

RESEARCH ARTICLE

Developing context-specific water, sanitation and hygiene guidance for National Cholera Plans: Qualitative inputs

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Abstract

Globally, cholera continues to cause morbidity and mortality, and the Global Task Force on Cholera Control (GTFCC) works with countries affected by cholera to develop National Cholera Plans (NCPs). Water, sanitation, and hygiene (WASH) can prevent and/or control cholera. However, WASH program success varies, and is not necessarily replicable across contexts. Thus, guidance needs to be developed to assist countries in appropriately designing WASH programming in NCPs. The objective of this project was to develop guidelines for selecting context-specific WASH for cholera response. For that, a literature review of WASH interventions in cholera was completed, a Working Group was convened to collaboratively develop the guidelines, and we conducted key informant interviews (KII) with Working Group experts, representing international and national non-governmental organizations, donors, international organizations and health authorities. Inductive qualitative content analysis of KIIs was completed. KIIs were conducted with 18 informants, and data was coded into 26 subcategories, categorized under: 1) intervention objectives; 2) decision factors; 3) intervention circumstances; 4) influencing factors; and, 5) WASH activities. Based on these categories, we developed guidelines with the following steps: 1) define the disease objective (control, prevention, or elimination); 2) understand and define the broad context (including existing WASH infrastructure and population habits, available funding, outbreak sources and transmission pathways, stakeholder capacity, and access difficulties); and, 3) focus on monitoring of activities, multi-sectoral coordination (including WASH and health), and targeted approaches, both for implementation and future research. Overall, while building upon previous research and guidance, our results expand to include specific guidance for countries incorporating WASH into their NCPs, and highlight the necessity of a broad contextual understanding to select the most appropriate and successful WASH for cholera programming. These results have been used, with GTFCC, to develop a guidance document for including context-specific WASH in NCPs.

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Introduction

Infection with toxigenic *Vibrio cholerae* O1/O139 bacteria can cause profuse watery stool, vomiting, and severe dehydration, and can result in death [1]. Cholera is highly transmissible through ingestion of contaminated food and water. In 2020, 27 countries reported 323,320 confirmed cases and 857 deaths related to cholera [2]. The total global cholera burden is estimated to 2.9 million cases and 95,000 deaths per year [3].

As cholera is transmitted through the fecal-oral route [4], long-term sustainable water, sanitation, and hygiene (WASH) interventions are critical to prevent and control outbreaks, by disrupting transmission routes [5–7]. Water interventions focus on access to safe drinking water; sanitation interventions aim to isolate feces from the environment; and, hygiene interventions target personal and environmental hygiene, such as handwashing and surface disinfection. In practice, two or more approaches are often implemented together, targeting multiple transmission routes [8].

Interrupting transmission pathways depends on the efficacy (ability to break the transmission route) and effectiveness (as implemented and used) of an intervention. As the effectiveness of interventions varies in different contexts, high efficacy levels do not always translate to high effectiveness, and interventions are not necessarily replicable across contexts [5, 9, 10]. Four systematic reviews found that WASH interventions can reduce disease transmission if they are context-appropriate [5–7, 11], with success factors including being appropriately timed, simple to use, community-driven, and the population having previous exposure with, and receiving trainings on, the intervention. Contextual understanding in program design and implementation is thus important to maximize the potential effectiveness of WASH programming.

The Global Task Force on Cholera Control (GTFCC) is a global network working to eliminate cholera. The GTFCC supports countries facing cholera to develop and implement National Cholera Plans (NCPs) [12], which include first identifying cholera hotspots, and then developing WASH (and other) interventions to reduce cholera. However, to date, the WASH guidance in NCPs is weak, stating only need to meet Sustainable Development Goals of ensuring safely managed water and wastewater, and not including context-specific cholera response interventions. Thus, there is a gap in summarizing context-specific recommendations on WASH interventions in current NCPs [13].

With support from the Bureau for Humanitarian Assistance of the United States Agency for International Development, Tufts University worked to understand cholera response by context by: 1) completing a literature review of WASH interventions in cholera, by context; 2) convening a Working Group to discuss cholera by context, including collaborative development of NCP guidance; and, 3) conducting key informant interviews (KIIs) with Working Group members to define priority factors for selecting and implementing WASH interventions in cholera contexts. This manuscript reports the results of the KIIs, used to help develop the WASH guidelines for NCPs.

Methods

As part of the overall project, a Working Group was created to collaboratively develop WASH guidance for NCPs. Its creation was advertised through e-newsletters, existing working groups, and professional contacts of the researchers. The target members were experts in WASH in cholera settings. Interested experts directly contacted the researchers to join the Working Group. There was no further selection for entry into the Working Group. The members represented international and national non-governmental organizations (NGO), donors, international organizations (e.g. UNICEF), and international and local government health

authorities. The Working Group was first convened in December 2020, and the last meeting was in February 2022 once the guidance was finalized. Working Group meetings were scheduled on a semi-monthly basis.

The study protocol was approved by the Social, Behavioral, and Educational Research Institutional Review Board at Tufts University (#STUDY00000442). We adhered to the guidelines from the Equator Network and others to conduct and report the qualitative research [14–16]. Potential participants for the key informant interviews were the 21 initial members of the Working Group. The participants were recruited by email. Included study participants reviewed the informed consent document and gave oral consent, as this research was no more than minimal risk to participants. The researcher recorded their consent in the consent form. Participants located in a European Economic Area country and Switzerland reviewed the General Data Protection Regulation Data Protection Notice and signed the informed consent document.

