 40–42], due in part to a lack of evidence on effectiveness [24, 43], transferability and scalability across contexts [40].

Hygiene kit distribution, like many public health interventions, is a complex intervention featuring several interacting components, and their effectiveness may vary across populations, settings and delivery modalities [44–46]. Process evaluations of complex interventions are increasingly conducted to help explain observed outcomes in intervention studies [47–51] and envision whether the intervention will achieve its intended effects in other contexts or scales [51, 52]. The process evaluation framework also allows implementation and change processes to be explored [47], the utility of theories underpinning intervention design such as hygiene kit distribution from health care facilities (HCFs) to be examined [53] and questions or hypotheses for future research to be generated. To date there have been no published process evaluations of the deployment of hygiene kits in cholera outbreaks.

We adapted conventional process evaluation methods developed for use in health impact trials to evaluate the distribution of hygiene kits by MSF during a cholera outbreak response in Kasansa district, Kasaï-Oriental province, DRC. This process evaluation ran in parallel with a prospective cohort study to assess the effect of the intervention on cholera incidence among household contacts of admitted cholera cases which will be published at a later date. This process evaluation sought to identify the successes and barriers of the hygiene kit distribution strategy for cholera control in order to understand delivery, use and scalability, and to propose recommendations to optimise future programmes. Three evaluation domains were explored including the implementation of the intervention, participants' responses to the intervention and the context in which it was delivered.

Methods

Epidemiology of cholera in Kasansa, Kasaï-oriental

The DRC Programme National d'Elimination du Choléra et de Lutte contre les autres Maladies Diarrhéiques (PNECHOL-MD), or National Program for the Elimination of Cholera and other Diarrhoeal Diseases, issued a country-wide alert of one laboratory confirmed cholera case in Kasansa district, Kasaï-Oriental province, DRC,

on 9th August 2018 (Epidemiological Week 28 (W28)) [54, 55]. A second alert and call for assistance came from the PNECHOL-MD in W34 [56–59].

Between W28–42, there were 443 suspected cholera cases and 29 deaths across Kasansa. MSF joined in W43, 16 weeks after the first laboratory-confirmed case, for 5 weeks between 22nd October to 23rd November 2018 (W43–47). A further 224 suspected cholera cases and 3 deaths occurred between W43–47 [55, 56, 58–66]. There was a high overall case fatality ratio (CFR) of 5% and Attack Rate (AR) of 0.28% between W28–47 [66].

Study setting and timeline of response

In 2018, there were an estimated 230,000 people living in Kasansa across 18 communities (Aires de Santé) [54]. Kasansa is a relatively homogeneous district in terms of socioeconomic composition of the population and agriculture-based income, and the local government had limited resources for health care [59, 65]. A high burden of cholera with high CFR had been observed throughout 2017 and 2018 across Kasaï-Oriental [9, 11, 67], and MSF had responded to other outbreaks earlier in 2018 [68]. Aside from MSF, there were few other public health programmes operating in Kasansa. Other non-governmental organisations (NGOs) and government programmes included hygiene education, malnutrition awareness and malaria prevention.

The cholera response in Kasansa was led by the Ministry of Health (MoH). MSF supported seven government HCFs, two CTUs and five Oral Rehydration Points (ORPs) to provide case management, essential medicine supply, enhanced surveillance, community-level health promotion, and infrastructure improvements. Due to a high CFR and low attendance at HCFs by cases [54, 56, 66], outreach community health workers (CHWs) and an ambulance were deployed from W43. A total of 196 suspected cholera cases (75% of total reported suspected cases) were admitted across all seven MSF-supported HCFs (121 in CTUs and 75 in ORPs) between W43–47. Hygiene kits were distributed with health promotion messaging to cholera patients admitted to the two MSF-supported CTUs, but not to patients at the ORPs, from W44–46 (Fig. 1).

Theory of change

Hygiene kit distribution was one component of the overall cholera response and a Theory of Change (ToC) was developed to provide a framework for the study (Fig. 2). Figure 2 shows how the effectiveness of the hygiene kit to reduce transmission of cholera among household contacts of cases and overall cholera incidence (Impact) may be influenced by factors along the ToC, beginning with i) national and local emergency preparedness supplies and the supply and delivery of hygiene kits to the intervention site (Inputs); which in turn determines ii) adequate health promotion, hygiene kit demonstrations in the CTUs and timely distribution of the kits to the target population at the point of admission (Activities); which leads to iii) the target population understanding the health promotion and hygiene kit demonstrations delivered at the CTUs and intending to take the kits home as soon as possible (Outputs); and finally, iv) intervention recipients who are motivated and have the ability to practice the target WASH behaviour/s

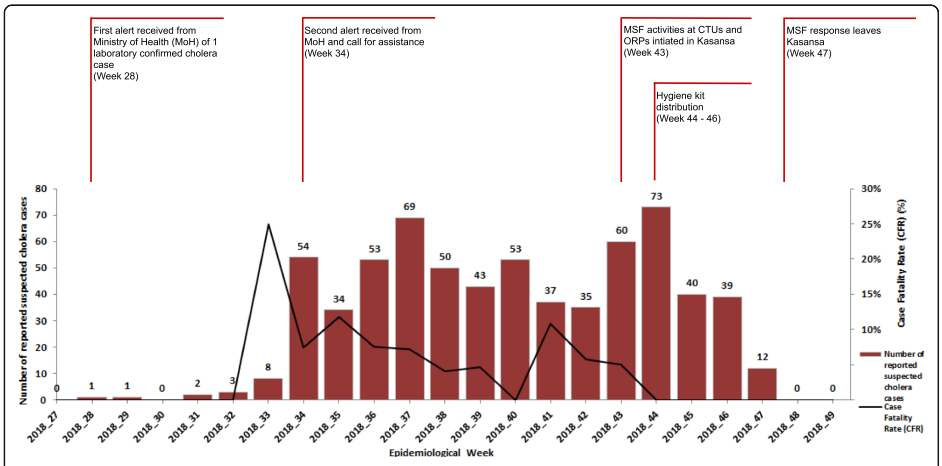

Fig. 1 Epidemiology of a cholera outbreak in Kasansa, Kasaï-Oriental, Democratic Republic of Congo (DRC) and timeline of response

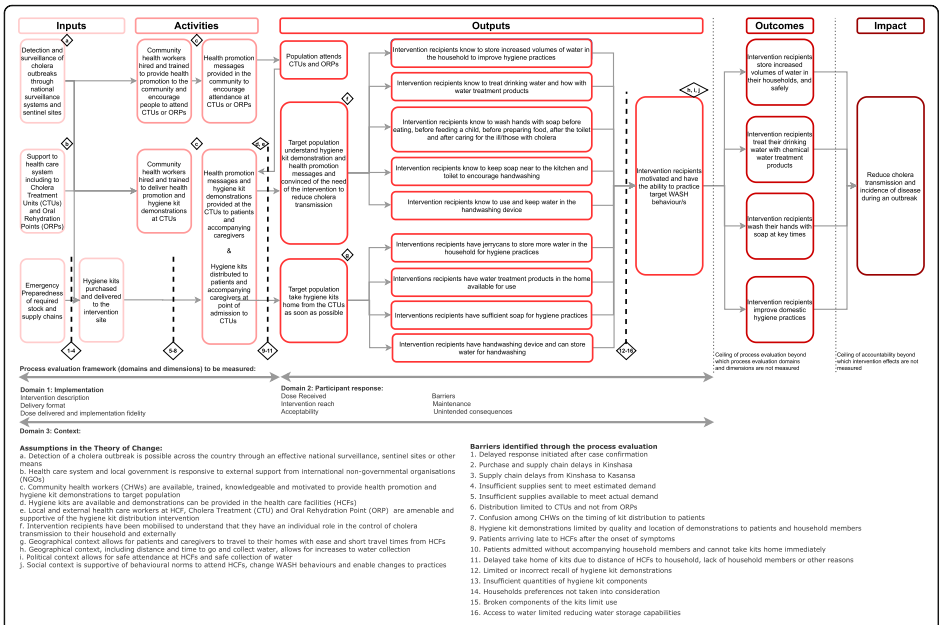

Fig. 2 A Theory of Change (ToC), including related assumptions, process evaluation framework and identified barriers from the analysis, for the distribution of hygiene kits and health promotion to cholera cases and their households

(Outputs & Outcomes). Other factors and assumptions that needed to hold true for change to occur as predicted are also illustrated in the ToC.

Process evaluation framework

A process evaluation framework, including the domains, dimensions, research questions and data collection methods (Table 1), was developed using the process evaluation literature [47, 49, 52, 69], as well as relevant published applications in public health [70, 71] together with complex system theory [53]. Accordingly, this mixed methods study included quantitative measures of intervention activities and qualitative exploration of the interaction between the three domains of intervention implementation, participant response to the intervention, and the context that mediated this relationship. The domain of intervention context was populated according to seven established "pillars" (geographical, political, ethical, legal, epidemiological, socio-cultural, and socio-economic structures) and at the macro (i.e. national systems and structures), meso (i.e. institutional and community) and micro (i.e. participants and local surroundings) levels, according to models developed in the literature [49, 50, 72].

Data collection

Most data collection was prospective, pre-specified and collected during and immediately following the MSF response, between October–December 2018 (W43–52). Some data, including intervention reports and additional surveillance data, were collected *post-hoc* between December 2018–February 2019 (W52–9).

The evaluation team comprised five experienced Congolese enumerators, all of whom held Bachelor's degrees and were MSF staff, partnered with five local less-experienced Congolese enumerators from Kasaï-Oriental, who had up to secondary level education and were hired on temporary contracts for the study period. All data collection was conducted with assistance from two female international investigators (one British and one Canadian), both of whom had Master's degrees. Prior to data collection, a five-day training was led by the two international investigators in Kinshasa to introduce the study, methods, ethics of research and to pilot all data collection tools. A two-day training was provided to the local Congolese enumerators at the study site. The evaluation team were MSF staff and study participants knew of the researchers' affiliations to the organisation. The

Table 1 Process evaluation framework: domains, dimensions, study population, data sources and data types

Process evaluation domains and dimensions	Research question	Core information sought	Study population	Data source	Data type
Domain 1: Implementation					
1. Intervention description	a. What was the design of the intervention?	Overall design of the intervention including site, population, health care facility and structure, rationale and timeline	MSF staff implementing the intervention (e.g. field coordinators, medical, logistics, WASH, supply and health promotion coordinators)	Semi-structured interviews (SSIs) and intervention reports and surveillance data from the local & national government including georeferenced maps	Qualitative
	b. What are the components of the intervention?	Content of the intervention including the intervention components and selection		MSF cholera guidelines, supply and kit catalogues, intervention reports and activity records (e.g. supply chain freight manifests, purchase orders, distribution lists, attendance registers)	Qualitative
2. Delivery format	Where and when was the intervention delivered?	Description of targeted area, population size, health care facility structure and environment, and timeline of the intervention	MSF staff, local government and national agencies (e.g. WASH and health clusters, PNECHOL-MD)	SSIs, intervention timeline and intervention reports	Qualitative/ Quantitative
			MSF staff, local government and other organisations (e.g. Save The Children, UNICEF, Solidarities International, Catholic Relief Services, Action Aid)	SSIs, intervention timeline and intervention reports	Qualitative/ Quantitative
	What other interventions (WASH and non-WASH) were provided by MSF?	Documentation of other interventions locally and nationally including the number of "competing" programmes, or components reaching the target population	MSF staff, local government and other organisations	SSIs and intervention reports	Qualitative/ Quantitative
	What other agencies were involved in implementation?	Documentation of the other agencies and government structures operating in the targeted area, including their roles and perceptions on the intervention	MSF staff, local government and other organisations	SSIs and intervention reports	Qualitative
	How was the intervention demonstrated and explained to users?	Documentation of the delivery format, timing and interaction with intervention recipients	MSF staff (e.g. CHWs)	Structured observations	Qualitative/ Quantitative
			MSF staff & intervention recipients	SSIs and intervention reports	Qualitative
	What resources were used to implement the intervention?	Human, material and financial resources utilised by the intervention	MSF staff, local government and other organisations	SSIs, intervention reports, activity records and budgets	Qualitative/ Quantitative
3. Dose delivered and implementation fidelity	How many interventions were delivered?	Number of interventions delivered and number of planned interventions		SSIs, intervention reports and activity records and surveillance data	Quantitative
	Was the intervention delivered as planned?	Documentation of the content, quality, successes and challenges of the intervention delivered	MSF staff & intervention recipients	SSIs and intervention reports	Qualitative/ Quantitative
Domain 2: Participant response					
4. Dose received	How many interventions were received?	Number of interventions received in the households of recipients	Intervention recipients	SSIs	Qualitative
5. Intervention reach	How many people interacted with the	Number of people in the household who interacted	Intervention recipients	SSIs	Qualitative

Table 1 Process evaluation framework: domains, dimensions, study population, data sources and data types *(Continued)*

Process evaluation domains and dimensions	Research question	Core information sought	Study population	Data source	Data type
	intervention? And their uptake of the intervention?	with the intervention and use			
6. Acceptability	What were the levels of participation and satisfaction?	Comprehension of emotional responses to the intervention, acceptability of the intervention and component preferences	Intervention recipients	SSIs	Qualitative
7. Barriers	What were the barriers to using the intervention?	Obstruction (physical and/or emotional barriers) to the intervention and concerns with the intervention	Intervention recipients, MSF staff, local government and other organisations	SSIs	Qualitative
8. Maintenance	How and why was the intervention sustained over time (or not)?	Retention of key messages, target behaviours and reflections of the intervention	Intervention recipients	SSIs	Qualitative/ Quantitative
9. Unintended consequences	What effects were not captured or were there unexpected outcomes, both related to the intervention and unrelated care?	Reasons for any deviation from the intended activities, interaction with and use of the intervention	Intervention recipients, MSF staff, local government and other organisations	SSIs	Qualitative
Domain 3: Context					
Context	What was the context?	Characteristics of the delivery context (geographical, political, legal, ethical, epidemiological, sociocultural, socioeconomic)	MSF staff, local government and other organisations	SSIs, intervention reports, activity records and budgets	Qualitative
	What external factors affected the implementation and the outcome?	Organisational context: culture, agenda, priorities, leadership styles and perceptions of leaders, perceptions on research and evaluation, and other contextual factors	MSF staff, local government and other organisations	SSIs and intervention reports	Qualitative

CHWs Community Health Workers, *MSF* Médecins Sans Frontières, *PNECHOL-MD* Programme National d'Elimination du Choléra et de Lutte contre les autres Maladies Diarrhéiques, *SSIs* Semi-structured interviews, *WASH* Water, sanitation and hygiene

evaluation team was not involved in the design or implementation of the intervention.

All tools were written in English, translated to French, piloted and translated to the local language, Tshiluba. The study is reported in accordance with the COREQ checklist for qualitative studies [73]. Specific data collection methods are described below and summarised in Table 1.

Semi-structured interviews and observations

Five Congolese enumerators conducted semi-structured interviews (SSIs) between W45–47 at households of a simple random sample of households enrolled in the parallel prospective cohort study who received a hygiene kit at an MSF-supported CTU. These SSIs lasted approximately 30 min and followed a topic guide including reported and observed measures of hygiene kit use to explore the participant response domain. SSIs with households were conducted until perceived data saturation.

SSIs with a purposive sample of MSF and non-MSF "implementers" were also conducted by three enumerators (one Congolese, one Canadian and one British) between W43–48, also until saturation. Implementers conducting activities in the study site were informed of the study in advance and requested to participate in SSIs. SSIs followed another topic guide to explore the implementation and context domains. Interviews were conducted for 30–45 min in participants' offices or at the CTUs.

Structured observations

Two Congolese enumerators conducted weekly unannounced visits to the two CTUs to observe hygiene kit

demonstrations and health promotion sessions. A structured form was used to record details about the implementation and participant response domains.

Intervention reports, activity records and budget

A total of 34 intervention documents were collected from implementers, local government and other organisations. Details of the strategy and description of the interventions were checked against guidelines [30], equipment catalogues [74] and internal policy documents. Attendance at hygiene kit demonstrations and health promotion sessions, and hygiene kit distribution lists were all recorded. Surveillance data were collected from the local and national government to describe the epidemiological context of the intervention. Any details of implementation and context domains were extracted from these reports.

Data management and analysis

SSI data were collected on tablets through the KOBO Toolbox platform (Harvard Humanitarian Initiative, Cambridge, MA, USA), which allows a combination of quantitative questions and audio recordings of the interviews. Field notes were also taken throughout the interview by the enumerators. Transcriptions from the audio recordings and field notes were made in MS Word (Microsoft, Redmond, VA, USA). Data from structured observations were collected on paper forms and transcribed to MS Excel (Microsoft, Redmond, VA, USA).

Quantitative data from surveillance, intervention documents and structured observations were entered into MS Excel to form a single dataset for analysis. Data on the implementation and receipt were cleaned and analysed in Stata 15 (StataCorp, College Station, TX, USA).

Qualitative analysis from the SSI transcriptions, structured observations and intervention documents was conducted in NVivo 11 (QSR International, Doncaster, Victoria, Australia) and analysis was based on thematic content analysis [75, 76] and example papers [69]. Following an iterative process to analyse the data, data were coded deductively according to the pre-specified domains and dimensions of our process evaluation framework.

Results

Description of study participants

Household SSIs featured 27 respondents (13 female; average age 43 years). All respondents were married with four children on average, and up to 22 people lived in their households. No household refused to participate in the study. All respondents were engaged in agriculture and/or artisanal diamond mining. None of the respondents had themselves been admitted to a CTU or ORP and all were relatives of the admitted case.

SSIs were conducted with 17 implementers (seven MSF, four local government and six from NGOs), three of whom were female. No implementer or organisation refused to participate. Implementers from MSF and NGOs had on average 3 years of experience in cholera outbreaks, and over 5 years working with NGOs. Government respondents had less than a year working in cholera outbreaks, and over 5 years of experience working in government.

Process evaluation findings

Following indexing of findings, a narrative was synthesised for each domain and dimension of the process evaluation. Table 2 presents illustrative quotations and are cited in the text. Barriers to intervention implementation and participant response are indicated below by numbers in square brackets e.g. **[Barrier 1]** and mapped back onto the ToC (Fig. 2).

Domain 1: implementation

Intervention description

Each cholera case and their accompanying household received a hygiene kit containing a 1 kg bar soap; 60 sachets of flocculant disinfectant (P&G Purifier of Water™, Procter & Gamble and Centers for Disease Control and Prevention, Pakistan) or 120 chlorine tablets (Aquatabs™, Medentech, Wexford, Ireland) estimated to be sufficient to treat 20-L of water per day for 30 days; a handwashing device of a 10-L bucket with tap and lid; and, a 20-L jerrycan. The appropriate water treatment product provided was determined based on the water source reportedly used by the household (flocculant-disinfectant for generally turbid open surface water sources; chlorine disinfectant for protected sources). Hygiene kits were distributed by local, MSF-trained CHWs to patients and their accompanying household members at the CTUs, with hygiene kit demonstrations provided 5–6 times per day.

Delivery format

The response was initiated midway through the cholera outbreak **[Barrier 1]** and quantitative findings indicated that hygiene kits distribution was limited to W44–46 **[Barrier 2].** Access and delivery of interventions to remote populations came with steep financial costs and required an influx of non-local staff and supplies, as mentioned in qualitative interviews with implementers (Quotation 1) **[Barrier 3 & 4]**.

Most hygiene kits were distributed on the day of admission (71%), with the remainder 1–3 days after **[Barrier 7]**. Between W44–46, 131 hygiene kit demonstrations and health promotion sessions were attended by 749 people at the two CTUs. Structured observations suggested good adherence of the demonstrations to

Table 2 Illustrative quotations from hygiene kit recipients and programme implementers from a cholera outbreak in Kasansa, Kasai-Oriental, Democratic Republic of Congo

Process evaluation dimension	*Quotation Number*	*Quotation*
Delivery format	1	*"The cholera programmes are challenging from logistics point of view. In Mbuyi Mayi* [provincial capital], *it's not possible to find P&G Purifier of Water™ and Aquatabs™. So, everything comes from Goma or Kinshasa. All of our staff come from Goma or Kinshasa. And our money does too- we are waiting for people to make signatures on the delivery of products and money to pay local RECOs* [community health workers]. " - Respondent #12, female
	2	*"It was loud in the CTU, and new patients were always arriving. Because it was small, there was not a big space for the demonstrations. The RECO* [community health workers] *also had to repeat parts many times. Sometimes there were differences between sessions."* - Respondent #2, male
Dose delivered and implementation fidelity	3	*"At the beginning, I gave the kit to the cases who had confirmed cholera. Then I gave them to all the patients. But some patients had no family. I had to give directly to the patient."* - Respondent #3, female
	4	*"In the intervention, we gave the kits at admission. But this was not happening at the beginning. At the beginning, I gave the kit to the cases who had confirmed cholera …. At the end I was giving them to everyone at admission to the CTU."* - Respondent #3, female
Dose received, reach and acceptability	5	*"Our water source is far away and has a lot of sediment, maybe 45 min, I walk. And the filter valve provided to filter the water does not easily pass water especially when the water is dirty from the river. It takes a long time to filter."* - Respondent #21, female
	6	*"If I have the necessary means and enough, I will buy kits for my wives, but the lack of money makes it difficult. I have 3 wives in three separate houses and there are not buckets to share."* - Respondent #24, male
Barriers to intervention use	7	*"Yes, I need several more elements than just the hygiene kit. I would like some foufou (maize flour), milk, clothes for the family, land my children need money to support school."* - Respondent #21, male
	8	*"So, we have no measure of impact for the kits we planned gave out. We need to conduct post distribution monitoring to see what has been used in kits and to also check precisely on the diversity of use. Some of the utensils of the kit including the bucket with tap served as storage of things rather than handwashing bucket. We also need to check if supplies need to be redistributed."* - Respondent #5, male
	9	*"So, I have the feeling that all of us are doing really short interventions, like the distribution of Aquatabs™, P&G Purifier of Water™, chlorination points. But the biggest challenge here is the lack of water. So, we were discussing also with the Hub, the WASH Cluster in Kasaï-Oriental today and also, he was thinking that maybe would have been better to focus funding durable solutions. So yes, it's true that there is the need now but maybe now that the cholera cases are reducing, we would be better looking at...maybe...financing new water points or chlorination points for 2 months. We could decide to rehabilitate the existing infrastructure or having, in this case, huge funding for rehabilitating the water gravity scheme that is here."* - Respondent #12, male

hygiene kit contents, described in Table 3, and that these were well received by the population and involved participants attending the CTUs. However, demonstrations were often interrupted by noise and other distractions (Quotation 2) [**Barrier 8**].

Dose delivered and implementation fidelity

MSF estimated 250 kits would be required for the response, but only 165 kits were delivered to Kasansa. This was insufficient for the 196 patients admitted between W43–47 [**Barriers 4 & 5**]. Moreover, quantitative findings indicated only 79 admissions, or their accompanying household members, received a hygiene kit, namely 52% of the 153 admissions across all seven HCFs during the period when hygiene kits were available between W44–46 or 40% of the 196 suspected cases admitted to MSF-supported facilities between W43–47 (Fig. 3). The 86 unused kits were donated to local government when MSF left Kasansa.

Reasons given by implementers for the low coverage included the late arrival of the kits to the project site [**Barriers 1–3**]; CHWs only distributing kits from the two CTUs and not the five ORPs [**Barrier 6**]; patients without accompanying household members which caused confusion as to whom the kit should be given [**Barrier 10**]; and, incorrect timing of distribution (i.e. giving kits at exit rather than at admission) which had to be re-emphasised multiple times to CHWs (Quotation 3 & 4) [**Barrier 7**].

Table 3 Content and delivery of health promotion and hygiene kit demonstrations at two Cholera Treatment Units (CTUs)

Observation site	Content of health promotion and hygiene kit demonstration													
	Hygiene kit component demonstrated					Health promotion messages included								Total components of a session
	Jerrycan (20 l (L))	*P&G Purifier of Water™ (flocculant disinfectant)*	*Aquatabs™ (chlorine tablets)*	*Soap (1 kg bar soap)*	*Handwashing device (10-L bucket with tap)*	*Cholera transmission (e.g. F-diagram)*	*Encouraging care-seeking behaviour to HCFs*	*Treatment at MSF facilities is free*	*Increase water stored in the household (by using the jerrycan)*	*Boil or treat drinking water*	*Limit open defecation*	*Practice safe corpse preparation*	*Wash hands at key times (before eating, before food preparation, after toilet, after changing a baby's nappy, after caring for the ill/ contact with a cholera case)*	
Nsenga Nsenga CTU	✓	✓	×	✓	×	✓	×	×	✓	✓	×	×	✓	**6**
Nsenga Nsenga CTU	✓	✓	✓	✓	✓	✓	×	×	×	✓	×	×	✓	**8**
Lukalaba CTU	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	×	×	✓	**10**
Lukalaba CTU	✓	×	✓	✓	×	✓	✓	✓	✓	✓	✓	✓	✓	**11**
Lukalaba CTU	✓	✓	✓	✓	✓	✓	×	×	×	✓	×	×	✓	**8**
Frequency among sessions	**5**	**4**	**4**	**5**	**3**	**5**	**2**	**2**	**2**	**5**	**1**	**1**	**5**	–

CHWs Community Health Workers, *CTU* Cholera Treatment Unit, *HCF* Healthcare Facility, *MSF* Médecins Sand Frontières

Table 3 Content and delivery of health promotion and hygiene kit demonstrations at two Cholera Treatment Units (CTUs) *(Continued)*

Observation site	Comments on the delivery of session, approach and activities
Nsenga Nsenga CTU	Demonstrations were conducted with a picture board but were often didactic and attendees were not able to ask questions or demonstrate recall of the messages or demonstration
Nsenga Nsenga CTU	CHWs instigated a question and answer game to check respondents understanding.
Lukalaba CTU	Demonstration of the hygiene kit was conducted through a picture board; CHWs responded to questions and encouraged use of the kits by households as soon as possible
Lukalaba CTU	CHWs repeatedly explained that the kit is only given to those with cholera patients in the house; and that households should start using them immediately
Lukalaba CTU	CHWs paused to take questions, ask the attendees to repeat the demonstrations and pauses to check any responses; CHWs emphasised the use of the kit by all household members.
Frequency among sessions	–

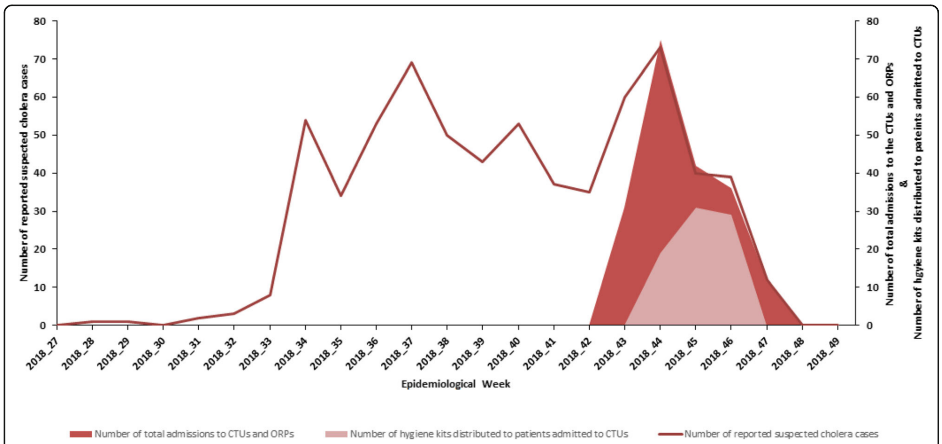

Fig. 3 Coverage of hygiene kits distributed to patients between Week 43–462,018 of a cholera outbreak in Kasansa, Kasaï-Oriental, DRC

Domain 2: participant response

Dose received, reach and acceptability

In interviews with intervention recipients, most regarded the intervention to be useful in their households, with preference for the soap and the handwashing device. It was reported by interviewees that they had not shared or sold any components. Distance to HCFs was self-reported as a barrier to seeking care by households, and the weight and size of the kit was cited as an issue when taking the kit home (Quotation 5) **[Barrier 10]**. Yet results indicate that, on average, patients arrived at the HCFs and were admitted within 1 day of the onset of symptoms (median 1 day, range 0–10 days) **[Barrier 9]**, and all interviewed households reportedly brought the hygiene kit directly home within 3 days of kit receipt and within 7 days after the onset of symptoms (median 3 days, range 1–6 days) **[Barrier 11]**.

All interviewed households attended a hygiene kit demonstration, and respondents reported that they understood how the kits should be used. This translated to self-reported changes in the targeted WASH behaviours among these households. Interviewed recipients reported using all components of the hygiene kit at varying frequencies. The handwashing device and jerry can were reportedly used two-to-three times per day whereas POU water treatment was used between once a day to three times a week. Recall of when and how to treat drinking water was frequently incorrect **[Barrier 12]** and self-reported adherence to POU water treatment was low.

The handwashing device and jerrycan were observed to be in use during household SSIs (i.e. water available in either container), and soap was both observed to be in use (i.e. visible bubbles, or visibly smaller in size) and located next to the handwashing device or cooking area. These practices mirrored the observed emphasis that CHWs placed on handwashing and use of soap in the hygiene kit demonstrations and health promotion provided at the CTUs (Table 3).

Barriers to hygiene kit use

An inadequate quantity of soap was the most cited barrier to using the hygiene kit, particularly among larger families as all households received the same quantity of soap irrespective of household size **[Barrier 13]**. Several interviewees from polygamous households reported that kits were either not shared among co-wives and respective dwellings or, if shared, that quantities were insufficient (Quotation 6). Similarly, one 20-L jerrycan for larger households was insufficient for their water storage needs, and households would have preferred a larger vessel (reported range 30–60-L). Other preferred items included money, more soap, food and clothes (Quotation 7) **[Barrier 14]**.

Implementers from MSF, local government and other NGOs also felt that quantities were insufficient for average-sized households **[Barrier 13]**, and repeated delivery would be required to facilitate effective disease control (Quotation 8). Many also felt that since the hygiene kit generally reduced risk of diarrhoeal diseases, households should be provided with enough materials to maintain use for longer than the outbreak. Implementers were also concerned that raising awareness of cholera and distribution of hygiene kits were limited actions,

particularly when a population has only basic or limited access to water supply (e.g. river and surface water sources) (Quotation 9) [**Barrier 16**].

Maintenance

Sustained use of the hygiene kits was difficult among interviewed households. Most households reported that they were unable to continue using the kit beyond 2 to 3 weeks, rather than the intended 1 month [**Barrier 13**]. Some parts of the kit were broken such as the tap on the handwashing device [**Barrier 15**]. Enthusiasm to continue using the kit was high, although the availability of stored water and water inside the handwashing device was affected by distances and time to water supply. All households reported over 5 km distances to water sources [**Barrier 16**].

Unintended consequences

There were no unintended consequences of hygiene kit use reported among intervention recipients. However, among the general population there was tension between households who had attended the CTU and received a hygiene kit and households who had attended the ORPs and not received a hygiene kit. Additionally, there was no retroactive distribution of kits to patients admitted to CTUs prior to the arrival of the hygiene kits. Households who lived close to admitted cholera cases but without admissions in their own households were anecdotally dissatisfied that they did not receive kits which could have led to discontent or stigmatisation of households with cholera cases.

Domain 3: context

Contextual events and influences unique to and across the macro, meso and micro levels were extracted from SSIs and intervention reports, conceptualised in Fig. 4, and supplement reported findings among the other domains and dimensions. Key examples of contextual factors affecting the implementation of and participant response to the intervention included: the limited surveillance leading to delayed response initiated after case confirmation [**Barrier 1**], the geographical context of limited access to WASH infrastructure and distances to water sources [**Barrier 16**]; the socioeconomic status of the population, which affected purchasing power and explains a preference for help with food and clothing in addition to hygiene kits [**Barrier 14**]; and the local political context which affected the limited resources available for cholera response programmes and lack of other actors available to respond.

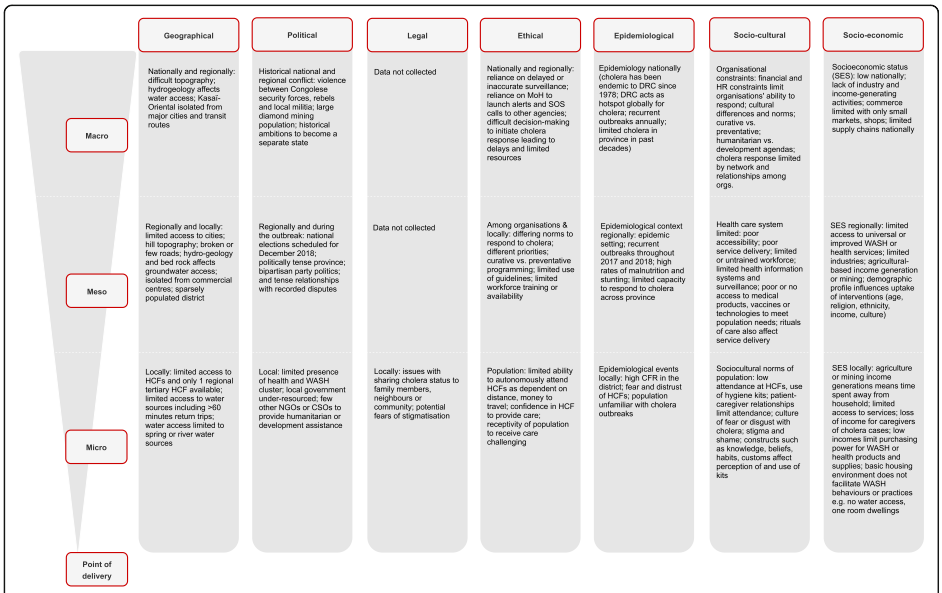

Fig. 4 Contextual influences and events that may have influenced the implementation and participant response to hygiene kit distribution during a cholera outbreak in Kasansa, Kasaï-Oriental, DRC

Discussion

This process evaluation of hygiene kit distribution during a cholera outbreak identified numerous barriers to effective implementation of and participant response to the intervention, and to our knowledge is the first published process evaluation of a cholera outbreak response by MSF. During the late-2018 cholera outbreak in Kasansa, Kasaï-Oriental, DRC, it was observed that only 52% of admitted suspected cholera cases received a hygiene kit intervention. Although the majority of admitted patients in receipt of a hygiene kit had received the intervention on the day of admission, the delay of the overall response, delayed supply of hygiene kits and insufficient quantities of hygiene kits available limited the intervention's coverage and utility, and may have diminished the effectiveness of the intervention. Overall, our process evaluation demonstrated that a large proportion of households either did not receive the kit or received the kit after the incubation period, or at least during the symptomatic period of the first case in the household, meaning that much of the infectiousness window from primary to secondary generation cholera cases within the household was not mitigated, nor would there be a reduction in the incidence of cholera among the population globally, as depicted in the ToC.

The analysis identified four key points in the ToC where barriers affected the implementation of and response to the hygiene kit intervention, and the ultimate reduction in cholera incidence and associated cholera morbidity and mortality (Fig. 2). In our case, the relative effect on within-household transmission will be reportedly separately in a parallel cohort study.

Barriers to hygiene kit arrival at the project site

The MSF response was delayed and launched 16 weeks into the outbreak, clearly diminishing any potential effect of a cholera outbreak response. Capacity to deliver the hygiene kits to the intervention site was largely lacking at the national level within MSF, and although hygiene kits are part of the emergency preparedness stocks in the capital city Kinshasa, insufficient quantities were delivered. This highlights the need for expansion of emergency preparedness supplies at the national level or regionally at other MSF project sites (e.g. in Kananga [77]) with a reliable supply chain and transport of standard components required in cholera responses [36, 78], as well as the need for market supply chain analysis in key sites nationally to increase the ability for local purchasing and supply [79].

Barriers to hygiene kit distribution at the HCFs

The distribution of hygiene kits was intended to target those households most at risk, but insufficient supplies and the decision to only distribute from CTUs and not the ORPs limited coverage and availability of the intervention to this population at risk. ORPs are typically located remotely and only provide rehydration to cases [30], however, they also may include 1–2 beds for case management and households may return home from these HCFs without attending the more centralised CTU or HCF. The exclusion of ORPs limited the intervention reach, and there is an opportunity to distribute hygiene kits to case-households from these HCFs and, in future responses, ORPs may need to be included for a more case-centred approach.

