

**BRIEF REPORT**  
CHOLERA IN YEMEN:  
A CASE STUDY OF  
EPIDEMIC PREPAREDNESS  
AND RESPONSE



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*Saving lives through research, education and empowerment*

# BRIEF REPORT

## CHOLERA IN YEMEN: A CASE STUDY OF EPIDEMIC PREPAREDNESS AND RESPONSE

### 1. BACKGROUND

Since 2014, Yemen has been grasped in a complex civil war between government forces in the south supported by US/UK-backed Saudi-led Coalition Forces (SLC), and Houthi forces in the north in an alliance with the forces loyal to the former President Saleh. In 2015, the UN declared Yemen a Level 3 (L3) emergency to activate the highest level of resource mobilization across the humanitarian system. By 2016, only 46% of all health facilities were operating.<sup>1</sup> Extreme insecurity restricts the movement of civilians and food insecurity has put more than half of the population at risk of famine. On September 28, 2016, a large-scale cholera outbreak began, resulting in more than one million suspected cases in two waves, as of July 1, 2018.<sup>2</sup> In the last decade, similar large-scale and high-mortality cholera outbreaks have occurred in complex emergencies in Iraq, Somalia, and South Sudan. While the issues of “what to do” to control cholera are largely known, practices concerning “how to do it” in order to surmount challenges in coordination, logistics, insecurity, access, and politics, remain.

### 2. OBJECTIVES AND METHODS

During the Yemen cholera outbreak response, questions arose concerning how to effectively respond to a cholera outbreak at a national scale during an existing L3 emergency. The Office of U.S. Foreign Disaster Assistance (OFDA), supported by the Department for International Development (DFID) and the European Civil Protection and Humanitarian Aid Operations (ECHO), provided funding to the Johns Hopkins Center for Humanitarian Health for an unsolicited proposal for a case study of the response.

The main objective was to identify lessons learned from September 28, 2016 to March 2018 (i.e., from the preparedness and detection phase to the end of second wave of the outbreak) to better prepare for

future outbreaks in Yemen and similar contexts. The methods included literature reviews of global cholera guidance including in complex emergencies and Yemen-specific documents on the outbreak, interpretation of surveillance data, and key informant interviews (KII) with practitioners, donors, and technical experts involved in the response. The main limitation was the inability for the study team to visit Yemen due to the difficult nature of entering Yemen on the humanitarian roster.

**This brief report summarizes the key findings of the full report.** The results of the KIIs are summarized first by sector (surveillance, preparedness and strategy, case management and nutrition, water, sanitation, and hygiene (WASH), and oral cholera vaccination (OCV)) and by cross-cutting themes (social mobilization, insecurity, and coordination). We used the Global Task Force for Cholera Control’s (GTFCC) strategy for cholera control and reduction in mortality as a framework for our analysis:<sup>3</sup>

- Early detection and quick response to contain outbreaks at an early stage, including early warning surveillance systems, pre-positioning stocks, preparedness of WASH systems, preparedness of the health care system and improved infrastructure, establishment of WASH and health rapid response teams (RRT), maintenance of WASH supplies, specific WASH interventions to prevent spread of disease, community engagement, OCV, and supply management;
- A multisectoral approach to prevent cholera in hotspots in endemic countries, including identification of hotspots requiring priority action, analysis of local transmission patterns, and implementation of a package of control measures adapted to local transmission patterns; and
- Coordination for technical support, resource mobilization, and partnership at local and global levels.



### 3. RESULTS

The study team reviewed 58 Yemen-specific documents and conducted 71 KIIs with Action Contre la Faim, Canadian Red Cross/Yemen Red Crescent Society, CARE, Centers for Disease Prevention and Control, Center for Civilians in Conflict, DFID, ECHO, Epicentre, International Rescue Committee (IRC), General Authority for Rural Water Supply Projects, Health, Nutrition, and WASH clusters, Human Rights Watch, International Committee of the Red Cross, International Medical Corps (IMC), Médecins Sans Frontières (MSF) Holland and Spain, Office for the Coordination of Humanitarian Affairs, OFDA, OXFAM, Relief International, Save the Children, SOUL for Development, UNICEF (country office/regional office-MENARO/HQ), World Health Organization (WHO) (country office/regional office-EMRO/HQ), the UN Humanitarian Coordinator, and the World Bank.

### 4. SURVEILLANCE AND LABORATORY

***Cholera epidemics demand a rapid cycle of early detection, verification, and response that usually outstrips the capacity of the national surveillance system to support real-time monitoring. The capacity for detection and laboratory confirmation is critical to verify the outbreak's existence, and limit its spread. In emergencies, surveillance must focus on early outbreak detection, rapid response and containment.***

**Cholera trends, past and present:** In Yemen, small outbreaks of less than 300 cases were reported in 2009 and 2010 after an interepidemic period of 15 years. In 2011, a large outbreak of 30,000 acute watery diarrhea (AWD)/suspected cholera cases (attack rate 1.4%, case fatality rate (CFR) <1%) was reported in the south.<sup>4</sup> Regarding the 2016 outbreak, the first wave started on September 28, 2016 and last seven months with 25,839 suspected cases and 1,663 deaths reported, and 181 (36.9%) of 491 specimens culture-confirmed.<sup>5</sup> The second wave started in April 2017 with a rapidly increasing trend over two months and a gradually decreasing trend over eight months. This increasing phase occurred at the onset of the rainy season and was likely associated with a shift from the use of deep well water to contaminated surface water. It presents the hallmarks of cholera transmission, including a sharp ascent consisting of synchronous bursts across the Western area leading to a large and broad peak, high cumulative attack rates comparable to anticipated

standards (0.1-2% in large-scale outbreaks)<sup>6</sup>, a declining proportion of suspect cases among children under five years, a large proportion of severe cases (30.6%), and a high CFR (>2%) at the onset that decreased to <1% with the scale-up of treatment.<sup>6</sup> In contrast, atypical trends for a cholera outbreak, such as a long epidemic curve tail and a low proportion of severe cases, during the first wave and the tail of the second wave, suggest a large proportion of endemic diarrhea of non-cholera origin.

#### KEY FINDINGS:

**Early warning surveillance was present but not optimized for outbreak control.** Prior to the outbreak in 2016, the Ministry of Public Health and Population (MoPHP) and WHO implemented an early warning system using mobile phones (“eDEWS”).<sup>7</sup> eDEWS became overwhelmed by the increasing caseload, and could not support outbreak management, line-listing, and rapid response. Spreadsheets were instead emailed daily to the central office in Sana’a, resulting in long delays in cleaning, compilation and in ascertaining patient outcomes. During the second wave, “EWARS in a Box”, another early warning system, improved automated data collection, analysis, and reporting.