Interviews were conducted online on, and audio recorded by, WebEx (Milpitas, CA, USA), from January to March 2021. Interviews lasted between 30 minutes and 2.5 hours. A 19-question semi-structured KII guide was developed. Questions were designed to collect qualitative information on WASH interventions related to cholera contexts and on programmatic aspects of WASH response in cholera. Based on the authors' extensive experience responding in, and academic knowledge of, cholera contexts and WASH activities, the questions were designed around categories of contexts (for example, epidemic/endemic, emergency/development, natural disaster/conflicts, host communities/camp settings) and WASH activities (water, sanitation, and hygiene interventions). A researcher conducted the interviews in English and French and verified the transcriptions.

Transcripts were uploaded to NVivo (Burlington, MA, USA) for qualitative analysis, using qualitative content analysis. The same researcher that conducted interviews also read and coded the transcripts. Preliminary codes were assigned to the pre-identified context and activity categories. However, many meaningful transcript segments were not classified into these categories, so additional categories and subcategories were created. After initial coding, transcripts were re-reviewed to harmonize codes across the transcripts, with categories and subcategories renamed and reordered based on updated codes. This process was completed iteratively until no more additional codes were found in the transcripts, and all codes were harmonized across all transcripts. The final coding tree is reported below in [Table 1](#).

The same researcher interpreted and triangulated the main categories and subcategories, reviewed by all co-authors. A narrative summary of main findings is presented in the results section, and an interpretation of the categories is presented in the discussion section. The KII findings were shared and discussed during the Working Group meetings. These KII findings were triangulated with the literature review results, and were used to develop the final guidelines for WASH in NCPs, through iterative discussion and edits from the Working Group.

Results

In total, 21 Working Group members were contacted for study inclusion and 18 KIIs were conducted. There were nine men and nine women. Informants worked for international and national NGOs ($n = 9$), international donors ($n = 3$), international organizations ($n = 1$), health ministries ($n = 2$), and as consultants ($n = 3$). A summary of the main findings is presented by coding category.

Table 1. Coding tree.

Intervention objectives	Decision factors	Intervention circumstances	Influencing factors	WASH activities
Disease control ^b Disease elimination ^b Disease prevention ^c	Existing WASH infrastructures and populations' habits ^c Available funding ^c Outbreak sources and transmission pathways ^c Stakeholders' capacity ^c Access difficulties ^c	Development ^a Camps ^a Emergency ^a Conflicts ^a Urban ^c Host communities ^a Rural ^c Population displacement ^c Natural disasters ^a	Coordination between stakeholders ^c Collaboration between WASH and health sectors ^c Targeting and mapping of activities and cases ^c Monitoring of interventions ^c	Water ^a Hygiene promotion ^a Sanitation ^a Kit distribution ^c Disinfection ^c

^a pre-identified themes

^b modified theme

^c added theme

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Intervention objectives

During outbreaks, ensuring safe water and hygiene promotion activities were considered essential by 16 informants, while sanitation was considered not a priority by nine informants, as increasing the use of toilets requires months or years. Chlorination or rehabilitation of all water sources was thought as necessary by fourteen informants. A need for strong sensitization and training of households in case of household water treatment was outlined by nine informants. Fourteen informants indicated that multiple streams of communication should be used to reach the population, especially using existing health networks and information channels trusted by the community. For example, oral rehydration points in communities or disinfection at household level of latrine slabs are opportunities to pass messages. Hygiene promotion focused on handwashing and water treatment, as highlighted by 14 informants. Additionally, inclusion of both disease and WASH related messages were detailed by 10 informants:

“The health promotion side of things about making sure households knew what the symptoms of cholera were, and when they should seek treatment. And then, obviously, the hygiene promotion, the increased emphasis on hand washing that you would expect to see as a cholera campaign.” Donor staff

Nine informants highlighted that cholera kits used in disease control should include very few items: soap, jerricans, and/ or water treatment, as every item added in a kit increases the cost and procurement distribution timeline, and reduces the overall effectiveness of the kit as a cholera response. Disinfection of households were favored to raise awareness by four informants, and distributing household disinfection kits were recommended as an alternative by four other informants. Implementing WASH activities in cholera and health centers was also outlined by 10 informants as a key activity in these contexts.

Thirteen informants indicated that improving safe water and sanitation access was the focus when elimination of cholera was the objective, via the rehabilitation and construction of durable water systems (such as networks or boreholes), favoring centralized systems and household level of service provision, and focusing on building long-term infrastructure and ensuring service provision. This is further explained by one informant:

“It’s looking at more sort of long term sanitation improvements. So essentially improving sanitation and fecal disposal so there’s less contamination, less possibility of transmission, or mitigate the cholera outbreaks.” Donor staff

Nine informants indicated that hygiene promotion should focus on long-term behavior change for cholera elimination, but was considered more complex in contexts with recurring cholera because people are used to cholera and may not fear it. Hygiene promotion in these settings has to be constant and thought in terms of long-term behavior change, considering cultural and religious aspects. Six informants indicated that the community was usually more involved in the design of WASH activities when cholera elimination was the objective.