MSF guidelines specify that timely distribution is at admission [30]: CHW confusion on the timing of distribution had an effect on when kits were distributed, suggesting a need to reinforce the recommended delivery times in future trainings. The design of the hygiene kit demonstrations and health promotion should also be reflected upon to ensure the timely and sustained use of the hygiene kits in patient's homes, and overall WASH intervention uptake. Evidence has shown that more participatory and engaging approaches, instead of simple health messaging [80, 81], are also needed to motivate and increase households' ability to mount disease control efforts [69] and future programmes should adopt such frameworks.

Barriers transferring hygiene kits to patient households

In many cases, admission of suspected cases to HCFs came 0–3 days after the onset of symptoms, but timely presentation of cases at HCFs remains a major issue experienced in cholera outbreaks [82]. Interviewees reported that many cases arrived without accompanying household members and thus were impeded from taking kits directly home whilst they were admitted. The time delay from receiving the kit, distance of HCFs to households and burden of transferring the kit home (i.e. bulky to transport for long distances) limited prompt use. These factors in turn may diminish the ability of the hygiene kits to reduce transmission within the transmission window from cases to household contacts.

One potential solution could be to increase active case finding at the district level and employ more CHWs to encourage cases to attend and household members to accompany suspected cases to HCFs. Another option could be to deploy rapid response teams (RRTs) to directly deliver hygiene kits and other interventions (e.g. other WASH materials, oral cholera vaccination (OCV) or antibiotic prophylaxis) to case households and the surrounding population at risk [27–29, 78], especially in densely populated or urban settings [28]. However, expanding the coverage of an intervention beyond patient-centred delivery may not be feasible for some organisations and a wider case-area targeted intervention (CATI) approach may require intensive case

identification, a highly mobile response and high financial resources.

Barriers to hygiene kit use by households

Recall of POU water treatment demonstrations was limited, and this may have curtailed the use or adherence to use of the Aquatabs™ chlorine tablets or P&G Purifier of Water™ flocculant disinfectant, as observed in other studies [44, 83]. Additionally, there was a limited supply of consumables in the kits and larger households found it difficult to maintain use for longer than a few weeks. Cholera contamination in the household can be sustained whilst cases are shedding bacteria for up to 14 days after onset of symptoms [20], and maintained use of interventions is required to reduce transmission [84]. This questions the use of standardised kits for variable household sizes, and suggests the additional need for contextual adaptations to be made to WASH intervention design considering household sizes, preferences and cultural norms [85].

Lastly, the hygiene kit intervention was designed to target key within-household transmission routes by treating contaminating drinking water and enabling improved hygiene practices. However, the intervention relies on a reliable supply of water and in sufficient volumes to facilitate hygiene practices [86]. Water sources were limited amongst this population, with distances >5 km return trip for most households, and volumes of water available for drinking, cooking and hygiene were broadly low, as seen in much of DRC [87]. Hygiene kit distribution is only one part of response efforts to reduce transmission and incidence of disease. Inadequate or limited access to WASH infrastructure will affect cholera prevention and control efforts [6], and may have interacted with the effect of the hygiene kit intervention, while other potentially important transmission routes have been ignored. Environment-to-human transmission of cholera directly from contaminated water sources [88], contact with faeces in the environment or lack of sanitation [18], fly transmission [89, 90] and safe burial practices [91], were not targeted with the hygiene kit intervention.

Successes of hygiene kit distribution

Although several barriers limited the effectiveness of the overall intervention, it was noted that the intervention was well received by households that did receive the hygiene kit, and interviewed households were observed to and self-reported that demonstrations at the CTUs were clear and easy to understand. All components of the kit were used but in varying frequencies. Soap, jerrycans and the handwashing device were reportedly and observably used the most, and high adherence to using the handwashing device was reported in SSIs. Overall, hygiene kit distribution successfully translated to reported and observed improvements in household WASH knowledge and practices, as expected in the Outputs and Outcomes listed in the ToC.

Existing research has provided examples where both the kit and its components can reduce the incidence of cholera [24, 47–50, 92, 93]. With one study in Bangladesh finding cholera-specific hygiene promotion and hygiene kit distribution - a similar case-centred strategy to this MSF response- among admitted cases and households contacts leading to a 50% reduction in cholera incidence among household contacts of cases [25]. Although barriers to coverage and utility have been identified in this study, the hygiene kit may be an effective rapid and short-term measure in contexts such as DRC, particularly where longer-term WASH improvements are under-resourced [8], and targeting interventions to case households where risk of transmission is higher may thus be more efficient [12–14, 94].

Limitations

The distribution of hygiene kits was implemented as a programme, not a research study, and accordingly this left many factors of intervention delivery open to change and interpretation by the implementers, rather than under control of the study staff. Although this allowed for the process evaluation to reflect real-world conditions, it limits the ability to rigorously test and draw certain conclusions on what could be effective models for delivery and adoption of the intervention by the population. Evidence around the effectiveness of WASH interventions in cholera prevention and control is limited [24], particularly from emergency contexts [95], and although the results here show the distribution of kits is a feasible response in this setting, a true assessment of this intervention to reduce cholera transmission would require a more rigorous study design.

Another limitation of the study is the reflexivity and bias of the researchers. It is possible that as the researchers were MSF staff and working closely under intense conditions with the intervention team, the relationship between the enumerator and interviewees may have exacerbated bias in their interactions and/or their reporting of events. There are already numerous challenges noted from conducting research in humanitarian contexts [95, 96], but the close relationship of the evaluation team to the implementers and pressures of the context may have resulted in social desirability bias on the side of the interviewees and interviewer bias in the side of enumerators. Most data were self-reported, and saturation of the data was reached quickly in our study population, potentially due to reporter and social desirability bias. Households who were interviewed may also have been more likely to recall positive experiences

to the MSF-related, and thus intervention-related, evaluation team, leading to an inflation of responses. It has also been argued that interviews and data collected on personal behaviours such as handwashing are often overestimated [45, 92].

Additionally, although a snapshot of the contextual events and influences have been captured during our study, it is difficult to both capture all events and influences that may impede or strengthen the effect of an intervention [93]. Our approach assumed a relatively stable relationship between context, implementation and participant response [97] and have taken a snapshot of one point in time. However, some of the identified factors may have existed prior to the intervention, or there may have been a dynamic relationship that emerged during implementation which does not capture the effect of the context on the programme [50, 98]. The causal pathway of the relationship between the three domains of context, implementation and participant response may not be fully understood and this study design may not have provided the means to understand the process. Despite these limitations, the results of the study are informative, and we have triangulated across multiple data collection methods.

Conclusions

Hygiene kit distribution is a promising intervention for cholera control. The integration of a WASH intervention at the point of admission of suspected cases is new in cholera control efforts, particularly in outbreaks and complex emergencies. This study has shown that it is possible to distribute interventions from the HCF and employ case-centred WASH interventions. However, the programme we evaluated suffered from barriers to the timely supply, inadequate availability and consequent coverage of the hygiene kits. These issues warrant consideration in subsequent cholera responses, the development of new guidelines, training of new staff and integration of these findings in national and organisation-specific cholera control efforts. Further research is also required to identify ways to improve implementation and delivery of this promising intervention.

Abbreviations

AR: Attack Rate; CFR: Case Fatality Rate; CHW: Community Health Worker; CTC: Cholera Treatment Centre; CTU: Cholera Treatment Unit; DRC: Democratic Republic of Congo; HCF: Health Care Facility; MSF: Médecins Sans Frontières; NGO: Non-Governmental Organisation; OCV: Oral Cholera Vaccination; ORP: Oral Rehydration Point; PNECHOL-MD: Programme National d'Elimination du Choléra et de Lutte contre les autres Maladies Diarrhéiques; POU: Point of Use; RRT: Rapid Response Teams; SSI: Semi-Structured Interview; ToC: Theory of Change; WASH: Water, Sanitation and Hygiene; W: Epidemiological Week

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Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the individuals involved or funding agency.

Authors' contributions

LDG conceived the study, and LDG and OC designed the study with input from RD, RVDB, PM and FC. SB contributed to the development of data collection tools and collected data during the intervention implementation. LDG, SB, AG and MM oversaw all data collection. LDG analysed the data with input from KG, FC and OC. LDG drafted the manuscript and all co-authors contributed revisions to the manuscript. LDG had final responsibility for the decision to submit for publication. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study protocol was approved by the ethics board at the London School of Hygiene and Tropical Medicine (No. 14425) and by the School of Public Health at the University of Kinshasa, Democratic Republic of Congo (No. 67/CNES/BN/PMMF/2018). The ethics board at Médecins Sans Frontières also provided approval of a generic protocol for the study (No. 1805c). Written informed consent was obtained from all study participants. All consent forms were available in French, English and the local language of Tshiluba. Consent forms were provided in the language appropriate for the participant. Participant interviews were transcribed and de-identified. All data was kept confidential.

Consent for publication

Not applicable.

Competing interests

On behalf of all authors, there are no competing interests to declare that could be construed to have influenced the work. The authors alone are responsible for their views expressed in this article and they do not represent the views, decisions or policies of the institutions with which they are associated. Authors from MSF (SB, RD, MM, AG, DV, RVDB, and PM) contributed independently in their own rights as individuals.

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Publisher's Note

Research Paper 4: Identifying transferable lessons from cholera epidemic responses by Médecins Sans Frontières in Mozambique, Malawi and the Democratic Republic of Congo, 2015-2018: a scoping review

This scoping review describes the implementation of twenty cholera responses by MSF between 2015-2018. It summarises the characteristics of previous cholera responses, time between alert and response and the challenges common across settings and time. The review concludes by providing evidence-based recommendations to improve cholera control efforts by MSF and other agencies.

This chapter is supplemented by Appendix D with the PRISMA-ScR checklist.

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Surname/Family Name	D'Mello-Guyett		
Thesis Title	Prevention and control of cholera in complex emergencies in Sub-Saharan Africa: evaluating the effectiveness of water, sanitation and hygiene interventions used by Médecins Sans Frontières		
Primary Supervisor	Dr Francesco Checchi		

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Identifying transferable lessons from cholera epidemic responses by Médecins Sans Frontières in Mozambique, Malawi and the Democratic Republic of Congo, 2015-2018: a scoping review

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Keywords

cholera, outbreaks, emergency, water, sanitation, hygiene, oral cholera vaccination

Abstract

Background

Cholera epidemics occur frequently in low-income countries affected by concurrent humanitarian crises. Evaluations of these epidemic response remains largely unpublished and there is a need to generate evidence on response efforts to inform

future programmes. This review of MSF cholera epidemic responses aimed to describe the main characteristics of the cholera epidemics and related responses in these three countries, to identify challenges to different intervention strategies based on available data; and to make recommendations for epidemic prevention and control practice and policy.

Methods

Case studies between 2015-2018 from the Democratic Republic of Congo, Malawi and Mozambique were purposively selected by MSF for this review due to the documented burden of cholera in each of the countries, frequency of cholera outbreaks, and risk of concurrent humanitarian crises. Data were extracted on the characteristics of the epidemics; time between alert and response; and, the delivery of health and water, sanitation and hygiene (WASH) interventions. A Theory of Change for cholera response programmes was built to assess factors that affected implementation of the responses.

Results and conclusions

20 epidemic response reports were identified, 15 in DRC, one in Malawi and four in Mozambique. All contexts experienced concurrent humanitarian crises, either armed conflict or natural disasters. Across the settings, median time between the date of alert and date of the start of the response by MSF was 23 days (IQR 14-41). Almost all responses targeted interventions community-wide, and all responses implemented in-patient treatment of suspected cholera cases in either established health care facilities (HCFs) or temporary cholera treatment units (CTUs). In three responses, interventions were delivered as case-area targeted interventions (CATI) and four responses targeted households of admitted suspected cholera cases. CATI or delivery of interventions to households of admitted suspected cases occurred from 2017 onwards only. Overall, 74 factors affecting implementation were identified including delayed supplies of materials, insufficient quantities of materials and limited or lack of coordination with local government or other agencies. Based on this review, the following recommendations are made to improve cholera prevention and control efforts: explore improved models for epidemic preparedness, including rapid mobilisation of supplies and deployment of trained staff; invest in and strengthen

partnerships with national and local government and other agencies; and to standardise reporting templates that allow for rigorous and structured evaluations within and across countries to provide consistent and accessible data.

Introduction

Across Sub-Saharan Africa, an estimated 430 million people are at risk of cholera (18). Annually, there are an estimated 1.3–4.0 million cases of cholera worldwide resulting in between 21000 and 143000 deaths (18). Many of the largest epidemics on the continent have occurred concurrently with armed conflict and ongoing humanitarian crises (126-129). Cholera epidemics can evolve rapidly and most often occur in settings with limited surveillance systems to detect the outbreak's onset.

By 2030, the Global Task Force on Cholera Control (GTFCC) has set a target to reduce cholera mortality by 90% and eliminate cholera in 20 out of 47 countries by 2030 (75). The renewed focus on cholera provides a framework for synchronising the efforts of countries, donors, implementing agencies and support coordinated multisectoral implementation of cholera control measures (76). The strategy has three axes: 1) to focus on cholera hotspots in endemic countries with well targeted interventions; 2) to reinforce early detection and response to contain epidemics quickly; and 3) to provide an effective mechanism for coordinated technical support, financing and resources at the global and country level (77). There are five pillars of the GTFCC including surveillance, case management, oral cholera vaccination (OCV), water, sanitation and hygiene (WASH), and community engagement. All pillars interact and play an integral role in multisector responses in short-term, emergency responses and for longer term sustainable elimination of the disease.

Progress towards this target set by the GTCC may benefit from critical review of past responses, particularly as LMIC governments, including Democratic Republic of Congo (DRC), Malawi and Mozambique, develop multisectoral National Cholera Plans (NCPs) to address cholera within their contexts (130). Typically, interventions to prevent and control cholera epidemics have varied between mass, community-wide campaigns, in which multisector interventions are aligned to other WASH-related

disease control efforts and aim to prevent the recurrence of outbreaks (123), to household-level or case-area targeted interventions (CATIs), in which services are delivered to a defined area surrounding a case to take advantage of the natural clustering of cases within a given radius, so as to contain or extinguish the outbreaks (50, 108-111). Whilst cholera responses will always be specific to the geographical and social context, it is important that the operational constraints for delivering timely interventions are documented and evaluated. Previous reviews have shown a dearth of evaluations of epidemic responses, depriving governmental and other response actors of an evidence base for improving practice and a baseline against which to track progress (115, 116). In particular, delayed detection, confirmation and response can considerably dampen the impact of CATI-like approaches, with delays of >2 weeks expected to result in spill-over beyond the initial outbreak cluster (74); interventions that seek to contain outbreaks before they propagate widely, including case-based or localised distribution of hygiene kits (125) and vaccination (7, 131) are particularly dependent on early response, as is case management of cholera cases (54, 107).

Over the last five decades, the international non-governmental organisation (NGO), Médecins Sans Frontières (MSF) has intervened in multiple cholera epidemics in crisis-affected Sub-Saharan African settings. In this review, we present three countries (DRC; Malawi; and Mozambique) as case studies of MSF's Operational Centre Belgium (OCB) response to cholera epidemics during the period 2015-2018. The aim of this study was to describe the main characteristics of the cholera epidemics and related responses in these three countries, to identify challenges of different intervention strategies based on available data; and to make recommendations for epidemic prevention and control practice and policy.

Methods

Study design, inclusion and exclusion criteria

This review analysed cholera response reports by MSF OCB. Intervention reports were eligible for inclusion if they were finalised during 2015-2018 and described or evaluated the organisation's intervention during a cholera outbreak. Mozambique,

Malawi and DRC were purposively selected due to the documented burden of cholera in each of the countries (75), frequency of cholera outbreaks (129); and risk of concurrent humanitarian crises (127, 128, 132). The period 2015 to 2018 was selected based on advice from advice on the availability of data within the organisation. World Health Organization (WHO) definitions for a cholera alert were used in both the responses and this analysis (60). The review is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines (133). The review was not pre-registered prior to publication.

Theory of Change

To guide the review, we developed a Theory of Change (ToC) diagram to identify requirements for implementing a cholera epidemic response, and pathways whereby the intended effects on cholera transmission and disease burden (Impact) may be achieved and/or influenced by common challenges (Figure 1). ToC models can be useful to create alongside evaluations of programmes as they can provide insights into the key bottlenecks and constraints of programme implementation (134-136). This ToC was developed with inputs from the study team and acts as a framework by which we can understand the barriers within the past responses. The ToC Inputs are i) national and local emergency preparedness supplies, the supply of interventions to the intervention site and national and local surveillance systems that can detect the outbreak; these determine ii) adequate health promotion and timely provision of the interventions to the target population (Activities); which in turn lead to iii) the target population understanding the health promotion and intending to accept or utilise the interventions (Outputs); iv) intervention recipients that are motivated and have the ability to practice the target behaviour/s or access cholera control services (Outputs); and, finally to v) a reduction in transmission of *Vibrio cholerae* and mortality of cholera cases (Outcomes & Impact).

Data extraction and analysis

Documents were shared by MSF's operational desks overseeing programmes in the three countries, and were transferred to Endnote X9 (Clarivate Analytics, Boston, USA). Reports were screened according to the inclusion criteria described and data

extracted by two reviewers into an MS Excel (Microsoft, Redmond, VA, USA) sheet. Data extraction was reviewed by two co-authors (LDG and ER) and any disagreements agreed by consensus.

Qualitative operational factors that affected the response were extracted from reports and analysis was conducted in MS Excel (Microsoft, Redmond, VA, USA). Based on thematic content analysis (137, 138), common challenges were identified and coded deductively according to pathways to the ToC. These have been mapped to Figure 1 to show the key challenges affecting an effective cholera response programme.

Data were extracted on the following, as available:

i) Description of the outbreak (e.g., country, geographical setting, transmission, and number of cases and deaths);
ii) Time lag from alert (i.e., through formal or informal surveillance systems) or onset (i.e., report of a suspected cholera case meeting the WHO definition) to response (i.e., initiation of health and/or WASH interventions for prevention and control of cholera, as specified in Table 4);
iii) Specific health and WASH interventions implemented (Table 4);
iv) Population targeted by interventions (e.g., community-wide interventions, CATI, households of cases or only cases treated at health care facilities, HCF);
v) Operational factors mentioned in the report that affected the response, organised thematically based on a Theory of Change (ToC) of cholera responses (see below and Figure 2).

Table 4. Categories and definitions of cholera prevention and control interventions included in the review

Health interventions (62)	Case management	Treatment is based on the degree of dehydration of the patient: no dehydration, some dehydration or severe dehydration. Patients with no signs or some signs of dehydration are treated with ORS (plan A and plan B, respectively). Patients with severe dehydration require IV rehydration (Plan C). Antibiotics are indicated in patients with severe dehydration and, in patients with high purging or treatment failure or in patients with coexisting conditions or comorbidities. In children aged 6 months to 5 years, zinc supplementation (20 mg p.o. zinc sulphate per day for 10 days) should be started immediately (62).
	Oral Cholera Vaccination (OCV)	Any of the two types of OCV, WC-rBS, killed whole cell monovalent (O1) vaccines with a recombinant B subunit of cholera toxin (Dukoral®) and (ii) WC, killed modified whole cell bivalent (O1 and O139) vaccines without the B subunit (Shanchol™, Euvichol® and mORCVAX™), currently available and recommended by WHO (103). Vaccination campaigns are guided by a series of criteria, governed by the GTFCC (131).
	Antibiotic chemoprophylaxis	Any antibiotic chemoprophylaxis, with doxycycline, azithromycin or ciprofloxacin, is currently not recommended by WHO. However, selective prophylaxis of household contacts of cholera cases (i.e., considered at high risk of being infected with *Vibrio cholerae*) has been implemented in the past.
	Other health interventions	As applicable
WASH interventions (123)	Improving the access to water sources and/or quantity of water	Any intervention to provide a new and/or improved water supply or distribution system, or both, i.e., to reduce direct and indirect exposure with contaminated water (e.g., installation of piped water supply, hand pumps, boreholes; installation or extension of distribution networks; water trucking or tankers; and protection of water sources)
	Improving the quality of water: water treatment at source	Any intervention to improve the microbiological quality of drinking water at the source, including: assessment and monitoring of water quality i.e., microbiological, chemical and physical quality removing or inactivating microbiological pathogens (e.g., water source level water treatment systems, filtration, sedimentation, chemical treatment, heat treatment, ultraviolet (UV) radiation or flocculation)
	Improving the quality of water: point of use (POU) and safe storage	Any intervention to expand use of or improve the microbiological quality of drinking water at the point of use (POU), including: assessment and monitoring of water quality i.e., microbiological, chemical and physical quality protecting the microbiological quality of water prior to consumption (e.g., chemical treatment, filtration, heat treatment, flocculation, UV radiation, residual disinfection, protected distribution, improved storage)
	Improving the access to and use of sanitation facilities and reducing exposure to faeces	Any intervention to introduce, improve or expand the coverage of facilities for the safe management, disposal and treatment of excreta, i.e., to reduce direct and indirect contact with human faeces, and to promote the use of sanitation facilities by the population (e.g., latrine construction, pour flush, composting or water sealed flush toilet, piped sewer system, septic tank, simple pit latrines, VIP latrine, defecation trenches or use of a potty or scoop for the disposal of child faeces)
	Behaviour change interventions to improve personal, domestic and food hygiene practices	Any intervention to improve hygiene, including: promotion of hygiene behaviours, norms or practices surrounding personal, food and hand hygiene assessment and monitoring of hygiene behaviours, norms or practices, including adaptation of activities any named method of delivery of hygiene promotion (e.g., interpersonal channels, house-to-house visits, community meetings, mass and social media, targeted areas or information, education and communication (IEC) materials, or other hygiene promotion activities) any named theory, framework or technique for hygiene promotion (e.g., behaviour change communication (BCC), community engagement, social marketing and demand creation, integrated hardware)
	Distribution of hygiene materials or non-food items (NFIs)	Any intervention that provides hygiene materials or use of hygiene materials (e.g., soap, hygiene kits, handwashing stands, sinks and other facilities)
	Promotion or distribution of disinfection and cleaning of households and community spaces and/or materials	Any intervention that provides or distributes disinfection materials (e.g., chlorine spraying, disinfection of clothes, disinfectants, disinfection of bedding or vehicles) or promotes household cleaning (e.g., safe laundry practices, cleaning of floors and furniture)
	Improving dead body management and safe funeral practices	Any intervention to improve safe funeral practices, funeral gatherings and management of corpses in the community
	Improving the management of wastewater and faecal sludge	Any intervention to improve management of wastewater and faecal sludge
	Provision of interventions that improve solid waste disposal	Any intervention to improve solid waste disposal, particularly in public places
	Use of vector control interventions to reduce flies	Any intervention to improve fly control and/or other vectors
	Other WASH interventions	As applicable

Results

Description of outbreaks and intervention sites

Twenty outbreak response reports, of the 35 provided by MSF, met the inclusion criteria. Of the 15 reports that were excluded from the analysis, eight were incomplete and did not provide enough data for extraction and seven were duplicative reports from the same outbreak but written by another person. There were 15 included reports from DRC, four from Mozambique and one from Malawi. Twelve outbreaks were in rural settings, seven in urban and one in both. All contexts experienced concurrent humanitarian crises, either armed conflict or natural disasters. In Mozambique, all outbreaks were among populations affected by armed conflict with one outbreak among a population affected by armed conflict and a natural disaster (flooding and cyclones). In Malawi, the outbreak started among displaced populations, and, in DRC, all outbreaks were in areas with ongoing medium-intensity conflict. All 20 reports reported the date of the initial outbreak alert, but no report detailed the date of onset of symptoms in the first identified cases. Alerts came through both formal surveillance systems (70%, n=14) and informal sources (30%, n=6), and were additionally investigated by MSF. Formal surveillance systems included routine health surveillance systems and sentinel sites. Informal sources included community-based reporting from community health workers (CHWs) to a local HCF, typically based on report of a person with suspected symptoms of cholera. Two of the alerts were confirmed by culture (10%, n=2), half were reported as confirmed but the authors did not specify if this was by culture (50%, n=10) and in two instances the alerts reported the use of RDTs, but it was unclear if this was for confirmation of the alert or for general use (10%, n=2). Other characteristics of the outbreaks such as previous MSF operations, locations and/or distances to HCFs, or length of the outbreaks were not included in any of the reports. Characteristics of the outbreaks including cumulative cases, cumulative deaths and approximate case fatality rate (CFR) are reported in Table 5.

Time from alert to response

Across the three countries, median time from the date of the alert to date of case confirmation was 10 days (IQR 3-28). The median time between the date of alert and date of the start of the response by MSF was 23 days (IQR 14-41). Among the eight reports that also reported when WASH interventions started, there was a further

median delay of 8 days (IQR 6-12) from the launch of a response to the launch of any WASH intervention. Median time from alert to response overall and by country are reported in Table 6.

Delivery of health and WASH interventions

Almost all responses targeted interventions community-wide, and all responses implemented in-patient treatment of suspected cholera cases in either established HCFs or temporary cholera treatment units (CTUs). In three responses, interventions were delivered as CATI and four responses targeted households of admitted suspected cholera cases. CATI responses or delivery of interventions to households of admitted suspected cases occurred from 2017 onwards only (Table 7).

Among the 20 responses, OCV was deployed only twice (both in DRC) and no response across the three countries included antibiotic chemoprophylaxis. WASH interventions deployed across responses varied between years and contexts, but the most widely implemented interventions were distribution of point-of-use (POU) water treatment, distribution of non-food items (NFIs) and behaviour change interventions that promoted hand washing with soap (Table 7).

Common challenges affecting cholera responses

For each outbreak, challenges that delayed the response and affected the implementation of programme activities were extracted from reports and mapped to the ToC (Figure 2). Overall, 74 challenges were identified across reports: 33 from DRC, 29 from Mozambique and 12 from Malawi (Table 8). Among the Inputs for programme delivery, delayed supplies of materials (c) and hiring or availability of health promotion staff (g & i) were frequently cited as challenges. In addition to delays, insufficient quantities of materials were delivered for effective programme delivery (d) and an insufficient number of key staff hired, particularly staff for infection, prevention and control (IPC) in the HCFs (h). The most widely reported challenge affecting Activities was the limited or lack of coordination with local government or other agencies (a), which is likely related to the second most commonly mentioned challenge of incomplete or inaccurate epidemiological data collection during the response (b), which could have affected timeliness of response initiation, the

appropriateness of the response strategy and real-time adaptation of the response. Activities were also affected by the distances between households and HCFs and the ability to reach the population during bad weather or insecurity (j, k and n). Among Outputs, adequate case management was constrained by staff inexperience with cholera case management protocols (e) and in some cases, the response was affected by stigma and fear of cholera among the population (f). Other aspects of programme delivery that were frequently reported as challenging included limited water supply available to the population (l), which may affect their ability to adopt hygiene behaviours, and the inadequate medical waste management in HCFs, which could pose a nosocomial transmission risk (m).

Table 5. Description of outbreaks in the Democratic Republic of Congo, Malawi and Mozambique between 2015-2018

Country	Year	District	Geographical context	Transmission	Political instability[Ψ]	Cumulative ascertained cases	Cumulative ascertained deaths	Case Fatality Ratio (%)	Alert confirmed by:
DRC	2015	Maniema	Urban	Endemic	Medium-intensity conflict	3316	70	2.1	Confirmed but not specified
DRC	2016	Maniema	Rural	Endemic	Medium-intensity conflict	319	16	5.0	Confirmed but not specified
DRC	2016	Tshopo	Rural	Endemic	Medium-intensity conflict	1 758	241	13.7	Confirmed but not specified
DRC	2016	Tshopo	Rural	Endemic	Medium-intensity conflict	72	3	4.2	Culture
DRC	2016	Tshopo	Rural	Endemic	Medium-intensity conflict	688	44	6.4	Confirmed but not specified
DRC	2016	Tshopo	Rural	Endemic	Medium-intensity conflict	137	11	8.0	Confirmed but not specified
DRC	2016	Mongala	Rural	Endemic	Medium-intensity conflict	12 292	32	0.3	Culture
DRC	2016	Equateur	Rural	Endemic	Medium-intensity conflict	620	20	3.2	Confirmed but not specified
DRC	2016	Kinshasa	Urban	Endemic	Medium-intensity conflict	8	1	12.5	Confirmed but not specified
DRC	2016	Kinshasa	Urban	Endemic	Medium-intensity conflict	15	3	20.0	Confirmed but not specified
DRC	2017	Kongo Lomami	Rural	Endemic	Medium-intensity conflict	786	60	7.6	Not specified
DRC	2018	Kasaï-Oriental	Urban	Endemic	Medium-intensity conflict	130	0	0.0	Not specified
DRC	2018	Kasaï-Oriental	Rural	Endemic	Medium-intensity conflict	666	32	4.8	Confirmed but not specified
DRC	2018	Kinshasa	Urban	Endemic	Medium-intensity conflict	1 153	35	3.0	Not specified
DRC	2018	Mai Ndombe	Urban/Rural	Endemic	Medium-intensity conflict	473	28	5.9	Not specified
Malawi	2015	Nhamayabue and Caia	Rural	Endemic	Population displacement	489	2	0.4	Confirmed but by use of RDT
Mozambique	2015	Mocuba	Urban	Endemic	Armed conflict	317	2	0.6	Not specified
Mozambique	2015	Tete	Urban	Endemic	Armed conflict	3591	22	0.6	Not specified
Mozambique	2017	Meconta and Monapo	Rural	Endemic	Armed conflict / Natural disaster	607	0	0.0	Confirmed but not specified
Mozambique	2018	Memba	Rural	Endemic	Armed conflict	409	2	0.5	Confirmed but by use of RDT

[Ψ] Political instability defined by World Bank Fragile and conflict-affected situations list FY06 to FY20 **(127)**, Complex Emergency Database **(132)** and International Disaster Database **(128)**

Table 6. Median delays (with interquartile range (IQR) and range) between cholera alerts, confirmation, response and launch of water, sanitation and hygiene (WASH) interventions in the Democratic Republic of Congo, Malawi and Mozambique, 2015-2018

Country	Year range	Median delay between alert and confirmation	IQR (days)	Range (days)	Median delay between alert and response	IQR (days)	Range (days)	Median delay between response and launch of any WASH intervention	IQR (days)	Range (days)
All	2015-2018	10	3-28	1-76	23	14-41	2-126	8	6-12	0-14
DRC	2015-2018	7	3-25	1-76	22	16-42	4-78	7	5-7	3-8
Malawi	2015	42	42	42	10	6-21	2-31	12	12	12
Mozambique	2015-2018	12	6-18	0-24	37	27-64	15-126	13	9-14	5-14

Table 7. Implementation of cholera responses in the Democratic Republic of Congo, Malawi and Mozambique, 2015-2018

Country		DRC															Malawi	Mozambique				Total
District		Maniema	Maniema	Tshopo	Tshopo	Tshopo	Tshopo	Mongala	Equateur	Kinshasa	Kinshasa	Kongo Lomami	Kasaï-Oriental	Kasaï-Oriental	Kinshasa	Mai Ndombe	Nhamayabue and Caia	Mocuba	Tete	Meconta and Monapo	Memba	
Year		2015	2016	2016	2016	2016	2016	2016	2016	2016	2016	2017	2018	2018	2018	2018	2015	2015	2015	2017	2018	
Target population	Community-wide		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	**19**
	Case Area Targeted Interventions (CATI)														■					■	■	**3**
	Households of cases											■	■	■	■							**4**
	Health Care Facilities (HCF) only	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	**20**
Health interventions	OCV	■	■													■						**2**
	Antibiotic chemoprophylaxis																					**0**
Water, sanitation and hygiene (WASH) interventions	Improving the access to water sources and/or quantity of water			■				■								■	■	■	■	■	■	**8**
	Improving the quality of water: water treatment at source			■	■		■	■	■	■	■		■									**8**
	Improving the quality of water: point of use (POU) and safe storage						■	■	■	■	■	■	■	■	■	■	■	■		■	■	**14**
	Improving the access to and use of sanitation facilities and reducing exposure to faeces			■	■		■	■								■	■	■		■	■	**9**
	Behaviour change interventions to improve personal, domestic and food hygiene practices		■	■		■	■		■			■	■	■	■					■	■	**11**
	Distribution of hygiene materials or non-food items (NFIs)	■		■	■			■	■				■	■	■	■	■	■		■		**12**
	Promotion or distribution of disinfection and cleaning of households and community spaces and/or materials			■				■										■		■	■	**5**
	Improving dead body management and safe funeral practices							■				■		■		■	■	■		■	■	**8**
	Improving the management of wastewater and faecal sludge			■																		**1**
	Provision of interventions that improve solid waste disposal															■	■	■		■		**4**
	Use of vector control interventions to reduce flies																					**0**
	Other WASH interventions																					**0**

HCF: Health Care Facilities; CATI: Case Area Targeted Interventions; OCV: Oral Cholera Vaccination; POU: Point of Use; WASH: Water, Sanitation and Hygiene

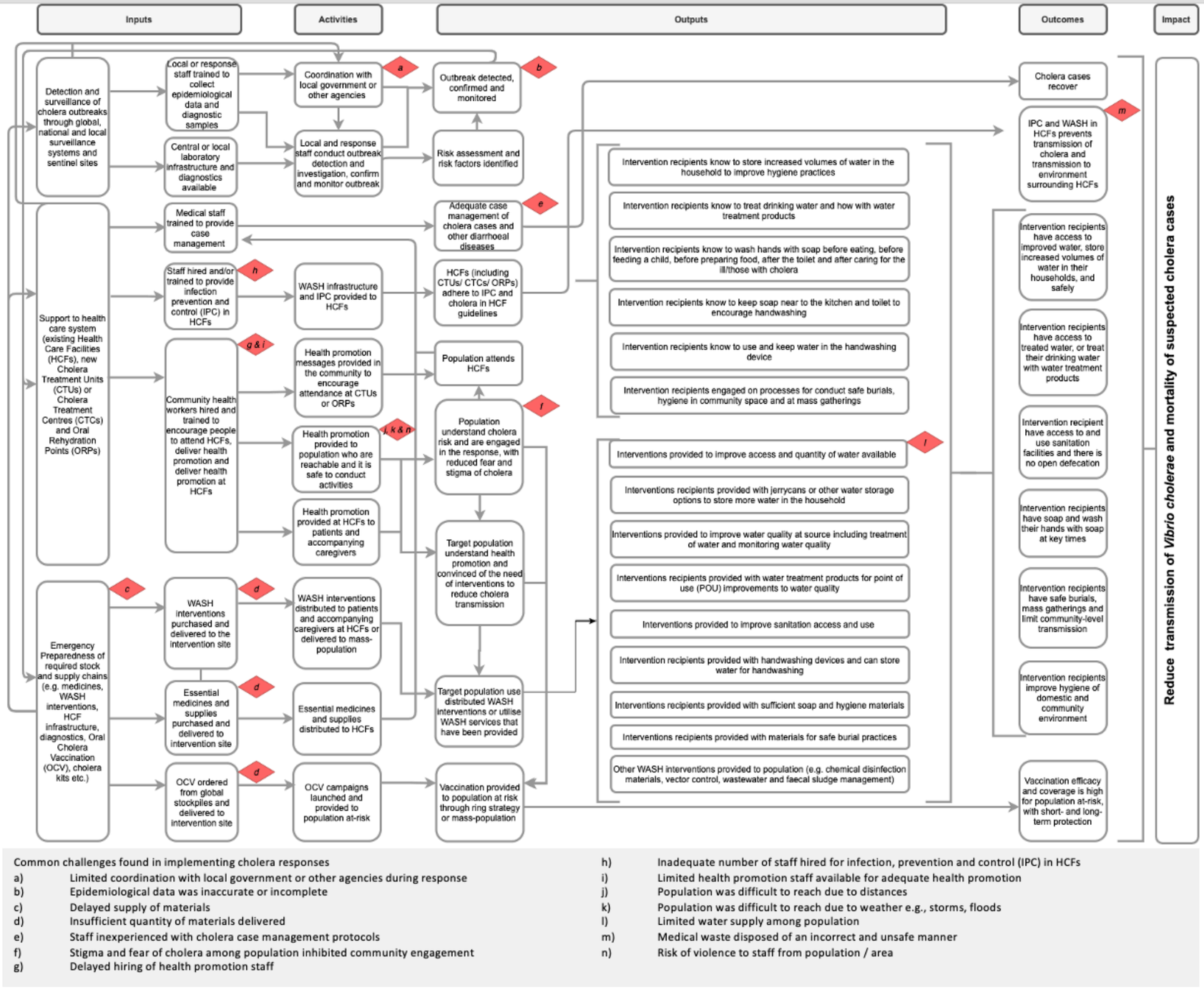

Figure 2. Theory of Change of cholera response programmes, with challenges identified in the case studies in DRC, Mozambique and Malawi, 2015-2018

Table 8. Common challenges found in implementing cholera responses, by country

	DRC	Mozambique	Malawi	Total
Number of reports (n)	**15**	**4**	**1**	**20**
Coordination with government or other agencies				
a) Limited coordination with local government or other agencies during response	7	6	1	14
Surveillance				
b) Epidemiological data was inaccurate or incomplete	6	3	1	10
Supply				
c) Delayed supply of materials	5	1	1	7
d) Insufficient quantity of materials delivered	6	1	2	9
Case management				
e) Staff inexperienced with cholera case management protocols	3	1	2	6
Community engagement				
f) Stigma and fear of cholera among population inhibited community engagement	-	4	1	5
Human resources				
g) Delayed hiring of health promotion staff	2	2	-	4
h) Inadequate number of staff hired for infection, prevention and control (IPC) in HCFs	-	1	2	3
i) Limited health promotion staff available for adequate health promotion	1	2	-	3
Geographical context				
j) Population was difficult to reach due to distances	1	2	-	3
k) Population was difficult to reach due to weather e.g., storms, floods	-	1	-	1
Water supply				
l) Limited water supply among population	1	1	1	3
Medical waste management at health care facilities (HCFs)				
m) Medical waste disposed of an incorrect and unsafe manner	-	2	1	3
Safety and security				
n) Risk of violence to staff from population / area	1	2	-	3
Total	**33**	**29**	**12**	**74**

Discussion

Responses to cholera epidemics among populations affected by humanitarian crises can be complex, comprising multiple interacting components, and are often applied in both urban and rural contexts. The case studies included in this review relate to largescale responses by one major humanitarian agency to cholera epidemics in three countries. The package of interventions mobilised for each response varied but common challenges were identified. The findings from this review are discussed in relation to three key areas: 1) characteristics of the included cholera epidemics; 2) time from alerts to response experienced by MSF; and 3) delivery of interventions and factors affecting implementation.