**Improvement of data quality could have been better addressed after the first wave.** While cholera outbreaks are characterized by over-reporting due to the sensitive case definition, in Yemen the true number of suspected cases and deaths is likely much lower than what has been reported. Although suspected cholera and AWD cases need to be treated, drawing a distinction between truly suspected cases and those not meeting the case definition is needed to target cholera transmission. Throughout the outbreak the suspected case definition was applied poorly for a number of reasons, including a large proportion of patients presenting to treatment centers to receive non-cholera care and the mixed use of both case register and cholera line-lists to document consultations. In addition, respondents reported health workers reporting cases falsely possibly due to fears that treatment centers would close and/or incentives would not be paid if there was an insufficient number of suspected cholera cases reported. Given the limited capacity of partners and the challenging environment, more accuracy in suspected and confirmed case ascertainment by geographic location would have helped with the targeting of resources, especially, the OCV campaign.

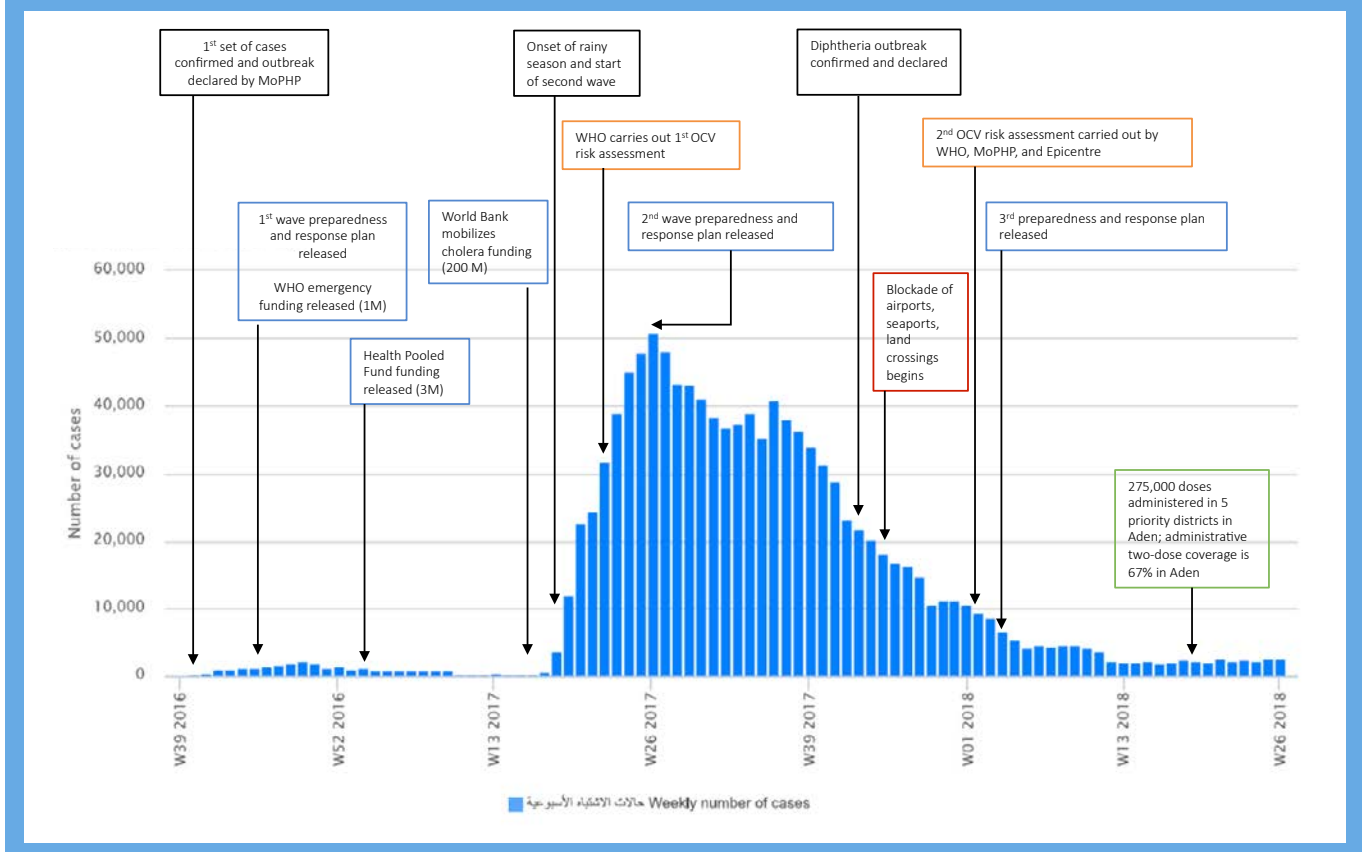
**Laboratory and epidemiological investigation were inadequate for monitoring the outbreak.** Laboratory guidance was inadequate, primarily due to a lack of a systematic method for culture use and a predictable lack of continuous supply of materials, specimen transport and testing capacity to meet demand. Laboratory refurbishment outside of two main cities should have been prioritized to ensure sufficient capacity to culture suspected cholera; this lack of culture capacity greatly affected the interpretation of trends. In addition, epidemiological investigations of transmission routes, high-risk groups, and hotspots did not occur at the start of the outbreak. The morbidity and mortality were difficult to monitor given that there were no discernable pathways to detect cases and deaths in the community. The lack of laboratory and investigation systems in the acute phase of the first and second waves hindered the ability of surveillance to adequately inform the response in epidemiological hotspots. This was demonstrated through the lack of inclusion of this key epidemiological information to guide the response across all of the cholera preparedness and response plans.

## 5. PREPAREDNESS, STRATEGY, AND FUNDING

*Preparedness for cholera detection and response involves strengthening early warning surveillance and laboratory systems, health systems and WASH systems to react to cholera, and pre-positioning stocks at strategic locations in the event of an outbreak. This is typically done by drafting a cholera preparedness and response plan, and updating the plan in the event of an outbreak.*

Figure 1 shows the critical points in time for disease occurrence, key interventions, and the release of funding. It does not however imply actions had immediate impacts on the caseload.