Hygiene promotion activities, and increasing water supply and water chlorination were considered key activities related to cholera prevention by five and four informants, respectively. Having quick access to essential items was outlined as important by six informants, as well as increasing latrine coverage, by three informants. Response plans prepared in multi-sectoral coordination were highlighted as key for preparedness by six informants. There is an opportunity for community involvement in developing preparedness plans and designing activities, and national plans allow preparing better before the cholera season, as it eases the coordination between actors and the articulation of activities:

“When we have a major refugee crisis, we have a framework agreement at the national level, so you can avoid crossing international borders which always delay supply of essential materials; we have a national agreement for rapid production and deployment. So our framework agreement for soap, from command, from demand to boxed and deployed, is three days.” UN staff

Four informants indicated that networks of practitioners, regularly trained on cholera response and WASH interventions, should be created to ensure a rapid response in case of outbreak.

Decision factors

WASH interventions strongly depend on existing services and infrastructures and population habits, and there can be multiple types of responses in one country. For example, in the 2009 cholera outbreak in Zimbabwe, the response was both in rural communities with rapid response mechanisms with local and international NGOs, and in urban areas with water treatment of major infrastructures. Thirteen informants highlighted that messages should be adapted to local risk behaviors and whether the population is used to cholera. Nine informants recommended that interventions should build on what exists, including the infrastructure, other actors, or what the population is used to. For example, if the population is used to cholera, alternatives to the shock and fear mobilization need to be found.

Availability of funding was considered a limiting factor for the implementation of WASH interventions by 14 informants. Five informants further explained that prioritization of interventions was thus needed:

“We’ve sort of always found ourselves a bit understaffed and under resourced. We’re always trying to prioritize our funding and our resources.” UN staff

Six informants indicated that the type and the sustainability of the interventions implemented depend on the funding available and the funding timeframe. The financial and human resources are never sufficient compared to the needs, so prioritization of interventions needs

to be done, both in outbreaks and longer-term interventions (health compared to WASH, or water compared to sanitation).

During an outbreak, 13 informants indicated that WASH interventions need to focus on disrupting the transmission cycle, prioritizing water chlorination and handwashing activities. Once the specific source and transmission pathways are identified, ten informants recommended that the interventions should be tailored to implement the necessary barriers. One informant detailed the following example from their experience:

“There was a cholera hotspot that developed around a particular water source that people had just moved to. There was a water source that was protected and was chlorinated as part of the cholera outbreak response. But people didn’t like the taste of it, and then some rains came and there was surface water available, which, for the taste element, a lot of people switched their water source to the open water supply. There was some open defecation upslope of that, that was clearly able to be identified as the source of the contamination. And so that was able to be addressed. And that’s an example where there is a clearly identified contamination pathway that can be blocked or changed.” Donor staff

The capacity of the government, international organizations, and overall health system were important in cholera response effectiveness, as indicated by four informants:

“There were capable government institutions, as well as capable UN and NGO partners there, that we were able to work through. So that response, we were able to focus much more, it was much more coherent, much more cohesive, better able to focus on monitoring the response.” Donor staff

Four informants outlined the need to strengthen capacity by training and capacity building on WASH interventions, especially focusing on networks of volunteers or rapid response teams. The extension staff from the local health authorities can be used to reach the population, as they are already trained.

Thirteen informants indicated that difficulties in accessing affected communities were mainly due to security issues, natural disasters, and remoteness. Eight informants indicated that this resulted in difficulties in assessing population needs, delivering materials, implementing and monitoring activities, and coordinating and communicating. Solutions include working with community-based workers, focusing on interventions that do not include infrastructures such as hygiene promotion activities, and to work with and support health facilities to distribute cholera kits and deliver hygiene messages to the population that can reach these facilities.

Intervention circumstances

Six informants stated long-term provision of safe water and sanitation services was the focus in development contexts, with five informants further recommending improving upon existing services. Working in coordination with national and local authorities was also considered a key feature by five informants.

Five informants indicated that responders provide the whole WASH package in camp settings, so they have more control over how the interventions are delivered. This is further described by one informant:

“Within a camp setting oftentimes all of the sanitation is provided by humanitarian actors, all of the water is provided by humanitarian actors, so in those situations, it’s easier to ensure that all the water is chlorinated, that everyone has access to hygienic latrines, etc.” Donor staff

Camp settings were the only context where informants stated latrines were built without direct impact for cholera control, as indicated by five informants.

Four informants indicated that in emergency contexts, interventions should focus on delivery of safe water and hygiene promotion activities, through water trucking or chlorination of water. Three informants recommended stockpiling of cholera kits in preparation of outbreaks, with a limited number of items such as soap and chlorine.

For both natural disaster and conflict settings, difficulties to access the community were highlighted by five and twelve informants respectively. One informant described an example from their experience:

“So I guess in Haiti, after the earthquake, just physical access, because the streets were blocked with rubble, was a major challenge. And DINEPA, the national authority did trucking water for a long time, at least six months, maybe a year. But the areas that they could access were so limited just because of the rubble everywhere.” Donor staff

Three informants indicated for each setting that the infrastructure was usually damaged. Three informants discussed that in conflict settings, the government may not have the capacity to coordinate the response, so working with non-state actors may be necessary. This issue was usually not present in natural disasters as highlighted by two informants.