Characteristics of included cholera epidemics

All epidemics reviewed here occurred in identified cholera hotpots in Sub-Saharan Africa (7), which have documented weak surveillance systems (139), low coverage of WASH services (140) and high global acute malnutrition (GAM) prevalence (6.1%, 2.7% and 8.10% in Mozambique, Malawi and DRC, respectively (141)), which all increase risk and severity of outbreaks. Additionally, concurrent armed conflict and population displacement likely exacerbated *V. cholerae* transmissibility and case fatality among symptomatic cases, as demonstrated by other research documenting the overlap between crises and cholera epidemics (1, 8, 64, 142). CFR was high in DRC compared to Mozambique and Malawi; however, any comparison may be erroneous as it does not reflect data from individual treatment centres, and varying levels of misclassification and under-ascertainment may apply to both the numerators and denominators. The CFR reported in this paper are not accurate estimates and should not be interpreted as such. Additional efforts to estimate overall CFR need to be undertaken during and after outbreaks to identify the circumstances where cholera cases are dying and to develop strategies to prevent those deaths.

Time from alert to response

Overall, from 2015-2018, median time from epidemic alert to confirmation by national actors and response by MSF were 10 and 22.5 days, respectively. In Malawi, DRC and Mozambique, up to 31, 78 and 126 days were observed from alert to response by

MSF, respectively. Epidemic detection and time to response in our review of MSF data were comparatively longer compared to a recently published review by Ratnayake et al (2020)(74), which found delays of 5 days between alert and confirmation and 10 days between alert and response, but similar to a review by Bruckner & Checchi (2011) of other infectious disease outbreaks in fragile states which showed median delays of 29 days between alert and confirmation or 55 days from alert to control (112). In most case studies described here, epidemics were confirmed but the methods were not specified. For CATI-like responses, this delay of >2 weeks in response will likely have resulted in spill-over beyond the initial outbreak cluster (74). Additionally, our data indicated that epidemiological data were often inaccurate or incomplete: reliance on under-resourced surveillance systems may have led to the data delays in the alert, delayed confirmation and resulting response (139).

Delivery of interventions and factors affecting implementation

Delivery of interventions to case-households and/or through CATI was only identified in seven case studies from MSF, all from 2017 onwards. The majority of responses implemented interventions community-wide. Although community-wide interventions are a theoretically equitable approach to intervention delivery, cholera control in outbreaks needs to focus on the dominant transmission pathways between cases and non-cases(123). Cholera clusters in both space and time within case-households and the areas surrounding case households (~150-200m radius around case households (49)) due to short incubation periods (14), bacterial shedding from both symptomatic and asymptomatic cases (11) and shared WASH risk factors and behaviours (36).

OCV has been recommended since 2010 for epidemic response and in humanitarian crises (143) since 2013, and made available for deployment from a global OCV stockpile, funded by GAVI (the Vaccine Alliance) since 2016. In a recent summary of the 83 deployments and 104 OCV campaigns globally between 2013-2018, there were 14 instances where Malawi deployed OCV to the population and 1-3 in DRC (105). However, only two responses included in this review included vaccination. In both cases in DRC, OCV was provided to MSF through the national government to use leftover and expiring supplies and not as the main intervention strategy. Reports provided little to no information on what factors affected delivery of vaccination in the

two instances it was available. Although OCV is available for deployment, our review highlights that there may still be barriers to humanitarian agencies such as MSF accessing or using those stockpiles and further work is required to understand these challenges. Antibiotic chemoprophylaxis was also not employed in any of the responses, despite being a potentially cost-effective option for cholera control (106).

Among the WASH interventions deployed across the 20 cholera epidemics, the most commonly implemented interventions were the distribution of POU water treatment products, NFIs and behaviour change interventions to promote handwashing with soap. There is considerable evidence to support the effectiveness of these interventions especially when delivered to case-households or areas surrounding suspected cholera cases (81, 82, 89), though high coverage needs to be accompanied by efforts to promote and facilitate their use (125). Generally, the heterogeneity in interventions and the need to come up with a context appropriate response package suggests problems with structured decision-making on the most locally appropriate intervention package. Although guidance for outbreak response has been provided by many agencies (55-62), there is currently no standard package of WASH interventions for cholera outbreaks in humanitarian contexts and there is disagreement between guidelines on intervention strategies (123).

By the time interventions were implemented, it is likely that their potential effects were reduced as some of the reports stated themselves. Limited coordination is not new in outbreak response nor public health, but the frequency in which this challenge was cited across reports indicates that more attention to partnership with local governments and other actors is required both to enhance the ability to detect outbreaks but also to maximise efficiency (75). Similarly, epidemic preparedness, whereby supplies are pre-positioned or ready to distribute, has been noted as a challenge previously and remains a consistent barrier to feasible and effective cholera control (123). Supply chain challenges will diminish the effectiveness of any intervention, underscoring the importance of strengthened national and local supply chains (7, 50, 125). Both supply of materials and human resources were challenges across these case studies and the development of operational models for scaling up

both staffing capacity and the supply of materials is an area that could be explored further.

Of immediate concern across the case studies was the reported across case studies inexperience of staff with cholera case management protocols and/or lack of training they received if they had little to no experience in cholera case management. Inadequate care was potentially provided to admitted cases, and this will not only affect the CFR among the population (11) but will likely affect the population's perception and uptake of the intervention (102, 144). Treatment of cholera cases relies on a strong supply chain of essential medicines and both training and supervision of health care providers on site. Additionally, medical waste management in HCFs needs to be monitored due to both the occupational hazard it poses to both patients and staff and also to avert nosocomial transmission.

Limitations

This review is based on the retrospective review of programmatic data of only one humanitarian agency's cholera responses in three Sub-Saharan African countries. The generalisability of our findings may be limited as we only have data from one agency and three countries. The data were neither publicly available nor in a prescribed format for this analysis. The review relied on the manual compilation of reports from the MSF archives in each target country and what was available at the time of request. There is no global compilation of cholera responses or cholera data internally in MSF nor globally, and we expect to have unintentionally excluded some reports in our data harvest from the organisation. The information presented across the reports may reflect biases of the report authors, or areas of emphasis typical of MSF's organisational culture, to an unquantifiable level. Reports are written subjectively, did not follow a set format to allow implementers to capture challenges or compare responses against one another. For example, the dates of programme delivery and activities may not be collected systematically, nor the dates recorded accurately. As noted in the search strategy, many of the initial reports retrieved were duplicative as they were from the same outbreaks but written by different authors. This

questions if the numerous reports written from one outbreak are an efficient use of human resources, and that there could potentially be other ways of writing to support capturing lessons from outbreak responses (115, 116, 118). The lack of a systematic structure reduces the utility of the reports to capture useful accounts of responses.

There are many more reports available from DRC than either Malawi or Mozambique. This could potentially skew the results and challenges extracted from these outbreak responses. The time frame may also add to the skew of the data. Whilst DRC has frequent outbreaks and can provide transferable lessons to the sub-Saharan African region, further retrospective reviews of outbreak responses would need to cover a broader geographical range and time frame to draw out generalisable recommendations. Interviews with individuals from operational agencies could also prove useful to further elucidate challenges.

Lastly, whilst our analysis draws out common challenges cited in the reports, it does not take into account the contextual constraints of these countries. The response may have been affected by the under-resourced national public health systems in these three countries, concurrent crises or the epidemiology of the settings, such as previous outbreaks, previous vaccination campaigns or the timing of the epidemics, which could all affect both the epidemic propagation and response efforts.

Conclusions and recommendations

Documentation and evaluation of cholera responses are limited and heterogenous. The case studies included in this review show that responses to cholera epidemics by MSF have varied in implementation strategy, selection of interventions and have incurred considerable delays from alert to response.

Based on this review, we can make a number of recommendations to improve the development of evidence-based, rapid epidemic cholera control efforts:

- Explore improved models for epidemic preparedness, including rapid mobilisation of supplies and deployment of trained staff;

- Focus on the competencies and processes required to rapidly take decisions on the appropriate package of interventions and modality (e.g., community based versus CATI) for their delivery;
- Invest in and strengthen partnerships with national and local government and other agencies as part of epidemic preparedness activities and invest in coordination mechanisms;
- Dedicate time and staff to training and supervising health care providers to provide adequate case management to admitted cholera patients;
- Conduct rigorous and structured evaluations of cholera response programmes to understand factors for delays, the interlink between health and WASH interventions and provide evidence-based guidance to programmes;
- Standardise reporting templates within and across countries, and across international humanitarian agencies, to provide consistent and accessible data by internal and external staff and collate learnings.

Abbreviations

CHW: Community Health Worker; CTC: Cholera Treatment Centre; CTU: Cholera Treatment Unit, DRC: Democratic Republic of Congo; HCF: Health Care Facility; IPC: Infection, Prevention and Control; MSF: Médecins Sans Frontières; MoH: Ministry of Health; NGO: Non-Governmental Organisation; OCV: Oral Cholera Vaccination; ORP: Oral Rehydration Point; PNECHOL-MD: Programme National d'Elimination du Choléra et de lutte contre les autres Maladies Diarrhéiques; POU: Point of Use; RDT: Rapid Diagnostic Test; WASH: Water, Sanitation and Hygiene

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Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the individuals involved or funding agency.

Author's contributions

LDG conceived and designed the study, with input from OC, RD, RVDB, PM and FC. LDG and ER extracted the data, LDG analysed the data with input from FC and OC. LDG drafted the manuscript and all co-authors contributed revisions to the manuscript. LDG had final responsibility for the decision to submit for publication. All authors read and approved the final manuscript.

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This study was funded by Médecins Sans Frontières. The ethics committee of MSF reviewed the study reviewed the study protocol but had no role in study design, data analysis or decision to publish.

Availability of data and materials

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval

No individual patient data were used in this study. All study procedures were approved by the Research Ethics Committee of the London School of Hygiene and Tropical Medicine (No. 17994) and received an ethics exemption from the International Ethics Board of Médecins Sans Frontières.

Consent for publication

Not applicable.

Competing interests

On behalf of all authors, there are no competing interests to declare that could be construed to have influenced the work. The authors alone are responsible for their views expressed in this article and they do not represent the views, decisions or policies of the institutions with which they are associated. Authors from MSF (RD, EM, MM, RVDB), UNICEF (PM) and respective Ministries of Health (PW) contributed independently in their own rights as individuals.

Data availability statement

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Supplementary material

Supplementary file 1: Preferred Reporting Items for Systematic Reviews and Meta Analyses extension for Scoping Reviews (PRISMA-ScR) checklist

Part Three

General discussion

Cholera will continue to challenge health systems in affected regions until access to safely managed WASH services is expanded (145-147). The world is not on track to meet Sustainable Development Goal (SDG) 6 for WASH (148) and it seems unlikely that the GTFCC goal to reduce cholera by 90% by 2030 will be attained without this progress (75). Sub-Saharan Africa, in particular, lags behind other regions in population coverage of improved access to safe WASH (149, 150), and populations in many African countries experience concurrent humanitarian crises including natural disasters (5, 128, 151-153), civil conflict or war (66, 127, 154), malnutrition and food insecurity (64, 141) and economic crises or chronic poverty (21, 22, 155, 156). These threats increase the risk of both transmission and case-fatality of cholera.

Efforts to control cholera across Sub-Saharan Africa have almost exclusively been reactive (74, 108, 109, 115). Although essential, the variation in intervention strategies between epidemics and reliance on operational memory to implement emergency responses is not sufficient to guarantee success of a control programme. Controlling cholera comes with a number of disease-specific challenges due to its diverse transmission dynamics, the lack of specific symptoms and the insufficiency of any single intervention to sustainably control cholera. Generation of evidence supporting the choice of interventions and on interventions that could be systematically used by organisations for cholera preparedness and control in hotspots is required. An iterative approach to intervention delivery featuring contextual adaptations and accompanying evaluations will also be needed to optimise existing and new interventions and respond to changing epidemic geographies.

Summary of findings

The overall aim of this thesis was to evaluate WASH interventions used by MSF in crisis contexts and to make recommendations to improve cholera response programmes in subsequent humanitarian crises. In achieving this aim, my thesis tackled four research questions: 1) Are current international WASH guidelines for cholera prevention and control consistent and reflect recent evidence on cholera

transmission? (Research Paper 1); 2) What is the effectiveness of a case-targeted WASH intervention delivered by MSF in response to a cholera outbreak in DRC? (Research Paper 2); 3) What factors affect the implementation of a case-targeted WASH intervention delivered by MSF in response to a cholera outbreak in DRC? (Research Paper 3); and, 4) What factors affect the timeliness of cholera responses and implementation of WASH and other health interventions by MSF during responses to cholera outbreaks? (Research Paper 4). This final chapter summarises the main findings across the thesis and formulates recommendations to improve the delivery of case-targeted WASH interventions during cholera responses in humanitarian crises contexts. The chapter also discusses the limitations of this thesis and suggests an agenda for future research.

RQ1: Are current international WASH guidelines for cholera prevention and control consistent and reflect recent evidence on cholera transmission?

In Research Paper 1, I undertook a scoping review which aimed to analyse consistency and concordance among recommended WASH interventions, and mapped existing recommendations to a Susceptible, Infected, Recovered (SIR) model of cholera transmission (33, 48, 157, 158). Of primary importance to this thesis was to understand what WASH interventions are currently predicated across operational agencies during cholera response. Eight international guidelines published between 2004-2019 were reviewed from three non-governmental organisations (NGOs), one from a non-profit organisation (NPO), three from multilateral organisations and one from a research institution including Oxfam (57), Action Contre La Faim (ACF)(58), MSF (60), Sphere (55), WHO (56), UNICEF (59), GTFCC (62) and International Centre for Diarrhoeal Disease Research Bangladesh (ICDDR'B) (61), respectively. There were 95 distinct WASH interventions recommended across all guidelines and concordance was poor to fair. All types of WASH intervention were featured in the guidelines, however, most WASH interventions proposed addressed community transmission rather than the high-risk household environment.

A high number of recommendations does not necessarily render guidelines more useful or likely to be used. To an extent, the low concordance among the listed

recommendations could suggest a potential challenge in using them by policy makers and practitioners, i.e., which one do you pick to guide your response, and interpretation may be especially difficult when conflicting recommendations are made.

Given that the body of evidence for WASH for cholera prevention and control is sparce (80-82), the discordance across guidelines further indicates the need to generate evidence regarding the effectiveness of different interventions, as well as evidence around the timeliness, prioritisation or inclusion of other interventions, and cost-effectiveness of recommended interventions. A central, authoritative new guideline generated by cholera control actors in coordination, e.g., the WHO-led GTFCC or UNICEF, could be the ideal way forward for condensing knowledge and facilitating rapid, effective decision making in future responses (159).

RQ2: What is the effectiveness of a case-targeted WASH intervention delivered by MSF in response to a cholera outbreak in DRC?

In the prospective cohort study, I conducted for Research Paper 2, the aim was to evaluate the effectiveness of a selected case-targeted WASH intervention and quantify risk factors for transmission during a cholera epidemic. Based on the collection of individual and household surveys, and laboratory analysis of environmental samples, the analysis found the distribution of hygiene kits to be an effective intervention to reduce suspected cholera incidence and self-reported diarrhoea among household contacts of admitted cases and to reduce environmental contamination in food and water. The paper presents an analysis of 444 individual household contacts of 94 admitted cholera patients. Multivariate analysis showed statistically significant evidence that the distribution and use of the hygiene kit intervention has the potential to reduce 22-66% of suspected cholera incidence compared to households without a kit. There was also a statistically significant decrease in *Enterococcus* spp coliform counts in household drinking water among households in receipt of the kit. Although non-significant reductions were estimated for self-reported diarrhoea and food sample contamination, both outcomes saw a decreased risk of suspected cholera incidence or contamination among households in receipt of the kit.

These empirical findings are broadly consistent with evaluations of other WASH interventions (8, 50, 74, 81, 83-86, 88, 108-111, 160). Furthermore, results suggest that the impact of these kits is greatest when compliance is highest, a dose-response relationship that also strengthens causal inference.

Thus, my study adds to the growing literature that the distribution of a household WASH intervention, such as the hygiene kit, to case-households is an effective method to reduce cholera transmission among household contacts and environmental contamination within the household. The study supports the use of hygiene kits in future responses, alone or possible within a larger package of CATI. Further evidence around what level of coverage of the population is required to limit both intra- and interhousehold transmission is still required, including research on how to integrate the hygiene kits with other interventions such an OCV (103, 104) or antibiotic prophylaxis (104, 106), and on the cost-effectiveness of the intervention compared to longer term WASH improvements.

RQ3: What factors affect the implementation of a case-targeted WASH intervention delivered by MSF in response to a cholera outbreak in DRC?

Research Paper 3 presents a process evaluation which aimed to understand the factors affecting implementation of the hygiene kit distribution and how it was received by the population. In this study, I used a range of methods including in-depth interviews, structured observations, and review of programme reports, to triangulate data and explore different factors relating to the response. Overall, it was observed that only 52% of admitted suspected cholera cases received a hygiene kit intervention. Although the majority of admitted patients in receipt of a hygiene kit received the intervention on the day of admission, the delay in the overall epidemic response, compounded by delayed supply of hygiene kits and insufficient quantities of hygiene kits available limited the intervention's coverage and utility, and plausibly diminished the overall impact of the intervention. In future work, it would be important to consider if new guidelines, training of staff or if other modalities could improve the timeliness of

delivery, adequate supply, and subsequent coverage of case-targeted WASH interventions.

The intervention was well received by the population, and all households utilised the soap, water container and handwashing device. Overall, the intervention was positively perceived by the study population. The focus on population experiences of the intervention was an important component of the process evaluation. Population responses to interventions are overlooked in emergency programming. Findings point to inter-household variation in using the hygiene kits and inequity of use, e.g., among different-size households. Components of the hygiene kits were also used quickly by households and increasing the quantity of consumables needs to be considered in future to ensure adequate protection and sustained use among high-risk households.

It would be useful if further research was conducted on the costs and value for money of distributing hygiene kits. The components of the kits are all typically low cost, however, the full economic costs of the kits and the implementation require further investigation. Other research has documented the costs of case-targeted WASH and hygiene promotion within an urban cholera context, and there estimates of $227.50 per cholera case averted and would likely be more cost-effective than a similar WASH intervention implemented at community level (81). Further, another study evaluating the cost-effectiveness of OCV would cost $226 per cholera case averted, similar to the cost of the hygiene kit (161). Economic evaluations in the DRC, and other responses, would be useful to indicate if and how the intervention can be scaled both depending on the size of the outbreak and to stock warehouses with emergency preparedness supplies for the next outbreak.

The future use of the hygiene kits in cholera response is an ongoing discussion within the cholera community. CATI protocols to organise responses to cholera outbreaks are being launched in DRC, Yemen, and Haiti (108, 109, 111, 162), by both MSF and other organisations. The hygiene kits are a likely candidate to be integrated with OCV campaigns, and the interventions complement one another. Whilst waiting the 7-10 days for vaccine protection in individuals (103, 163), households can use the hygiene kit to prevent intra- and interhousehold transmission. The evidence published as part

of this thesis promotes the use of the hygiene kits and provides valuable lessons in which to address challenges when replicating or scaling this effective intervention component.

Lastly, the process evaluation framework used to evaluate this response, adapted from conventional process evaluations methods and frameworks, were easy to implement and to my knowledge is the first paper to offer a meaningful way to compare the performance of cholera response programmes than using outcome evaluations alone. There is scant evidence for cholera response and the inclusion of both an outcome and process evaluation underscore the importance of carrying out evaluations of programme delivery and receipt alongside outcome evaluations to gain a full understanding of how interventions do or do not achieve their intended effects.

RQ4: What factors affect the timeliness of cholera responses and implementation of WASH and other health interventions by MSF during responses to cholera outbreaks?

In Research Paper 4, I reviewed 20 recent MSF cholera responses and identified several common challenges and areas for improvement. Responses to cholera epidemics among populations affected by humanitarian crises can be complex, comprising multiple interacting components. Overall, median time from epidemic alert to response was 22.5 days, and comparatively longer than those reported in a recent review (74). Almost all responses targeted interventions community-wide, and all responses implemented in-patient treatment of suspected cholera cases in either established HCFs or temporary cholera treatment units (CTUs). In three responses, interventions were delivered as CATI and four responses targeted households of admitted suspected cholera cases. CATI or delivery of interventions to households of admitted suspected cases was a reasonably recent occurrence and only started being implemented from 2017 onwards only. Overall, 74 factors affecting implementation were identified across reports including delayed supplies of materials, insufficient quantities of materials were delivered for effective programme delivery and limited or lack of coordination with local government or other agencies.

Diagnostic capacity was largely lacking among the countries included, and the time to perform confirmation of the epidemic diminished the effectiveness of a response. This highlights a need for expanded use of rapid diagnostic tests (RDTs) and strengthening surveillance both locally and regionally (164, 165). The delayed responses also highlight a need for more systematic interventions to be deployed and streamlining the decision-making process on which interventions to deploy, how and where. At the time of writing, there are no standardised guidelines for initiating rapid cholera interventions in Sub-Saharan Africa.

This thesis was primarily focussed on the sub-Saharan African region, and crises contexts. Paper 4 did not include reflections from South Asia and Latin America nor reflections from urban contexts. Work from the 2019 cholera outbreak and continued epidemic in Haiti has been integral to the development of cholera responses (91, 92, 109, 144, 166-168). Further exploration of the experiences from these contexts on how interventions are delivered and how effective their interventions are would be useful to both compare against experiences in sub-Saharan Africa and provide other lessons to learn from. Similarly, MSF predominantly operates in rural contexts. There are often other implementers available in urban contexts, as seen in Kinshasa, DRC in early 2018 (169), and by limiting this thesis to rural contexts there may be a skew in the implications from the work. As cholera is a disease that affects both urban and rural contexts, valuable further research is needed across other urban rural divides to evaluate WASH interventions and cholera responses overall.

Targeted interventions, as shown to be effective in this thesis, could help achieve progress on controlling cholera epidemics within the next decade. However, their utility in practice rests on adequate epidemic preparedness (e.g., stockpiling of required supplies; blueprints for response that streamline processes of decision-making), potential forecasting of cholera outbreaks (152, 165, 170, 171) and proactive monitoring and response to clusters of suspected cholera cases. Such a proactive approach could reduce the time between alert to response observed across the 20 reviewed responses. Other interventions such as OCV or antibiotic prophylaxis could also be integrated into such an approach, dependent on global stockpiles and national policies (77, 110, 172, 173).

Limitations of the thesis

Implementing research in the context of an ongoing cholera outbreak is complex and often compounded by the broader instability which characterises settings where cholera outbreaks occur (121, 122). There are important limitations to the research conducted in this thesis as a whole. These limitations relate to three main areas:

1) Uncontrolled study conditions and limited scope of the study interventions

Challenges with implementation, compounded by the ongoing conflict in DRC in Research Paper 2 and 3 (174), led to a delayed response and low coverage of the intervention. Randomisation was not logistically feasible in the acute phase of an emergency response and our studies thus relied on comparison groups who did not receive the intervention due to implementation failures rather than deliberate study design (122, 175). There is a risk of confounding due to their plausibly different baseline circumstances (e.g., other factors related to poverty or lower access to care, beyond those I adjusted for). Additionally, and as noted earlier in Research Paper 2 and 3, due to political instability in the country (174) and upcoming elections in December 2018 (176), I did not reach the required sample size for the study and our power to detect an association was reduced. If I had been able to enrol our target sample size, the study may have had power to observe associations more precisely.

Although Research Paper 2 was able to demonstrate effectiveness of the intervention, it was narrow in scope in that it investigated only one modality of delivering the hygiene kit, i.e., to households of known admitted cases. There are other potential modalities, e.g., distribution to a given radius ring as discussed above, but this study was unable to explore these.

Lastly, in Research Paper 2, our measurement of intervention exposures was based on uptake and use of the intervention. I assigned equal weight to each kit component due to lack of evidence to the contrary (82) but also because the intervention was delivered as a package: the study thus does not shed light on which components are

more effective, are preferred or should be included in future kit compositions. Without observing behaviours in the household, I was unable to understand which components were truly used frequently by the households. Similarly, soap and water availability at the handwashing device does not necessarily mean that people wash hands (177). Positive behaviours related to WASH are often overreported (178, 179).

2) Bias of internal evaluations

Across the studies, there may not have been a clear division between the evaluation being carried out and the providers of the interventions. Both sets of staff were employed and worked for MSF, and both were present in the community at similar times. There may be challenges in the reflexivity of the evaluators and potential bias introduced to data collected.

Additionally, the research was restricted to English and French languages. I have not included Portuguese or Spanish speaking contexts within this thesis, particularly in Research Paper 4 where I did not find any Portuguese language reports from Mozambique, and the results may not be generalisable to these contexts where these languages are spoken. It would be useful to broaden the geographic spread when conducting evaluations to extract challenges or lessons from other settings to aid future responses.

The evaluations included in this thesis were not independent of MSF the organisation and although this work contributes to increasing the quantity of operational research evaluations and meaningful partnerships in the humanitarian sector, it brings risk to independence. I hope to have addressed this through being open and transparent throughout the evaluation, and MSF has no say in the analysis or publication of results nor the conclusions made in this thesis.

3) Outcome ascertainment

Another limitation of my thesis is the use of suspected symptomatic cholera as an outcome measure among household contacts compared to collection of rectal swab samples for case ascertainment. A decision that was made by MSF and outside of the influence or control of the study team. The ascertainment of our primary outcome was

therefore based on self-reported symptoms and may lead to misclassification of our outcomes, as other studies have found (180, 181). It may have also led to an inflation of suspected cholera at enrolment, as the case definition may have been too broad and captured any cause diarrhoea. I was unable to test suspected cholera diagnoses among our study population by RDT or culture. Other studies have been able to test the stool or rectal swab samples of household contacts (81, 157), and this would have strengthened outcome ascertainment and investigated the potential aetiology of acute watery diarrhoea (AWD) in the study site (182-184).

Additionally, the study only examined faecal indicator bacteria counts for *Enterococcus* spp. in food and water. I was unable to conduct microbiological analysis of *V. cholerae* in environmental samples or extend the microbiological analysis to other samples such as hand rinses (185) or surfaces within the household which have been found to be heavily contaminated with *V. cholerae* in other studies (186).

In-depth outcome ascertainment would strengthen the evidence base, and other more rigorous study designs including these additional measures would be useful in future studies to understand the effect on overall cholera transmission within the household.

Conclusions and recommendations from this thesis

This thesis was done in collaboration with operational actors and in close partnership with global coordination mechanisms, such as the GTFCC and Global WASH Cluster, and aimed to pay particular emphasis on translating evidence into practical recommendations. Although each of the four research papers makes its own recommendations in turn, three overarching recommendations stand out as particularly important.

1) Inclusion and delivery of case-targeted WASH interventions in future cholera responses

The effectiveness of case targeted interventions to reduce local transmission depends on the ability of combined interventions to affect both transmission routes with rapid

protection and within an adequate radius of implementation. Rapidly acting interventions such as the distribution of household level WASH interventions are a priority and, as demonstrated in this thesis, can be easily implemented in responses. Case-targeted WASH interventions, such as the hygiene kit, protect both uninfected and infected hosts. The hygienic behaviours enabled by the hygiene kit and hygiene promotion are a cornerstone to disrupting within household transmission.

The potential benefits of case-targeted WASH are supported by this thesis and other studies, and the hygiene kit coupled with hygiene promotion is an effective option to be included in future reactive cholera response and distribution of such an intervention should be promoted among organisations and included in any normative guidelines for epidemic control as they are updated. CATI that includes a comprehensive WASH package can selectively protect susceptible, high-risk household contacts and provides a model for future evidence-based epidemic response. Further work is required on which components should be added to the hygiene kits, perhaps to allow for household cleaning and laundry processes, and on what resources are required to enable distribution within the immediate area surrounding case households, as supported by other research and models of disease control (47, 49, 51, 52, 187). There needs to standardisation of what constitutes a case-targeted WASH intervention and what is required to feasibly achieve high coverage within a 1-week period at the start of an epidemic.

2) Consistent monitoring and evaluation frameworks across settings

Consistent reporting of cholera response across contexts is a crucial first step in evaluating what is working well for disease control. Collaboration with MSF and review of multiple past responses suggested a consistent lack of standard reporting frameworks or evaluation methods. Data that shared for this thesis was limited and often did not include any critical reflection by the authors. MSF is a mature organisation known for its operational research: when other actors conduct responses, it is possible that the gap in evaluations and documentation may be even greater, as suggested by a recently published systematic review (116). However, the inability to share more than 20 usable reports suggests that reflections made not be systematically collated or reviewed. Strengthening capacity and governance around epidemic responses and

their transparent reporting is imperative to track progress in global cholera control efforts.

Going forward, agencies and institutions should reflect on the data they are reporting and publish systematic information on the performance and community perception of their responses. Basic process evaluations of programme quality can be carried out using simple tools, for example based on those provided in this thesis, and using data and documents that are already being collected at local or national levels.

3) Appropriate methods and indicators for cholera evaluations

Given the dynamic nature of cholera epidemics and variability of response characteristics, especially in crisis-affected contexts, quantifying the outcomes or potential impact of a response can be difficult. The three study designs from Research Papers 2, 3 and 4 included a prospective cohort study, process evaluation and scoping review. Research activities were a partnership between LSHTM and MSF. The study designs were simple to understand by both academics and practitioners, based on programme design theory and, although new data collection tools were developed for Research Paper 2 and 3, a large portion of this thesis relied on existing data sources from MSF. All three study designs are replicable and have the potential to be easily adopted by other implementing organisations as frameworks to evaluate their responses. Additionally, the laboratory capacity established for Research Paper 2 was easy to set-up with the in-country team and could be set up in other contexts as it required only a few additions to standard water quality analysis techniques carried out across the WASH sector.

The indicators across data collection tools, including quantitative measures of intervention coverage and use e.g., presence of water and soap presence with the handwashing device or free residual chlorine measures to assess use of the water treatment products, or qualitative indicators of intervention use, e.g., satisfaction with the intervention components or how long behaviours were maintained for, are appropriate for both academic study and to inform operational response. The quantitative and qualitative study designs enabled quantification of the effectiveness of the intervention and exploration of the factors that facilitated or impeded the theory

of change leading to intervention effect. The quantitative indicators used in Research Paper 2 aligned with standard monitoring indicators generated by the WHO/UNICEF Joint Monitoring Programme (149) and previous studies (36, 166, 188), and are all familiar across the WASH and cholera sectors. The qualitative indicators employed in Research Paper 3 align to the Medical Research Council guidance for process evaluations (189), Theory of Change models (134, 138, 190-192) are familiar to programme designers as they use similar terminology and constructs. All tools were useful for evaluating interventions among high-risk populations and could be used by organisations of different capacities.

Agenda for future research

Several priorities for future research have been identified, throughout the four papers of this thesis. Here I list five that aim to promote further between research and implementers and address the research gaps in epidemic cholera response and for the populations affected by cholera outbreaks. These include:

1) What are the most essential components, and/or what other components are required, in a case-targeted WASH interventions to reduce risk of transmission within the household?

2) What level of coverage or radius around case-households for case-targeted WASH interventions are required to control both intra- and interhousehold transmission?

3) What is required to scale up delivery of case-targeted WASH interventions?

4) What is the cost-effectiveness of different modalities of case-targeted WASH interventions?

5) What is the additional benefit of adding OCV campaigns or antibiotic chemoprophylaxis to case-targeted WASH interventions?

Across this thesis, key elements were consistently identified as necessary to build an evidence base for cholera control efforts and accelerate progress towards eliminating cholera from the world. The partnership and collaboration with country stakeholders, such as the partnership between LSHTM, MSF, UNICEF and the Ministries of Health for this thesis, provides a supportive framework for evidence to be produced from research to inform decision-making, policies, strategies, and practices, and to advocate for the value and relevance of research. Collaboration across academia, implementing agencies and donors, supported by agencies such as the Global WASH Cluster and the GTFCC, could also further strengthen country capacity to identify, finance and implement locally relevant research activities. A common research agenda on reactive measures, as stated above, will help align limited resources and improve the outcomes for populations at risk, and will additionally answer questions on proactive measures to prevent outbreaks including sustainable access to WASH which are slowly being realised across LMICs.