**Figure 1: Timeline of key events of the cholera outbreak, 2016-present**



**KEY FINDINGS:**

**Prior to the outbreak, Yemen did not have an adequate cholera preparedness and response plan despite prior cholera outbreaks, endemicity in the region, its active conflict, and WHO regional office initiatives.** Upon declaration of the outbreak in October 2016, the health and WASH clusters and the MoPHP rapidly developed an integrated cholera preparedness and response plan in the same week, and a second plan in November 2016. Both plans emphasized preventative WASH approaches in governorates where cholera had been confirmed or was likely to erupt rather than targeted approaches.<sup>8</sup>

**The initial cholera preparedness and response plans did not prioritize standard components** such as epidemiological analysis, use of the oral cholera vaccine, community surveillance, and infection prevention and control or clear gaps (e.g., improvement of poor laboratory capacity due to lack of culture-capacity and remote monitoring of the application of the case definition). One respondent specified that if the strategy was more institutionalized in the first wave and lessons were applied, the second wave could have been better controlled.

**Subsequent iterations of the plans were detailed and well-developed, but were late to address the acute phase of the second wave.** This third iteration of the cholera preparedness and response plan was issued at the peak of the second wave, in July 2017, and emphasized targeted control in 286 districts and prevention in 47 districts.<sup>9</sup> A fourth iteration was released in February 2018 in preparation for a potential surge. It was more comprehensive, including information on target populations and coordination mechanisms, and more targeted toward affected populations.<sup>10</sup>

**Funding was adequate and rapidly accessible for cholera.** During the second wave, the World Bank resumed funding (USD 483 million) to WHO and UNICEF in response to pre-famine conditions and cholera through a recommitment of cancelled International Development Association grants via the Crisis Response Window. Some respondents from WHO Yemen stated that they believed the organization was able to respond in a timely manner in the second wave due to the World Bank's flexibility. The aim was to preserve basic health and nutrition services at the governorate level, and strengthen cholera control including surveillance, training, and district health operations. This initiated the

vital payment of health worker incentives, as salaries had not been paid in months. A positive consequence was that the joint funding ensured WHO and UNICEF could work and coordinate closely together to effect changes on the ground.

## 6. CASE MANAGEMENT, HEALTH, AND HIGH-RISK GROUPS (E.G. SEVERE ACUTE MALNUTRITION)

**Case management ensures prompt access to treatment to reduce the risk of severe dehydration and death and reduces community transmission by isolating patients. Most cases do not display symptoms or have mild or moderate symptoms that can be treated with oral rehydration solution. About 20% of symptomatic cases are severe and require intravenous rehydration and antibiotics. With access to appropriate treatment, the CFR in a treatment facility should remain below 1%.**

**KEY FINDINGS:**

**The treatment network of diarrhea treatment centers (DTC) and oral rehydration corners (ORC) was insufficiently decentralized and did not ensure adequate access for the entire population.** The strategy focused on establishing DTCs (both waves) and ORCs (second wave only) in or near existing health facilities, covering only the first zone within a district (e.g., walking distance to a health facility), rather than areas of need and more remote and less accessible areas.<sup>11</sup> ORCs provide access to rehydration at the community-level and should be the first point of contact for patient care. However, ORCs were only established after the start of the second wave in April 2017. The placement of ORCs did not address the epidemiological picture, and there was not a sufficient number to reach the intended ratio of ORCs to DTCs (see Figure 2: UNICEF and WHO recommended 5 to 8 ORCs for each DTC). Camacho et al. demonstrated that only 32.4% of suspect cholera cases in Yemen visited a DTC on the same day of symptom onset, while for 10.2% of patients it took two or more days to access care.<sup>5</sup> However, patients should be able to access an ORC within one hour of walking. Respondents called the health response to be “*treatment-focused*” and “*unable to address the outbreak at the source*”

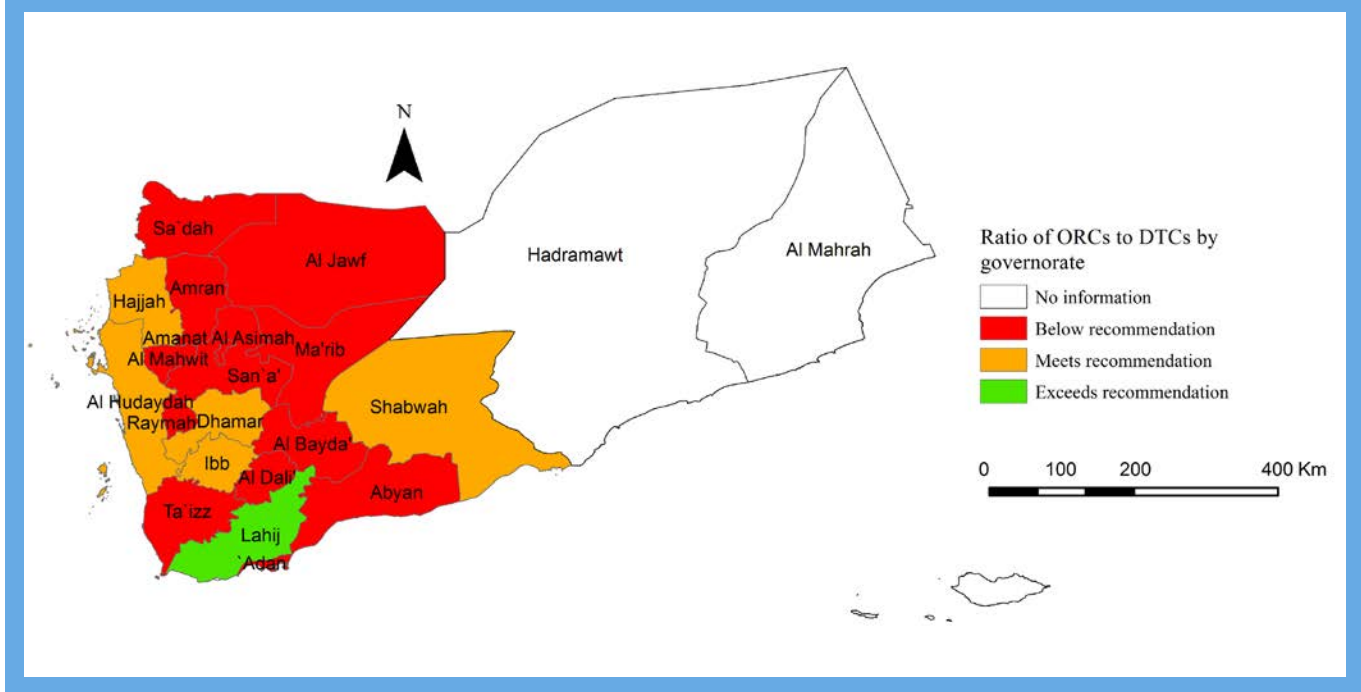
in the communities. The feasibility of undertaking a fully decentralized community-focused response was unlikely given the ongoing conflict and high insecurity. However, respondents stated that more outreach and decentralization of care could have been attempted.