Six informants indicated that, in urban contexts, the existing water networks and utilities are treated with chlorine when there is an outbreak, as urban contexts usually have water networks and utilities. Overall, improvement and rehabilitation of WASH infrastructure and drainage was recommended by five informants. Moreover, five informants indicated a lack of sanitation infrastructure, and sewers in particular, to treat and convey the wastewater away from the population.

Reaching displaced populations dispersed among host communities was highlighted as a major difficulty by three informants, as well as considering the power dynamics between these two populations and the consequences of the response in the host communities, as indicated by three informants.

Three informants highlighted that there is usually no WASH service provided by a central authority in rural contexts and that water supply is from a limited number of sources (surface water, boreholes, or open wells). In many contexts, the services are at the village level or very local level, and there is no strong presence of utilities or governmental bodies that provides centralized services.

When populations are moving, two informants considered it a challenge to provide WASH services and that household water treatment may then be the only adequate option. Three informants indicated that displacement may also be a vector of cholera transmission:

“In Ethiopia there was a huge cholera outbreak once [. . .], and it was being spread by the religious pilgrimages going on in Ethiopia where there was a lot of traditional eating of raw foods and also through religious need.” UN staff

Influencing factors

Thirteen informants discussed that good coordination was essential for a coherent response. Fifteen informants indicated the Ministry of Health was a key stakeholder and often the lead of the cholera response. For example, in South Africa, after a post-cholera analysis, the institutional arrangements were reviewed and the number of ministries involved in sanitation was reduced from thirteen to four to ease coordination. Sixteen informants highlighted that engaging with the community, especially to decide on the type of activity to implement and how (14 informants), and involving women (12 informants), was fundamental to ensure an appropriate response. Eleven informants indicated that collaboration between the WASH and health sectors allows the WASH sector to better target their interventions using epidemiological data. What the coordination should look like is further described by one informant:

“So it’s like moving with the health people, coordinate with them, find out what they know about from their disease surveillance and also help them with any knowledge that we know through any risk hotspots, whether it’s sort of related to WASH or just community hotspots where there’s a lot of solid waste or where there’s a lot of congestion of people, like in markets or that sort of thing. Or where there’s low lying areas which are often flooded or ponds where children are swimming, which are close to open flowing latrines.” UN staff

Eight and nine informants respectively stated that mapping of cases and adequate targeting of interventions are necessary to increase the efficiency of the response. Mapping of cases helps understand how the outbreak is evolving and ensures better targeting of WASH activities, and comparing WASH facility maps with case maps is key to understanding the source and transmission of the outbreak. Targeted approaches can have a higher impact with often scarce resources. One informant discussed an outbreak where the lack of mapping impacted the response:

“You often don’t find a decent cholera map until after the outbreak. So the Haiti one you can see it was definitely associated with the river, and so if I was a WASH person there, I would have focused on the river but actually you weren’t getting that data in a timely fashion.” Consultant

Water quality monitoring and data quality control were considered important to ensure the effectiveness of water activities by eight and three informants, respectively. Two kinds of indicators were used to measure the interventions’ success: indicators related to access to and safe use of WASH services, and mortality and morbidity data. Fourteen informants indicated using the first and nine the second, of which six indicated using both types of indicators. One informant discussed using both:

“The immediate ones about the quality of water, the quantity of water, people receiving messages, people understanding how cholera works and what happens there. Obviously we want a reduced number of cases of cholera, we’ll monitor those and ask those questions and try to get health data to figure out if we’re having that kind of impact.” NGO staff

Discussion

The objective of the overall project was to develop WASH guidelines for NCP development. The objective of the KIIs discussed herein was to define context-specific factors for the selection and implementation of appropriate WASH interventions in cholera contexts. We summarized results from 18 key informant interviews with WASH in cholera sector experts who participated in a Working Group on the overall project. We then: 1) identified factors useful to define the context for the selection of WASH interventions, 2) developed guidelines for responders in selecting context-appropriate cholera interventions; and, 3) highlighted factors that are key for successful implementation of interventions, and for further investigation and research. Each point is described below.

Overall, we found four categories that help define the context for WASH in cholera interventions. The main factor that emerged for the selection of WASH in cholera interventions was the aim of the intervention. Three distinct objectives emerged from interviews: cholera control, cholera prevention, and cholera elimination. *Cholera control* refers to the control of cholera during an outbreak with the aim to prevent further spread and transmission. *Cholera prevention* includes interventions implemented before an outbreak, to be ready to respond when the outbreak starts or to avoid having an outbreak by implementing activities ahead of time. Lastly, in contexts affected by recurrent cholera outbreaks, the objective is *cholera elimination*, through the overall improvement of WASH services to avoid outbreaks.

Five additional factors emerged as decisive for informants in defining contexts and selecting cholera related WASH interventions. These decision factors complement and feed into the intervention objectives categories to define cholera contexts, and indicate specific actions to take into account for the implementation of interventions. These factors include existing WASH infrastructure and population habits, available funding, the outbreak sources and transmission pathways, stakeholder capacity, and access difficulties.

A third category includes the general circumstances in which cholera-related WASH interventions are implemented, referring to contexts broadly understood by humanitarian practitioners. As the subcategories overlap with one another, with one context sometimes belonging to multiple circumstances (for example, a conflict setting with camps in a rural area), it is difficult to define a firm list of WASH interventions to be implemented in each of them. Contexts included in each circumstance however share some similar characteristics. In total, there were nine subcategories, including development, camps, emergency, conflicts, natural disasters, urban, host communities, rural, and population displacement.