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Appendix A: Supplementary materials for Research Paper 1

A. List of 95 water, sanitation and hygiene (WASH) recommendations featured in eight guidelines for cholera prevention and control

Table S1. List of 95 water, sanitation and hygiene (WASH) recommendations featured in eight guidelines for cholera prevention and control

#	Recommendation	WHO, 2004	OXFAM, 2012	ACF, 2013	UNICEF, 2013	MSF, 2017	SPHERE, 2018	ICDDR'B, 2018	GTFCC, 2019	Total	Transmission level	Theoretical interruption of cholera transmission pathway
Improving the access to water sources and/or quantity of water												
1	Assessment and mapping of existing water sources (i.e., availability, types, access, quantity of water, risks of contamination)	✓	✓	✓	✓	✓	✓	✓	✓	8	Household/ Community	Both
2	Minimum requirement of 15-20 litres per person per day	✓	×	×	✓	✓	✓	✓	×	5	Household	Human-to-human
3	Minimum 500m distance to water sources required, with no more than 15-30 minutes queuing times	×	×	×	×	✓	✓	✓	×	3	Community	Environment-to-human
4	Installation or repair of temporary or permanent improved water sources (e.g., boreholes, protected wells, protected hand pumps, protected springs, water tankers, water distribution systems including taps to households or public spaces and/or protection of the water source)	✓	✓	✓	✓	✓	✓	×	✓	7	Household/ Community	Environment-to-human
5	Trucking/transport of water where there is no water supply nearby or existing	×	✓	✓	✓	✓	✓	×	×	5	Community	Environment-to-human

6	Closing of contaminated or high-risk water points and providing alternatives	×	×	✓	✓	✓	×	×	×	3	Community	Environment-to-human
7	Installation of bulk water storage at the community-level	×	×	×	✓	×	×	×	×	1	Community	Environment-to-human
8	Monitoring of water quantity at the household-level (e.g., checking sufficient quantity of water at per capita per day)	×	✓	✓	×	×	✓	✓	×	4	Household	Human-to-human
9	Monitoring of water supply at the community-level (e.g., checking water vendors, water tankers and distribution systems)	×	×	✓	×	×	✓	×	×	2	Community	Environment-to-human
Improving the quality of water: water treatment at source												
10	A free residual chlorine (FRC) concentration of >0.5 mg/l measured, at source	✓	✓	✓	✓	✓	✓	✓	✓	8	Community	Environment-to-human
11	A turbidity less than 5 NTU at the water source, up to 20 NTU acceptable	×	×	✓	×	✓	✓	✓	×	4	Community	Environment-to-human
12	Optimal pH range of water for chlorine to be effective is 6.5-8.5 at point of delivery	×	×	✓	×	✓	×	×	✓	3	Community	Environment-to-human
13	Water quality tests meeting minimum of <10 CFU/100ml at source, in absence of chlorination	×	×	×	×	×	✓	×	×	1	Community	Environment-to-human
14	Target a higher FRC at pH >7-8, at source	×	×	✓	×	✓	×	×	×	2	Community	Environment-to-human
15	Highly turbid water, at source, should not be chlorinated and filtration, coagulation-flocculation or other pre-treatments should be used to reduce turbidity before treatment	✓	✓	✓	×	✓	✓	✓	✓	7	Community	Environment-to-human

16	Use of double dosage of chlorine temporarily for highly turbid water, at source	×	×	×	×	×	✓	×	×	1	Community	Environment-to-human
17	Microbiological testing for *Vibrio cholerae* at source	×	×	✓	×	×	×	×	×	1	Community	Environment-to-human
18	Monitoring of water quality at source	×	✓	✓	✓	×	×	✓	✓	5	Community	Environment-to-human
19	Bulk or batch chlorination of water sources (e.g., in-line chlorination of water distribution systems, temporary bladders, water tanks and trucking), with dosage determined by jar tests	✓	✓	✓	✓	✓	✓	✓	×	7	Community	Environment-to-human
20	Bucket chlorination at water sources of household containers (5, 10 or 20 litre Containers) with an effective chlorine residual (0.2 to 0.5mg/litre), with dosage determined by jar tests	×	✓	✓	✓	✓	×	×	×	4	Community	Environment-to-human
21	Chlorination of unimproved water sources (e.g., unprotected wells, unlined wells)	×	×	×	NR	NR	×	×	×	2NR	Community	Environment-to-human
Improving the quality of water: point of use (POU) and safe storage												
22	A free residual chlorine (FRC) concentration of 0.2 to 0.5mg/l measured after 30 minutes contact time measured, at the point of use	×	✓	✓	✓	×	×	✓	✓	5	Household	Human-to-human
23	A turbidity less than 5 NTU, at point of use	×	×	×	×	×	✓	✓	×	2	Household	Human-to-human
24	Target a higher FRC at pH >7-8, at point of use	×	×	✓	×	✓	×	×	×	2	Household	Human-to-human

25	Highly turbid water, at point of use, should not be chlorinated and filtration, coagulation-flocculation or other pre-treatments should be used to reduce turbidity before treatment	✓	✓	✓	×	✓	✓	✓	✓	7	Household	Human-to-human
26	Use of double dosage of chlorine temporarily for highly turbid water, at point of use	×	×	×	×	×	✓	×	×	1	Household	Human-to-human
27	Microbiological testing for Vibrio cholerae at point of use	×	×	✓	×	×	×	×	×	1	Household	Human-to-human
28	Monitoring of water quality at the household level	×	✓	✓	✓	✓	✓	✓	✓	7	Household	Human-to-human
29	Distribution of household water treatment products/technologies	×	✓	✓	✓	✓	✓	✓	✓	7	Household	Human-to-human
30	Promotion of household water treatment products/technologies	✓	✓	✓	✓	✓	✓	✓	✓	8	Household	Human-to-human
31	Distribution of safe water storage containers	×	×	✓	✓	✓	✓	×	✓	5	Household	Human-to-human
32	Promotion of cleaning, coverage and/disinfection of safe water storage containers	✓	✓	✓	✓	✓	✓	×	✓	7	Household	Human-to-human
Improving the access to and use of sanitation facilities and reducing exposure to faeces												
33	Assessment and mapping of existing sanitation facilities (i.e., coverage, types, access, risks of contamination)	✓	✓	×	✓	✓	✓	×	✓	6	Community	Environment-to-human
34	Sanitation facilities should be a minimum 50m distance to sanitation facilities including facilities that are: >30m away from a groundwater source, 1.5-2m above the water table, limit vector	×	×	×	✓	✓	✓	✓	✓	5	Community	Environment-to-human

	breeding (e.g., flies and mosquitoes), private, considerate of gender, safe to use and have an adequate water supply											
35	Limit or control open defecation	×	×	✓	✓	×	✓	×	✓	4	Community	Environment-to-human
36	Installation or repair of household sanitation	✓	✓	×	✓	✓	×	×	✓	5	Community	Environment-to-human
37	Distribution of latrine construction materials to households	×	×	×	×	×	✓	✓	×	2	Community	Environment-to-human
38	Installation or repair of communal latrines (e.g., in marketplaces, harbours, schools, refugee camps)	×	✓	✓	✓	✓	✓	✓	×	6	Community	Environment-to-human
39	Distribution of potties, scoops or nappies to dispose of child faeces	×	×	×	×	×	✓	×	×	1	Household/ Community	Both
40	Promotion of latrine construction and use (e.g., behaviour change communication (BCC), Community Led Total Sanitation (CLTS), social marketing)	✓	×	×	✓	×	✓	×	✓	4	Community	Environment-to-human
41	Replacement of bucket latrines, public or shared latrines or trenches as soon as possible, and/or provision of these options in emergency contexts	✓	×	×	×	✓	✓	×	×	3	Community	Environment-to-human
42	Establish collection, transport and disposal of plastic bag-based sanitation, if used or introduced	×	×	×	✓	×	✓	×	×	2	Community	Environment-to-human
43	Promotion of sharing latrines in urban settings	×	×	×	✓	×	×	×	×	1	Community	Environment-to-human
44	Promotion of faeces burial ("cat method")	×	×	✓	✓	×	×	×	×	2	Community	Environment-to-human

45	Distribution of latrine cleaning materials for communal and/or household latrines (e.g., detergent, lime, etc.)	×	✓	×	✓	✓	✓	×	×	4	Community	Environment-to-human
Behaviour change interventions to improve personal, domestic and food hygiene practices												
46	Promotion of handwashing after defecation, before eating, before preparing food, before feeding a child, after cleaning a child's faeces and after contact with a cholera case	✓	✓	✓	✓	✓	✓	✓	✓	8	Household	Human-to-human
47	Promotion of safe water collection, treatment and storage (e.g., for drinking and cooking)	✓	✓	✓	✓	✓	✓	×	✓	7	Household	Human-to-human
48	Promotion of safe food preparation, cooking and storage (e.g., covering food to avoid flies and contamination, promotion of breastfeeding)	✓	✓	×	✓	✓	✓	✓	✓	7	Household	Human-to-human
49	Promotion of safe dish washing after eating	✓	×	×	✓	×	×	×	×	2	Household	Human-to-human
50	Promotion of safe defecation practices (e.g., no open defecation, use of latrines, cleaning of latrines, safe disposal of child faeces)	✓	✓	×	✓	✓	✓	✓	✓	7	Household/ Community	Both
51	Promotion of solid waste disposal	×	✓	✓	✓	×	✓	×	×	4	Household/ Community	Both
52	Promotion of safe food preparation to street food vendors and restaurants	×	×	×	✓	×	×	×	×	1	Community	Human-to-human
53	Assessment and analysis of hygiene practices (i.e., identify high risk practices, cultural practices and preferences)	×	×	×	×	×	✓	×	×	1	Household/ Community	Human-to-human

54	Hygiene promotion through house-to-house visits or community meetings	×	✓	✓	✓	✓	✓	✓	✓	7	Household/ Community	Human-to-human
55	Hygiene promotion and cholera awareness using mass media (e.g., radio, television, SMS, social media)	✓	✓	✓	✓	✓	✓	✓	✓	8	Household/ Community	Human-to-human
56	Distribution of hygiene promotion materials (e.g., Information Education Communication (IEC))	×	✓	✓	✓	×	×	✓	✓	5	Household	Human-to-human
57	Hygiene promotion in schools and other institutions (e.g., churches, mosques)	×	✓	✓	✓	×	✓	×	×	4	Community	Human-to-human
58	Hygiene promotion targeted at funerals, marriages, religious festivals and other public gatherings	✓	✓	✓	✓	×	×	×	✓	5	Household/ Community	Human-to-human
59	Hygiene promotion including handwashing and solid waste management among food and water vendors and marketplaces	×	×	✓	✓	✓	×	×	✓	4	Household/ Community	Human-to-human
60	Monitoring of food safety among food vendors and marketplaces including closures, enforcement of food hygiene standards with public health authorities	×	✓	✓	✓	×	×	✓	✓	5	Household/ Community	Human-to-human
61	Hygiene and health promotion through behaviour change communication (BCC), social marketing or community engagement (CE) or other theory-based techniques and frameworks	×	✓	✓	✓	×	✓	✓	✓	6	Household/ Community	Human-to-human
62	Promotion of alternative food-based solutions to limit cholera transmission (e.g., use acidifying foods such as lime, tomatoes, yoghurt)	✓	×	×	✓	×	×	×	×	2	Household	Human-to-human

63	Monitoring of hygiene items and practices (e.g., soap use, changes to hygiene practices)	×	✓	✓	✓	✓	✓	×	✓	6	Household	Human-to-human
Distribution of hygiene materials or non-food items (NFIs)												
64	Distribution of soap to households	×	✓	✓	✓	✓	✓	✓	✓	7	Household	Human-to-human
65	Distribution of soap at the community level	×	✓	×	✓	✓	✓	×	×	4	Household/ Community	Human-to-human
66	Distribution of hygiene kits which include soap, hand washing devices, water treatment products, water storage containers and/or cholera IEC materials	×	✓	✓	✓	✓	✓	×	×	5	Household	Human-to-human
67	Distribution of hygiene kits with materials sufficient for 1 month	×	✓	✓	×	×	×	×	×	2	Household	Human-to-human
68	Distribution of drinking cups, washing bowls and eating equipment to persons in refugee camps, prisons and other institutions	×	×	×	✓	×	×	×	×	1	Household	Human-to-human
69	Distribution of detergents for cleaning water storage containers	×	✓	×	×	×	×	×	×	1	Household	Human-to-human
70	Distribution of items to schools and other communal facilities to aid personal hygiene, food preparation and waste management	×	×	×	✓	×	✓	×	×	2	Household	Human-to-human
71	Installation of handwashing points in public places (e.g., markets, schools, public toilets)	×	✓	✓	✓	✓	✓	✓	✓	7	Household/ Community	Human-to-human
Promotion or distribution of disinfection and cleaning of households, community spaces and/or materials												

72	Promotion of household cleaning and/or disinfection (e.g., floors, furniture and surfaces)	×	×	×	✓	✓	×	×	×	2	Household	Human-to-human
73	Disinfection of households with chlorine spraying (especially vomit and faeces)	×	NR	NR	NR	NR	×	×	×	4NR	Household	Human-to-human
74	Provision of disinfection materials to households for household cleaning and disinfection (e.g., detergents, 0.5-2% chlorine solution)	×	NR	✓	✓	✓	×	×	×	3/1NR	Household	Human-to-human
75	Promotion of safe laundry practices, including disinfection of clothes and bedding of cholera cases with chlorine, boiling for 5 minutes or drying in the sun; alternatively burn or bury with the deceased	✓	×	✓	✓	✓	✓	✓	✓	7	Household	Human-to-human
76	Disinfection of household items that cannot be washed in the sun (e.g., mattresses)	×	×	×	×	✓	×	×	×	1	Household	Human-to-human
77	Disinfection of non-households with chlorine spraying (e.g., in vehicles, marketplaces)	×	NR	NR	NR	NR	×	×	×	3NR	Community	Human-to-human
78	Wash vehicles that have been used to transport cholera cases	×	×	×	✓	×	×	×	×	1	Household/ Community	Human-to-human
Improving dead body management and safe funeral practices												
79	Promotion of safe and hygienic practices for corpse preparation and discouraging funeral feasts (e.g., through house-to-house visits, community meetings, and through community and/or religious leaders)	✓	✓	×	✓	✓	×	✓	✓	6	Household/ Community	Human-to-human

80	Engage with local authorities, community and/or religious leaders for safe funeral practices and corpse management	×	✓	✓	✓	✓	×	✓	✓	6	Household/ Community	Both
81	Encouragement of funerals within 24hours of a death or as soon as possible	×	×	×	×	✓	×	×	✓	2	Household	Human-to-human
82	Promotion or provision of hygiene materials to households for safe and hygienic corpse preparation (e.g., detergents, 0.5-2% chlorine solution, body bags)	✓	NR	✓	✓	✓	×	×	×	4/1NR	Household	Human-to-human
83	Promotion or provision of safe burial sites (e.g., away from water sources)	×	✓	✓	✓	✓	×	×	✓	5	Community	Environment-to-human
84	Adaptation or discouragement of funeral feasts and community meetings	×	×	×	✓	✓	×	✓	✓	4	Household/ Community	Human-to-human
85	Disinfection of corpses with chlorine, and fill mouth and anus with cotton wool soaked in chlorine	✓	✓	✓	✓	✓	×	✓	✓	7	Household/ Community	Both
86	Provision of handwashing facilities at funerals	×	×	✓	✓	×	×	×	✓	3	Household/ Community	Human-to-human
87	Allocation of designated health workers to supervise hygienic practices at funerals	✓	×	✓	×	✓	×	✓	✓	5	Household/ Community	Human-to-human
88	Disinfection of graves (e.g., using lime)	×	✓	×	×	×	×	×	×	1	Community	Environment-to-human
Improving the management of wastewater and faecal sludge												
89	Installation or maintenance of wastewater drains or on-site drainage, particularly around water sources	×	✓	✓	✓	×	✓	×	×	4	Community	Environment-to-human

90	Treatment of faecal sludge in latrines (e.g., with chlorinated lime or lime)	×	✓	×	×	×	×	×	×	1	Community	Environment-to-human
91	Adequate measures are in place for latrine desludging, handling, transportation and disposal (if off-site), including avoidance of latrine desludging	×	×	×	×	×	✓	×	✓	2	Community	Environment-to-human
Provision of interventions that improve solid waste disposal												
92	Assessment and mapping of solid waste disposal and hazards (i.e., define hazards, identify adequate measures)	×	×	×	×	×	✓	×	×	1	Community	Environment-to-human
93	Encouragement of or support to safely manage solid waste control in markets, harbours and other human environments where solid waste presents a health hazard	×	✓	×	✓	×	✓	×	×	3	Community	Environment-to-human
94	Organisation of periodic solid waste campaigns and/or a system to periodically remove waste from waste zones	×	×	×	✓	×	✓	×	×	2	Community	Environment-to-human
Use of vector control interventions to reduce flies												
95	Reduction of fly populations through insecticide spraying in breeding areas	×	NR	×	×	×	×	×	×	1NR	Community	Environment-to-human
NR- Not Recommended by a guideline; WHO- World Health Organization, MSF- Médecins Sans Frontières, ICDDR'B- International Centre for Diarrhoeal Disease Research Bangladesh, ACF- Action Contre la Faim, UNICEF- United Nations Children's Fund, GTFCC- Global Task Force on Cholera Control												

B. Search terms and resources

Appendix S1 Search Strategy and resources searched	
Organisation	**Website**
Global WASH Cluster	www.washcluster.org
World Health Organization (WHO)	www.who.int
United Nations Children's Fund (UNICEF)	www.unicef.org
United Nations High Commissioner for Refugees (UNHCR)	www.unhcr.org
United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA)	www.unocha.org
World Food Programme (WFP)	www.wfp.org
International Organization for Migration (IOM)	www.iom.org
Médecins Sans Frontières (MSF)	www.msf.org
Oxfam	www.oxfam.org.uk
International Red Cross and Red Crescent (ICRC)	www.icrc.org
International Federation of the Red Cross (IFRC)	www.ifrc.org
Action Contre la Faim (ACF)	www.actionagainsthunger.org
International Rescue Committee (IRC)	www.irc.org
Care International	www.careinternational.org.uk
Save the Children	www.nrc.no
Norwegian Refugee Council (NRC)	www.savethechildren.org.uk
The Sphere Project	www.sphereproject.org
US Centers for Disease Control and Prevention (CDC)	www.cdc.gov
International Centre for Diarrhoeal Disease Research Bangladesh (ICDDR'B)	www.icddrb.org
London School of Hygiene and Tropical Medicine (LSHTM)	www.lshtm.ac.uk
Water, Education and Development Centre (WEDC)	www.wedc.lboro.ac.uk
Relief Web	www.reliefweb.int
Humanitarian Response	www.humanitarianresponse.info

C. Search strategy

Appendix S2 Search Terms
Water Quality
(water adj3 (treatment or quality or cleaning or microbiology)) OR (water adj3 (purif* or chlor* or decontamination or filt* or disinfect* or floccul* or radiat* or irradiati* or sediment*)) OR (water adj3 (storage or recontamination or re-contamination)) OR (water adj3 (drinking or consumption))
Water Supply
(water adj3 (supply or availability or access or connect* or distance or improve* or distribut* or quantity or volume or piped or standpipe$1 or handpump$1))
Sanitation
(toilet* or latrine* or pit or pits or sanita* or ecosan or "ecological sanita*" or privy or WC or "water closet") OR ((f$eces or f$ecal or excre* or waste or defecation) adj3 (disposal or manag* or service*)) OR (sewage or sewer$1 or sewerage) OR "septic tank$" OR "open defecation"
Hygiene
(hygiene or handwashing or hand-washing or (hand$1 adj3 wash*) or (hand$1 adj3 hygien*) or (hand$1 adj3 clean) or (hand$1 adj3 disinfect*) or (hand$1 adj3 sterili*) or soap*)
Cholera
(cholera or cholera*) OR (vibrio cholerae or V. cholerae or vibrio) OR (diarrhoea or (diarrh*) adj3 (acute or watery or rice or water or loose or bloody)) OR (stool adj3 (acute or watery or rice or water or loose or bloody))

OR

Dysentery adj3 (acute or watery or rice or water or loose or bloody))

Guidelines

(guidelines or guide)

OR

(manual*)

OR

(protocol*)

Prevention and control

(prevention OR control OR implementation OR delivery OR management OR practice OR response OR programme OR program)

D. Excluded guidelines

Appendix S3 Excluded guidelines			
Organisation	**Year**	**Title**	**Reason for exclusion**
WaterAid	2017	The War To End Cholera: How A Lack Of Clean Water And Sanitation Are Contributing To The Global Spread Of Disease	Document is not a guideline
Global Task Force on Cholera Control	2017	Ending Cholera: A Global Roadmap To 2030	Document is not a guideline
ACF	2017	WASH 'Nutrition: A Practical Guidebook On Increasing Nutritional Impact Through Integration Of WASH And Nutrition Programmes (For Practitioners In Humanitarian And Development Contexts)	Guideline is not specific to cholera prevention and control
WHO	2017	Guidelines For Drinking Water Quality 4th Edition, Incorporating The 1st Addendum	Guideline is not specific to cholera prevention and control
MSF	2016	Evidence-Based Guidelines For Centralizes Chlorination In Emergencies: Background To The New FRC Guidance: Study Methodologies And Outcomes	Guideline is not specific to cholera prevention and control
WHO	2016	Health Care Without Avoidable Infections: The Critical Role Of Infection Prevention And Control	Guideline for WASH in Health Care Facilities and/or Infection Prevention and Control
Oxfam	2013	Oxfam Minimum Requirements For WASH Programmes	Guideline is not specific to cholera prevention and control
LSHTM	2013	Choose Soap Toolkit	Guideline is not specific to cholera prevention and control
ICRC	2013	Water, Sanitation, Hygiene And Habitat In Prisons	Guideline is not specific to cholera prevention and control

Sphere	2011	The Sphere Project: Humanitarian Charter And Minimum Standards in Humanitarian Response	Historical version of guideline
Oxfam	2011	Oxfam Guidelines For Water Treatment In Emergencies	Guideline is not specific to cholera prevention and control
MSF	2010	Public Health Engineering In Precarious Situations	Guideline is not specific to cholera prevention and control
WHO	2009	Who Guidelines On Hand Hygiene In Health Care	Guideline for WASH in Health Care Facilities and/or Infection Prevention and Control
UNICEF	2009	Water, Sanitation And Hygiene (WASH) Cluster Coordination Handbook: A Practical Guide For All Those Involved In The Water, Sanitation And Hygiene Cluster	Guideline is not specific to cholera prevention and control
WHO	2009	Core Components For Infection Prevention And Control Programmes	Guideline for WASH in Health Care Facilities and/or Infection Prevention and Control
UNHCR	2008	Guidance For UNHCR Field Operations On Water And Sanitation Services	Guideline is not specific to cholera prevention and control
IFRC	2008	Household Water Treatment And Safe Storage In Emergencies	Guideline is not specific to cholera prevention and control
Heymann, D. L	2008	Control Of Communicable Diseases Manual	Guideline is not specific to cholera prevention and control
WHO	2008	Essential Environmental Health Standards In Health Care	Guideline for WASH in Health Care Facilities and/or Infection Prevention and Control
ICDDR'B	2006	Cots Programme	Historical version of guideline

ACF	2006	Water, Sanitation And Hygiene For Populations At Risk	Guideline is not specific to cholera prevention and control
WHO	2005	Communicable Disease Control In Emergencies	Guideline is not specific to cholera prevention and control
Cairncross, S. Feachem, R.	2005	Environmental Health Engineering In The Tropics: An Introductory Text	Guideline is not specific to cholera prevention and control
World Bank	2005	The Handwashing Handbook: A Guide For Developing A Hygiene Promotion Programme	Guideline is not specific to cholera prevention and control
MSF	2004	Cholera Guidelines	Historical version of guideline
Sphere	2004	The Sphere Project: Humanitarian Charter And Minimum Standards in Humanitarian Response	Historical version of guideline
Young, H; Borrel, A; Holland, D; Salama, P.	2004	Public Nutrition In Complex Emergencies	Guideline is not specific to cholera prevention and control
House, S.; Reed, B.	2004	Emergency Water Sources: A Guideline For Selection And Treatment	Guideline is not specific to cholera prevention and control
WHO	2002	Environmental Health In Emergencies And Disasters	Guideline is not specific to cholera prevention and control
Harvey, P.; Baghri, S; Reed, B.	2002	Emergency Sanitation Assessment And Programme Design	Guideline is not specific to cholera prevention and control
Davis, J; Lambert, R.	2002	Engineering In Emergencies: A Practical Guide For Relief Workers	Guideline is not specific to cholera prevention and control
Sphere	2000	The Sphere Project: Humanitarian Charter And Minimum Standards in Humanitarian Response	Historical version of guideline
Ferron, S.; Morgon, J.; O'Reilly, M.	2000	Hygiene Promotion: A Practical Manual For Relief And Development	Guideline is not specific to cholera prevention and control

E. PRISMA-ScR Checklist for Scoping Reviews

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist			
SECTION	**ITEM**	**PRISMA-ScR CHECKLIST ITEM**	**REPORTED ON PAGE #**
TITLE			
Title	1	Identify the report as a scoping review.	Title, page 1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Abstract, paragraphs 1-4, pages #1-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Introduction, paragraphs 1-5, pages #4-7
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Introduction, paragraph 6, pages #7
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and	Methods, paragraph 1. The review has not been

		if available, provide registration information, including the registration number.	registered prior to publication, pages #7
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Methods, paragraph 3-4, pages #8-9
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Methods, paragraph 2, S1 Appendix; Results, paragraph 1, Figure 2, page #8
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	S2 Appendix
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Methods, paragraph 1-5, pages #7-10
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Methods, paragraph 6-7, pages #9-10
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Methods, paragraph 7-8, Table 1, Table 2 and Figure 1, pages #9-12

Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Methods, paragraph 7-8, Table 1, Table 2 and Figure 1, pages #9-12
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Methods, paragraph 7-8, Table 1, Table 2 and Figure 1, pages #9-12
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Results, paragraph 1, Figure 2, S3 Appendix, page #13
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Results, paragraph 1-3, pages #13-15
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Not done
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Results, 4-10, Table 3, Table 4, Table 5, Table 6, pages #16-21
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Results, 4-10, Table 3, Table 4 Table 5, Table 6, pages #16-21
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available),	Discussion, paragraph 1, page #22

		link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	Limitations, paragraph 1-4, pages #27-29
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Conclusions, paragraph 1-2, pages #29-30
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Funding

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where sources of evidence (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with information sources (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

Appendix B. Supplementary materials for Research Paper 2

F. Data collection tools: Individual Survey (English)

Supplementary File 1. Data collection tools				
B1. Baseline and Follow Up Survey- Individual Household Contact				
Thank you for agreeing to participate in this survey.				
Before getting started, I need to write down my name, the time and date of the survey. Please give me a minute to do so.				
Reminder to interviewer: This survey is for an individual household contact. For every household contact, this survey must be completed.				
Reminder to interviewer: If the household contact is between 2-18 years, you will need to ask the parent/guardian or caregiver to provide the responses on behalf of the child.				
Reminder to interviewer: Children <2yrs are not eligible in this study.				
Reminder to interviewer: You will first check eligibility and then proceed to take informed consent from the household contact.				
As mentioned, when I was explaining the study to you all, I will ask you some questions about your socioeconomic status, education, relationship to the primary case and your water, sanitation and hygiene practices. If you have any questions during the survey, please ask.				
	Question	**Code**	**Options**	**Logic**
a	What is the date?			
b	What is the time?			
c	Household ID number			
	(This should be the same on all surveys taken from all people in one household and you should check off the daily Household ID checklist)			

d	Enumerator name			
	(This will appear as a pre-entered list of names in the survey. Please select your name)			
I will now check your eligibility to participate in the study.				
e	Are you above the age of 2 years old?	0	No	END
		1	Yes	
f	Have you resided in the same house as the primary case for 50% of the time in the preceding two weeks? This includes sleeping under the same roof or sharing the same food with the primary case.	0	No	END
		1	Yes	
g	Have you already been recruited for this study?	0	No	
		1	Yes	END
h	Have you been enrolled into the study within 48hrs of the primary case being admitted to the CTC?	0	No	END
		1	Yes	
Instruction to interviewer: After checking the eligibility of the household contact, please proceed to read the informed consent form to the participant and ensure all parts are signed. Each household contact will have a separate signed informed consent form. If the participant is between 7-18 years old, please complete the additional Children's Assent Form with the participant. You will still need a completed informed consent form from the parent or guardian for any child between 2-18 years old. You keep one copy of all forms, and they keep the other.				
i	Do you agree to take part in the study?	0	No	END
		1	Yes	1
		2	Come back later	j
j	What time should we come back later?			
	Participant Information: I will ask you some questions about you and your lifestyle. This is to have an idea of the different types of people in our study.			
1	Participant ID number (tick off checklist)			
	(This should be linked to the Household ID number, and you follow the checklist)			

2	Zone de Santé			
3	Aire de Santé			
4	Village			
5	Sub-village			
6	Telephone number			
7	Age (years)			
8	Gender	0	Female	
		1	Male	
9	Have you been vaccinated for cholera in the past 12 months?	0	No	12
		1	Yes	
10	Can I see your vaccination card?	0	No	12
		1	Yes	
11	[Observe vaccination status in card- date of vaccination]			
12	What is your level of formal education?	1	None	
		2	Primary	
		3	Secondary	
		4	Tertiary	
		88	Other	
13	Are you able to read?	0	No	
		1	Yes	
14	Are you able to write?	0	No	
		1	Yes	
15	What is your current occupation? (This will need to be defined in pre-testing)	1	Housewife	
		2	Farmer (own land)	

		3	Farmer (work for others)	
		4	Skilled worker	
		5	Petty trader	
		6	Shop owner	
		7	Business	
		8	Unemployed	
		88	Other	
	Symptoms of cholera			
17	Have you had symptoms of diarrhoea in the past 5 days (three or more loose stools over a 24hour period)?	0	No	19
		1	Yes	
18	If yes, when did your symptoms start?			
19	Have you experienced vomiting in the past 5 days?	0	No	21
		1	Yes	
20	If yes, when did your symptoms start?			
21	Have you had cholera in the past 5 days?	0	No	26
		1	Yes	
22	When did your cholera symptoms start?			
23	Was this confirmed by a doctor at the health care facility?	0	No	26
		1	Yes	
24	If yes, which date did you visit the doctor or health care facility?			
25	If yes, what was your diagnosis by the doctor?			
	Contact with primary cases			

26	What is your relationship to the primary cholera case?	1	Wife	
		2	Mother	
		3	Daughter	
		4	Sister	
		5	Husband	
		6	Father	
		7	Son	
		8	Granddaughter	
		9	Grandson	
		10	Grandfather	
		11	Grandmother	
		12	Mother-In-Law	
		13	Daughter-In-Law	
		14	Sister-In-Law	
		15	Father-In-Law	
		16	Son-In-Law	
		17	Brother-In-Law	
		18	Cousin	
		19	Friend	
		20	Neighbour	
		99	Don't know	
		88	Other	
27	Have you shared a meal with the primary cholera case in the last 5 days?	0	No	END
		1	Yes	
28	Have you shared the same water with the primary cholera case in the last 5 days?	0	No	END

		1	Yes	
29	Have you washed the bed linen or clothes of the primary cholera case in the last 5 days?	0	No	
		1	Yes	
30	Have you cared for or prepared the dead body of the primary cholera case in the last 5 days?	0	No	
		1	Yes	
	Contact with other cholera cases			
31	Have you been in contact with anyone else suffering from cholera in the last 5 days?	0	No	37
		1	Yes	
32	If yes, did you share a meal with them in the last 5 days?	0	No	
		1	Yes	
33	If yes, did you share the same drinking water with them in the last 5 days?	0	No	
		1	Yes	
34	If yes, did you wash the bed linen or clothes of case in the last 5 days?	0	No	
		1	Yes	
35	If yes, did you care for or prepare the dead body of the case in the last 5 days?	0	No	
		1	Yes	
36	What is your relationship to this other cholera case?	1	Wife	
		2	Mother	
		3	Daughter	
		4	Sister	
		5	Husband	
		6	Father	
		7	Son	
		8	Granddaughter	

		9	Grandson	
		10	Grandfather	
		11	Grandmother	
		12	Mother-In-Law	
		13	Daughter-In-Law	
		14	Sister-In-Law	
		15	Father-In-Law	
		16	Son-In-Law	
		17	Brother-In-Law	
		18	Cousin	
		19	Friend	
		20	Neighbour	
		99	Don't know	
		88	Other	
	Water and food exposures outside the home			
37	Have you been drinking water outside of you home in the last 5 days?	0	No	39
		1	Yes	
38	If yes, where:	1	In the street	
		2	Restaurant	
		3	In the market	
		4	At school	
		5	In the home of a friend, neighbour or family member	

		88	Other	
39	Have you eaten outside of the family home in the last 5 days?	0	No	41
		1	Yes	
40	If yes, where:	1	In the street	
		2	Restaurant	
		3	In the market	
		4	At school	
		5	In the home of a friend, neighbour or family member	
		88	Other	
	Hygiene inside the home: individual behaviours			
41	What do you use soap for? [Allow the participant to free list answers and select all that are mentioned]	1	Washing your hands	
		2	Washing your body	
		3	Washing your plates	
		4	Washing your surfaces	
		5	Washing clothes	
		88	Other	
42	Do you use the same soap to wash your clothes/bed linens?	0	No	44
		1	Yes	
43	If no, what do you use?			
44	Do you use the same soap to wash your surfaces and floors?	0	No	46
		1	Yes	

45	If no, what do you use?			
46	When do you wash your hands? [Allow the participant to free list answers and select all that are mentioned]	1	I do not wash my hands	
		2	Before eating	
			Before cooking	
		3	After eating	
		4	After using the latrine	
		5	After cleaning child faeces	
		6	After cleaning, sick person's faeces	
		99	No response	
		88	Other	
47	What do you use to wash your hands? [Allow the participant to free list answers and select all that are mentioned]	1	Hand soap and water	
		2	Ash and water	
		3	Lemon and water	
		4	Laundry soap and water	
		5	Water only	
		6	Nothing	
		88	Other	
	END			
	Thank you participating in our survey. We thank you for all of your responses and time to take this survey with us.			

G. Data collection tools: Household Survey (English)

B2 Baseline and Follow Up Survey- Household				
Thank you for agreeing to participate in this additional survey about your household.				
Before getting started, I need to write down my name, the time and date of the survey. Please give me a minute to do so.				
Note to interviewer: This survey is for the entire household. You must either ask the household head (female or male) or another adult if they have been given permission by the head of the household to answer questions.				
As mentioned, when I was explaining the study to you all, I will ask you some questions about your household, the water, sanitation and hygiene practices and I will also request to collect some environmental samples from your water and food. If you have any questions during the survey, please ask.				
	Question	**Code**	**Options**	**LOGIC**
a	What is the date?			
b	What is the time?			
c	Household ID number (This should be the same on all surveys taken from one household and you should check off the daily Household ID checklist)			
d	Location of the house (Take the GPS)			
e	Enumerator name (This will appear as a pre-entered list of names in the survey. Please select your name)			
	Socioeconomic information: I will ask you some questions about your household and your household members. This is to have an idea of the different types of people in our study.			

1	How many people live in your house? (Explain to the household that this is defined as sharing the same meal and sleeping in the house for 50% or more of the time)			
2	How many adults (over 18 years) live in the house?			
3	How many children/adolescents (5-18 years) live in the house?			
4	How many children (under five years) live in the house?			
5	[Question for Interviewer: Calculate total number of people living in the house to confirm estimates from Q3+ 4+ 5]			
6	What language is mostly spoken in your house? (Select one option)	1	Lingala	
		2	Swahili	
		3	Chilwa	
		4	Kikongo	
		5	Tshiluba	
		6	French	
		88	Other	
7	What ethnicity would you most associate your household with? (Select one option)	1	Baluba	
		2	Bakongo	
		3	Kongo	
		4	Swahili	
		88	Other	
8	What religion would you most associate your household with? (Select one option)	1	Catholic/Protestant/Eglise De Revel	
		2	Muslim	
		3	Other	
9	Does your household have electricity?	0	No	

		1	Yes	
10	Does your household have a:	1	Radio	
		2	Mobile phone	
		3	Television	
		4	Fridge	
		5	Bicycle	
		6	Motorcycle	
		7	Boat	
11	Do you own this land?	0	No	
		1	Yes	
12	Do you own any livestock or animals?	0	No	14
		1	Yes	
13	If yes, how many animals do you own?			
14	[Observe what the floor is made from]	1	Earth	
		2	Animal dung	
		3	Wood	
		4	Tent	
		5	Cement	
		88	Other	
15	[Observe the wall materials]	1	Earth	
		2	Animal dung	
		3	Wood	
		4	Tent	
		5	Cement/Bricks	
		88	Other	

16	[Observe roof materials]	1	Palm	
		2	Wood	
		3	Corrugated iron	
		4	Tent	
		5	Plastic sheet	
		88	Other	
	Food exposures inside the home: I will now ask some questions about your food practices and ask to take a sample of today's meal.			
17	Does your family prepare food together?	0	No	
		1	Yes	
18	Do you eat from the same pot/plate?	0	No	
		1	Yes	
19	How do you take food from the same pot/plate? [Allow the participant to answer freely, do not read out the options]	1	By hand	
		2	By spoon	
		88	Other	
20	Do you cover the food?	0	No	
		1	Yes	
21	[Observe if food is covered]	0	No	
		1	Yes	
22	Do you re-heat the food?	0	No	
		1	Yes	
23	If yes, how do you reheat the food?	1	Boiling	
		2	Frying	
		88	Other	
24	Where is the food stored?			