**The approach for treatment facilities resulted in challenges in maintaining infection prevention and control (IPC) standards and likely caused disruption to primary health care services.** Decision-making regarding the infrastructure and location and for DTCs was driven primarily by the humanitarian need to integrate health services, including primary health care, nutrition, and cholera, in a single complex/building due to limited funding, human, and physical resources. This caused tension with cholera guidelines that typically recommend treating cholera in isolated centers. Physical spaces for DTCs included schools and health facilities, which were not ideal as they displace services and pose considerable challenges to maintaining IPC standards. It is also unclear how the non-cholera cases at the health centers were accommodated. As seen in some areas during the 2014-2016 West Africa Ebola outbreak, it is possible that patients with other conditions received little or no care.

**Case management guidance was delayed and inconsistent.** Adapted technical guidance on case management was provided with substantial delay. Technical guidance is usually the domain of a country's Cholera Task Force (CTF). Protocols from CTF/MoPHP/WHO for treatment were not published until the end of May 2017, after the start of the second wave. Similarly, there was no comprehensive list of DTCs and ORPs from the first wave available for reactivation in the second wave. At the start of the second wave, many DTCs were dysfunctional as they were occupied by displaced persons, looted of supplies, or being run as private businesses. Therefore, reactivation of DTCs for the second wave was less timely and efficient than it could have been. In response, the health cluster, MoPHP, and WHO released guidance for decommissioning of DTCs and standards for rapid reactivation.

**Quality of case management was always difficult to monitor.** Ongoing conflict and extreme insecurity severely limited the ability of international and national staff to travel within Yemen. Partners interviewed (e.g., IRC, IMC, MSF) had few or no expatriate health staff working or supervising work in the DTCs and ORCs. Thus, monitoring the quality of case management could not be

**Figure 2: Ratio of ORCs to DTCs during the second wave, April 24, 2017 – March 12, 2018**



Notes: The intended ratio was 5 to 8 ORCs per DTC; data sourced from Health Cluster list of DTCs and ORCs, current as of June 2, 2018<sup>12</sup> and Camacho et al., 2018.<sup>5</sup>



done systematically. One implementing partner stated that DTCs “clearly had quality issues”. However, beyond the use of national staff to conduct routine site visits and collect data when possible, and UNICEF’s use of third party monitoring, few respondents discussed tailored strategies to monitor quality.

**In large-scale cholera outbreaks in famine-prone areas, high-risk groups including pregnant women and children with severe acute malnutrition (SAM) require case management protocols.** Several standards and protocols key to a widespread cholera outbreak in a famine-prone country were not addressed, or addressed late. These include: the provision of food for patients and caregivers in DTCs; the treatment of pregnant women; and the treatment of patients with the co-morbid cholera and SAM.<sup>13</sup> Children with SAM require specific attention due to the risk of complications.<sup>14</sup> During the first wave, it was estimated that almost half of the country was famine-prone, and there were insufficient numbers of malnutrition treatment facilities.<sup>15</sup> In July 2017 during the second wave, WHO, UNICEF, and the MoPHP published a guidance note on fluid management for children with cholera and SAM, but it did not address management of SAM-specific complications (e.g., hypothermia and hypoglycemia) or operational guidance for children referred for SAM treatment after discharge from the DTC who may have still been shedding, and thus posing an infection risk to other SAM-affected children.<sup>16</sup> The management of acute malnutrition and cholera is discussed in detail in the full report.



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## 7. WATER, SANITATION, AND HYGIENE (WASH)

**WASH interventions fall into five categories: 1) increasing water quantity; 2) improving water quality; 3) isolating feces from the environment; 4) promoting (and facilitating with materials) hygiene; and 5) reducing environmental risks. For outbreak response, the goal of WASH is to rapidly interrupt disease-specific transmission routes; infrastructure development is not typically implemented.**

### KEY FINDINGS:

**WASH activities remained inappropriately comprehensive and generalized after the onset of the cholera outbreak.** Before the outbreak in 2016, UN agencies and international and national non-governmental organizations (INGO/NNGO) undertook development-style WASH. This included provision of water supply and sanitation, hygiene campaigns, and solid waste management. One INGO respondent described its cholera response as including “rehabilitat[ion] of water supply schemes” and “improvement of sanitation [by] improving the latrine coverage”. At the onset of the first wave in late 2016, INGOs continued generalized WASH practices with some modifications such as targeting interventions to cholera hotspots, adding cholera messages to hygiene programming, or managing waste in DTCs. A late 2017/early 2018 evaluation by the WASH cluster found that most beneficiaries were reached through system support to target urban districts (e.g., fuel, operations and maintenance support, rehabilitation, and support to sewage treatment plants).<sup>17</sup>

**In September 2017, 12 months after the start of the first wave of the outbreak and after the peak of the second wave, a cholera-specific WASH response was operationalized.** In the first wave, the WASH strategy focused on developing standard operating procedures, halting ineffective programming (e.g., well chlorination), and developing a strategic approach. The October 2016 integrated cholera preparedness and response plan included blanket distribution to generalized high-risk areas with reported confirmed or suspect cases, rather than interventions in cholera-affected households and communities. In July and August 2017, after the peak of the second wave, a new strategy included chlorination



at all points in the water chain to reduce transmission risk in hotspots and use of decentralized rapid response teams (RRT) to target cholera-affected households to prevent intra-familial and neighborhood transmission. This response aimed to proactively get ahead of the outbreak, target hotspots, and interrupt transmission. Run through the governments and RRTs, the strategy could achieve access and scale, but faced challenges for rapid implementation.

**Monitoring using free residual chlorine (FRC) as a primary outcome remained a gap, though this should be a main facet of a remote monitoring approach.**

While 64% (16/25) of responding partners in a survey of WASH cluster partners reported routinely completing post-distribution monitoring and FRC testing, there were significant difficulties in collating FRC data at the WASH cluster level.