The final category includes factors that influence the overall successful implementation of WASH in cholera response. These four factors are coordination between stakeholders, collaboration between the WASH and health sectors, targeting and mapping of activities and cases, and monitoring of interventions.

These results allowed us to develop guidelines for selecting context-appropriate WASH interventions in cholera, with the process shown in Fig 1. The first consideration is the cholera objective. This will determine a set of activities to prioritize, such as water chlorination for cholera control, stockpiling necessary items for cholera prevention, or ensuring long-term behavior change regarding hygiene practices for cholera elimination. These three objectives are not exclusive of one another and may be implemented at the same time in one context: interventions should be regularly adapted to ensure they address the most pressing issues.

Once the aim of the WASH interventions or program is clarified, the type of interventions that can be implemented and how to implement them will be further influenced by the decision factors. These factors define specifics of the context that will greatly influence the selection of WASH interventions. The situation for each of these factors needs to be known and the

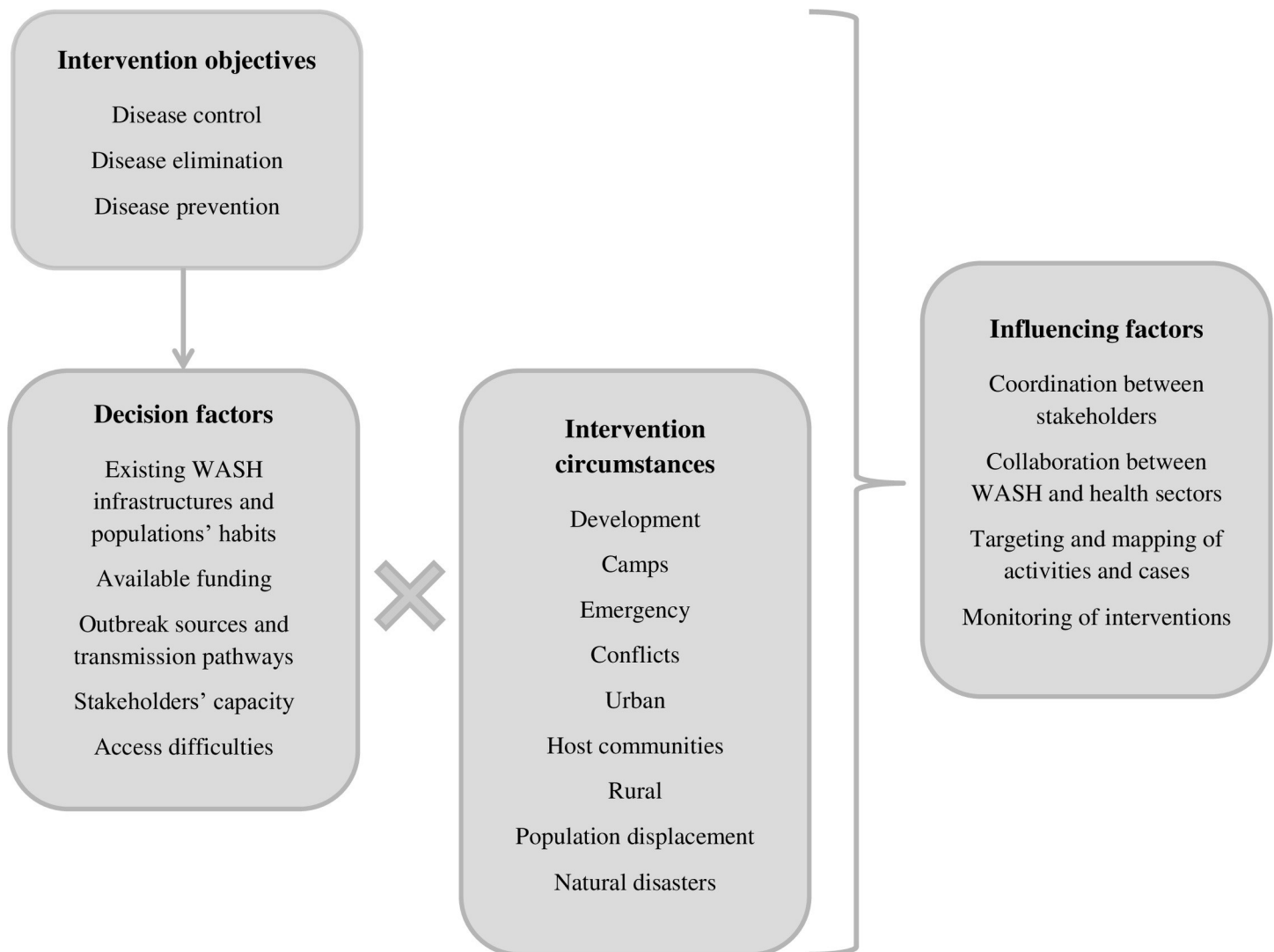


Fig 1. Process for selecting context-appropriate WASH interventions in cholera.