25	[Observe where the food is stored- this list will extend or change depending on the context]	1	Cupboard	
		2	Under a plate	
		88	Other	
26	[Observe flies near or around food]	0	No	
		1	Yes	
27	What is this food called (the main shared meal)?			
28	Can I take a sample from today's shared meal?	0	No	
		1	Yes	
	We would like to collect a sample of the food to test for the presence of bacteria. [Note to interviewer: Collect food with a spoon borrowed from the household. Ask the interviewee to help you. Please ensure the food sample bag in labelled with DATE, TIME and HH ID NUMBER]			
	Water exposures inside the home: I will now ask you some questions about how your household collects and uses their water. I will ask to take some samples at the end of this section.			
29	By looking at this chart of water containers, can you select how much water you have stored in your house today (in litres)? [Note to interviewer: Show the chart of water vessels to the interviewee. It will be easier for them to point to vessels and for you to calculate the volume from this. The volume of each vessel is labelled on the chart]		litres	
30	Do you store water for drinking separately from water for other purposes?	0	No	
		1	Yes	
31	Could you show me where the storage vessels for drinking water are kept?	0	No	36
		1	Yes	
32	[Observe the types of storage receptacle for drinking water available in the household]	1	Container (10l)	
		2	Container (15l)	
		3	Container (20l)	

		4	Bucket (10l)	
		5	Bucket (20l)	
		6	Gourd	
		7	Clay pot	
		88	Other	
33a	[Observe if the water storage receptacle for drinking water is covered]	0	No	
		1	Yes	
33b	[Observe if the inside the water storage receptacle is visibly dirty or clean	0	Dirty	
		1	Clean	
34	[Observe if the water storage receptacle for drinking water is within animal contact]	0	No	
		1	Yes	
35	[Observe/estimate the volume of the water storage receptacle for drinking water (in litres)]			
36	Where did you buy, or receive the water storage receptacle?	1	Shop near house	
		2	Provided by MSF	
		3	Provided by another agency	
		4	Provided by government	
		9	Don't know	
		88	Other	
37	How do you take water from the receptacle?	1	By hand	
		2	By cup	
		9	Other	
38	Do you boil, treat or filter your drinking water?	0	No	42
		1	Yes	
39	Can I see your treatment products or device?	0	No	

		1	Yes	
40	If yes, can I see your treatment device/product for water? [Observe products]	1	Boil	
		2	Filter (ceramic)	
		3	Filter (sand)	
		4	Filter (cloth)	
		5	Filter (other)	
		6	Chlorine tablet	
		7	Chlorine liquid	
		8	Chemical (other)	
		9	Don't know	
		88	Other	
41	Where did you buy, or receive the water treatment products?	1	Shop near house	
		2	Provided by MSF	
		3	Provided by another agency	
		4	Provided by government	
		9	Don't know	
		88	Other	
42	Can I take a sample of this water?	0	No	
		1	Yes	
	We would like to collect a sample of the stored water to test for the presence of bacteria. [Note to interviewer: Collect water direct from the receptacle from the tap or with a cup the household uses. Ask the interviewee to help you. Please ensure the sample bag in labelled with DATE, TIME and HH ID NUMBER]			
	Note to interviewer: Take FRC level with pool tester and DPD tablet and record results			

43a	What is the FRC level in the water sample?			
	Note to interviewer: Test pH with pH meter and record results			
43b	What is the pH of the water sample?			
	Hygiene inside the home			
44	Do you have soap in your house?	0	No	48
		1	Yes	
45	What types of soap do you have?	1	Bar soap	
		2	Laundry soap/powder soap	
		3	Both	
		88	Other	
46	How many bars or bags of soap do you have?			
47	Where did you buy, or receive the soap?	1	Shop near house	
		2	Provided by MSF	
		3	Provided by another agency	
		4	Provided by government	
		9	Don't know	
		88	Other	
48	Do you have a sink or hand washing device?	0	No	
		1	Yes	
49	[Observe if water is connected to or present inside the hand washing device]	0	No	
		1	Yes	
50	[Observe if soap is on or next to (within 1m) hand washing device/sink]	0	No	
		1	Yes	
51	[Observe soap in the kitchen within 1m]	0	No	

		1	Yes	
	Latrine use			
52	Do you have a household latrine?	0	No	54
		1	Yes	
53	[Observe the location of the latrine]	1	Inside house	55
		2	Inside compound	55
		3	No household latrine	
54	If no household latrine, where do you defecate?	1	Latrine at neighbour's house	60
		2	Public latrine block	60
		3	Open defecation	62
		4	Not recorded	62
		88	Other	62
55	Could we take a quick look at the latrine? [Observe the type of latrine]	1	Pour flush with ceramic or cement slab	
		2	Pit latrine with cement	
		3	Pit latrine with wood	
		4	Pit latrine with mud	
		88	Other	
56	[Observe soap within 1m of latrine]	0	No	
		1	Yes	
57	[Observe sink/hand washing device within 1m of latrine]	0	No	
		1	Yes	
58	[Observe if the sink/hand washing device has a water supply]	0	No	
		1	Yes	

59	[Observe flies in and around the latrine]	0	No	
		1	Yes	
60	How many people share the latrine (total number of people)?			
61	How many households share the latrine (total number of households)?			
	Water outside of the home			
62	Where have you collected water for drinking from in the last 5 days? [This list will extend or change depending on the context]	1	Tap in house	
		2	Tap in compound	
		3	Tap stand in community	
		4	Tap at private kiosk	
		5	Hand pump in community	
		6	Protected well in community	
		7	Open well in community	
		8	Rainwater tank	
		9	Spring	
		10	Water trucking	
		11	Shop	
		888	Other	
63	Who was the water point provided by?	1	Government	
		2	Private	
		3	Household	
		4	NGO	
		5	MSF	
		99	Don't Know	
		88	Other	

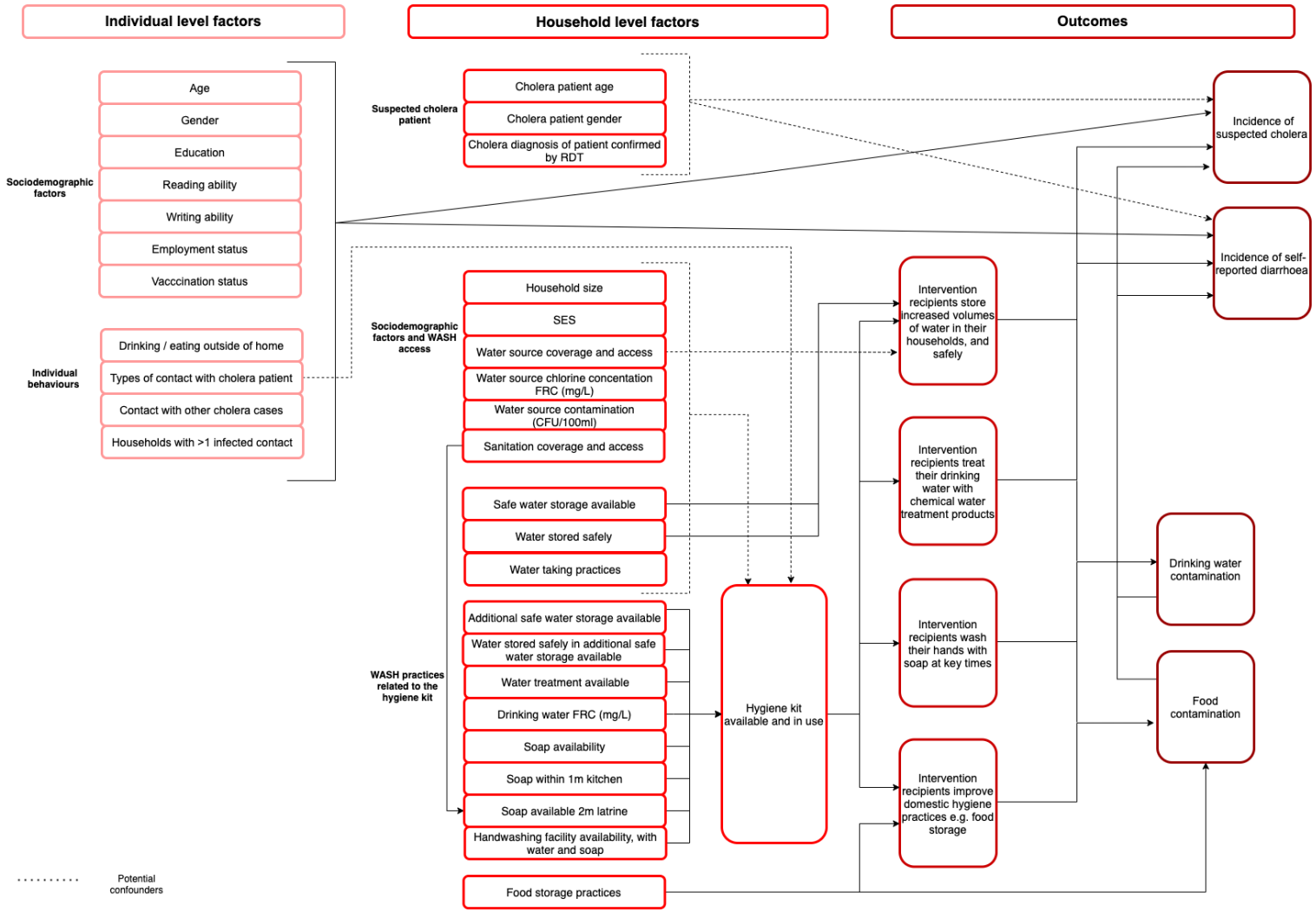
64	How long does it take to collect the water (there and back in minutes including waiting time)?			
65	Do you use another source for other uses (laundry, toilet, bathing)?	0	No	67
		1	Yes	
66	If yes, what type of water source is this (this list will extend or change depending on the context)?	1	Tap in house	
		2	Tap in compound	
		3	Tap stand in community	
		4	Tap at private kiosk	
		5	Hand pump in community	
		6	Protected well in community	
		7	Open well in community	
		8	Rainwater tank	
		9	Spring	
		10	Water trucking	
		11	Shop	
		888	Other	
67	Can we go and see the water point you use for drinking water? [Observe the water point with participant now or at the end of the survey, confirm the type of water source]	1	Tap in house	
		2	Tap in compound	
		3	Tap stand in community	
		4	Tap at private kiosk	
		5	Hand pump in community	
		6	Protected well in community	
		7	Open well in community	

		8	Rainwater tank	
		9	Spring	
		10	Water trucking	
		11	Shop	
		888	Other	
68	Can I take a sample from this water source?	0	No	
		1	Yes	
69	Take GPS marker for this water point:			
	We would like to collect a sample of the source water to test for the presence of bacteria. [Note to interviewer: Collect water direct from the receptacle from the tap or with a cup the household uses. Ask the interviewee to help you. Please ensure the sample bag in labelled with DATE, TIME and HH ID NUMBER]			
	Note to interviewer: Take FRC level with pool tester and DPD tablet and record results			
70a	What is the FRC level in the water sample?			
	Note to interviewer: Test pH with pH meter and record results			
70b	What is the pH of the water sample?			
71	Have you received a hygiene kit?	0	No	
		1	Yes	
72	What was included in your hygiene kit? [Allow participant to free list responses and select all that are mentioned and to check that these were the items distributed as part of the intervention]	1	20L container	
		2	Bar soap	
		3	Laundry soap/powder soap	
		4	Water treatment tablets (chlorine)	

		5	Water treatment sachets (PUR)	
		6	10L Bucket with tap	
		9	Don't know	
		88	Other	
73	What date did you receive your hygiene kit?			
74	[Observe any components of the hygiene kit in the household and check that these were the items distributed as part of the intervention]	1	20L container	
		2	Bar soap	
		3	Laundry soap/powder soap	
		4	Water treatment tablets (chlorine)	
		5	Water treatment sachets (PUR)	
		6	10L Bucket with tap	
		9	Don't know	
		88	Other	
75	[Observe if any of the following items are being used from the hygiene kit]	1	Water in the 20L container	
		2	Bar soap 1m of kitchen	
		3	Bar soap 2m of latrine/toilet	
		4	10L Bucket with tap as handwashing device	
		5	10L bucket with tap and water inside	

		6	10L bucket with tap and water inside and soap next to it / on top	
		9	Don’t know	
		88	Other	
	END			
	Thank you participating in our survey. We thank you for all of your responses and time to take this survey with us.			

H. Cholera Incidence Causal Framework



I. Additional Tables of Results

Table S1. Univariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period

	Contacts (n)	Suspected cholera (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Age of household contact						
2-5 years	77	24 (6)	1.24	0.48	3.19	0.655
5-15 years	176	28 (7)	0.63	0.25	1.57	0.324
>15 years (reference)	191	48 (12)	(ref.)			
Gender of household contact						
Male (reference)	210	48 (12)	(ref.)			
Female	234	52 (13)	0.97	0.45	2.08	0.942
Education						
None	122	28 (7)	1.03	0.44	2.40	0.952
Any education (reference)	322	72 (18)	(ref.)			
Reading ability						
No (reference)	305	60 (15)	(ref.)			
Yes	139	40 (10)	1.46	0.67	3.18	0.336
Writing ability						
No (reference)	307	64 (16)	(ref.)			
Yes	137	36 (9)	1.26	0.57	2.78	0.566
Socioeconomic status						
Lowest	319	64 (16)	0.70	0.32	1.53	0.370
Highest (reference)	125	36 (9)	(ref.)			

Table S1 continued. Univariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period

	Contacts (n)	Suspected cholera (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Currently employed						
No employment, child or school student (reference)	96	20 (5)	(ref.)			
Income generating employment	348	80 (20)	1.10	0.43	2.86	0.840
Types of contact with suspected cholera patient during surveillance period						
Shared food and water	361	76 (19)	0.73	0.30	1.77	0.483
Shared food and water and caring responsibilities (reference)	83	24 (6)	(ref.)			
Drinking or eating outside of the household during surveillance period						
No (reference)	38	4 (1)	(ref.)			
Yes	406	96 (24)	2.25	0.31	16.15	0.421
Contact with other cholera cases during the surveillance period						
No (reference)	285	48 (12)	(ref.)			
Yes	159	52 (13)	1.94	0.91	4.15	0.087
Age of suspected cholera patient						
2-5 years	54	4 (1)	0.28	0.04	2.01	0.204
5-15 years	61	8 (2)	0.49	0.12	2.03	0.326
>15 years (reference)	329	88 (22)	(ref.)			
Gender of suspected cholera patient						
Male (reference)	226	52 (13)	(ref.)			
Female	218	48 (12)	0.96	0.45	2.05	0.910

Table S1 continued. Univariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period

	Contacts (n)	Suspected cholera (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Cholera treatment plan of suspected cholera patient						
Plan A (reference)	175	48 (12)	(ref.)			
Plan B	199	40 (10)	0.73	0.32	1.65	0.454
Plan C	70	12 (3)	0.63	0.18	2.15	0.456
Cholera diagnosis of patient confirmed by rapid diagnostic test (RDT)						
No (reference)	248	68 (17)	(ref.)			
Yes	196	32 (8)	0.60	0.26	1.35	0.215
Water source coverage and access						
Improved: basic (improved, <30minutes) & limited (improved, >30minutes) (reference)	58	8.0 (2)	(ref.)			
Unimproved: unimproved & surface water (rivers, unprotected springs)	386	92 (23)	1.73	0.42	7.14	0.450
Source water with a median chlorine concentration <1.0mg/L FRC	444	100 (25)	1	-	-	-
Source water with >10 *Enterococcus* spp (CFU/100ml)	181	44 (11)	1.14	0.53	2.46	0.735
Sanitation coverage						
Limited (improved, shared >2 households) (reference)	75	16 (4)	(ref.)			
Unimproved	354	80 (20)	1.06	0.37	3.00	0.914
Open defecation	15	4 (1)	1.25	0.15	10.41	0.837

Table S1 continued. Univariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period

	Contacts (n)	Suspected cholera (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Water storage and treatment practices						
Any safe water storage available at enrolment						
No (reference)	16	0 (0)	(ref.)			
Yes	428	100 (25)	0.60	0.27	1.32	0.204
Water present in any safe water storage during surveillance period						
No (reference)	38	4 (1)	(ref.)			
Yes	416	96 (24)	0.62	0.09	4.41	0.632
Water practices at enrolment						
Decant or drink water from storage container with glass or cup (reference)	426	96 (24)	(ref.)			
Pour from the container	18	4 (1)	0.99	0.14	6.89	0.989
Soap and handwashing facility availability						
Any soap available at enrolment						
No (reference)	101	28 (7)	(ref.)			
Yes	342	72 (18)	0.76	0.33	1.76	0.519
Soap observed within 1m of kitchen at enrolment						
No (reference)	406	100 (25)	(ref.)			
Yes	38	0 (0)	-	-	-	-
Soap observed within 2m of latrine at enrolment						
No (reference)	428	100 (25)	(ref.)			
Yes	16	0 (0)	-	-	-	-

Table S1 continued. Univariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period

	Contacts (n)	Suspected cholera (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Handwashing facility at enrolment						
Basic facility (facility, water and soap) (reference)	86	8 (2)	0.27	0.06	1.13	0.074
Limited facility (facility and water)	150	20 (5)	0.39	0.15	1.01	0.053
No handwashing facility	208	72 (18)	(ref.)			
Food storage practices at enrolment*						
Food covered at time of visit (reference)	190	58.8 (10)	(ref.)			
Food not covered	90	41.2 (7)	1.48	0.58	3.76	0.412
Food storage practices at follow up*						
Food covered (reference)	205	81.3 (13)	(ref.)			
Food not covered	52	18.7 (3)	0.91	0.27	3.08	0.879
Receipt of a hygiene kit during surveillance period						
No (reference)	99	36.0 (9)	(ref.)			
Yes	345	64.0 (16)	0.51	0.23	1.1	0.093
Receipt of a hygiene kit and intervention compliance during surveillance period						
Did not receive the hygiene kit (reference)	99	36 (9)	(ref.)			
Received a hygiene kit with low use	54	16 (4)	0.81	0.26	2.52	0.722
Received a hygiene kit with mid-use	149	28 (7)	0.52	0.20	1.34	0.175
Received a hygiene kit with high use	142	20 (5)	0.39	0.13	1.12	0.080

** Not available for all 444 household contacts

Table S2. Multivariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period

	Contacts (n)	Suspected cholera (%/n)	Univariate (Risk Ratio (RR))	Multivariate (adjusted Risk Ratio (aRR))	Lower 95% CI	Upper 95% CI	p-value
Age of household contact							
2-5 years	77	24 (6)	1.24	2.99	0.59	15.29	0.186
5-15 years	176	28 (7)	0.63	0.82	0.30	2.25	0.706
>15 years (reference)	191	48 (12)	(ref.)				
Gender of household contact							
Male (reference)	210	48 (12)	(ref.)				
Female	234	52 (13)	0.97	0.99	0.46	2.14	0.982
Education							
None	122	28 (7)	1.03	0.75	0.17	3.24	0.702
Any education (reference)	322	72 (18)	(ref.)				
Currently employed							
No employment, child or school student (reference)	96	20 (5)	(ref.)				
Income generating employment	348	80 (20)	1.10	1.72	0.37	7.98	0.490
Types of contact with suspected cholera patient during surveillance period							
Shared food and water	361	76 (19)	0.73	0.70	0.25	1.95	0.493
Shared food, water and caring responsibilities (reference)	83	24 (6)	(ref.)				
Sanitation coverage							
Limited (improved, shared >2 households) (reference)	75	16 (4)	(ref.)				

Table S2 continued. Multivariate analysis for suspected cholera (diarrhoea, vomiting and/or cholera) during the surveillance period

	Contacts (n)	Suspected cholera (%/n)	Univariate (Risk Ratio (RR))	Multivariate (adjusted Risk Ratio (aRR))	Lower 95% CI	Upper 95% CI	p-value
Unimproved	354	80 (20)	1.06	1.19	0.41	3.45	0.746
Open defecation	15	4 (1)	1.25	1.84	0.20	16.76	0.589
Receipt of a hygiene kit and intervention compliance during surveillance period							
Did not receive the hygiene kit (reference)	99	36 (9)	(ref.)				
Received a hygiene kit with low use	54	16 (4)	0.81	0.78	0.24	2.53	0.684
Received a hygiene kit with mid-use	149	28 (7)	0.52	0.47	0.17	1.29	0.144
Received a hygiene kit with high use	142	20 (5)	0.39	0.34	0.11	1.03	0.055

Table S3. Univariate analysis for self-reported diarrhoea during the surveillance period

	Contacts (n)	Self-reported diarrhoea (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Age of household contact	444	3.6 (16)	0.90	0.46	1.76	0.755
2-5 years	77	25 (4)	1.10	0.35	3.47	0.868
5-15 years	176	18.8 (3)	0.36	0.10	1.31	0.123
>15 years (reference)	191	56.2 (9)	(ref.)			
Gender of household contact						
Male (reference)	210	50 (8)	(ref.)			
Female	234	50 (8)	0.90	0.34	2.35	0.826
Education						
None	122	25 (4)	(ref.)			
Any education (reference)	322	75 (12)	0.88	0.29	2.68	0.821
Ability to read						
No (reference)	305	43.7 (7)	(ref.)			
Yes	139	56.3 (9)	1.71	0.65	4.49	0.279
Ability to write						
No (reference)	307	37.5 (6)	(ref.)			
Yes	137	62.5 (10)	1.34	0.50	3.63	0.559
Socioeconomic status						
Lowest	319	68.8 (11)	0.86	0.31	2.43	0.779
Highest (reference)	125	31.2 (5)	(ref.)			

Table S3 continued. Univariate analysis for self-reported diarrhoea during the surveillance period

	Contacts (n)	Self-reported diarrhoea (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Currently employed						
No employment, child or school student (reference)	96	18.8 (3)	(ref.)			
Income generating employment	348	81.2 (13)	1.20	0.35	4.11	0.777
Types of contact with suspected cholera patient during the surveillance period						
Shared food and water	361	68.7 (11)	0.51	0.18	1.42	0.195
Shared food, water and caring responsibilities (reference)	83	31.3 (5)	(ref.)			
Drinking or eating outside of the household during surveillance period						
No (reference)	38	0 (0)	(ref.)			
Yes	406	100 (16)	1	-	-	-
Contact with other cholera cases during the surveillance period						
No (reference)	285	50.0 (8)	(ref.)			
Yes	159	50.0 (8)	1.79	0.69	4.68	0.234
Age of suspected cholera patient						
0-5 years	54	0 (0)	1	-	-	-
5-15 years	61	12.5 (2)	0.77	0.18	3.31	0.726
>15 years (reference)	329	87.5 (14)	(ref.)			
Gender of suspected cholera patient						
Male (reference)	226	50.0 (8)	(ref.)			
Female	218	50.0 (8)	1.04	0.40	2.71	0.941

Table S3 continued. Univariate analysis for self-reported diarrhoea during the surveillance period

	Contacts (n)	Self-reported diarrhoea (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Cholera treatment plan of suspected cholera patient						
Plan A (reference)	175	18.8 (3)	(ref.)			
Plan B	199	43.7 (7)	1.03	0.35	3.00	0.963
Plan C	70	37.5 (6)	1.25	0.32	4.86	0.747
Cholera diagnosis of patient confirmed by rapid diagnostic test (RDT)						
No (reference)	248	56.3 (9)	(ref.)			
Yes	196	43.7 (7)	0.98	0.37	2.60	0.974
Water source coverage and access						
Improved: basic (improved, <30minutes) & limited (improved, >30minutes) (reference)	58	6.3 (1)	(ref.)			
Unimproved: Unimproved & Surface water (rivers, unprotected springs)	386	93.7 (15)	2.25	0.30	16.74	0.427
Source water with a median free residual chlorine concentration (FRC) <1.0mg/L *	444	100 (16)	1	-	-	-
Source water with >10 CFU/100ml of *Enterococcus*	181	43.8 (7)	1.13	0.43	2.98	0.805
Sanitation coverage						
Limited (improved, shared >2 households) (reference)	75	0 (0)	(ref.)			
Unimproved	354	100 (16)	1	-	-	-
Open defecation	15	0 (0)	1	-	-	-

Table S3 continued. Univariate analysis for self-reported diarrhoea during the surveillance period

	Contacts (n)	Self-reported diarrhoea (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Water storage and treatment practices at enrolment						
Any safe water storage available at enrolment						
No (reference)	16	0 (0)	(ref.)			
Yes	426	100 (16)	0.74	0.26	2.09	0.572
Water present in any safe water storage during surveillance period						
No (reference)	416	93.7 (15)	(ref.)			
Yes	28	6.3 (1)	0.99	0.14	7.23	0.992
Water practices at enrolment						
Decant or drink water from storage container with glass or cup (reference)	426	93.8 (15)	(ref.)			
Pour from the container	18	6.25 (1)	1.58	0.22	11.30	0.650
Soap and handwashing facility availability						
Any soap available at enrolment						
No (reference)	101	18.7 (3)	(ref.)			
Yes	343	81.3 (13)	1.28	0.37	4.39	0.699
Soap observed within 1m of kitchen at enrolment						
No (reference)	406	100 (16)	(ref.)			
Yes	38	0 (0)	-	-	-	-
Soap observed within 2m of latrine at enrolment						
No (reference)	428	100 (16)	(ref.)			
Yes	16	0 (0)	-	-	-	-

Table S3 continued. Univariate analysis for self-reported diarrhoea during the surveillance period

	Contacts (n)	Self-reported diarrhoea (%/n)	Univariate (Risk Ratio (RR))	Lower 95% CI	Upper 95% CI	p-value
Handwashing facility at enrolment						
Basic facility (facility, water and soap)	86	12.5 (2)	0.40	0.09	1.76	0.053
Limited facility (facility and water)	150	12.5 (2)	0.23	0.05	1.01	0.053
No handwashing facility (reference)	208	75 (12)	(ref.)			
Food storage practices at enrolment *						
Food covered at time of visit (reference)	190	33.3 (3)	(ref.)			
Food not covered	90	66.7 (6)	4.22	1.08	16.50	0.038
Food storage practices at follow up*						
Food covered at time of visit (reference)	205	100 (12)	(ref.)			
Food not covered	52	0 (0)	-	-	-	-
Receipt of a hygiene kit during surveillance period						
No (reference)	99	4.6 (7)	(ref.)			
Yes	345	3.1 (9)	0.63	0.22	1.77	0.383
Receipt of a hygiene kit and intervention compliance during surveillance period	444	3.6 (16)	0.83	0.55	1.25	0.364
Did not receive the hygiene kit (reference)	99	31.2 (5)	(ref.)			
Received a hygiene kit with low use	54	12.5 (2)	0.73	0.15	3.65	0.705
Received a hygiene kit with mid-use	149	31.3 (5)	0.66	0.20	2.23	0.509
Received a hygiene kit with high use	142	25.0 (4)	0.56	0.15	2.02	0.375

* Not available for all 444 household contacts

Table S4. Multivariate analysis for self-reported diarrhoea during the surveillance period

	Contacts (n)	Self-reported diarrhoea (%/n)	Univariate (Risk Ratio (RR))	Multivariate (adjusted Risk Ratio (aRR))	Lower 95% CI	Upper 95% CI	p-value
Age of household contact							
0-5 years	77	25 (4)	1.10	1.46	0.40	5.32	0.562
5-15 years	176	18.8 (3)	0.36	0.47	0.11	1.91	0.290
>15 years (reference)	191	56.2 (9)	(ref.)	(ref.)			
Types of contact with suspected cholera patient							
Shared food and water	361	68.7 (11)	0.52	0.56	0.17	1.85	0.338
Shared food, water and caring responsibilities (reference)	83	31.3 (5)	(ref.)	(ref.)			
Receipt of a hygiene kit and intervention compliance during surveillance period							
Did not receive the hygiene kit (reference)	99	31.2 (5)	(ref.)	(ref.)			
Received a hygiene kit with low use	54	12.5 (2)	0.73	0.80	0.16	4.00	0.786
Received a hygiene kit with mid-use	149	31.3 (5)	0.66	0.65	0.18	2.21	0.487
Received a hygiene kit with high use	142	25.0 (4)	0.56	0.55	0.15	2.00	0.366

Table S5. Univariate analysis for the change in *Enterococcus* spp. coliform density counts in drinking water samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Socioeconomic status						
Lowest	69	73.4	81.8	-27.6	191.3	0.143
Highest (reference)	25	26.6	(ref.)			
Water source coverage and access						
Improved: basic (improved, <30minutes) & limited (improved, >30minutes) (reference)	13	13.8	(ref.)			
Unimproved: Unimproved & surface water (rivers, unprotected springs)	81	86.2	43.2	-97.6	184.0	0.547
Source water with a median chlorine concentration <1.0mg/L FRC	94	100	-	-	-	-
Source water with >10 *Enterococcus* spp (CFU/100ml)	40	42.6	68.9	-29.2	167.0	0.168
Sanitation coverage						
Limited (improved, shared >2 households) (reference)	11	11.7	(ref.)			
Unimproved	79	84.0	28.2	-123.9	180.3	0.717
Open defecation	4	4.3	56.7	-222.4	335.8	0.691
Water storage and treatment practices						
Any safe water storage available at enrolment						
No (reference)	19	20.2	(ref.)			
Yes	75	79.8	-19.4	-140.7	101.9	0.754
Water present in any safe water storage during surveillance period						
No (reference)	86	91.5	(ref.)			
Yes	8	8.5	-129.1	-301.7	43.5	0.143

Table S5 continued. Univariate analysis for the change in *Enterococcus* spp. coliform density counts in drinking water samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Water practices at enrolment						
Decant or drink water from storage container with glass or cup (reference)	90	95.7	(ref.)			
Pour from the container	4	4.3	30.9	-212.9	274.7	0.804
Soap and handwashing facility availability						
Any soap available at enrolment						
No (reference)	17	18.1	(ref.)			
Yes	77	81.9	-104.9	-230.8	21.0	0.102
Soap observed within 1m of kitchen at enrolment						
No (reference)	86	91.5	(ref.)			
Yes	8	8.5	-147.0	-319.3	25.3	0.094
Soap observed within 2m of latrine at enrolment						
No (reference)	90	95.7	(ref.)			
Yes	4	4.3	-141.2	-380.2	97.7	0.247
Handwashing facility at enrolment						
Basic facility (facility, water and soap)	19	20.2	-178.1	-306.4	-49.8	0.007
Limited facility (facility and water)	34	36.2	-16.8	-124.9	91.3	0.761
No handwashing facility (reference)	41	43.6	(ref.)			
Food storage practices at enrolment*						
Food covered at time of visit (reference)	36	66.7	(ref.)			
Food not covered	18	33.3	31.5	-89.0	152.1	0.608

Table S5 continued. Univariate analysis for the change in *Enterococcus* spp. coliform density counts in drinking water samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Food storage practices at follow up*						
Food covered at time of visit (reference)	42	79.3	(ref.)			
Food not covered	11	20.7	-74.9	-222.3	72.4	0.319
Receipt of a hygiene kit during surveillance period						
No (reference)	18	19.2	(ref.)			
Yes	76	80.8	-201.6	-323.5	-79.7	0.001
Receipt of a hygiene kit and intervention compliance during surveillance period						
Did not receive the hygiene kit (reference)	18	19.2	(ref.)			
Received a hygiene kit with low use	10	10.6	-219.1	-399.0	-39.2	0.017
Received a hygiene kit with mid-use	33	35.1	-149.7	-284.7	-14.7	0.030
Received a hygiene kit with high use	33	35.1	-245.6	-380.1	-111.2	0.000

* Not available for all 94 households

Table S6. Multivariate analysis for change in *Enterococcus* spp. coliform density counts in drinking water samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Socioeconomic status						
Lowest	25	26.6	93.0	-13.1	199.1	0.086
Highest (reference)	69	73.4	(ref.)			
Handwashing facility at enrolment						
Basic facility (facility, water and soap)	19	20.2	-79.2			
Limited facility (facility and water)	34	36.2	68.9	-52.4	190.1	0.266
No handwashing facility (reference)	41	43.6	(ref.)	-217.6	59.2	0.262
Receipt of a hygiene kit during surveillance period						
No (reference)	18	19.2	(ref.)			
Yes	76	80.8	-224.1	-365.9	-82.3	0.002

* Not available for all 94 households

Table S7. Univariate analysis for the change in *Enterococcus* spp. coliform density counts in food samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Socioeconomic status						
Lowest	69	73.4	186.5	-103.9	477.0	0.208
Highest (reference)	25	26.6	(ref.)			
Water source coverage and access						
Improved: basic (improved, <30minutes) & limited (improved, >30minutes) (reference)	13	13.8	(ref.)			
Unimproved: unimproved & surface water (rivers, unprotected springs)	81	86.2	-8.05	-353.2	337.1	0.964
Source water with a median chlorine concentration <1.0mg/L FRC	94	100	-	-	-	-
Source water with >10 *Enterococcus* spp (CFU/100ml)	40	42.6	-60.1	-310.9	190.6	0.638
Sanitation coverage						
Limited (improved, shared >2 households) (reference)	11	11.7	(ref.)			
Unimproved	79	84.0	170.6	-189.9	531.2	0.354
Open defecation	4	4.3	-264.5	-882.0	352.9	0.401
Water storage and treatment practices						
Any safe water storage available at enrolment						
No (reference)	19	20.2	(ref.)			
Yes	75	79.8	-358.1	-677.8	-38.3	0.028
Water present in any safe water storage during surveillance period						
No (reference)	86	91.5	(ref.)			
Yes	8	8.5	399.9	-75.2	875.0	0.099

Table S7 continued. Univariate analysis for the change in *Enterococcus* spp. coliform density counts in food samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Water practices at enrolment						
Decant or drink water from storage container with glass or cup (reference)	90	95.7	(ref.)			
Pour from the container	4	4.3	259.4	-402.0	920.8	0.442
Soap and handwashing facility availability						
Any soap available at enrolment						
No (reference)	17	18.1	(ref.)			
Yes	77	81.9	-175.6	-501.3	150.1	0.291
Soap observed within 1m of kitchen at enrolment						
No (reference)	86	91.5	(ref.)			
Yes	8	8.5	-162.6	-598.4	273.3	0.465
Soap observed within 2m of latrine at enrolment						
No (reference)	90	95.7	(ref.)			
Yes	4	4.3	418.4	-157.7	994.5	0.155
Handwashing facility at enrolment						
Basic facility (facility, water and soap)	19	20.2	-30.7	-353.5	292.2	0.852
Limited facility (facility and water)	34	36.2	-166.1	-452.0	119.8	0.255
No handwashing facility (reference)	41	43.6	(ref.)			
Food storage practices at enrolment*						
Food covered at time of visit (reference)	36	66.7	(ref.)			
Food not covered	18	33.3	209.9	-165.3	585.2	0.273

Table S7 continued. Univariate analysis for the change in *Enterococcus* spp. coliform density counts in food samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Food storage practices at follow up*						
Food covered at time of visit (reference)	42	79.3	(ref.)			
Food not covered	11	20.7	-172.3	-574.2	229.6	0.401
Receipt of a hygiene kit during surveillance period						
No (reference)	18	19.2	(ref.)			
Yes	76	80.8	-79.4	-381.5	222.7	0.607
Receipt of a hygiene kit and intervention compliance during surveillance period						
Did not receive the hygiene kit (reference)	18	19.2	(ref.)			
Received a hygiene kit with low use	10	10.6	-80.9	-553.6	391.8	0.737
Received a hygiene kit with mid-use	33	35.1	-155.6	-489.8	178.7	0.362
Received a hygiene kit with high use	33	35.1	13.2	-336.2	362.7	0.941

* Not available for all 94 households

Table S8. Multivariate analysis for change in *Enterococcus* spp. coliform density counts in food samples during the surveillance period

	n	%	Effect estimate	Lower 95% CI	Upper 95% CI	p-value
Socioeconomic status						
Lowest	25	26.6	205.2	-88.8	499.2	0.171
Highest (reference)	69	73.4	(ref.)			
Receipt of a hygiene kit during surveillance period						
No (reference)	18	19.2	(ref.)			
Yes	76	80.8	-114.44	-417.4	188.5	0.459

J. STROBE Statement for Cohort Studies

STROBE Statement—Checklist of items that should be included in reports of cohort studies			
	Item No	**Recommendation**	**Page No**
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-7
		(b) For matched studies, give matching criteria and number of exposed and unexposed	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-9

Bias	9	Describe any efforts to address potential sources of bias	23-25
Study size	10	Explain how the study size was arrived at	9-10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10-11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10-11
		(b) Describe any methods used to examine subgroups and interactions	10-11
		(c) Explain how missing data were addressed	n/a
		(d) If applicable, explain how loss to follow-up was addressed	10-11
		(e) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12-16
		(b) Give reasons for non-participation at each stage	14
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders	12-16
		(b) Indicate number of participants with missing data for each variable of interest	n/a
		(c) Summarise follow-up time (e.g., average and total amount)	12-16
Outcome data	15*	Report numbers of outcome events or summary measures over time	12-16
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	17-20
		(b) Report category boundaries when continuous variables were categorized	17-20

		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	21-23
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	23-25
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	25
Generalisability	21	Discuss the generalisability (external validity) of the study results	21-23
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	26

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Appendix C. Supplementary Materials for Research Paper 3

K. Data collection tools: Qualitative topic guide for households (English)

Purpose of interview

This survey is only for Day 7 at the last follow up visit. The interview is designed to understand how you and your household used the hygiene kits. We wish to evaluate the different components, your preferences and how you interacted with the kit to aid future designs of the programme.

Requirements

This interview will not take longer than 30 minutes of your time and we are free to stop at any point. All data will be kept anonymous. I will ask you to read and sign the informed consent sheets before we begin the interview.