**The main reported barriers to operationalizing a cholera-specific WASH response were insecurity, coordination, line-list access, and funding to NNGOs and the government.**

- Both INGOs and NNGOs noted security concerns that meant technical staff had difficulty obtaining visas to come in-country, and when in Yemen they faced difficulties in leaving their offices and had an insufficient on-the-ground sense of what was happening in programs; these issues made the response less technical, slower, and more expensive;
- While national-level cluster coordination that occurred from Sana'a was well regarded, there were less positive perspectives regarding technical knowledge and the organization of the sub-national clusters and in working with the cluster in Aden;
- The lack of timely access to the line-list data interfered with cholera-specific WASH programming to prevent transmission by the RRTs. The line-list was outdated by one to two weeks when released, and not formally available to WASH partners. The poor application of the case definition led to RRTs arriving at a home that did not appear to have anyone infected with cholera. While the consensus within the WASH sector was that it did not matter if it was cholera or another type of diarrhea, as it still needed to be treated and prevented, there was a balance that had to be struck between actual cases and limited WASH resources; and
- While noting sufficient funding at the country-level earlier in this report, WASH NNGOs and the government noted that there was insufficient funding that came to them. NNGOs reported that they did not have enough funds to maintain their operations, and there were large delays in receiving funds that NNGOs, with small cash reserves, could not absorb.

## 8. ORAL CHOLERA VACCINATION

***The oral cholera vaccine is relatively new to cholera prevention and control. Shanchol and Euvichol, two-dose, low-cost OCVs are maintained in a global stockpile for reactive use against outbreaks, and to prevent outbreaks during humanitarian emergencies. Similar to the yellow fever global stockpile, countries must send a request to the International Coordinating Group (ICG) backed by an epidemiological risk assessment and the overall control plan showing integration of control measures.***

### KEY FINDINGS:

**The introduction of OCV in Yemen faced significant challenges that delayed its use for reactive and preventative purposes. The reasons included both those common to countries that lack experience implementing OCV, and those resulting from Yemen's complex environment.** Reasons included MoPHP concerns about the ability to cover an adequate proportion of the population; difficulty targeting the vaccine within the population based on the lack of rigorous data; a poor operational context for implementation; disagreement within the alliance of loyalists and Houthi divisions of the MoPHP; a need to ensure that the risk assessment approach did not create misunderstandings of inequity in aid between the north and south; and, skepticism about vaccination.

**The response in the first wave did not favor the integration of OCV as the cholera preparedness and response plan did not reference OCV, and there was a lack of familiarity and knowledge about OCV among the key players.** This lack of knowledge is not unique to Yemen, and has affected nearly all countries that

consider OCV for the first time. Haiti, South Sudan, Somalia, Iraq, as well as the more stable Sierra Leone, all took several rounds of information sharing and negotiation to prepare a stockpile application.<sup>18</sup> The adoption of OCV, even during a cholera outbreak, requires that a Ministry of Health and its partners have a baseline knowledge of OCV's effectiveness, feasibility in emergencies, stockpile procurement, and a strong implementation plan.<sup>19,20</sup> WHO, donors and others voiced concerns that OCV was not being considered as a tool to reduce infection risk in unaffected populations using a 1-dose strategy for short-term protection, which had been used in other insecure settings (e.g., South Sudan).<sup>21</sup> The lack of discussion of OCV among the health and WASH clusters and the lack of inclusion in the cholera preparedness and response plan impeded the conduct of a risk assessment, an essential component of a stockpile request, and one that requires external epidemiology expertise and a dedicated timeline.

**WHO-led efforts to strategically use OCV to interrupt spread of the second wave occurred during May/June 2017.** Detailed technical discussions on OCV among WHO Cholera Team, the regional office, WHO Yemen, and the MoPHP continued as the second wave began. This involved bringing MoPHP advisors in communicable diseases up-to-date on the evidence-base regarding the effectiveness, feasibility, and impact of OCV. Following the first risk assessment in June 2017 that recommended preventative vaccination in less affected districts,<sup>22</sup> the MoPHP requested nearly all 3.4 million doses from the global stockpile. Some UN partners and the ICG considered the plan too ambitious given the lack of implementation experience in Yemen and insufficient details in the implementation plan. Eventually, the ICG approved the request, with the caveat that the stockpile would supply only 500,000 doses initially, with more to come. The MoPHP, particularly in the north, may have been dissatisfied with this response, or may have used this to cancel the request for other reasons.