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WASH interventions adapted accordingly. For example, if there is no access to the affected populations, remote management of activities will be favored; if limited funding is available, more targeted interventions will be promoted; or if transmission happens mainly in households, WASH in households interventions will be implemented. These are usually the factors that will most help frame the overall response and interventions that can be implemented. Describing the local situation for all of these factors enables defining the context and selecting the appropriate interventions. Lastly, the circumstances help identify the set of characteristics that can help rapidly frame the response and understand what type of interventions can be implemented. For example, conflict settings usually mean difficulty accessing the affected populations; or population displacement and movement may mean additional cholera transmission pathways. However, these characteristics are not always true, depending on the context, and need to be verified in relation to each decision factor. For example, in a conflict setting, humanitarian actors can be granted access to populations to conduct life-saving activities.

Overall, these results are unique compared to existing WASH in cholera guidelines, because of their holistic nature. The separation of interventions by objective regarding the cholera can be found in Action Contre la Faim (ACF) guidelines and the UNICEF cholera toolkit [17, 18]. The focus on monitoring, coordination and targeting of activities with epidemiological data is also present in guidelines [17, 19, 20]. To our knowledge, in no other place does this type of holistic guidance exist.

These results corroborate previous research that a broad understanding of the context is needed to consider the WASH activities best suited for that context. The categories usually discussed (urban/rural, emergency/develop) provide a limited perspective of the context, and do not cover all the parameters that influence WASH intervention implementation. For that reason, it is not sufficient for the appropriate selection of WASH in cholera interventions. This is consistent with results from the systematic reviews summarized in the introduction, where it was found that interventions that were appropriately timed, simple to use, and community-driven were the most effective [6]; that HWT uptake was often linked to contextual factors, including: previous exposure to interventions, trainings by community health workers, and ease of use [13]; and, that contextual factors influence WASH intervention implementation [9].

The Global Task Force on Cholera Control supports countries facing cholera in developing their National Cholera Plans. Currently, in the absence of holistic cholera-specific guidance, the WASH guidance developed in these NCPs is primarily based on the Sustainable Development Goals to have safely managed water and sanitation, with broad and non-specific recommendations for context-appropriate WASH interventions in outbreak or emergency contexts [21, 22]. As part of this project, and based on the results of the KIIs, a WASH guidance for NCPs was developed. It provides guidelines for NCP developers to incorporate WASH into NCP development. Through semi-monthly conference calls with the Working Group, the guidance was collaboratively and iteratively developed over a year into a streamlined and approved document. The guidance has been published on the Global Task Force on Cholera Control website (<https://www.gtfcc.org/>), and is incorporated into their NCP development package.

The results also highlighted influencing factors, that are a focus for current and recommended future research, including coordination with other sectors (including on WASH and health), targeting of activities and mapping of cases, and monitoring of activities, each further described below.

Cholera response involves several sectors or clusters and, in particular, coordination between WASH and Health is crucial. For instance, Gartley *et al.* [23] in Haiti and D’Mello-Guyett *et al.* [24] in Democratic Republic of the Congo (DRC) were providing WASH interventions under the same organizational umbrella that was also managing the cholera treatment centers, and were able to target cholera patients coming to a clinic with hygiene items. The CHoBI7 program in Bangladesh [25] also had a strong connection to healthcare facilities. Lastly, Ngwa *et al.* [26] used a multi-sectoral WASH program in conjunction with an OCV program to halt an outbreak. In 2020, the Global Health and WASH Clusters developed a Joint Operational Framework [27] to promote a coordinated and integrated cholera response. Future research is needed on how best to integrate the WASH and Health sectors.

Recently, there has been research on using targeted WASH interventions toward individuals or hotspot areas in cholera to interrupt transmission. For example, targeted hygiene kits toward cholera patients and families were evaluated in DRC and Nepal [24, 28]. Bompangue *et al.* [29] targeted hot spot areas of an urban city with a focused WASH campaign including water disinfection and hygiene promotion. Called “case-area targeted interventions” (CATIs), this is a promising delivery mechanism for WASH (and other) interventions to reduce cholera. A retrospective observational study conducted over two years in Haiti suggested that rapid and repeated CATIs were effective at mitigating and shortening cholera outbreaks [30]. The

CHoBI7 hospital based intervention conducted in Dhaka, Bangladesh [25] resulted in reduced infections among household contacts of cholera patients. Furthermore, Sikder et al. [31] identified through systematic reviews and case studies that “CATIs appear effective in reducing cholera outbreaks, but there is limited and context specific evidence of their effectiveness in reducing the incidence of cholera cases”. Future research is needed on context-specific evidence for CATIs.

Multiple activities were found effective but they have to be regularly monitored over time. For instance, a decrease of free chlorine residual below the level recommended for safe drinking water was found a few days after chlorination for a well chlorination program in Cameroon [32]. Additionally, regular monitoring for appropriate chlorine residual in household stored water is critical to ensure effectiveness of source treatment. This was seen for bucket chlorination in Cameroon where households reported receiving the intervention, yet few households actually had the minimum free chlorine residual levels for safe drinking water [33]. However, even when activities are monitored, the scarcity and inconsistency of the reported data can make it difficult to draw conclusions about program effectiveness and to make recommendations to improve the response [34]. Future research is needed on how best to complete effective monitoring in cholera outbreaks.