Interview questions

A	Date	
B	Time	
C	Location	
D	Enumerator Name	
E	Household ID number	
F	Gender of Interviewee	
G	Age of interviewee	

	Dose received		
1	Did you receive a hygiene kit at the Cholera Treatment Centre?		
	No	0	
	Yes	1	
2	Do you have the hygiene kit here in the house?		
	No	0	
	Yes	1	
3	Do you remember the day you received the hygiene kit?	Date or specific estimated time below:	
	3 weeks ago,	1	
	2 weeks ago,	2	
	1 week ago,	3	
	Less than 1 week ago	4	
	Did not receive	5	
	Don’t know	9	
4	Can you show me the items from the hygiene kit?		
	Container (20l)	1	
	Container (15l)	2	
	Container (10l)	3	
	Bar soap	4	
	Laundry soap	5	
	Water treatment tablets/sachets	6	
	Bucket with tap	7	

	Bucket without tap	8	
	None available	9	
	Don’t know	99	
5	Did you bring the kit straight home after receiving it?		
	No	1	
	Yes	2	
	Cannot remember	3	
	Don’t know	9	
6	If no, when did you bring it home?		
	Next day	1	
	2 days later	2	
	3-5 days later	3	
	Other	4	
7	If other, when did you bring it home?		
	Delivery format		
8	Did anyone attend the demonstration of the hygiene kit? (Select one)		
	No	0	
	Yes	1	
9	If yes, who attended the demonstration?		
	Interviewee attended demonstration	1	
	The other head of the household attended	2	
	Another adult household member attended	3	

	Only the patient attended the CTC	4	
	Don’t know	9	
	Other	88	
10	If other, who attended the demonstration?		
	We will now use the paper survey to ask you questions and the tablet will record the answers. Whilst one of us is asking the questions, the other will still record some of your responses on the paper survey. We will now switch on the recording on the phone. Please give us 1 minute to get everything ready. Thank you.		
11	Did you understand the demonstration and was each component of the kit explained to you? If no, what was unclear?		
12	Do you remember the date you received the hygiene kit?		
13	Did you bring the hygiene kit straight home after receiving it? Or did you go somewhere first? Did you share or sell any items?		
	Intervention reach		
14	What items were in the hygiene kit that you received?		
15	Did you use the hygiene kit? If so, which parts did you use?		

16	Why did you use ……. component of the hygiene kit?
17	How often did you use ……...? And why did you use it?
18	Was everyone in the household able to use the hygiene kit components? If not, why?
19	Which components of the hygiene kit were used least frequently? And, why?
	Exposure
20	Which components of the kit did you use?
21	Which components of the kit did you prefer most? And, why?
22	Have you received a hygiene kit before? If so, can you remember when?

	Barriers
23	Were there any particular components that you didn't use? And, why?
24	Is there anything else that you would prefer to have in the kit?
25	What other issues/barriers did you have in using the hygiene kit? Did you have any concerns with particular kit components?
	Maintenance
26	Are you still using the kit or some components of the kit? And, why?
27	Will you continue to use any components of the hygiene kit? And, why?
28	If needed, would you replace any components of the kit? If yes, are there any barriers to replacing components of the kit?
	Unexpected outcomes
29	Did anything else happen after you used the hygiene kit? Anything unexpected?

30	Did you receive anything else from MSF or another organisation during this outbreak? E.g., health promotion or other materials
	Overall
31	Overall, how was your experience using the hygiene kit?
32	**End Time of the Interview**

G. Data collection tools: Qualitative topic guide for MSF staff (English)

Purpose of interview

The interview is designed to understand the DRC context before and during the cholera outbreak, the implementation of the cholera response and the challenges with implementation of programmes.

Requirements

This interview will not take longer than 30 minutes of your time and we are free to stop at any point. All data will be kept anonymous. I will ask you to read and sign the informed consent sheets before we begin the interview.

Interview questions

A	Date	
B	Start Time of the Interview	
C	Location	
D	Enumerator Name	
E	Gender of Interviewee	
F	Education level of interviewee	
G	Job title of interviewee	
H	How long have you worked with MSF?	
I	How long have you been involved in this specific project?	
J	Have you implemented response activities to cholera outbreaks in the past? If so, where?	

K	How many people are employed by MSF for the household hygiene kit distribution?		
L	Of these, how many are local or international staff?	Local	
		International	
	Introduction		
M	Can you describe your role within MSF?		
	Intervention description		
1	What are the components of the hygiene kit?		
2	Where were the components of the hygiene kit purchased?		
3	How did you select items for the kit?		
4	Are the kit items locally available? Have you experienced any difficulties finding selected kit items? If so, which ones?		

5	Is it possible for people to purchase new items locally to replace parts of the kit? And can you tell me which items are not available locally?
6	In your opinion, what do beneficiaries like and/or dislike about the hygiene kits?
7	Would you change any of the kit components? If so, which ones?
	Delivery format
8	Where were the hygiene kits distributed? And to who?
9	How was the kit demonstrated and explained to users?
10	And what questions were asked in the kit demonstration sessions?
11	How do you identify people who should be given the hygiene kits? Did everyone who was intended to receive the kit receive the kit? Were there any reasons why some people did not receive the kit?

12	When is the hygiene kit given to people? On admission? During their stay? During discharge?
13	Were there any challenges in demonstrating the kit to households?
14	Would you say, in your opinion, that the hygiene kit is an effective intervention?
	Implementation fidelity
15	How many kits were planned to be delivered?
16	When did you start distribution of the hygiene kit?
17	How many were actually delivered?
18	From the perspective of your organisation, what are the challenges in the distribution of the hygiene kits? Were there any challenges in the quality of the products (local to international products)? Or did some kit components run out?

	Resources
19	What resources were used to deliver the kits? Material? Financial? Human resources? Did people require more components of the kit than they received?
20	How were people trained to deliver the kits in MSF? And how long does it take?
21	Are there any documents or guidelines for training HP staff to distribute the kits? And where do the messages come from?
	Recruitment
22	How were people attracted or told to come to the Cholera Treatment Centre (CTC)?
23	How were people attracted to the demonstration of the hygiene kits? And how many people attended the HP sessions?
24	Why were the CTC chosen as the delivery point for the hygiene kits?
25	And why this CTC, in particular?

	Context
26	Why does MSF support this CTC?
27	How is this outbreak similar or different from other outbreaks that you have responded to?
28	How does that impact your activities, and the distribution of the hygiene kit in particular?
	Contamination
29	What are the activities were implemented by MSF during the cholera outbreak? Medical? WatSan? HP?
30	What other agencies were involved in the cholera outbreak?
31	Do you wish you make any other comments about MSF activities during the cholera response?
32	**End time of the interview**

H. Data collection tools: Qualitative topic guide for other implementers (English)

Purpose of interview

The interview is designed to understand the DRC context before and during the cholera outbreak, the implementation of the cholera response and the challenges with implementation of programmes.

Requirements

This interview will not take longer than 30 minutes of your time and we are free to stop at any point. All data will be kept anonymous. I will ask you to read and sign the informed consent sheets before we begin the interview.

Interview questions

A	Date	
B	Time	
C	Name of organisation and role within organisation	
D	Location	
E	Enumerator Name	
F	Gender of Interviewee	
G	Education level of interviewee	
H	Job title of interviewee	
J	Organisation	
K	Can you describe your role within your organisation?	
L	How long have you worked with your organisation?	

M	How long have you been involved in this specific project?		
N	Have you implemented response activities to cholera outbreaks in the past? If so, where?		
O	How many people are employed by your organisation for the household hygiene kit distribution?		
P	Of these, how many are local or international staff?	Local	
		International	
	Context		
5	Can you tell me about the cholera outbreak and how your organisation acted?		
6	What other organisations were active in this outbreak?		
7	How is this outbreak similar or different from other outbreaks that you have responded to?		
8	How does that impact your activities, and the distribution of the hygiene kit in particular?		
9	What was going on in DRC and the area at the time of the outbreak?		

	Intervention description
10	What activities did your organisation carry out? Could you list and describe them.
11	How does your organisation select the activities to carry out?
12	In your opinion, are there any issues with your organisation's current choice of interventions?
13	How does that impact your activities, and the distribution of the hygiene kit in particular?
	Delivery format
14	Where and when did you deliver your activities?
15	Were there any challenges, barriers or issues with delivering your activities?
	Recruitment
16	How did the community hear about your activities and access them?

17	How many people did you serve i.e., how many people received interventions, treatment or other activities?	
18	Why did your organisation choose to act here?	
	Resources	
19	What resources did you need to implement those activities? Material? Financial? Human resources?	
20	Are there any other comments you wish to make about programmes and activities delivered during the cholera outbreak?	
21	**End time of the interview**	

I. Data collection tools: Structured observation of hygiene kit demonstrations (English)

B7 Structured Observation Data Collection Form					
Date		**Start Time:**		**End Time:**	
Enumerator Name:		**Name of CTC/CTU:**			
Activity	**Time of Activity (hh:mm)**	**Write down the details of each activity, what happens, any questions (how, who, what, when and why)**			
Greeting the family members of cases and introducing themselves and MSF					
Explaining cholera transmission and risk factors					
Demonstrating each component of the kit and explaining how and when to use it					

Distribution of the hygiene kits		
Additional demonstration		
Other activities or questions		
Comments?		
N.B., if possible, include all times that activities were conducted as this helps us to understand the timeline of events. If you need more space, use another blank form and complete it alongside this sheet.		

M. COREQ Checklist for Qualitative Studies

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist			
Topic	**Item No.**	**Guide Questions/Description**	**Reported on Page No.**
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	8-9
Credentials	2	What were the researcher's credentials? E.g., PhD, MD	8-9
Occupation	3	What was their occupation at the time of the study?	8-9
Gender	4	Was the researcher male or female?	8-9
Experience and training	5	What experience or training did the researcher have?	8-9
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	9
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g., personal goals, reasons for doing the research	9
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g., Bias, assumptions, reasons and interests in the research topic	21-22
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis	7-8
Participant selection			

Sampling	10	How were participants selected? e.g., purposive, convenience, consecutive, snowball	9 and 10
Method of approach	11	How were participants approached? e.g., face-to-face, telephone, mail, email	9 and 10
Sample size	12	How many participants were in the study?	11
Non-participation	13	How many people refused to participate or dropped out? Reasons?	11
Setting			
Setting of data collection	14	Where was the data collected? e.g., home, clinic, workplace	9 and 10
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	9 and 10
Description of sample	16	What are the important characteristics of the sample? e.g., demographic data, date	11
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot? tested?	8-10
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	N/A
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	10
Field notes	20	Were field notes made during and/or after the interview or focus group?	10
Duration	21	What was the duration of the inter views or focus group?	9-10
Data saturation	22	Was data saturation discussed?	9
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	N/A
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	22
Description of the coding tree	25	Did authors provide a description of the coding tree?	12, Table 1

Derivation of themes	26	Were themes identified in advance or derived from the data?	8-10,12,26-28
Software	27	What software, if applicable, was used to manage the data?	10-11
Participant checking	28	Did participants provide feedback on the findings?	Not reported
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g., participant number	 Table 3
Data and findings consistent	30	Was there consistency between the data presented and the findings?	12-16
Clarity of major themes	31	Were major themes clearly presented in the findings?	16-21
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	16-21
Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007. Volume 19, Number 6: pp. 349 – 357			

Appendix D. Supplementary materials for Research Paper 4

N. PRISMA-ScR checklist for Scoping Reviews

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist			
SECTION	**ITEM**	**PRISMA-ScR CHECKLIST ITEM**	**REPORTED ON PAGE #**
TITLE			
Title	1	Identify the report as a scoping review.	Title, page 1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Abstract, pages #1-2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Introduction, pages #3-4
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Introduction, pages #4
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Methods. The review has not been registered prior to publication, pages #4

Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Methods, pages #4-6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Methods, page #4-6; Results, page #8
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	N/A
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Methods, pages #4-6
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Methods, pages #4-7
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Methods, pages #4-7, Table 1
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Methods, pages #4-6, Table 1
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Methods, pages #4-7, Table 1, Figure 1
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Results, pages #8, Table 2

Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Results, pages #8, Table 2
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Not reported
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Results, pages #8-15, Table 2, Table 3, Table 4, Figure 1
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Results, pages #8-15, Table 2, Table 3, Table 4, Figure 1
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Discussion, page #16-18
Limitations	20	Discuss the limitations of the scoping review process.	Limitations, pages #19
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Conclusions, pages #19-20
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Funding

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where sources of evidence (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with information sources (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

Appendix E. Participant Information Sheets and Informed Consent Forms

O. Informed Consent Form: For Admitted Suspected Cholera Cases (French)

Organisations : Médecins Sans Frontières, London School of Hygiene and Tropical Medicine
Investigateur principal : Lauren D'Mello-Guyett & Maria Mashako
Numéro de téléphone : +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80
Titre de l'étude : Évaluation de l'effet de la distribution par MSF d'une trousse d'hygiène sur la transmission domestique du choléra au niveau des membres du foyer de patients infectés par le choléra

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Par qui est sponsorisée cette étude ?
Cette étude est menée par Médecins Sans Frontières en collaboration avec la London School of Hygiene & Tropical Medicine. Cette étude est financée par MSF, qui souhaite suivre et évaluer les projets visant à améliorer l'approvisionnement en eau, l'assainissement et l'hygiène pour contrôler le choléra dans le cadre des crises humanitaires. Cette étude a été approuvée par le Comité d'éthique du LSHTM, Médecins Sans Frontières et par l'École de santé publique de l'Université de Kinshasa.

Informations générales sur les études de recherche
Si vous signez ce document en qualité de parent ou de tuteur d'un enfant âgé de 2 à 18 ans recruté pour participer à cette étude, le **« vous »** fait référence au participant à l'étude au nom duquel vous signez le présent document.

On vous a demandé de participer à une étude de recherche. La participation à cette étude est volontaire. Vous pouvez refuser de participer à cette étude ou décider de retirer votre consentement à participer à cette étude à tout moment et pour n'importe quelle raison. Les études de recherche ont pour objectif d'acquérir de nouvelles connaissances susceptibles d'aider d'autres personnes à l'avenir. Il se peut que vous ne tiriez aucun bénéfice direct de votre participation à cette étude de recherche. La participation à des études de recherche peut aussi comporter des risques.

Si vous décidez de ne pas participer à l'étude ou de vous en retirer avant qu'elle ne soit terminée, cela n'aura aucune influence sur votre relation avec l'investigateur, avec MSF ou avec tout autre membre du personnel sanitaire ou médical. Si vous êtes malade, vous n'avez pas besoin de participer à l'étude de recherche pour recevoir des soins de santé.

Avant de vous décider à participer à l'étude, il est important que vous compreniez pourquoi cette recherche est effectuée et ce qu'implique pour vous de participer à cette étude. Il est important que vous compreniez ces informations afin de pouvoir faire un choix éclairé quant à votre participation à cette étude de recherche. N'hésitez pas à nous contacter si vous avez des questions et prenez le temps de bien réfléchir avant de décider de participer ou pas à cette étude. Nous sommes à votre disposition à tout moment pour répondre à toutes les questions que vous pourriez vous poser sur l'étude de recherche.

Quel est l'objectif de cette étude de recherche ?
Le choléra est une maladie diarrhéique grave qui sévit en République Démocratique du Congo. La prévention du choléra peut prendre différentes formes et nous procédons à une évaluation qui a pour

but de nous aider à déterminer quelles interventions sont les plus efficaces pour contribuer à prévenir la maladie.

Votre foyer a reçu une trousse d'hygiène au CTC. MSF a distribué un kit d'hygiène identique à tous les patients atteints de choléra admis au CTC et à leur foyer. Le contenu de la trousse a été expliqué par un membre de l'équipe de promotion de la santé de MSF au CTC. Ces explications vous ont été données à vous-même ou au membre de votre foyer qui vous accompagnait au moment où la trousse vous a été remise. Même si vous refusez de participer à cette étude de recherche, cette trousse ou le contenu de cette trousse ne vous seront pas repris. Pour votre information, la trousse contient un bidon de 20 litres, du savon pour couvrir les besoins de 5 personnes pendant 2 mois (250g de savon par personne par mois), un seau doté d'un robinet et des comprimés pour le traitement de l'eau. MSF remet la même trousse à tous les patients admis, ainsi qu'à leur famille.
Nous vous avons choisis, vous et votre famille, pour participer à notre étude visant à nous permettre de comprendre comment vous et votre famille utilisez la trousse d'hygiène pendant une épidémie de choléra à **[insérer la emplacement**] **……**. République Démocratique du Congo. Nous voulons aussi déterminer dans quelle mesure, si un membre de votre foyer est infecté par le choléra, l'utilisation de la trousse d'hygiène réduit le risque d'infection pour les autres membres du foyer.

Cette étude est menée par des chercheurs de la London School of Hygiene and Tropical Medicine (LSHTM) et mise en œuvre par Médecins Sans Frontières. Cette étude a été approuvée par le Comité d'éthique de la LSHTM, par le Comité d'éthique de Médecins Sans Frontières et par l'École de santé publique de l'Université de Kinshasa.

Avant de vous décider à participer à l'étude, il est important que vous compreniez pourquoi cette recherche est effectuée et ce qu'implique pour vous de participer à cette étude. N'hésitez pas à nous contacter si vous avez des questions et prenez le temps de bien réfléchir avant de décider de participer ou pas à cette étude.

Pourquoi avez-vous été sélectionné pour participer à cette étude ?
Lorsque vous avez été admis au CTC avec le choléra, nous vous avons sélectionné pour participer à cette étude, après concertation avec l'équipe sanitaire et médicale sur votre état de santé. Si vous ne vous sentez pas suffisamment bien pour continuer, vous ne devez en aucun cas hésiter à refuser de participer à cette étude. Toute participation à cette étude se fait sur une base volontaire.
Au cours des prochaines semaines, nous sélectionnerons un total de 250 patients admis au CTC, ainsi que leurs foyers.

Nous inviterons également tous les membres de votre foyer (personnes qui partagent le même repas familial et qui résident chez vous) à participer à l'étude. A la fin de ce formulaire, nous vous demanderons de nous donner l'autorisation de les contacter. Chacun d'entre eux devra lire et signer un formulaire de consentement pour participer à l'étude.

Nous inviterons également tous autres les membres des foyers (environ 1 500 personnes) des 250 autres patients admis à participer à cette étude. Tous ces foyers seront situés dans les zones qui entourent le CTC. Tous ces foyers ont reçu la même trousse d'hygiène de MSF.

Qu'attend-on de moi si je participe à cette étude ?
Nous vous invitons à participer à cette étude pendant 1 mois entre le **[insérer la date]……...** et le **[insérer la date]……..**

Comme vous êtes le patient qui a été admis au CTC, nous ne vous interrogerons qu'une seule fois dans le courant du mois à venir. Cela se fera aujourd'hui au CTC. Par contre, nous interrogerons les membres de votre foyer à trois reprises dans le courant du mois à venir (aujourd'hui, dans 7 jours et

dans 21 jours). Ces entretiens supplémentaires avec les membres de votre foyer nous serviront à évaluer l'utilisation de la trousse d'hygiène et l'apparition de tout symptôme du choléra parmi eux.
Vos réponses ne seront entendues que par les investigateurs et seront utilisées de façon confidentielle sans jamais faire référence à votre nom ou à votre famille. Vous serez interrogé dans un endroit privé et confortable de votre choix.

L'investigateur cochera l'option **d'application** à chaque participant :

☐ Entretien au CTC : Étant donné que vous êtes le patient qui a été admis au CTC, nous aimerions que vous participiez à un entretien. On vous demandera de répondre à mes questions, mais vous serez libre de refuser, à tout moment, de répondre à n'importe quelle question. Cet entretien prendra environ 10-15 minutes. Mes questions concerneront des informations socioéconomiques et votre mode de vie, p. ex. votre âge, votre genre et vos revenus. Nous vous poserons des questions sur vos antécédents médicaux et sur certaines de vos pratiques en matière d'alimentation et d'eau au cours de la dernière semaine.

☐ Écouvillonnage rectal au CTC : Étant donné que vous êtes le patient qui a été admis au CTC, nous aimerions procéder / vous demander de procéder à un écouvillonnage rectal. Cet échantillon sera testé pour la bactérie *V. cholerae* à l'aide d'un test diagnostique rapide effectué directement dans notre laboratoire au CTC. A l'issue du test, tous les échantillons seront détruits. Si vous vous en sentez capable, vous pourrez procéder à l'écouvillonnage rectal vous-même et nous vous donnerons pour cela toutes les instructions nécessaires. Dans le cas contraire, nous vous aiderons à l'effectuer. Vous êtes libre de refuser à tout moment de procéder à l'écouvillonnage rectal. Cet entretien prendra environ 5-10 minutes.

Où cette étude sera-t-elle réalisée ?
Cette étude est menée à **[insérer la emplacement] ……**…… en République Démocratique du Congo.

Votre participation est VOLONTAIRE
Quand vous aurez bien compris toutes les informations que nous vous avons données et si vous acceptez de participer à l'étude, il vous sera demandé de bien vouloir signer le formulaire, soit en indiquant votre nom, soit en y plaçant l'empreinte de votre pouce. Avant que vous ne signiez le formulaire, le personnel chargé de l'étude vous aidera à le comprendre et répondra à toutes vos questions. Il est toutefois important, avant de signer, que vous compreniez bien ce qui suit :

Votre participation est volontaire ; vous ne devez pas participer à cette étude contre votre gré.

Vous êtes libre de **mettre fin à votre participation à tout moment (pendant ou après l'étude)** sans que cela n'ait aucune conséquence pour vous ou votre famille ; si vous décidez de vous retirer de l'étude, vous continuerez de bénéficier des soins que MSF vous dispense habituellement. Si vous décidez de vous retirer de l'étude au moment de l'entretien de suivi, vos données ne seront pas utilisées dans le cadre de l'étude. Tous vos échantillons seront détruits après analyse et, si vous sortez de l'étude, les résultats de vos analyses seront retirés de l'ensemble des données de l'étude. Les participants qui se retirent de l'étude ne participeront pas aux entretiens de suivi. Si le chef du foyer se retire de l'étude, il se peut que nous retirions aussi de l'étude tous les autres membres du foyer. Dans ce cas, nous ne poursuivrons avec eux ni les entretiens de suivi, ni la collecte des échantillons.

Quels sont les bénéfices potentiels liés à ma participation à cette étude ?
Nous ne pouvons pas vous assurer que vous tirerez un bénéfice direct de votre participation à cette étude.
La recherche a pour but de bénéficier à la société dans son ensemble, grâce à l'acquisition de nouvelles connaissances, qui serviront de base à l'élaboration des futurs programmes de santé. Les résultats de

cette étude nous aideront à concevoir des programmes plus efficaces relatifs à l'eau, à l'assainissement et à l'hygiène et à proposer de meilleurs soins aux communautés exposées au risque d'épidémies de choléra. Les informations recueillies dans le cadre de cette étude pourront également nous permettre de réduire les diarrhées en renforçant les interventions de MSF dans les domaines de l'eau, de l'assainissement et de l'hygiène et pourraient appuyer de nouvelles stratégies de lutte contre le choléra en RDC.

Que se passera-t-il si je développe des symptômes de choléra et/ou si je tombe malade pendant l'étude ?

Si votre état de santé se dégrade à nouveau au cours du mois à venir, y compris si vous présentez de nouveaux symptômes du choléra, nous vous demanderons de bien vouloir vous présenter au CTC pour une consultation et la mise en place d'un traitement.

Pour votre information, les symptômes du choléra peuvent inclure des vomissements, des douleurs à l'estomac et une diarrhée (3 selles molles ou plus sur une période de 24 heures) qui peut avoir une couleur et une consistance ressemblant à celles de l'eau de riz. Si, à un moment ou un autre de l'étude ou après l'étude, vous développez des symptômes de choléra, de diarrhée, de vomissements ou si vous vous sentez mal, veuillez demander une consultation et/ou un traitement au CTC. Ces symptômes peuvent survenir à n'importe quel moment pendant l'étude ou après celle-ci.

MSF s'engage à dispenser des soins de santé gratuits à la population et nous vous conseillons de vous rendre au centre de santé soutenu par notre organisation (centre de traitement du choléra, unité de traitement du choléra) pour y être vu par un membre de notre personnel sanitaire et médical. Vous pourrez y bénéficier d'un traitement gratuit.

Si d'autres membres de votre famille, vos amis ou vos voisins présentent également des symptômes du choléra, nous vous recommandons également de consulter MSF et/ou d'autres prestataires de soins de santé.

Quels sont les risques potentiels liés à ma participation à cette étude ?

Les investigateurs sont tenus d'expliquer aux participants à l'étude tous les risques liés à leur participation. Cette étude peut présenter certains risques pour les participants potentiels ou leur famille. Les interactions avec le personnel chargé de l'étude et avec d'autres personnes étrangères peuvent, p. ex. poser un problème au niveau psychologique/émotionnel. Pour cette raison, l'équipe a été formée à respecter les émotions et les sentiments des participants et à leur faire comprendre que l'objectif de l'étude est de comprendre et documenter ces émotions et non de porter un jugement sur les participants ou leur famille.

En ce qui concerne l'écouvillonnage rectal, il peut provoquer un certain inconfort et un certain embarras au moment de sa réalisation. Nous sommes une équipe de personnel infirmier expérimenté et, en tant que tels, nous sommes habitués à prélever des échantillons cliniques. Nous nous efforçons à vous causer le moins d'inconfort possible. En principe, le prélèvement de l'échantillon n'est pas douloureux. Qui plus est, pour préserver votre dignité, un écran sera placé autour du lit pendant le prélèvement. Les autres patients et/ou les personnes de votre foyer qui vous accompagnent ne pourront pas vous voir au moment du prélèvement de l'échantillon. Si quelque chose vous préoccupe ou si vous souhaitez refuser de poursuivre votre participation à l'étude, vous êtes libre de nous poser toutes vos questions et de refuser le prélèvement d'échantillons.

Il se peut également qu'on vous reproche d'être à l'origine du choléra dans votre foyer. La contagion du choléra n'est la faute de personne. L'exposition au choléra est due au contact avec un environnement contaminé et n'est nullement le résultat des activités d'une personne en particulier. Cela vous sera expliqué clairement, ainsi qu'à vos proches, et nous organiserons également des réunions

communautaires destinées à lutter contre toute stigmatisation. Si vous êtes inquiet à ce sujet ou si vous avez des questions, n'hésitez pas à nous contacter pour nous faire part de vos préoccupations. Nous serons alors heureux de répondre à toutes les questions que vous pourriez vous poser.

Le fait de participer à cette étude peut aussi vous exposer à des risques sociaux. Les membres de l'équipe chargés de collecter les données vous rendront visite à trois reprises. Cela risque d'attirer l'attention de vos voisins ou de la communauté sur votre foyer. Avant de lancer l'étude, nous organiserons des réunions communautaires pour expliquer en quoi consiste notre étude, ainsi que la manière dont elle est appelée à se dérouler. Ces réunions se dérouleront dans votre village avant la collecte des données et rassembleront les chefs du village et la communauté. Si vous avez la moindre question ou si quelque chose vous préoccupe, vous pouvez nous contacter à tout moment.

En cas d'arrêt prématuré de l'étude ou à l'issue de celle-ci, les membres de l'équipe chargée de la collecte des données informeront les participants par téléphone. S'ils ne disposent pas des numéros de téléphone de tous les participants, des visites à domicile et des réunions communautaires seront organisées pour informer tout le monde de l'arrêt de l'étude. Si l'étude est arrêtée prématurément, les recenseurs engagés sur place et avec qui nous travaillons en parallèle avec les autorités locales, nous aideront à en informer la population de l'étude. Nous organiserons des réunions communautaires dans les villages de l'étude et nous serons disponibles pour répondre aux questions de la population lorsque ce sera possible. Les participants seront informés de la raison pour laquelle l'étude a été arrêtée, de la possibilité de retirer leurs données de l'étude, ainsi que des étapes suivantes de l'étude concernant les données collectées qui n'ont pas été retirées.

Mes informations seront-elles traitées de manière confidentielle ?

Cette étude accorde une très grande importance à la confidentialité des données. Les données à caractère personnel relatives aux participants seront conservées dans une base de données distincte protégée par un mot de passe, accessible à un nombre limité de membres du personnel autorisés. Le personnel autorisé comprendra le personnel du ministère de la Santé (PNECHOL-M), l'Université de Kinshasa, Médecins Sans Frontières et la London School of Hygiene and Tropical Medicine.

À tous les stades, des efforts seront consentis pour protéger la confidentialité des données des participants : les participants ne seront pas identifiés par des moyens permettant de les reconnaître, y compris leur nom. Des numéros d'ID uniques, attribués à vous et aux membres de votre foyer, seront utilisés pour identifier vos données.

Toutes les données de l'étude seront collectées sur des appareils protégés par un mot de passe. Ces fichiers seront stockés dans des bases de données protégées par un mot de passe chez MSF et LSHTM. Au moment de l'analyse des données et avant de partager les données avec nos partenaires de recherche, nous supprimerons tous les éléments d'identification directe ou indirecte.
À la fin du projet, les données seront déposées dans un référentiel ou dans les archives de la LSHTM ou de MSF. Les données resteront disponibles pendant une durée minimum de cinq ans. Toutes les données resteront privées, protégées et confidentielles.

Une convention d'accès sera élaborée pour toute personne souhaitant examiner les données ou y avoir accès. Vos données pourront être examinées par les autorités suivantes, chargées de contrôler que vos droits en tant que participant à une étude sont respectés :

- École de Santé Publique, Université de Kinshasa
- Médecins Sans Frontières, OCB, République Démocratique du Congo
- Comité d'éthique de la London School of Hygiene & Tropical Medicine, R-U

Vais-je être rémunéré pour ma participation à l'étude ?

Non, la participation à cette étude n'est liée à aucune compensation directe.

Dois-je payer pour participer à l'étude ?
Non, la participation à cette étude n'est liée à aucun coût pour les participants.

A qui puis-je poser mes questions sur l'étude ?
Vous avez le droit de poser toutes les questions que vous vous voulez à propos de l'étude, ainsi que le droit d'obtenir des réponses. Si vous avez la moindre question ou la moindre préoccupation concernant l'étude, n'hésitez pas à nous contacter et cela à n'importe quel moment. Si vous avez des questions, des plaintes ou des préoccupations à formuler, vous pouvez contacter :

- **Investigateur principal :** Lauren D'Mello-Guyett & Maria Mashako
- **Numéro de téléphone :** +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

A qui puis-je poser mes questions concernant mes droits en tant que participant à une étude ?
Toutes les recherches menées sur des volontaires humains sont revues par MSF, LSHTM et l'Ecole de Santé Publique de l'Université de Kinshasa. Trois comités qui œuvrent à la protection de vos droits et de votre bien-être. Si vous avez des questions ou des préoccupations concernant vos droits en tant que participant à une étude de recherche, vous pouvez contacter :

- Nom : Maria Mashako
- Adresse : Coordinatrice Médicale Adjointe, MSF-OCB
- Numéro de téléphone : +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

Si vous souhaitez contacter un collaborateur de l'Université de Kinshasa qui siège au comité d'éthique national :

- Nom : Jack Kiyembi
- Adresse : École de Santé Publique, Université de Kinshasa
- E-mail : kiyembi@gmail.com

Consentement de participation :
Je déclare avoir lu les informations reprises plus haut, ou que ces informations m'ont été lues, et les avoir comprises. Je déclare avoir posé toutes les questions qui me sont venues à l'esprit à ce moment. Je déclare vouloir volontairement participer à cette étude de recherche (cocher une seule case).

☐ **Oui** ☐ **Non**

Je déclare autoriser l'utilisation confidentielle des informations que j'ai fournies pendant mes entretiens pour communiquer les résultats de la présente étude de recherche et dans le cadre de l'analyse de la présente étude de recherche.

Les informations relatives à l'étude pourront potentiellement être vues par les investigateurs, les professionnels de la santé et les décideurs en République Démocratique du Congo et en dehors (cocher une seule case).

Numéro d'ID du ménage		**Date**
Numéro d'ID du participant		
Numéro de téléphone du participant		
Signature ou empreinte du pouce du participant à l'étude de recherche ou d'un parent/tuteur du participant qui signe pour le compte du participant		
Nom en lettres majuscules du participant à l'étude de recherche ou d'un parent/tuteur du participant qui signe pour le compte du participant		
Signature du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Nom en lettres majuscules du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Signature du témoin		
Nom en lettres majuscules du témoin*		

***Remarque : Le nom du témoin, la signature et la date ne doivent être repris dans le présent formulaire de consentement que si le volontaire qui consent à participer à l'étude ne sait pas lire (illettré)**

Le témoin doit être âgé de plus de 18 ans, être capable de comprendre le formulaire de consentement éclairé et avoir été choisi personnellement par le participant à l'étude.

1 copie du feuillet d'information pour le participant à l'étude et du consentement éclairé à la participation à l'étude

P. Informed Consent Form: For Household Contacts of Cases (French)

Organisations : Médecins Sans Frontières, London School of Hygiene and Tropical Medic**ine**
Investigateur principal : Lauren D'Mello-Guyett & Maria Mashako
Numéro de téléphone : +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80
Titre de l'étude : Évaluation de l'effet de la distribution par MSF d'une trousse d'hygiène sur la transmission domestique du choléra au niveau des membres du foyer de patients infectés par le choléra

Par qui est sponsorisée cette étude ?
Cette étude est menée par Médecins Sans Frontières en collaboration avec la London School of Hygiene & Tropical Medicine. Cette étude est financée par MSF, qui souhaite suivre et évaluer les projets visant à améliorer l'approvisionnement en eau, l'assainissement et l'hygiène pour contrôler le choléra dans le cadre des crises humanitaires. Cette étude a été approuvée par le Comité d'éthique du LSHTM, Médecins Sans Frontières et par l'École de santé publique de l'Université de Kinshasa.
Informations générales sur les études de recherche

Si vous signez ce document en qualité de parent ou de tuteur d'un enfant âgé de 2 à 18 ans recruté pour participer à cette étude, le « vous » fait référence au participant à l'étude au nom duquel vous signez le présent document.

On vous a demandé de participer à une étude de recherche. La participation à cette étude est volontaire. Vous pouvez refuser de participer à cette étude ou décider de retirer votre consentement à participer à cette étude à tout moment et pour n'importe quelle raison. Les études de recherche ont pour objectif d'acquérir de nouvelles connaissances susceptibles d'aider d'autres personnes à l'avenir. Il se peut que vous ne tiriez aucun bénéfice direct de votre participation à cette étude de recherche. La participation à des études de recherche peut aussi comporter des risques.

Si vous décidez de ne pas participer à l'étude ou de vous en retirer avant qu'elle ne soit terminée, cela n'aura aucune influence sur votre relation avec l'investigateur, avec MSF ou avec tout autre membre du personnel sanitaire ou médical. Si vous êtes malade, vous n'avez pas besoin de participer à l'étude de recherche pour recevoir des soins de santé.

Avant de vous décider à participer à l'étude, il est important que vous compreniez pourquoi cette recherche est effectuée et ce qu'implique pour vous de participer à cette étude. Il est important que vous compreniez ces informations afin de pouvoir faire un choix éclairé quant à votre participation à cette étude de recherche. N'hésitez pas à nous contacter si vous avez des questions et prenez le temps de bien réfléchir avant de décider de participer ou pas à cette étude. Nous sommes à votre disposition à tout moment pour répondre à toutes les questions que vous pourriez vous poser sur l'étude de recherche.

Quel est l'objectif de cette étude de recherche ?
Le choléra est une maladie diarrhéique grave qui sévit en République Démocratique du Congo. La prévention du choléra peut prendre différentes formes et nous procédons à une évaluation qui a pour but de nous aider à déterminer quelles interventions sont les plus efficaces pour contribuer à prévenir la maladie.

Votre foyer a reçu une trousse d'hygiène au CTC. MSF a distribué un kit d'hygiène identique à tous les patients atteints de choléra admis au CTC et à leur foyer. Le contenu de la trousse a été expliqué par un membre de l'équipe de promotion de la santé de MSF au CTC. Ces explications vous ont été données à vous-même ou à une autre personne de votre foyer au moment où la trousse vous a été remise. Même si vous refusez de participer à cette étude de recherche, cette trousse ou le contenu de

cette trousse ne vous seront pas repris. Pour votre information, la trousse contient un bidon de 20 litres, du savon pour couvrir les besoins de 5 personnes pendant 2 mois (250g de savon par personne par mois), un seau doté d'un robinet et des comprimés pour le traitement de l'eau. MSF remet la même trousse à tous les patients admis, ainsi qu'à leur famille.