### **Eventual use of OCV was related to the prevention of anticipated endemic transmission of cholera.**

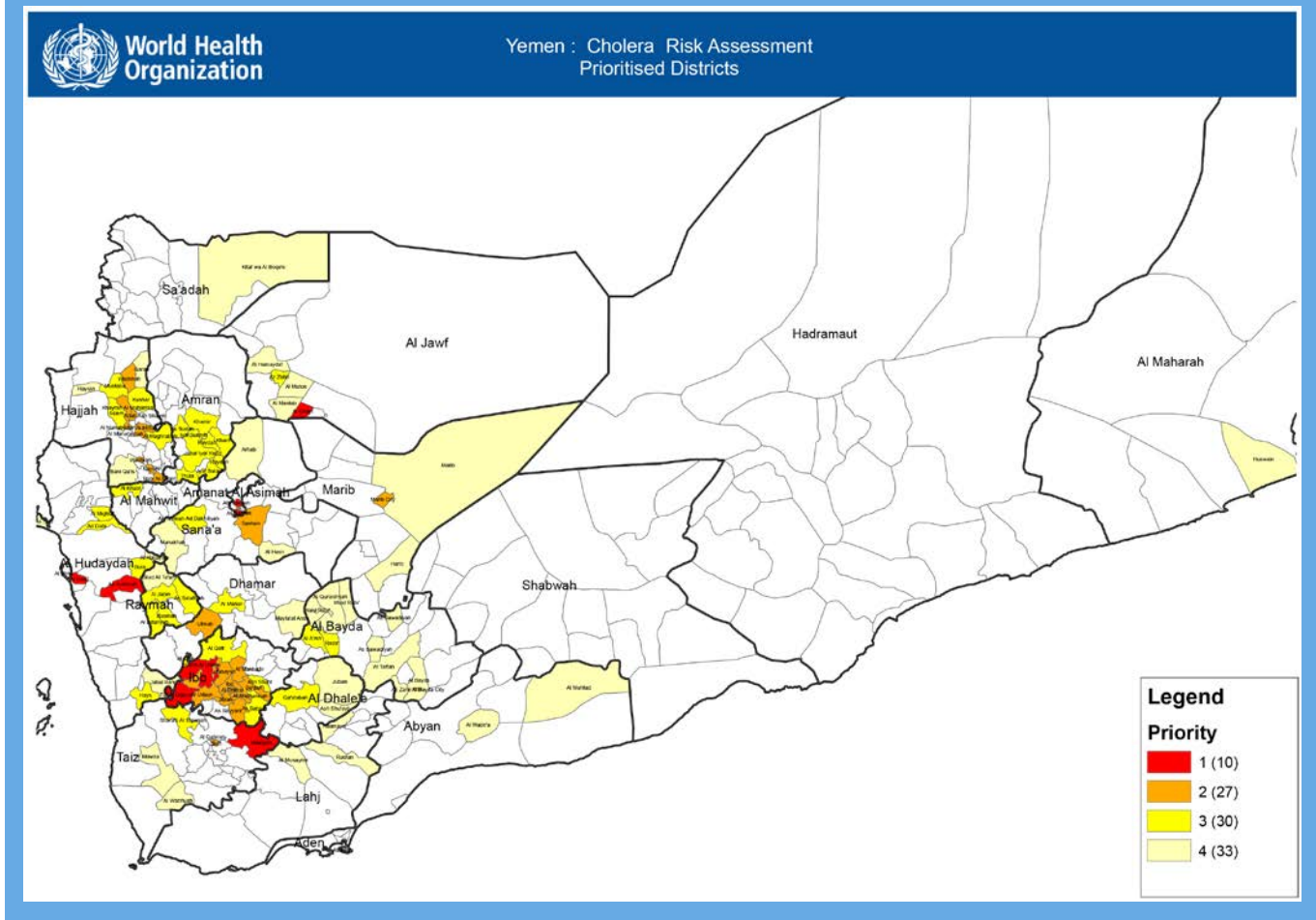
Following a second risk assessment by WHO, MoPHP, and Epicentre in January 2018,<sup>23</sup> the focus shifted toward boosting prevention efforts for an anticipated surge of cholera during the rainy season between April to August 2018. The risk assessment included modeling of the risk of cholera emergence across districts based on indicators of vulnerability (e.g., risk factors for infection including rainfall, access to water and sanitation and health care) and susceptibility (persons not yet immunized by infection or who had OCV). One hundred districts were recommended to be prioritized for vaccination (Figure 3).

The March 2018 cholera preparedness and response plan is the first time that an OCV strategy is mentioned, based on a risk assessment. The MoPHP made a successful request to the GTFCC in April 2018 for 4.6 million doses using a 2-dose strategy to reach 2.3 million persons in the most at-risk districts for surges of cholera. As of May 2018, vaccination was initiated in the south (Aden, 500K doses as a first-dose campaign). Given the intense conflict, a request was made to shift the focus in the north to a first-dose campaign in six districts in Hodeidah as well as Ibb.<sup>24</sup> Once completed, the list of high-risk districts from the risk assessment will be addressed.

### **KEY FINDING:**

**OCV and preparedness planning for the 2018 rainy season should have been the focus across all sectors and agencies, with OCV playing a major role within that discussion.** Respondents reported that discussions on OCV were prolonged, and other key elements of preparedness including pre-positioning supplies and WASH interventions may have been delayed or insufficiently considered.

Figure 3: Oral cholera vaccine risk assessment map for Yemen, January 2018



## 9. CROSS-CUTTING ISSUE: COMMUNICATION AND SOCIAL MOBILIZATION

*Social mobilization promotes treatment and household hygiene, makes use of information, education, and communication (IEC) materials, and provides support for OCV campaigns. Given the poor accessibility to communities and lack of government services, effective social mobilization for cholera was paramount.*

### KEY FINDINGS:

**Respondents underlined that severe insecurity made it difficult to organize community services including social mobilization.** The response focused on IEC materials that were meant to have clear goals: to

encourage symptomatic persons to present rapidly to DTCs and ORCs; and to encourage preventative actions in households. In August 2017, late into the second wave, a national house-to-house awareness campaign occurred in which 40,000 volunteers carried awareness messages across 14 million households. Several respondents commended the massive effort and also expressed the need for this effort earlier in the second wave.

**Community health volunteers (CHVs) supported separately by the MoPHP, Yemen Red Crescent Society, and UNICEF were not mobilized under a single program for social mobilization, referral, and surveillance.**

Through their natural role in social mobilization, CHVs could have also supported these functions more systematically. However, this remained a difficult issue due to the need for training at a massive scale and to assure adequate quality of services. As discussed by UNICEF staff: "We used them where they could deliver, which was hygiene promotion and awareness raising".



## 10. CROSS-CUTTING ISSUE: INSECURITY AND ITS EFFECTS ON THE CHOLERA OUTBREAK

*Both the progressive degradation of civilian infrastructure and social services in Yemen and the acute destruction of infrastructure have required the humanitarian system to rethink how best to provide aid in a protracted conflict and how to address a rapidly expanding outbreak in this extremely constrained context. At the current time, war in Hodeidah is putting half a million persons at risk and threatening the flow of aid, food, and goods at the port.*