This study has several limitations: 1) the KII methodology is limited to self-reported data by each individual, and interpretations are subject to personal bias, selective memory, or misattribution; 2) there may have been a self-selection of participants that participated in an international working group comprised of WASH in cholera experts; 3) there was only one cholera affected country government represented in the informants; and, 4) the KII question guide focused more on outbreak response, resulting in more information collected on the ‘cholera control’ category. We do not feel these limitations impacted our results as presented herein.

Conclusions

Overall, to implement context specific WASH in cholera interventions, responders should: 1) define the context through the cholera objective (control, prevention or elimination); 2) understand and define specifics to take into account for implementing interventions, including existing WASH infrastructures and populations’ habits, available funding, the outbreak sources and transmission pathways, stakeholders’ capacity, and access difficulties; 3) know which WASH interventions are the most effective, especially considering aspects for successful implementation; and, 4), when implementing a program, ensure multi-sectoral coordination (including WASH and health), targeted approaches, and monitoring of activities.

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References

1. Sack D, Sack R, Nair G, Siddique A. Cholera. *The Lancet*. 2004; 363 (9404): 223–233. [https://doi.org/10.1016/S0140-6736\(03\)15328-7](https://doi.org/10.1016/S0140-6736(03)15328-7) PMID: 14738797
2. World Health Organization. Weekly Epidemiological Record: Cholera, 2020. Geneva, Switzerland: World Health Organization; 2021. p 445–454.
3. Ali M, Nelson A, Lopez A, Sack D. Updated global burden of cholera in endemic countries. *PLoS Negl Trop Dis*. 2015 Jun 4; 9(6). <https://doi.org/10.1371/journal.pntd.0003832> PMID: 26043000
4. Center for Disease Control and Prevention [Internet]. Cholera—*Vibrio cholerae* infection. General Information. How does a person get cholera?. 2022 Sept 30. Available from: <https://www.cdc.gov/cholera/general/index.html>.
5. Taylor DL, Kahawita TM, Cairncross S, Ensink JHJ. The impact of water, sanitation and hygiene interventions to control cholera: a systematic review. *PLoS One*. 2015 Aug 18; 10(8):e0135676. <https://doi.org/10.1371/journal.pone.0135676> PMID: 26284367
6. Yates T, Vujcic JA, Joseph ML, Gallandat K, Lantagne D. Water, sanitation, and hygiene interventions in outbreak response: A synthesis of evidence. *Waterlines*. 2018; 37(1): 5–30.
7. Wolfe M, Kaur M, Yates T, Woodin M, Lantagne D. A systematic review and meta-analysis of the association between water, sanitation, and hygiene exposures and cholera in case-control studies. *Am J Trop Med Hyg*. 2018 Aug; 99(2):534–545. <https://doi.org/10.4269/ajtmh.17-0897> PMID: 29968551
8. Yates T, Vujcic JA, Joseph ML, Gallandat K, Lantagne D. Efficacy and effectiveness of water, sanitation, and hygiene interventions in emergencies in low- and middle-income countries: a systematic review. *Waterlines*. 2018 Jan; 37(1): 31–65.
9. Enger KS, Nelson KL, Rose JB, Eisenberg JNS. The joint effects of efficacy and compliance: A study of household water treatment effectiveness against childhood diarrhea. *Water Res*. 2013 Mar 1; 47(3):1181–90. <https://doi.org/10.1016/j.watres.2012.11.034> PMID: 23290123
10. Steele A, Clarke B. Problems of treatment process selection for relief agency water supplies in an emergency. *J Water Health*. 2008 Dec; 6(4):483–9. <https://doi.org/10.2166/wh.2008.059> PMID: 18401113
11. Lantagne D, Yates T. Household water treatment and cholera control. *J. Infect. Dis*. 2018 Nov; 218 (Suppl 3):S147–S153. <https://doi.org/10.1093/infdis/jiy488> PMID: 30215739
12. Global Task Force for Cholera Control (GTFCC). WHO | Ending Cholera: A Global Roadmap to 2030. WHO; 2017. <https://www.gtfcc.org/wp-content/uploads/2019/10/gtfcc-ending-cholera-a-global-roadmap-to-2030.pdf>
13. Global Task Force for Cholera Control (GTFCC). 4th Meeting of the Global Task Force on Cholera Control—WASH Working Group. Mérieux Foundation; 2019. <https://www.fondation-merieux.org/en/events/4th-meeting-of-the-global-task-force-on-cholera-control-gtfcc-wash-working-group/>
14. Korstjens I and Moser A. Series: Practical guidance to qualitative research. *European Journal of General Practice*. 2018.
15. Tong A, Sainsbury P and 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; 19(6):349–357. <https://doi.org/10.1093/intqhc/mzm042> PMID: 17872937
16. O'Brien BC, Harris IB, Beckman TJ, Reed DA and Cook DA. Standards for Reporting Qualitative Research: A Synthesis of Recommendations. *Academic Medicine*. 2017; 89(9).
17. Dunoyer J. Lutter contre le choléra ! Le rôle des secteurs EAH et SMPS dans la lutte contre le choléra. Paris, France: ACF International; 2013. <https://www.actioncontrelafaim.org/publication/lutter-contre-le-cholera-le-role-des-secteurs-eah-et-smps-dans-la-lutte-contre-le-cholera-2013/>
18. United Nations Children's Fund. Cholera Toolkit. New York, USA: UNICEF; 2013. https://sites.unicef.org/cholera/index_71222.html