Nous avons choisi votre foyer pour comprendre comment vous et votre famille utilisez la trousse d'hygiène pendant une épidémie de choléra à [insérer la emplacement] ……. République Démocratique du Congo. Nous voulons aussi évaluer si quelqu'un dans votre foyer est actuellement infecté par le choléra et comment l'utilisation de la trousse d'hygiène réduit le risque d'infection parmi les membres du foyer.

Cette étude est menée par des chercheurs de la London School of Hygiene and Tropical Medicine (LSHTM) et mise en œuvre par Médecins Sans Frontières. Cette étude a été approuvée par le Comité d'éthique de la LSHTM, par le Comité d'éthique de Médecins Sans Frontières et par l'École de santé publique de l'Université de Kinshasa.

Avant de vous décider à participer à l'étude, il est important que vous compreniez pourquoi cette recherche est effectuée et ce qu'implique pour vous de participer à cette étude. N'hésitez pas à nous contacter si vous avez des questions et prenez le temps de bien réfléchir avant de décider de participer ou pas à cette étude.

Pourquoi avez-vous été sélectionné pour participer à cette étude ?

Quand le membre de votre foyer a été admis au CTC avec le choléra, nous lui avons demandé de participer à notre étude et il a eu un bref entretien avec nos investigateurs. Nous lui avons aussi demandé l'autorisation de vous contacter ; Il a signé un formulaire similaire à celui-ci qui nous autorise à le faire. Bien que le membre de votre foyer ait accepté de participer à notre étude, vous, vous n'êtes pas obligé d'y participer. Vous pouvez donc refuser d'y participer à tout moment.

Au total, nous inviterons 250 foyers et environ 1 500 personnes à participer à notre étude. Tous ces foyers seront situés dans les zones qui entourent le CTC. Tous ces foyers ont reçu la même trousse d'hygiène de MSF.

Nous inviterons également tous les membres de votre foyer (personnes qui partagent le même repas familial et qui résident chez vous) à participer à l'étude. Chacun de vous devra lire et signer un formulaire de consentement.

Qu'attend-on de moi si je participe à cette étude ?

Nous vous invitons à participer à cette étude pendant 1 mois entre le [insérer la date]……... et le [insérer la date]……..

Au cours du mois à venir, nous vous interrogerons à trois reprises. Ces entretiens auront lieu aujourd'hui, dans 7 jours et dans 21 jours.

Vos réponses ne seront entendues que par les investigateurs et seront utilisées de façon confidentielle sans jamais faire référence à votre nom ou à votre famille. Vous serez interrogé dans un endroit privé et confortable de votre choix.

L'investigateur cochera l'option d'application à chaque participant :

☐ Entretien au CTC : Étant donné que vous êtes le membre du foyer qui accompagnait le patient admis au CTC, nous aimerions que vous participiez à un entretien. On vous demandera de répondre à mes questions, mais vous serez libre de refuser, à tout moment, de répondre à n'importe quelle question. Cet entretien prendra environ 10-15 minutes. Mes questions

concerneront des informations socioéconomiques et votre mode de vie, p. ex. votre âge, votre genre et vos revenus. Dans le cadre de cet entretien, nous vous poserons des questions sur vos antécédents médicaux, nous vous demanderons si vous avez déjà eu le choléra et nous vous poserons aussi quelques questions sur vos habitudes en matière d'hygiène. Nous répéterons cet entretien avec vous dans 7 jours et dans 21 jours, mais, cette fois, chez vous.

☐ Entretien individuel chez vous : Le membre de votre foyer qui a été admis au CTC avec le choléra ou le membre de votre foyer qui l'accompagnait nous a autorisés à vous contacter parce que vous faites aussi partie du même foyer. Nous aimerions que vous participiez à un entretien. On vous demandera de répondre à mes questions, mais vous serez libre de refuser, à tout moment, de répondre à n'importe quelle question. Cet entretien prendra environ 10-15 minutes. Mes questions concerneront des informations socioéconomiques et votre mode de vie, p. ex. votre âge, votre genre et vos revenus. Dans le cadre de cet entretien, nous vous poserons des questions sur vos antécédents médicaux, nous vous demanderons si vous avez déjà eu le choléra et nous vous poserons aussi quelques questions sur vos habitudes en matière d'hygiène. Nous répéterons cet entretien avec vous dans 7 jours et dans 21 jours.

☐ Entretien chez vous concernant votre foyer : Après votre entretien individuel et étant donné que vous êtes le chef du foyer, nous aimerions vous poser quelques questions supplémentaires sur les activités domestiques dans votre foyer et notamment sur vos habitudes en matière d'eau, d'assainissement et d'hygiène, ainsi que sur certaines activités et certains dispositifs de promotion de la santé que vous auriez vus. J'aimerais prélever des échantillons de l'eau à l'endroit où vous vous approvisionnez, ainsi que de l'eau et de la nourriture que vous conservez chez vous. Ces échantillons seront prélevés en vue de réaliser des tests sur la présence de la bactérie *Vibrio cholerae*. Les échantillons seront testés en toute confidentialité pour déterminer la présence de la bactérie dans l'environnement. Les échantillons ne seront pas liés à votre nom ou à d'autres informations qui seraient susceptibles de permettre votre identification. Les échantillons seront traités et analysés au laboratoire de terrain de MSF au CTC. Une fois traités, les échantillons seront détruits. Vous serez libre, à tout moment, de refuser de répondre à n'importe quelle question ou de refuser le prélèvement des échantillons. Cela prendra environ 30 minutes. Nous répéterons cet entretien avec vous dans 7 jours et dans 21 jours. Nous répéterons le prélèvement des échantillons dans 7 jours seulement.

☐ Participation au deuxième entretien de l'étude chez vous au Jour 21 : En plus de cette étude, nous contacterons également un sous-groupe de 250 foyers recrutés pour cette étude. Nous souhaitons les interroger sur les difficultés ou les bénéfices liés à l'utilisation de la trousse et leur poser des questions sur la manière dont l'utilisation de la trousse a été expliquée au CTC. Le deuxième entretien durera 30 minutes. Nous vous demandons maintenant de nous autoriser à vous contacter pour ce deuxième entretien de l'étude. Si votre foyer a été sélectionné pour ce deuxième entretien de l'étude, nous vous expliquerons l'étude dans son entièreté et nous vous demanderons de signer un autre formulaire similaire à celui-ci.

Où cette étude sera-t-elle réalisée ?

Cette étude est menée à [insérer la emplacement] …… en République Démocratique du Congo.

Votre participation est VOLONTAIRE

Quand vous aurez bien compris toutes les informations que nous vous avons données et si vous acceptez de participer à l'étude, il vous sera demandé de bien vouloir signer le formulaire, soit en indiquant votre nom, soit en y plaçant l'empreinte de votre pouce. Avant que vous ne signiez le formulaire, le personnel chargé de l'étude vous aidera à le comprendre et répondra à toutes vos questions. Il est toutefois important, avant de signer, que vous compreniez bien ce qui suit :

Votre participation est volontaire ; vous ne devez pas participer à cette étude contre votre gré.

Vous êtes libre de mettre fin à votre participation à tout moment (pendant ou après l'étude) sans que cela n'ait aucune conséquence pour vous ou votre famille ; si vous décidez de vous retirer de l'étude, vous continuerez de bénéficier des soins que MSF vous dispense habituellement. Si vous décidez de vous retirer de l'étude au moment de l'entretien de suivi, vos données ne seront pas utilisées dans le cadre de l'étude. Tous vos échantillons seront détruits après analyse et, si vous sortez de l'étude, les résultats de vos analyses seront retirés de l'ensemble des données de l'étude. Les participants qui se retirent de l'étude ne participeront pas aux entretiens de suivi. Si le chef du foyer se retire de l'étude, il se peut que nous retirions aussi de l'étude tous les autres membres du foyer. Dans ce cas, nous ne poursuivrons avec eux ni les entretiens de suivi, ni la collecte des échantillons.

Quels sont les bénéfices potentiels liés à ma participation à cette étude ?
Nous ne pouvons pas vous assurer que vous tirerez un bénéfice direct de votre participation à cette étude.

La recherche a pour but de bénéficier à la société dans son ensemble, grâce à l'acquisition de nouvelles connaissances, qui serviront de base à l'élaboration des futurs programmes de santé. Les résultats de cette étude nous aideront à concevoir des programmes plus efficaces relatifs à l'eau, à l'assainissement et à l'hygiène et à proposer de meilleurs soins aux communautés exposées au risque d'épidémies de choléra. Les informations recueillies dans le cadre de cette étude pourront également nous permettre de réduire les diarrhées en renforçant les interventions de MSF dans les domaines de l'eau, de l'assainissement et de l'hygiène et pourraient appuyer de nouvelles stratégies de lutte contre le choléra en RDC.

Que se passera-t-il si je développe des symptômes de choléra et/ou si je tombe malade pendant l'étude ?
Les symptômes du choléra peuvent inclure des vomissements, des douleurs à l'estomac et une diarrhée (3 selles molles ou plus sur une période de 24 heures) qui peut avoir une couleur et une consistance ressemblant à celles de l'eau de riz. Si, à un moment ou un autre de l'étude ou après l'étude, vous développez des symptômes de choléra, de diarrhée, de vomissements ou si vous vous sentez mal, veuillez demander une consultation et/ou un traitement au CTC. Ces symptômes peuvent survenir à n'importe quel moment pendant l'étude ou après celle-ci.

MSF s'engage à dispenser des soins de santé gratuits à la population et nous vous conseillons de vous rendre au centre de santé soutenu par notre organisation (centre de traitement du choléra, unité de traitement du choléra) pour y être vu par un membre de notre personnel sanitaire et médical. Vous pourrez y bénéficier d'un traitement gratuit.

Si d'autres membres de votre famille, vos amis ou vos voisins présentent également des symptômes du choléra, nous vous recommandons également de consulter MSF et/ou d'autres prestataires de soins de santé.

Quels sont les risques potentiels liés à ma participation à cette étude ?
Les investigateurs sont tenus d'expliquer aux participants à l'étude tous les risques liés à leur participation. Cette étude peut présenter certains risques pour les participants potentiels ou leur famille. Les interactions avec le personnel chargé de l'étude et avec d'autres personnes étrangères peuvent, p. ex. poser un problème au niveau psychologique/émotionnel. Pour cette raison, l'équipe a été formée à respecter les émotions et les sentiments des participants et à leur faire comprendre que l'objectif de l'étude est de comprendre et documenter ces émotions et non de porter un jugement sur les participants ou leur famille.

Il se peut également qu'on vous reproche d'être à l'origine de la propagation du choléra. La contagion du choléra n'est la faute de personne. L'exposition au choléra est due au contact avec un environnement contaminé et n'est nullement le résultat des activités d'une personne en particulier. Si vous êtes inquiet à ce sujet ou si vous avez des questions, n'hésitez pas à nous contacter pour nous faire part de vos préoccupations. Nous serons alors heureux de répondre à toutes les questions que vous pourriez vous poser.

Le fait de participer à cette étude peut aussi vous exposer à des risques sociaux. Les membres de l'équipe chargés de collecter les données vous rendront visite à trois reprises. Cela risque d'attirer l'attention de vos voisins ou de la communauté sur votre foyer. Avant de lancer l'étude, nous organiserons des réunions communautaires pour expliquer en quoi consiste notre étude, ainsi que la manière dont elle est appelée à se dérouler. Ces réunions se dérouleront dans votre village avant la collecte des données et rassembleront les chefs du village et la communauté. Si vous avez la moindre question ou si quelque chose vous préoccupe, vous pouvez nous contacter à tout moment.

En cas d'arrêt prématuré de l'étude ou à l'issue de celle-ci, les membres de l'équipe chargée de la collecte des données informeront les participants par téléphone. S'ils ne disposent pas des numéros de téléphone de tous les participants, des visites à domicile et des réunions communautaires seront organisées pour informer tout le monde de l'arrêt de l'étude. Si l'étude est arrêtée prématurément, les recenseurs engagés sur place et avec qui nous travaillons en parallèle avec les autorités locales, nous aideront à en informer la population de l'étude. Nous organiserons des réunions communautaires dans les villages de l'étude et nous serons disponibles pour répondre aux questions de la population lorsque ce sera possible. Les participants seront informés de la raison pour laquelle l'étude a été arrêtée, de la possibilité de retirer leurs données de l'étude, ainsi que des étapes suivantes de l'étude concernant les données collectées qui n'ont pas été retirées.

Mes informations seront-elles traitées de manière confidentielle ?

Cette étude accorde une très grande importance à la confidentialité des données. Les données à caractère personnel relatives aux participants seront conservées dans une base de données distincte protégée par un mot de passe, accessible à un nombre limité de membres du personnel autorisés. Le personnel autorisé comprendra le personnel du ministère de la Santé (PNECHOL-M), l'Université de Kinshasa, Médecins Sans Frontières et la London School of Hygiene and Tropical Medicine. À tous les stades, des efforts seront consentis pour protéger la confidentialité des données des participants : les participants ne seront pas identifiés par des moyens permettant de les reconnaître, y compris leur nom. Des numéros d'ID uniques, attribués à vous et aux membres de votre foyer, seront utilisés pour identifier vos données.

Toutes les données de l'étude seront collectées sur des appareils protégés par un mot de passe. Ces fichiers seront stockés dans des bases de données protégées par un mot de passe chez MSF et LSHTM. Au moment de l'analyse des données et avant de partager les données avec nos partenaires de recherche, nous supprimerons tous les éléments d'identification directe ou indirecte. À la fin du projet, les données seront déposées dans un référentiel ou dans les archives de la LSHTM ou de MSF. Les données resteront disponibles pendant une durée minimum de cinq ans. Toutes les données resteront privées, protégées et confidentielles.

Une convention d'accès sera élaborée pour toute personne souhaitant examiner les données ou y avoir accès. Vos données pourront être examinées par les autorités suivantes, chargées de contrôler que vos droits en tant que participant à une étude sont respectés :

- École de Santé Publique, Université de Kinshasa
- Médecins Sans Frontières, OCB, République Démocratique du Congo
- Comité d'éthique de la London School of Hygiene & Tropical Medicine, R-U

Vais-je être rémunéré pour ma participation à l'étude ?
Non, la participation à cette étude n'est liée à aucune compensation directe.

Dois-je payer pour participer à l'étude ?
Non, la participation à cette étude n'est liée à aucun coût pour les participants.

A qui puis-je poser mes questions sur l'étude ?
Vous avez le droit de poser toutes les questions que vous vous voulez à propos de l'étude, ainsi que le droit d'obtenir des réponses. Si vous avez la moindre question ou la moindre préoccupation concernant l'étude, n'hésitez pas à nous contacter et cela à n'importe quel moment. Si vous avez des questions, des plaintes ou des préoccupations à formuler, vous pouvez contacter :

- Investigateur principal : Lauren D'Mello-Guyett & Maria Mashako
- Numéro de téléphone : +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

A qui puis-je poser mes questions concernant mes droits en tant que participant à une étude ?
Toutes les recherches menées sur des volontaires humains sont revues par MSF, LSHTM et l'Ecole de Santé Publique de l'Université de Kinshasa. Trois comités qui œuvrent à la protection de vos droits et de votre bien-être. Si vous avez des questions ou des préoccupations concernant vos droits en tant que participant à une étude de recherche, vous pouvez contacter :

- Nom : Maria Mashako
- Adresse : Coordinatrice Médicale Adjointe, MSF-OCB
- Numéro de téléphone : +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

Si vous souhaitez contacter un collaborateur de l'Université de Kinshasa qui siège au comité d'éthique national :

- Nom : Jack Kiyembi
- Adresse : École de Santé Publique, Université de Kinshasa
- E-mail : kiyembi@gmail.com

Consentement de participation :
Je déclare avoir lu les informations reprises plus haut, ou que ces informations m'ont été lues, et les avoir comprises. Je déclare avoir posé toutes les questions qui me sont venues à l'esprit à ce moment. Je déclare vouloir volontairement participer à cette étude de recherche (cocher une seule case).

☐ **Oui** ☐ **Non**

Je déclare autoriser l'utilisation confidentielle des informations que j'ai fournies pendant mes entretiens pour communiquer les résultats de la présente étude de recherche et dans le cadre de l'analyse de la présente étude de recherche.
Les informations relatives à l'étude pourront potentiellement être vues par les investigateurs, les professionnels de la santé et les décideurs en République Démocratique du Congo et en dehors (cocher une seule case).

☐ **Oui** ☐ **Non**

Numéro d'ID du ménage		**Date**
Numéro d'ID du participant		
Signature ou empreinte du pouce du participant à l'étude de recherche ou d'un parent/tuteur du participant qui signe pour le compte du participant		
Nom en lettres majuscules du participant à l'étude de recherche ou d'un parent/tuteur du participant qui signe pour le compte du participant		
Signature du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Nom en lettres majuscules du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Signature du témoin		
Nom en lettres majuscules du témoin*		

*Remarque : Le nom du témoin, la signature et la date ne doivent être repris dans le présent formulaire de consentement que si le volontaire qui consent à participer à l'étude ne sait pas lire (illettré)

Le témoin doit être âgé de plus de 18 ans, être capable de comprendre le formulaire de consentement éclairé et avoir été choisi personnellement par le participant à l'étude.

1 copie du feuillet d'information pour le participant à l'étude et du consentement éclairé à la participation à l'étude

Q. Child Assent Form: For Children Aged 7-18 years (French)

Organisations : Médecins Sans Frontières, London School of Hygiene and Tropical Medicine et
Investigateur principal : Lauren D'Mello-Guyett & Maria Mashako
Numéro de téléphone : +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80
Titre de l'étude : Évaluation de l'effet de la distribution par MSF d'une trousse d'hygiène sur la transmission domestique du choléra au niveau des membres du foyer de patients infectés par le choléra

Qui ?
Il a été demandé à tous les patients admis au Centre de Traitement du Choléra âgés de plus de 2 ans de participer à notre étude de recherche. Et nous sommes venus vous parler parce que, soit vous êtes un des cas admis au Centre de Traitement du Choléra, soit quelqu'un dans votre foyer a eu le choléra et a été admis au Centre de Traitement du Choléra.

Ce formulaire doit être lu et signé par les enfants et les adolescents âgés de 7 à 18 ans auxquels il a été demandé de participer à l'étude de recherche.

Quoi ?
Nous sommes venus vous parler aujourd'hui afin d'obtenir des informations sur vous et sur votre foyer. Nous aimerions vous parler, en présence de vos parents/tuteurs de ce que vous avez fait la semaine dernière. Nous parlerons des endroits où vous allez chercher de l'eau, où vous allez à la toilette et où vous vous lavez les mains, de ce que vous avez mangé ainsi que des personnes à qui vous avez rendu visite.

Si vous êtes un membre du foyer d'une personne qui a eu le choléra, nous viendrons vous parler chez vous. Nous prélèverons également des échantillons d'eau et de nourriture chez vous. Nous les testerons dans un laboratoire à Kinshasa sur la présence de différentes bactéries qui peuvent nous rendre malade.

Si vous avez été admis au Centre de Traitement du Choléra, nous vous poserons ces questions directement au Centre de Traitement du Choléra. Nous vous demanderons aussi si vous nous autorisez à procéder à un écouvillonnage rectal. Nous sommes du personnel infirmier expérimenté et ce prélèvement sera effectué au Centre de Traitement du Choléra. Si vous le souhaitez, vous pourrez aussi procéder vous-même à cet écouvillonnage rectal. Le prélèvement des échantillons entraînera un léger inconfort et vous pouvez, à tout moment, refuser de vous y soumettre. Cet échantillon nous servira à tester la présence de la bactérie qui provoque le choléra.

Tous les échantillons prélevés (frottis rectal, échantillons d'eau et de nourriture) seront emmenés à notre laboratoire du Centre de Traitement du Choléra. Nous traiterons ces échantillons et les résultats de leur analyse seront utilisés dans le cadre de notre étude de recherche. Lorsqu'ils auront été traités, tous les échantillons seront détruits.

Dans le courant du mois à venir, nous reviendrons aussi à deux reprises chez vous pour parler de la manière dont vous utilisez la trousse d'hygiène qui a été remise à votre famille.
Cela prendra environ 15 minutes. Si vous le souhaitez, vous pourrez demander à vos parents ou à votre tuteur de vous aider à répondre à certaines questions.

Conservation des informations en toute sécurité et respect de la confidentialité
Nous enregistrerons vos réponses sur nos formulaires de l'étude. Votre nom ne sera repris sur aucun de nos formulaires ni dans aucun de nos rapports. Il est très important pour nous que toutes les informations soient conservées en toute sécurité et soient protégées.

Pourquoi faisons-nous cela ?
Nous aimerions en apprendre plus sur la manière de prévenir le choléra. Nous voulons déterminer si la trousse d'hygiène est utile et efficace au niveau de la prévention de la maladie. Cela nous aidera à améliorer nos programmes qui vous seront destinés à l'avenir.

Inconvénients et bénéfices
Vous ne tirerez aucun bénéfice direct mais vous aurez la satisfaction de nous avoir aidés à en apprendre plus sur les enfants qui vivent ici.

Nous ne pensons pas que le fait de participer à cette partie de l'étude puisse avoir le moindre inconvénient pour vous. Le fait de participer à cette étude peut entraîner certains risques pour vous :
Il se peut que vous vous soyez mal à l'aise face à certaines questions sur votre vie
Il se peut que, si vous participez à notre étude de recherche, certains de vos amis ou de vos voisins vous posent des questions.

Si vous êtes un patient, vous pouvez ressentir un certain inconfort au moment de l'écouvillonnage rectal.

Vous devez savoir que :
Si vous ne voulez pas participer à cette étude, rien ne vous y oblige. Vous n'aurez aucun problème si vous refusez d'y participer.

Vous pouvez décider d'arrêter de participer à l'étude à n'importe quel moment. Si vous ne voulez pas répondre à une question précise, il vous suffira de dire que vous ne voulez pas répondre à cette question ou vous ne devez même rien dire du tout.

Il a été demandé à vos parents / votre tuteur s'ils étaient d'accord que vous participiez à cette étude. Même s'ils ont donné leur accord, c'est vous qui décidez si vous voulez ou non participer à l'étude.
Vous pouvez me poser toutes les questions que vous voulez sur l'étude maintenant.

Consentement du participant :

Numéro d'ID du ménage		Date
Numéro d'ID du participant		
Signature ou empreinte du pouce de l'enfant		
Nom en lettres majuscules du participant à la recherche (si l'enfant ne sait pas écrire, veuillez l'écrire pour lui)		
Signature du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Nom en lettres majuscules du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		

1 copie du feuillet d'information pour le participant à l'étude et du consentement éclairé à la participation à l'étude

Nous vous remercions d'avoir pris le temps de lire et de signer ce document.

R. Informed Consent Form: For Qualitative Household Interviews (French)

Organisations : Médecins Sans Frontières, London School of Hygiene and Tropical Medicine et
Investigateur principal : Lauren D'Mello-Guyett & Maria Mashako
Numéro de téléphone : +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

Titre de l'étude : Mener un processus d'évaluation de la mise en œuvre, du contexte et des mécanismes d'impact de la distribution de la trousse d'hygiène pendant une épidémie de choléra

Par qui est sponsorisée cette étude ?
Cette étude est menée par Médecins Sans Frontières. Cette étude est menée en collaboration avec la London School of Hygiene & Tropical Medicine. Cette étude est financée par MSF, qui veut suivre et évaluer les projets destinés à améliorer l'approvisionnement en eau, l'assainissement et l'hygiène pour arriver à contrôler le choléra dans le cadre des crises humanitaires.

Informations générales sur les études de recherche
On vous a demandé de participer à une étude de recherche. La participation à cette étude est volontaire. Vous pouvez refuser de participer à cette étude ou décider de retirer votre consentement à participer à cette étude à tout moment et pour n'importe quelle raison. Les études de recherche ont pour objectif d'acquérir de nouvelles connaissances susceptibles d'aider d'autres personnes à l'avenir. Il se peut que vous ne tiriez aucun bénéfice direct de votre participation à cette étude de recherche. La participation à des études de recherche peut aussi comporter des risques.

Si vous décidez de ne pas participer à l'étude ou de vous en retirer avant qu'elle ne soit terminée, cela n'aura aucune influence sur votre relation avec l'investigateur, avec MSF ou avec n'importe quel autre membre du personnel sanitaire ou médical.

Les détails relatifs à cette étude sont discutés ci-dessous. Il est important que vous compreniez ces informations afin de pouvoir faire un choix éclairé quant à votre participation à cette étude de recherche. Une copie de ce formulaire de consentement éclairé vous sera remise. Vous pouvez, à tout moment, poser toutes vos questions sur l'étude aux investigateurs ou aux membres du personnel qui les assistent.

Quel est l'objectif de cette étude de recherche ?
L'objectif de cette étude est de comprendre comment les trousses d'hygiène ont été distribuées pendant une épidémie de choléra à **[insérer la emplacement]** **……** et de décider comment élaborer au mieux les futurs programmes pour réduire le risque de maladie en République Démocratique du Congo.

Cette étude est menée par des chercheurs de la London School of Hygiene and Tropical Medicine (LSHTM) et mise en œuvre par Médecins Sans Frontières. Cette étude a été approuvée par le Comité d'éthique de la LSHTM, par le Comité d'éthique de Médecins Sans Frontières et par l'École de santé publique de l'Université de Kinshasa.

Avant de vous décider à participer à l'étude, il est important que vous compreniez pourquoi cette recherche est effectuée et ce qu'implique pour vous de participer à cette étude. N'hésitez pas à nous contacter si vous avez des questions et prenez le temps de bien réfléchir avant de décider de participer ou pas à cette étude.

Le choléra est une maladie diarrhéique grave qui sévit en République Démocratique du Congo. Les personnes qui se présentent au Centre de Traitement du Choléra (CTC) avec une diarrhée sévère

recevront une trousse d'hygiène de MSF. Cette étude a pour objectif de comprendre votre expérience avec la trousse d'hygiène que vous avez reçue.

Cette évaluation peut fournir des informations sur les mécanismes sous-jacents de l'impact de l'intervention et permettre d'identifier les facteurs limitants et facilitateurs importants dans le cadre des recommandations et de l'optimisation de la conception des futures interventions. Les informations publiées ou obtenues dans le cadre de rapports sur les programmes de contrôle de la maladie dans le cadre des crises humanitaires ou des épidémies de choléra sont peu nombreuses. Documenter cette situation fait partie intégrante de l'évaluation et peut s'avérer utile au niveau de l'élaboration, du suivi et de l'évaluation des interventions EHA destinées à contrôler les épidémies de choléra.

Vous avez déjà été recruté dans le cadre d'une partie précédente de l'étude. Dans le cadre de cette précédente étude, nous nous sommes rendus dans votre foyer et nous vous avons posé des questions sur vos habitudes au niveau de l'eau, de l'assainissement et de l'hygiène. Nous avons aussi prélevé des échantillons de votre nourriture et de l'eau que vous utilisez. Nous vous avons également posé des questions sur la trousse d'hygiène.

Cette nouvelle partie de l'étude met l'accent sur l'examen des barrières à / des facteurs facilitateurs de l'utilisation de la trousse. Notre objectif est d'explorer les difficultés ou les expérience positives que vous avez rencontrées avec la trousse. Nous vous poserons une série de questions relatives à l'utilisation de la trousse.

Votre foyer a reçu une trousse d'hygiène au CTC. Nous l'avons distribuée à tous les patients atteints de choléra admis au CTC et à leur famille. Le contenu de la trousse a été expliqué par un membre de l'équipe de promotion de la santé de MSF au CTC. Ces explications vous ont été données à vous-même ou à une autre personne de votre foyer au moment où la trousse vous a été remise. Pour votre information, la trousse contient un bidon de 20 litres, du savon pour couvrir les besoins de 5 personnes pendant 2 mois (250g de savon par personne par mois), un seau doté d'un robinet et des comprimés pour le traitement de l'eau. MSF remet la même trousse à tous les patients admis, ainsi qu'à leur famille. Cette étude avait pour objectif d'évaluer comment vous et votre famille vous avez utilisé la trousse d'hygiène et d'évaluer si quelqu'un a ensuite été infecté par le choléra.

Nous mènerons des entretiens dans de nombreux foyers qui ont reçu la trousse d'hygiène au CTC. Comme vous le savez peut-être, nous avons demandé à 250 foyers de participer à l'étude précédente. Pour cette partie de l'étude, nous avons demandé à 30-50 de ces foyers de participer à l'étude. La sélection de ces foyers repose sur la sélection aléatoire de 30-50 foyers sur les 250 foyers qui ont participé à l'étude précédente. Nous mènerons également des entretiens avec les membres de l'équipe de mise en œuvre de MSF et d'autres personnes impliquées dans la réponse au choléra.

Qu'attend-on de moi si je participe à cette étude ?

Que vous participiez à un entretien chez vous : Si vous acceptez de participer à cette étude, on vous demandera de répondre à mes questions, mais vous serez toujours libre de refuser, à tout moment, de répondre à n'importe quelle question. Cela prendra environ 30 minutes. Mes questions permettront de documenter la mise en œuvre de l'intervention, y compris : si vous avez reçu la trousse, comment vous l'avez utilisée, votre expérience d'utilisation de la trousse et toutes les difficultés/tous les bénéfices liés à son utilisation. Nous ferons aussi des enregistrements audio des entretiens pour nous aider à les retranscrire ultérieurement et vérifier les réponses. Les réponses ne seront entendues que par les investigateurs et seront utilisées de façon confidentielle pour en extraire ce que vous aurez dit, mais sans faire aucune référence à votre nom ou à votre famille. Vous serez interrogé dans un endroit privé et confortable de votre choix.

Où cette étude sera-t-elle réalisée ?

Cette étude est menée à **[insérer la emplacement] ……**…… en République Démocratique du Congo.

Votre participation est VOLONTAIRE
Quand vous aurez bien compris toutes les informations que nous vous avons données et si vous acceptez de participer à l'étude, il vous sera demandé de bien vouloir signer le formulaire, soit en indiquant votre nom, soit en y plaçant l'empreinte de votre pouce. Avant que vous ne signiez le formulaire, le personnel chargé de l'étude vous aidera à le comprendre et répondra à toutes vos questions. Il est toutefois important, avant de signer, que vous compreniez bien ce qui suit :
Votre participation est volontaire ; vous ne devez pas participer à cette étude contre votre gré.

Vous êtes libre de **mettre fin à votre participation à n'importe quel moment (pendant ou après l'étude)** sans que cela ait de conséquence sur vous ou sur votre famille ; si vous sortez de l'étude, vous continuerez à bénéficier des services de soins habituels qui vous sont dispensés par le personnel soignant. Si vous décidez de participer à cette étude, vous pourrez décider, à tout moment, de ne pas poursuivre l'étude et vous ne devez pas répondre à toutes les questions.

Si vous choisissez de vous retirer de l'étude à n'importe quel moment de l'étude, vos données ne seront pas utilisées dans le cadre de l'étude. Dans ce cas, vos réponses aux questions, les retranscriptions de vos entretiens et les enregistrements audio seront supprimés de l'ensemble de données et détruits.

Quels sont les bénéfices potentiels liés à ma participation à cette étude ?
La recherche a pour but de bénéficier à la société dans son ensemble, grâce à l'acquisition de nouvelles connaissances, qui serviront de base à l'élaboration des futurs programmes de santé. Il se peut que vous ne tiriez aucun avantage direct de votre participation à cette étude.

Les résultats de cette étude nous aideront à concevoir des programmes plus efficaces relatifs à l'eau, à l'assainissement et à l'hygiène et à proposer de meilleurs soins aux communautés exposées au risque d'épidémies de choléra.

Les informations recueillies dans le cadre de cette étude pourront également nous permettre de réduire les diarrhées en renforçant les interventions de MSF dans les domaines de l'eau, de l'assainissement et de l'hygiène et pourraient appuyer de nouvelles stratégies de lutte contre le choléra en RDC.

Quels sont les risques potentiels liés à ma participation à cette étude ?
Les investigateurs sont tenus d'expliquer aux participants à l'étude tous les risques liés à leur participation. Cette étude n'est liée à aucun risque potentiel pour les participants ou leur famille. Au niveau psychologique/émotionnel, les interactions avec le personnel de l'étude et des personnes étrangères peuvent poser problème. Pour cette raison, l'équipe a été formée à respecter les émotions et les sentiments des participants et à leur faire comprendre que l'objectif de l'étude est de comprendre et documenter ces émotions et non de porter un jugement sur les participants ou leur famille.

Mes informations seront-elles traitées de manière confidentielle ?
Cette étude accorde une très grande importance à la confidentialité des données. Les données à caractère personnel relatives aux participants seront conservées dans une base de données distincte protégée par un mot de passe, accessible à un nombre limité de membres du personnel autorisés. Le personnel autorisé comprendra le personnel du ministère de la Santé (PNECHOL-M), l'Université de Kinshasa, Médecins Sans Frontières et la London School of Hygiene and Tropical Medicine. A tous les stades, des efforts seront consentis pour protéger la confidentialité des données des participants : les participants ne seront pas identifiés par des moyens permettant de les identifier personnellement et les propos rapportés resteront confidentiels et privés. Des numéros d'ID uniques, attribués à vous et aux membres de votre foyer, seront utilisés pour identifier vos données. Aucune information personnelle

identifiable ne quittera le pays. L'équipe de l'étude pourrait souhaiter utiliser les propos, les récits recueillis ou des extraits de ceux-ci ou quelque chose que vous aurez dit pendant l'entretien ou une discussion dans le cadre de leur travail, mais tous les propos utilisés dans ce cadre resteront confidentiels et ils ne permettront à aucun moment de vous identifier vous ou votre famille.

Toutes les données de l'étude seront collectées sur des appareils protégés par un mot de passe. Ces fichiers seront stockés dans des bases de données protégées par un mot de passe chez MSF et LSHTM. L'accès sera limité aux seuls utilisateurs autorisés. À la fin du projet, les données seront déposées dans un référentiel ou dans les archives de la LSHTM ou de MSF. Les données resteront disponibles pendant une durée minimum de cinq ans. Toutes les données resteront privées, protégées et confidentielles.

MSF et LSHTM ont conclu un mémorandum d'entente (Memorandum of Understanding) relatif au partage des données issues de cette étude. Les bases de données de l'étude ne seront partagées qu'avec les partenaires de l'étude. Les bases de données de l'étude seront toutes pseudonymisées et seul l'IP et personne d'autre ne disposera de la clé.

Les entretiens seront enregistrés de manière confidentielle en utilisant la plate-forme KOBO. Nous conserverons les données de manière sécurisée comme décrit plus haut et seul le personnel autorisé aura accès aux données. Tous les entretiens seront menés dans votre langue (lingala/swahili/ciluba/autre) et traduits en français et en anglais. Il ne sera pas demandé aux participants de révéler leur nom ou des informations personnelles mais nous avons conscience que les voix des enregistrements pourraient permettre l'identification de certaines personnes. Les enregistrements audio seront retranscrits pendant l'étude. Quand toutes les retranscriptions auront été vérifiées et validées par deux personnes distinctes et l'IP, les données des enregistrements audio seront détruites 6 mois après leur retranscription, le délai supposé nécessaire pour finaliser l'analyse des données. Les retranscriptions et les consentements éclairés seront conservés pendant cinq ans après la fin de l'étude.

Au moment de l'analyse des données et avant de partager les données avec nos partenaires de recherche, nous supprimerons tous les éléments d'identification directe ou indirecte.
Vos données pourront être examinées par les autorités suivantes, chargées de contrôler que vos droits en tant que participant à une étude sont respectés :

- Médecins Sans Frontières, OCB, République Démocratique du Congo
- École de Santé Publique, Université de Kinshasa, RDC
- Comité d'éthique de la London School of Hygiene & Tropical Medicine, R-U

Vais-je être rémunéré pour ma participation à l'étude ?
Non, la participation à cette étude n'est liée à aucune compensation directe.

Dois-je payer pour participer à l'étude ?
Non, la participation à cette étude n'est liée à aucun coût pour les participants.

A qui puis-je poser mes questions sur l'étude ?
Vous avez le droit de poser toutes les questions que vous vous voulez à propos de l'étude, ainsi que le droit d'obtenir des réponses. Si vous avez des questions, des plaintes ou des préoccupations à formuler, vous pouvez contacter :

- **Investigateur principal :** Lauren D'Mello-Guyett & Maria Mashako
- **Numéro de téléphone :** +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

A qui puis-je poser mes questions concernant mes droits en tant que participant à une étude ?