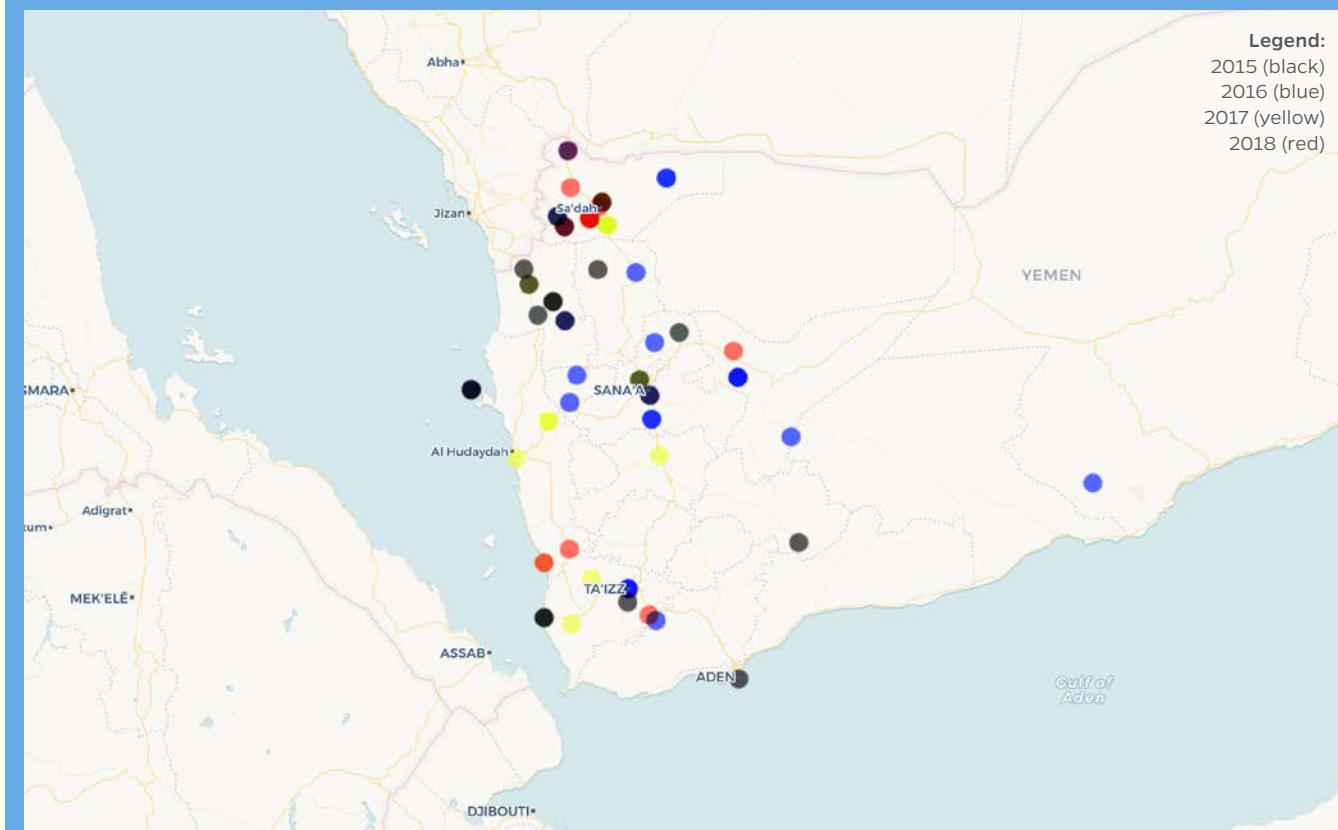
### KEY FINDINGS:

**Repeated airstrikes on water infrastructure, including several desalination facilities, strongly suggests that these sites were purposefully targeted.** Between April 2015 and December 2017, there was extensive damage to civilian infrastructure due to SLC airstrikes, including:<sup>25</sup>

74 reported instances of damage to water-related infrastructure including damage to desalination plants in Taiz, Hodaydah, Hayz, and Al Mukha; damage to water bottling plants and Coca Cola factories; 70 reported instances of targeting of health facilities; and damage to four cranes used to move goods in Hodeidah port.

Figure 4 demonstrates that airstrikes on civilian water and sanitation infrastructure continued throughout the conflict, despite repeated calls for the protection of these sites. Purposeful destruction of civilian water infrastructure is a violation of several international agreements. There is currently no government funding or salaries for the operation of water supply and sanitation systems. Several respondents reported that such extensive infrastructure damage is difficult and costly to repair, and that a humanitarian donor would overrun its budget quickly if it were to keep up with the repairs needed. Some of this damage may have been inadvertent and associated with military activity near these sites. However, the ongoing pattern of repeated strikes on water infrastructure suggests that these sites were purposefully targeted as part of the SLC military campaign.

**Figure 4: Locations of airstrikes targeting water infrastructure, 2015-2018<sup>25</sup>**



**Conflict-related closures of ports, airports, and blockades of imported food, fuel, medications, and medical supplies by the SLC led to disruption and delays in program implementation.** In retaliation to rockets fired by Houthi-Saleh forces at Riyadh, in November 2017 the SLC closed the majority of seaports, airports, and land crossings. Ports in government controlled areas were opened shortly after, though in the north they remained closed. This had the immediate effect of halting the flow of goods to 27 million persons who are reliant on 80 to 90% of food, fuel, medicine, and other key goods that are imported into Yemen.<sup>26</sup>

**Artillery fire together with restriction of movement and goods threatened local-level delivery of aid.**

Respondents stated that aid was in the hands of district-level warring parties. Indiscriminate firing into Taizz and Aden created an insecure operating environment. The blocking of food and medicines, and the restriction of the movements of aid and humanitarian workers affected the speed of the cholera response. At least one NGO reported being unable to open a DTC due to the lack of assurances of its safety.



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## 11. CROSS-CUTTING ISSUE: COORDINATION

***A coordination structure that incorporates the multiple sectors and organizations involved in cholera control is the backbone of an effective response. Yemen's need for strong coordination remains paramount given the extensive humanitarian responses necessitated by complex emergency and the two governments and the cluster system which was already in place due to the conflict and displacement.***

### KEY FINDINGS:

**The cluster approach showed agility in coordinating the initial response through a humanitarian lens, but could not alone provide all technical, strategic, and multisector input for the large-scale outbreak.** The health and WASH clusters had existing relationships with the government(s) and understood the operational environment and geographical distribution of partners. For instance, the clusters rapidly developed the first cholera preparedness and response plan. However, staff from the clusters did this in addition to their already heavy workload of coordinating the humanitarian response. The plans and the epidemiological projections could have benefited from more input from WHO/UNICEF cholera experts. The former Humanitarian Coordinator (2015 to 2018) remarked that in retrospect, the response should have been centralized in the Humanitarian Country Team earlier to ensure a more multi-sectoral and integrated response. The Inter-Agency Standing Committee procedures to designate a large-scale outbreak as an L3 emergency were enacted in 2013, and could have been evoked here at an earlier stage to develop a more intersectoral coordination structure.<sup>27</sup>

**The Cholera Task Force, which normally guides strategy and technical decision-making, did not have technical working groups or generate timely guidance.**

The separation of responsibilities and roles between the clusters and CTF was unclear to respondents and likely contributed to the late appearance of protocols across sectors which, as a consequence, the clusters produced.

**Technical advice was delivered remotely from the headquarters of institutions and not always followed.**

Technical advice from WHO and UNICEF was not often taken into account through the MoPHP, government(s), or the CTF. Technical advisors were located remotely with respect to programs; either based in Amman, Sana'a, or Aden. Experienced cholera epidemiologists and WASH implementers could not easily enter through the humanitarian roster. In other settings like South Sudan, cholera-specific trainings in secure locations have been delivered to frontline staff and advisors in country. Respondents did not highlight tailored means wherein WHO, UNICEF, and clusters delivered technical assistance to partners.