19. Lamond E, Kinyanjui J. Cholera outbreak guidelines—Preparedness, prevention and control. Oxford, GB: Oxfam GB; 2012. <https://policy-practice.oxfam.org/resources/cholera-outbreak-guidelines-preparedness-prevention-and-control-237172/>
20. Solidarités International. Fighting Cholera Operational handbook—Response to outbreaks and risk prevention in endemic areas. Paris, France: Solidarités International; 2018. <https://reliefweb.int/report/world/fighting-cholera-operational-handbook-response-outbreaks-and-risk-prevention-endemic>
21. The Government of the Republic of Zambia. Zambia Multisectoral Cholera Elimination Plan 2019–2025. Lusaka, Zambia: The Government of the Republic of Zambia; 2019. <https://www.gtfcc.org/wp-content/uploads/2019/05/national-cholera-plan-zambia.pdf>
22. Revolutionary Government of Zanzibar. Zanzibar Comprehensive Cholera Elimination Plan (ZACCEP) 2018–2027. Revolutionary Government of Zanzibar; 2018. <https://www.gtfcc.org/wp-content/uploads/2019/05/national-cholera-plan-zanzibar.pdf>
23. Gartley M, Valeh P, de Lange E, Dicarolo S, Viscusi A, Lenglet A, et al. Uptake of household disinfection kits as an additional measure in response to a cholera outbreak in urban areas of Haiti. *J Water Health*. 2013 Dec; 11(4):623–8. <https://doi.org/10.2166/wh.2013.050> PMID: 24334836
24. D'Mello-Guyett L, Greenland K, Bonneville S, D'hondt R, Mashako M, Gorski A, et al. Distribution of hygiene kits during a cholera outbreak in Kasai-Oriental, Democratic Republic of Congo: a process evaluation. *Conflict and Health*. 2020; 14(1):1–17.
25. George CM, Monira S, Sack DA, Rashid M, Saif-Ur-Rahman KM, Mahmud T, et al. Randomized controlled trial of hospital-based hygiene and water treatment intervention (CHoBI7) to reduce cholera. *Emerg Infect Dis*. 2016 Feb; 22(2):233–41. <https://doi.org/10.3201/eid2202.151175> PMID: 26811968
26. Ngwa MC, Wondimagegnehu A, Okudo I, Owili C, Ugochukwu U, Clement P, et al. The multi-sectorial emergency response to a cholera outbreak in Internally Displaced Persons camps in Borno State, Nigeria, 2017. *BMJ Glob Health*. 2020 Jan 28; 5(1):e002000. <https://doi.org/10.1136/bmjgh-2019-002000> PMID: 32133173
27. Global Health Cluster, Global WASH Cluster. Joint Operational Framework. Improving coordinated and integrated multi-sector cholera preparedness and response within humanitarian crises. Global Health Cluster, Global WASH Cluster; 2020. <https://www.washcluster.net/cholera-joint-operational-framework>
28. Roskosky M, Acharya B, Shakya G, Karki K, Sekine K, Bajracharya D, et al. Feasibility of a comprehensive targeted cholera intervention in The Kathmandu Valley, Nepal. *Am J Trop Med Hyg*. 2019 May; 100(5):1088–1097. <https://doi.org/10.4269/ajtmh.18-0863> PMID: 30887946
29. Bompangue D, Moore S, Taty N, Impouma B, Sudre B, Manda R, et al. Description of the targeted water supply and hygiene response strategy implemented during the cholera outbreak of 2017–2018 in Kinshasa, DRC. *BMC Infect Dis*. 2020 Mar 18; 20(1):226. <https://doi.org/10.1186/s12879-020-4916-0> PMID: 32183745
30. Michel E, Gaudart J, Beaulieu S, Bulit G, Piarroux M, Boncy J, et al. Estimating effectiveness of case-area targeted response interventions against cholera in Haiti. *eLife*. 2019 Dec; 8: e50243. <https://doi.org/10.7554/eLife.50243> PMID: 31886768
31. Sikder M, Altare C, Doocy S, Trowbridge D, Kaur G, Kaushal N, et al. Case-area targeted preventive interventions to interrupt cholera transmission: Current implementation practices and lessons learned. *PLoS Negl Trop Dis*. 2021 Dec 17; 15(12):e0010042. <https://doi.org/10.1371/journal.pntd.0010042> PMID: 34919551
32. Guévert E, Van CH, Noeske J, Sollé J, Bitá AF, Manga B. Handmade devices for continuous delivery of hypochlorite for well disinfection during the cholera outbreak in Douala, Cameroon (2004). *Med Trop (Mars)*. 2008 Oct; 68(5):507–13.
33. Murphy J, Cartwright E, Johnson B, Ayers T, Worthington W, Mintz ED. An evaluation of a bucket chlorination campaign during a cholera outbreak in rural Cameroon. *Waterlines*. 2018; 37(4):266–279. <https://doi.org/10.3362/1756-3488.00009>
34. Ricau M, Lacan L, Ihemezue E, Lantagne D, String G. Evaluation of monitoring tools for WASH response in a cholera outbreak in northeast Nigeria. *Journal of Water, Sanitation and Hygiene for Development*. 2021; 11(6):972–982. <https://doi.org/10.2166/washdev.2021.056>