Toutes les recherches menées sur des volontaires humains sont revues par MSF, LSHTM et l'Ecole de Santé Publique de l'Université de Kinshasa. Trois comités qui œuvrent à la protection de vos droits et de votre bien-être. Si vous avez des questions ou des préoccupations concernant vos droits en tant que participant à une étude de recherche, vous pouvez contacter :

- Nom : Maria Mashako
- Adresse : Coordinatrice Médicale Adjointe, MSF-OCB
- Numéro de téléphone : +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

Si vous souhaitez contacter un collaborateur de l'Université de Kinshasa qui siège au comité d'éthique national :

- Nom : Jack Kiyembi
- Adresse : École de Santé Publique, Université de Kinshasa
- E-mail : kiyembi@gmail.com

Titre de l'étude : Mener un processus d'évaluation de la mise en œuvre, du contexte et des mécanismes d'impact de la distribution de la trousse d'hygiène pendant une épidémie de choléra

Consentement de participation :

Je déclare avoir lu les informations reprises plus haut, ou que ces informations m'ont été lues, et les avoir comprises. Je déclare avoir posé toutes les questions qui me sont venues à l'esprit à ce moment. Je déclare vouloir volontairement participer à cette étude de recherche (cocher une seule case).

☐ **Oui** ☐ **Non**

Je déclare autoriser que les informations que j'ai fournies pendant mes entretiens soient citées de manière confidentielle pour communiquer les résultats de la présente étude de recherche et dans le cadre de l'analyse de la présente étude de recherche ainsi qu'à des fins didactiques. Les informations relatives à l'étude pourront potentiellement être vues par les investigateurs, les professionnels de la santé et les décideurs en République Démocratique du Congo et en dehors (cocher une seule case).
Si vous ne savez pas lire ou écrire, un témoin devra être recruté pour observer le processus de consentement éclairé. Nous vous demandons de choisir à cet effet un tuteur, un membre de votre famille ou un proche, âgé de plus de 18 ans.

☐ **Oui** ☐ **Non**

Numéro d'ID du foyer		**Date**
Signature ou empreinte du pouce du participant à la recherche		
Nom en lettres majuscules du participant à la recherche		
Signature du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Nom en lettres majuscules du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Signature du témoin		
Nom en lettres majuscules du témoin*		

*Remarque : Le nom du témoin, la signature et la date ne doivent être repris dans le présent formulaire de consentement que si le volontaire qui consent à participer à l'étude ne sait pas lire (illettré)

1 copie du feuillet d'information pour le participant à l'étude et du consentement éclairé à la participation à l'étude

S. Informed Consent Form: For Qualitative Implementer Interviews (French)

Organisations : Médecins Sans Frontières, London School of Hygiene and Tropical Medicine
Investigateur principal : Lauren D'Mello-Guyett & Maria Mashako
Numéro de téléphone : +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80
Titre de l'étude : Mener un processus d'évaluation de la mise en œuvre, du contexte et des mécanismes d'impact de la distribution de la trousse d'hygiène pendant une épidémie de choléra

Par qui est sponsorisée cette étude ?

Cette étude est menée par Médecins Sans Frontières. Cette étude est menée en collaboration avec la London School of Hygiene & Tropical Medicine. Cette étude est financée par MSF, qui veut suivre et évaluer les projets destinés à améliorer l'approvisionnement en eau, l'assainissement et l'hygiène pour arriver à contrôler le choléra dans le cadre des crises humanitaires.

Informations générales sur les études de recherche

On vous a demandé de participer à une étude de recherche. La participation à cette étude est volontaire. Vous pouvez refuser de participer à cette étude ou décider de retirer votre consentement à participer à cette étude à tout moment et pour n'importe quelle raison. Les études de recherche ont pour objectif d'acquérir de nouvelles connaissances susceptibles d'aider d'autres personnes à l'avenir. Il se peut que vous ne tiriez aucun bénéfice direct de votre participation à cette étude de recherche. La participation à des études de recherche peut aussi comporter des risques.

Si vous décidez de ne pas participer à l'étude ou de vous en retirer avant qu'elle ne soit terminée, cela n'aura aucune influence sur votre relation avec l'investigateur.

Les détails relatifs à cette étude sont discutés ci-dessous. Il est important que vous compreniez ces informations afin de pouvoir faire un choix éclairé quant à votre participation à cette étude de recherche. Une copie de ce formulaire de consentement éclairé vous sera remise. N'hésitez pas à demander aux investigateurs ou aux membres du personnel qui les assistent de répondre à vos questions sur l'étude, et cela, à n'importe quel moment.

Quel est l'objectif de cette étude de recherche ?

L'objectif de cette étude est de comprendre comment les trousses d'hygiène ont été distribuées pendant une épidémie de choléra à **[insérer la emplacement]** **……** et de décider comment élaborer au mieux les futurs programmes pour réduire le risque de maladie en République Démocratique du Congo.

Cette étude est menée par des chercheurs de la London School of Hygiene and Tropical Medicine (LSHTM) et mise en œuvre par Médecins Sans Frontières. Cette étude a été approuvée par le Comité

d'éthique de la LSHTM, par le Comité d'éthique de Médecins Sans Frontières et par l'École de santé publique de l'Université de Kinshasa.

Avant de vous décider à participer à l'étude, il est important que vous compreniez pourquoi cette recherche est effectuée et ce qu'implique pour vous de participer à cette étude. N'hésitez pas à nous contacter si vous avez des questions et prenez le temps de bien réfléchir avant de décider de participer ou pas à cette étude.

Le choléra est une maladie diarrhéique grave qui sévit en République Démocratique du Congo. Les personnes qui se présentent au Centre de Traitement du Choléra (CTC) avec une diarrhée sévère recevront une trousse d'hygiène de MSF. Cette recherche a pour objectif de comprendre la mise en œuvre, le contexte et la manière dont la trousse d'hygiène a été utilisée dans ce cadre.

L'évaluation du processus peut fournir des informations sur les mécanismes sous-jacents de l'impact de l'intervention et permettre d'identifier les facteurs limitants et facilitateurs importants dans le cadre des recommandations et de l'optimisation de la conception des futures interventions. Les informations publiées ou obtenues dans le cadre de rapports sur les programmes de contrôle de la maladie dans le cadre des crises humanitaires ou des épidémies de choléra sont peu nombreuses. Documenter cette situation fait partie intégrante de l'évaluation et peut s'avérer utile au niveau de l'élaboration, du suivi et de l'évaluation des interventions WASH destinées à contrôler les épidémies de choléra.

Une approche basée sur la combinaison de différentes méthodes sera utilisée pour obtenir les détails sur la réponse de MSF à l'épidémie de choléra et la remise des trousses d'hygiène par MSF.

Ces méthodes comprendront des entretiens approfondis qualitatifs avec des informateurs clés (p. ex. les coordinateurs de terrain, les responsables du programme WASH, les coordinateurs médicaux, le responsable de la promotion de la santé, les agents de santé communautaire, d'autres membres du personnel opérationnel de MSF), des informateurs clés d'autres organisations actives dans la lutte contre l'épidémie de choléra dans la région et des revues des dossiers/journaux d'activités des équipes opérationnelles. Des observations structurées des interventions seront menées pendant la présentation de la trousse d'hygiène aux utilisateurs et aux séances de formation du personnel. Nous ferons aussi des enregistrements audio des entretiens pour nous aider à les retranscrire ultérieurement et vérifier les réponses.

Un échantillon stratifié empirique de foyers ayant reçu les trousses d'hygiène sera également contacté. Des entretiens qualitatifs semi-structurés seront menés pour explorer l'utilisation des trousses d'hygiène par les foyers.

Nous vous invitons à participer à cette étude pendant 1 jour le **[insérer la date]……...**

Qu'attend-on de moi si je participe à cette étude ?

L'investigateur cochera l'option applicable à chaque participant :

Informateurs clés (MSF, WASH Cluster, autres)

☐ Entretien sur votre lieu de travail : Si vous acceptez de participer à cette étude, on vous demandera de répondre à mes questions, mais vous serez toujours libre de refuser, à tout moment, de répondre à n'importe quelle question. Cet entretien prendra environ 30 minutes à 1 heure. Nos questions nous permettront de documenter la mise en œuvre de l'intervention, y compris : une description de l'intervention, le recrutement, la distribution, les ressources et les autres activités en cours au moment de la mise en œuvre. Les réponses ne seront entendues que par les investigateurs et seront utilisées de manière confidentielle pour en extraire ce que vous aurez dit, mais sans faire aucune référence à votre nom. Nous vous demanderons aussi de pouvoir **enregistrer** l'entretien à l'aide du logiciel de collecte de données KOBO en vue de la retranscription des entretiens pour analyse. Vous serez interrogé dans un endroit privé et confortable de votre choix.

☐ Dossiers de mise en œuvre : Si vous acceptez de participer à l'étude, nous demanderons des copies des dossiers des interventions utilisés pendant la remise des trousses d'hygiène. Cela pourra comprendre des informations telles que des cartes, des nombres distribués, des ressources, d'autres interventions, des chaînes logistiques ou d'autres détails. Toutes les données seront anonymisées et conservées de manière sûre. Il se peut qu'une autorisation des responsables ou des autorités soit nécessaire pour partager les dossiers des activités. Avant que vous ne puissiez partager ces données avec nous, nous demanderons l'autorisation de le faire à votre employeur ou à la personne désignée. Ces informations ne seront pas partagées en dehors de MSF et de la LSHTM.

☐ Observations structurées : Si vous acceptez de participer à l'étude, nous aimerions que vous procédiez à des observations structurées sur la distribution et la démonstration de l'utilisation des trousses d'hygiène par vos soins. Nous prendrons des notes et nous évaluerons la distribution des trousses d'hygiène. Cette activité sera similaire au monitoring et aux évaluations standards avec votre HP Manager. Nous ne vous observerons pas pendant vos activités en dehors du CTC ou vos activités non liées à la démonstration de l'utilisation ou à la distribution des trousses.

☐ Autorisation de partage des dossiers de mise en œuvre pour les organisations / autorités : Des membres de votre organisation ont accepté de participer à cette étude. Nous les interrogerons séparément sur leur rôle dans le cadre de la réponse. Au cours de cet entretien, nous aimerions leur demander des copies des dossiers d'intervention de votre organisation, utilisés pendant la réponse au choléra. Cela pourra comprendre des informations telles que des cartes, des nombres distribués, des ressources, d'autres interventions, des chaînes logistiques ou d'autres

détails. Toutes les données seront anonymisées et conservées de manière sûre. Ces informations ne seront pas partagées en dehors de MSF et de la LSHTM. Nous vous demanderons de bien vouloir signer votre consentement au partage de ces dossiers.

Où cette étude sera-t-elle réalisée ?

Cette recherche se déroulera à **[insérer la emplacement] ……**…… en République Démocratique du Congo.

Votre participation est VOLONTAIRE

Quand vous aurez bien compris toutes les informations que nous vous avons données et si vous acceptez de participer à l'étude, il vous sera demandé de bien vouloir signer le formulaire, soit en indiquant votre nom, soit en y plaçant l'empreinte de votre pouce. Avant que vous ne signiez le formulaire, le personnel chargé de l'étude vous aidera à le comprendre et répondra à toutes vos questions. Il est toutefois important, avant de signer, que vous compreniez bien ce qui suit :

Votre participation est volontaire ; vous ne devez pas participer à cette étude contre votre gré.

Vous êtes libre de **mettre fin à votre participation à tout moment (pendant ou après l'étude)** sans que cela n'ait aucune conséquence pour vous ou votre famille. Si vous décidez de participer à cette étude, vous pourrez décider, à tout moment, de ne pas poursuivre l'étude et vous ne devez pas répondre à toutes les questions.

Si vous choisissez de vous retirer de l'étude à n'importe quel moment de l'étude, vos données ne seront pas utilisées dans le cadre de l'étude. Dans ce cas, vos réponses aux questions, les retranscriptions de vos entretiens et les enregistrements audio seront supprimés de l'ensemble de données et détruits.

Avant de vous rencontrer aujourd'hui, nous avons aussi eu une réunion avec l'ensemble du personnel du projet afin de clarifier que la participation n'est pas obligatoire et que chacun est libre de refuser d'y participer. Ces explications portent tous les éléments de l'étude (y compris l'enrôlement du cas primaire, les frottis rectaux, l'enrôlement du membre du foyer, la collecte des données dans les foyers, la collecte des échantillons dans les foyers, les entretiens approfondis dans les foyers, les observations structurées, les entretiens avec le personnel, la collecte des dossiers des activités, les entretiens avec d'autres organisations). Comme conseillé par l'ERB, nous : 1) fournirons les lettres d'autorisation de MSF et les copies des approbations des comités d'éthique nationaux de la LSHTM et de MSF au cas où quelqu'un souhaiterait les consulter ; 2) présenterons le personnel de recherche et nous stipulerons clairement que le personnel opérationnel a parfaitement le droit de refuser de participer à cette recherche ou de se tenir éloigné de l'équipe de recherche ou de ses activités ; 3) clarifierons que nous n'utiliserons pas les propos ou les données des personnes qui n'auront pas consenti à participer à la recherche ; et 4) nous soulignerons que l'équipe de recherche est disponible pour répondre à toutes

les questions concernant l'étude. L'équipe de recherche sera composée de personnel de MSF, mais sera indépendante de l'équipe de mise en œuvre. Ses membres ne seront donc pas impliqués dans les soins cliniques ou la distribution des trousses et n'occuperont pas d'autres fonctions chez MSF. Les équipes de recherche font partie du personnel de MSF mais ne doivent pas signer d'accord de confidentialité strict avec MSF HR et restent indépendantes pendant toute la durée de l'étude.

Quels sont les bénéfices potentiels liés à ma participation à cette étude ?

La recherche a pour but de bénéficier à la société dans son ensemble, grâce à l'acquisition de nouvelles connaissances, qui serviront de base à l'élaboration des futurs programmes de santé. Il se peut que vous ne tiriez aucun avantage direct de votre participation à cette étude.

Les résultats de cette étude nous aideront à concevoir des programmes plus efficaces relatifs à l'eau, à l'assainissement et à l'hygiène et à proposer de meilleurs soins aux communautés exposées au risque d'épidémies de choléra.

Les informations recueillies dans le cadre de cette étude pourront également nous permettre de réduire les diarrhées en renforçant les interventions de MSF dans les domaines de l'eau, de l'assainissement et de l'hygiène et pourraient appuyer de nouvelles stratégies de lutte contre le choléra en RDC.

Quels sont les risques potentiels liés à ma participation à cette étude ?

Les investigateurs sont tenus d'expliquer aux participants à l'étude tous les risques liés à leur participation. Cette étude n'est liée à aucun risque potentiel pour les participants. Au niveau psychologique/émotionnel, les interactions avec le personnel de l'étude et des personnes étrangères peuvent poser problème. Pour cette raison, l'équipe a été formée à respecter les émotions et les sentiments des participants et à leur faire comprendre que l'objectif de l'étude est de comprendre et documenter ces émotions et non de porter un jugement sur les participants.

Les entretiens menés dans le cadre de cette étude seront strictement subordonnés à l'objectif de l'étude ; ils ne contribueront pas aux évaluations du personnel et personne ne sera licencié ou réengagé sur la base des résultats de cette évaluation. Si après l'analyse des données, le principal investigateur et l'équipe de recherche découvrent des manquements au niveau des pratiques cliniques ou de la prestation des services, ceux-ci seront discutés avec l'organisation (s'il s'agit de MSF : PUC, équipe de coordination et Bureau de Bruxelles) en toute confidentialité. La décision pourra être prise qu'une formation corrective s'impose au niveau de la mise en œuvre et de l'équipe clinique. En ce qui concerne les décisions relatives à la formation, nous nous en remettrons à votre organisation ou, pour MSF, à la coordination, au PUC et au Bureau de Bruxelles. Si une formation est organisée, il faudra qu'elle le soit sous la forme d'une activité de groupe afin de n'exclure personne et toutes les données devront rester confidentielles et être sécurisées.

Nous demanderons que l'entretien soit mené pendant les heures de travail. Nous pensons qu'il ne sera pas nécessaire de participer à l'étude pendant vos heures de loisirs non payées. Nous estimons que l'entretien prendra entre 30 minutes et 1 heure. Nous discuterons de la durée de l'entretien avec votre responsable, afin de nous assurer de ne pas perturber vos responsabilités. Cela révélera inévitablement votre participation à cette recherche. Vous êtes libre de refuser d'y participer à tout moment. Notre but est de nous adapter aux besoins du projet en cours et de réduire au minimum les perturbations.

Mes informations seront-elles traitées de manière confidentielle ?

Cette étude accorde une très grande importance à la confidentialité des données. Les données à caractère personnel relatives aux participants seront conservées dans une base de données distincte protégée par un mot de passe, accessible à un nombre limité de membres du personnel autorisés. A tous les stades, des efforts seront consentis pour protéger la confidentialité des données des participants : les participants ne seront pas identifiés par des moyens permettant de les identifier personnellement et les propos rapportés resteront confidentiels et privés. Aucune information personnelle identifiable ne quittera le pays. L'équipe de l'étude pourrait souhaiter utiliser les propos, les récits recueillis ou des extraits de ceux-ci ou quelque chose que vous aurez dit pendant l'entretien ou une discussion dans le cadre de leur travail, mais tous les propos utilisés dans ce cadre resteront confidentiels et ils ne permettront à aucun moment de vous identifier vous ou votre famille.

Concernant la gestion des données et le stockage des données qualitatives, nous suivrons les protocoles standards de gestion des données, tant pour les données quantitatives que pour les données qualitatives. Les transcriptions des données et les séries de données seront recueillies sur des appareils protégés par un mot de passe en passant par la plateforme KOBO et les données seront exportées vers Excel s'il s'agit de fichiers .csv et vers Word s'il s'agit de fichiers .doc. Ces fichiers seront stockés sur des serveurs protégés par un mot de passe chez MSF et à la LSHTM. Des mesures de sécurité seront prises, qui comprendront la limitation de l'accès aux seuls utilisateurs autorisés, le stockage crypté des données, la suppression des informations identifiables et une protection par mot de passe. À la fin du projet, les données seront déposées dans un référentiel ou dans les archives de la LSHTM ou de MSF. Les données resteront disponibles pendant une durée minimum de cinq ans. Une convention d'accès sera élaborée pour toute personne souhaitant examiner les données ou y avoir accès. Nous demanderons conseil à MSF et à la LSHTM sur toute convention de partage de données établie avant le partage.

MSF et LSHTM ont conclu un mémorandum d'entente (Memorandum of Understanding) relatif au partage des données issues de cette étude. Les bases de données de l'étude ne seront partagées qu'avec les partenaires de l'étude. Les bases de données de l'étude seront toutes pseudonymisées et seul l'IP et personne d'autre ne disposera de la clé.

Les entretiens seront enregistrés en utilisant la plate-forme KOBO. Nous pouvons intégrer des questions préliminaires (p. ex. sur le rôle dans l'organisation, le nom de l'organisation, la date, l'heure, etc.) dans la plate-forme et ensuite l'autoriser à enregistrer l'entretien. Cela permettra d'étiqueter chaque enregistrement audio et d'inclure certaines données relatives à l'entretien. Toutes les retranscriptions, tous les enregistrements audio et tous les dossiers des activités seront conservés de manière sûre et confidentielle. Nous conserverons les données de manière sécurisée comme décrit plus haut et seul le personnel autorisé aura accès aux données. Tous les entretiens seront menés en français (étant donné que nous serons des informateurs clés et notamment du personnel de projet et des coordinateurs externes) et seront traduits en anglais. Pour la traduction des enregistrements audio de cette étude, nous avons choisi de faire appel aux services de Translators Without Borders. Au moment de la conclusion du contrat avec Translators Without Borders, des clauses de confidentialité seront incluses dans le contrat. L'IP, le responsable de l'étude et l'équipe consultative seront aussi disponibles pour apporter leur aide dans le cadre de la traduction et clarifier les termes clés de la recherche ou de l'intervention avec lesquels les traducteurs pourraient ne pas être familiarisés. Au moment de l'analyse des données et avant de partager les données avec nos partenaires de recherche, nous supprimerons tous les éléments d'identification directe ou indirecte. Il ne sera pas demandé aux participants de révéler leur nom ou des informations personnelles mais nous avons conscience que les voix des enregistrements pourraient permettre l'identification de certaines personnes. Les enregistrements audio seront retranscrits pendant l'étude. Quand toutes les retranscriptions auront été vérifiées et validées par deux personnes distinctes et l'IP, les données des enregistrements audio seront détruites 6 mois après leur retranscription, le délai supposé nécessaire pour finaliser l'analyse des données. Les retranscriptions et les consentements éclairés seront conservés pendant cinq ans après la fin de l'étude.

Au moment de l'analyse des données et avant de partager les données avec nos partenaires de recherche, nous supprimerons tous les éléments d'identification directe ou indirecte.

Vos données pourront être examinées par les autorités suivantes, chargées de contrôler que vos droits en tant que participant à une étude sont respectés :

- Médecins Sans Frontières, OCB, République Démocratique du Congo
- École de Santé Publique, Université de Kinshasa, RDC
- Comité d'éthique de la London School of Hygiene & Tropical Medicine, R-U

Vais-je être rémunéré pour ma participation à l'étude ?

Non, la participation à cette étude n'est liée à aucune compensation directe.

Dois-je payer pour participer à l'étude ?

Non, la participation à cette étude n'est liée à aucun coût pour les participants.

A qui puis-je poser mes questions sur l'étude ?

Vous avez le droit de poser toutes les questions que vous vous voulez à propos de l'étude, ainsi que le droit d'obtenir des réponses. Si vous avez des questions, des plaintes ou des préoccupations à formuler, vous pouvez contacter :

- **Investigateur principal :** Lauren D'Mello-Guyett & Maria Mashako
- **Numéro de téléphone :** +243 (0) 85 41 85 443 ou +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

A qui puis-je poser mes questions concernant mes droits en tant que participant à une étude ?

Toutes les recherches menées sur des volontaires humains sont revues par MSF, LSHTM et l'Ecole de Santé Publique de l'Université de Kinshasa. Trois comités qui œuvrent à la protection de vos droits et de votre bien-être. Si vous avez des questions ou des préoccupations concernant vos droits en tant que participant à une étude de recherche, vous pouvez contacter :

- Nom : Maria Mashako
- Adresse : Coordinatrice Médicale Adjointe, MSF-OCB
- Numéro de téléphone : +243 (0) 84 136 68 86 ou +243 (0) 81 715 25 80

Si vous souhaitez contacter un collaborateur de l'Université de Kinshasa qui siège au comité d'éthique national :

- Nom : Jack Kiyembi
- Adresse : École de Santé Publique, Université de Kinshasa
- E-mail : kiyembi@gmail.com

Titre de l'étude : Mener un processus d'évaluation de la mise en œuvre, du contexte et des mécanismes d'impact de la distribution de la trousse d'hygiène pendant une épidémie de choléra

Consentement de participation :

Je déclare avoir lu les informations reprises plus haut, ou que ces informations m'ont été lues, et les avoir comprises. Je déclare avoir posé toutes les questions qui me sont venues à l'esprit à ce moment. Je déclare vouloir volontairement participer à cette étude de recherche (cocher une seule case).

☐ **Oui** ☐ **Non**

Je déclare autoriser que les informations que j'ai fournies pendant mes entretiens soient citées de manière confidentielle pour communiquer les résultats de la présente étude de recherche et dans le cadre de l'analyse de la présente étude de recherche ainsi qu'à des fins didactiques. Les informations relatives à l'étude pourront potentiellement être vues par des chercheurs, des professionnels de la santé et des décideurs de la République Démocratique du Congo (cocher une seule case).

☐ **Oui** ☐ **Non**

Numéro d'ID du participant		Date
Signature ou empreinte du pouce du participant à la recherche		
Nom en lettres majuscules du participant à la recherche		
Signature du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		
Nom en lettres majuscules du membre de l'équipe de l'étude de recherche qui a obtenu le consentement		

1 copie du feuillet d'information pour le participant à l'étude et du consentement éclairé à la participation à l'étude

Ce feuillet d'information vous est destiné et doit être conservé. Nous vous remercions d'avoir pris le temps de lire et de signer ce document.

Appendix F. Ethical Approval Certificates

T. Ethical approval for Research Paper 2 and 3 from LSHTM

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
United Kingdom
Switchboard: +44 (0)20 7636 8636

www.lshtm.ac.uk

Observational / Interventions Research Ethics Committee

Ms. Lauren D'Mello-Guyett
LSHTM

19 December 2017

Dear Ms. Lauren D'Mello-Guyett

Study Title: Prevention and control of cholera in complex emergencies in Sub-Saharan Africa: evaluating the effectiveness of water, sanitation and hygiene interventions used by Médecins Sans Frontières

LSHTM Ethics Ref: 14425

Thank you for responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Protocol / Proposal	1 Study Component 1_Case-Control_Protocol_South Sudan_Cholera	29/09/2017	1
Protocol / Proposal	2 Study Component 2- Prospective Cohort_Protocol_South Sudan_Cholera	29/09/2017	1
Protocol / Proposal	3 Study Component 3- Process Evaluation_Protocol_South Sudan_Cholera	29/09/2017	1
Protocol / Proposal	Annex B1 South Sudan_Cholera_Case-Control Survey_Word Document	29/09/2017	1
Protocol / Proposal	Annex B2.1_South Sudan_Cholera_Prospective Cohort_Baseline Survey_Word Document	29/09/2017	1
Protocol / Proposal	Annex B2.2. South Sudan_Cholera_Prospective Cohort_Follow Up Survey_Word Document	29/09/2017	1
Protocol / Proposal	Annex B3.1. South Sudan_Cholera Process Evaluation_Semi-structured observation form	29/09/2017	1
Protocol / Proposal	Annex B3.2. South Sudan_Cholera Process Evaluation_Key informant interview form_MSF	29/09/2017	1
Protocol / Proposal	Annex B3.3. South Sudan_Cholera Process Evaluation_Key informant interview form_other organisations	29/09/2017	1
Protocol / Proposal	Annex B3.4. South Sudan_Cholera Process Evaluation_Key informant interview form_households	29/09/2017	1
Protocol / Proposal	Annex B3.5 South Sudan_Cholera_Process Evaluation_Activity log data extraction form_Word Document	29/09/2017	1

Investigator CV	Annex G2.1 2017 CV- D'Mello-Guyett, Lauren	29/09/2017	1
Investigator CV	Annex G2.2 2017 CV Peter Maes	29/09/2017	1
Investigator CV	Annex G2.3_2017 CV Mathew Tut	29/09/2017	1
Investigator CV	Annex G2.4 201704_CV Rob D'HONDT	29/09/2017	1
Investigator CV	Annex G2.5 2017 CV Farah Hossain	29/09/2017	1
Investigator CV	Annex G2.6 2017 Ruben Conner CV	29/09/2017	1
Investigator CV	Annex G2.7 2017 CV_Francesco_Checchi	29/09/2017	1
Investigator CV	Annex G2.8 2017 Oliver Cumming_LSHTM CV	29/09/2017	1
Investigator CV	Annex G2.9 2017 CV Rafael Van Den Berghpdf	29/09/2017	1
Information Sheet	Annex F1 South Sudan_Cholera Case-Control_Informed Consent and Participant Information Sheet	29/09/2017	1
Protocol / Proposal	Annex C1 South Sudan_Cholera_Water sample collection- SOP	29/09/2017	1
Protocol / Proposal	Annex D South Sudan_Cholera_Food sample collection- SOP	29/09/2017	1
Protocol / Proposal	Annex E South Sudan_Cholera_Rectal swab collection-SOP	29/09/2017	1
Information Sheet	Annex F2 South Sudan_Cholera Prospective Cohort_Informed Consent and Participant Information Sheet	29/09/2017	1
Information Sheet	Annex F3 South Sudan_Cholera Process Evaluation_Informed Consent and Participant Information Sheet	29/09/2017	1
Covering Letter	South Sudan_Cholera_LSHTM_Reply to ethics_D'Mello-Guyett	14/12/2017	1

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

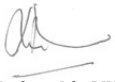
An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: http://leo.lshtm.ac.uk

Additional information is available at: www.lshtm.ac.uk/ethics

Yours sincerely,



Professor John DH Porter
Chair

ethics@lshtm.ac.uk
http://www.lshtm.ac.uk/ethics/

Improving health worldwide

U. Ethical approval for Research Paper 2 and 3 from the Ministry of Health, DRC

REPUBLIQUE DEMOCRATIQUE DU CONGO
MINISTERE DE LA SANTE PUBLIQUE
COMITE NATIONAL D'ETHIQUE DE LA SANTE – CNES –

Arrêté Ministériel n°1250/CAB/MIN/S/ZKM/043/MC/2006 du 18 Décembre 2006
N° d'enregistrement au U.S. Department of health and Human Services (HHS) : IORG0008558/ IRB
N° d'enregistrement au Federalwide Assurance (FWA) : 00026293

Avis du Comité National d'Ethique de la Santé n°67/CNES/BN/PMMF/2018 du 12/02 /2018

MEDECINS SANS FRONTIERES
BELGIQUE KINSHASA
Secrétariat
Courrier reçu le 13/02/2018
Nr. 232

Kinshasa, le 12 Février 2018

A Madame Hilde Vochten,
Coordinatrice Médicale,
Médecins Sans frontière – Belgique.

Concerne : Avis éthique sur le protocole d'étude intitulé : « Prévention et lutte contre le choléra lors d'urgences complexes en Afrique subsaharienne : évaluer l'efficacité des interventions eau – hygiène - assainissement de Médecins Sans frontières en république démocratique du Congo ».

Madame la Coordinatrice,

Le Comité National d'Ethique de la Santé du Ministère de la Santé de la République Démocratique du Congo a bien reçu votre protocole de recherche dont l'intitulé est repris en marge et vous en remercie.

Après l'examen dudit protocole d'étude selon les lignes directrices nationales d'éthique de la recherche impliquant des êtres humains du Ministère de la santé de notre pays et conformément à la décision du CNES n° 001/CNES/SR/03/2015 du 13 Mars 2015 exigeant aux chercheurs œuvrant dans le secteur de la santé de soumettre leurs études à l'évaluation éthique, le Comité National d'Ethique de la Santé a donné son approbation à cette étude.

Il autorise son déroulement dans la Ville-province de Kinshasa, respectivement dans les centres de traitement du choléra pour la période allant du 13 Février 2018 au 12 Février 2019.

Veuillez agréer, Madame la Coordinatrice, l'expression de nos sentiments les meilleurs.

Professeur Félicien MUNDAY MU
Président du Comité National d'Ethique d
République Démocratique du Cong

Siège Administratif : Immeuble [illegible] 1er Niveau, Local 5, Commune de Kasa-Vubu
Contact :(+243) 99 84 19 8 16, cnesrdcongo@gmail.com , feli1munday @yahoo.fr

V. Ethical approval for Research Paper 2 from Médecins Sans Frontières

Ethics Review Board
Instituted by *Médecins Sans Frontières*

Tony Reid
Medical Editor
Operational Research Unit, Luxembourg
MSF Brussels

Cc: Annick Antierens

17 July 2018

Re: Ethics approval of the generic protocol "Evaluating the effect of an MSF hygiene kit intervention on domestic transmission of cholera among household contacts of cholera-infected patients", Version 6 dated 06/07/2018 (ID 1805b)

Dear Tony;

Thank you for your reply to our review of the above-mentioned protocol. We are happy with the answers provided by the investigators and **thus approve this *generic protocol***. Please ensure that all people associated with the research receive a copy of the final, approved generic protocol.

Because this generic protocol is now approved, contextualized protocols may be submitted for rapid emergency review and approval as the need arises. It would help if any contextualized protocols were in track-changes to facilitate our rapid review.

As indicated in the generic protocol, we would require, in due time, copies of the ethics approvals from the *LSHTM Ethics Committee* and the *University of Kinshasa School of Public Health*.

We wish you much success with the research.

Yours sincerely,

[redacted]

Raffaella Ravinetto
Chairperson, Ethics Review Board

W. Ethical approval for Research Paper 3 from Médecins Sans Frontières

Ethics Review Board
Instituted by *Médecins Sans Frontières*

Tony Reid
Medical Editor
Operational Research Unit, Luxembourg
MSF Brussels

Cc: Annick Antierens

17 July 2018

Re: Ethics approval of "Conducting a process evaluation on the implementation, context and mechanisms of impact of hygiene kit distribution during a cholera outbreak", Version 6 dated 05/07/2018 (ID 1805c)

Dear Tony;

Thank you for your reply to our review of the above-mentioned protocol. We are happy with the answers provided by the investigators and **thus approve this *generic protocol***. Please ensure that all people associated with the research receive a copy of the final, approved generic protocol.

Because this generic protocol is now approved, contextualized protocols may be submitted for rapid emergency review and approval as the need arises. It would help if any contextualized protocols were in track-changes to facilitate our rapid review.

As indicated in the generic protocol, we would require, in due time, copies of the ethics approvals from the *LSHTM Ethics Committee* and the *University of Kinshasa School of Public Health*.

We wish you much success with the research.

Yours sincerely,

[redacted]

Raffaella Ravinetto
Chairperson, Ethics Review Board

X. Ethical approval for Research Paper 4 from LSHTM

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
United Kingdom
Switchboard: +44 (0)20 7636 8636

www.lshtm.ac.uk

Observational / Interventions Research Ethics Committee

Ms. Lauren D'Mello-Guyett
LSHTM

8 November 2019

Dear Lauren,

Study Title: Responding to cholera: a review of MSF interventions in in settings of recurrent cholera to identify facilitators to effective implementation of water, sanitation and hygiene (WASH) interventions

LSHTM Ethics Ref: 17994

Thank you for your application for the above research project which has now been considered by the Observational Committee via Chair's Action.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Approved documents

The final list of documents reviewed and approved is as follows:

Document Type	File Name	Date	Version
Investigator CV	Annex G2 2017 CV Peter Maes	29/10/2019	1
Investigator CV	Annex G3 2017_CV Rob D'HONDT	29/10/2019	1
Investigator CV	Annex G4 2017 CV Rafael Van Den Berghpdf	29/10/2019	1
Investigator CV	Annex G6 2017 CV_Francesco_Checchi	29/10/2019	1
Investigator CV	LSHTM 2019 CV- D'Mello-Guyett, Lauren	29/10/2019	1
Investigator CV	Annex G5 2017 Oliver Cumming_LSHTM CV	30/10/2019	1
Protocol / Proposal	LSHTM_D'Mello-Guyett_Cholera Response Review_Protocol (1)	30/10/2019	1

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using the End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: http://leo.lshtm.ac.uk.

Further information is available at: www.lshtm.ac.uk/ethics.

Yours sincerely,

[redacted]

Professor Jimmy Whitworth
Chair

ethics@lshtm.ac.uk

Y. Ethical approval exemption for Research Paper 4 from Médecins Sans Frontières

Ethics Review Board
Instituted by *Médecins Sans Frontières*

Tony Reid
Medical Editor
Operational Research Unit, Luxembourg
MSF Brussels

Cc: Veerle Hermans, Jo Robays

ID: Opinion on the research protocol "Responding to cholera: a review of past water, sanitation and hygiene (WASH) interventions implemented by Médecins Sans Frontières (MSF) in areas with recurrent cholera", Version 1 dated January 2020

Protocol received for ERB opinion on 25/02/2020 from Tony Reid
ERB opinion shared on 26/02/2020 with Tony Reid

Dear Dr Reid,

Thank you requesting the ERB opinion on the above-mentioned protocol. From our understanding, for this scoping review, the unit of analysis is the cholera intervention report; and such reports would only contain aggregated data, with no direct or indirect personal identifiers. If it is so, and if the reports do not contain sensitive information at community or country level, we agree the exemption criteria apply here.

Concerning the need of the local ethical approvals, the MSF ERB does not have the authority / legitimacy to waive them, nor have we country-by-country information about the local requirements. Therefore, it remains the researchers' responsibility (a) to ensure compliance with local requirements in the DR Congo, Nigeria, Mozambique and Zimbabwe; and (b) to verify if permission to share these reports is needed from MSF local operational partners (e.g. MoH in each of sites), based on any former agreements with them, and on whether the reports contain any other (non-patient level) sensitive information.

Relatedly, we note that the research group seems not to include any individual or institutional (non-MSF) partners from the four countries where data originated. This would be very important for fairness, collaborative partnership, and for making it more likely that the research findings may inform local policies in these countries.

On a formal note, the sentence in the protocol (search strategy) "*The intervention reports will be published in French and English*" is suggestive or publication of individual reports: perhaps this could be clarified, as individual reports would not be published as part of this research.

We hope this is helpful, and we remain available for any further clarification.

With best regards

For the ERB,

[redacted]

Chairperson, Ethics Review Board