**An incident management system (IMS) was implemented by WHO and the MoPHP at the start of the second wave and suffered from a lack of a clear mandate and technical support.** The implementation of an IMS reflects recent global efforts by the WHO to follow its Emergency Response Framework, and thus to have more predictable responses for health emergencies through an IMS/Emergency Operations Centers (EOC) that integrates the government and other partners into a unified command structure.<sup>28</sup> According to respondents, the IMS aimed to “adopt a more operational posture by reducing the number of meetings and increasing the face-to-face working of the relevant stakeholders” as compared to the “information sharing forum” of the cluster system. While 22 EOCs affiliated with one health RRT per district was planned, only four to five were operational by the end of 2017, with seven in total planned for April 2018.<sup>29</sup>

The IMS and EOC concepts were new to Yemen and there was a lack of familiarity by the government(s) and WHO partners. There was minimal WHO headquarters technical assistance from the EOC Operations Team in Geneva compared to that provided to other countries in the past. The objectives and its manner of implementation were unclear to many respondents. Some reported that WHO introduced IMS as a solution for the initial “*weak and delayed response*” and “*the failure of clusters to coordinate*”, rather than its stated mandate to improve teamwork and operations. The large EOC that was built in Sana'a experience political and security issues, and had to be moved to a smaller office in WHO. It did not operate as envisaged. These issues may have been compounded by a lack of decentralized technical assistance for the implementation of the IMS. There was confusion as to how the existing clusters who had been managing the cholera response would interact with the IMS and EOCs, and this led to resisting the adoption of IMS and EOCs by the health and WASH clusters in particular. Despite its shortcomings, the national EOCs in Sana'a and Aden made progress in improving the data processing and information management, and EOCs in general were cited by respondents as housing local expertise in epidemiology and case management in a unified structure.

**When implemented during the second wave, RRTs showed the importance of decentralizing core early response functions, including investigation, early intervention, and quality control of ongoing interventions.** Health RRTs operated at the community-level to provide localized and timely investigation and sample collection, response, community-level awareness, and monitoring where the health system could not provide that function. WASH RRTs focused on the household level to investigate and provide immediate household-based response within the first 48 hours of detection when clusters of a specific number (reported between five to 20 suspected new cases) or more suspected cases in an area that already had suspected cases were detected. The principle is that the interruption of most at-risk households and their neighbours can interrupt community transmission. A key linkage was made by UNICEF who recently introduced sub-national “control rooms” where health and WASH RRTs can access data immediately, discuss actions taken, and establish coordination mechanisms at the sub-national level.





### 13. CONCLUSION

The preparedness and response to a large-scale cholera epidemic in a conflict-affected and extremely insecure and political environment such as Yemen is a massive and complex challenge. The multitude and complexity of the political, security, cultural, and environmental barriers severely restricted the scope of the response. We strongly commend the government(s), INGOs, NNGOs, and donors for trying to find solutions in this very difficult context. There are no easy fixes to these challenges, and the case study recommendations are meant to be constructive and practical, while taking into account the extremely constricted environment of Yemen. We acknowledge that partners have carried out intensive work to optimize the response after the end of the second wave. We hope this report is useful for further improving the cholera response in Yemen and for similar contexts.

The study team found that several areas gained strength throughout the second wave, including, an extensive operational footprint which reached into insecure areas despite the constrained context; the strengthening of the collaboration among WHO, UNICEF and the health and WASH clusters; the initiation of a funding mechanism through the World Bank that enabled a timely response at scale; the revitalization of the WASH strategy; and the eventual consensus and use of OCV.

The major gaps in this response are rooted in the weaknesses in preparedness and the early strategies developed during the first wave. First, the conflict and the history of cholera in Yemen and in the region should have triggered a strong focus on epidemic preparedness. Pre-planning should have integrated: scenario planning for OCV; protocols for laboratory reinforcement in peripheral areas; the judicious stockpiling of supplies; ensuring WASH-cholera and case management capacity among INGOs and NNGOs; reinforcing networks for community-based surveillance; improved referral and social mobilization; and decentralizing RRT support. An after-action review following the first wave could have institutionalized these areas, and possibly reduced the magnitude of the much larger second wave.

Second, the surveillance system in a complex emergency should focus on the early warning of outbreaks and should be capable of the large-scale data management necessary to support the response. This includes additional laboratory capacity to support culture confirmation at peripheral levels.

Third, the WASH strategy should have been cholera-specific and geographically-targeted, compared to the focus on generalized programming implemented early in the response. Fourth, given the severe insecurity and remote context in much of Yemen, the decentralization of community-based approaches to treatment, referral and WASH should have been incorporated earlier as a strategy. Finally, coordination structures were unnecessarily confusing with the mandates, roles, and reporting lines of the clusters, CTF, and IMS overlapping and incompletely developed. The lack of harmonization across these areas hampered management, technical output, and trust among agencies. IMS should have been implemented at the beginning of the first or second waves, as per WHO's Emergency Response Framework. Global guidance and standards from WHO for IMS application with the cluster system is needed.

While funding for epidemic preparedness globally is lacking, funding for the cholera response in Yemen was sufficient.<sup>30</sup> An important positive step was the World Bank's support to the response, which was instrumental in rapidly disbursing funds and improving coordination between WHO and UNICEF. The World Bank's commitment to supporting the United Nations and its partners in crisis-affected countries, provides the rationale for major investment in bolstering preparedness activities in conflict-affected and fragile state contexts. This would significantly improve many of the foundational gaps noted in this case study.<sup>30,31</sup>

**In the following section, the top 20 recommendations for improved response in Yemen and/or for global cholera response in future emergencies are listed.**

**More detailed recommendations by sector and cross-cutting theme are discussed in the full report.**

## TOP 20 RECOMMENDATIONS FOR FUTURE PREPAREDNESS AND RESPONSE

### SURVEILLANCE AND LABORATORY

1. **Global recommendation:** In a complex humanitarian emergency with a weakened public health system, a large, explosive outbreak should be anticipated. The early warning alert and response functions of the surveillance system should be evaluated and primed, such that the surveillance system should be able to handle outbreak detection and response. This includes detection, alerts, routine reporting from health facilities, epidemiological investigation, and patient-level data management required to contain an expanding outbreak as quickly as possible.
2. **Global and Yemen-specific recommendation:** An early priority should be to increase the capacity to culture cholera through the establishment and/or rehabilitation of peripheral laboratories. An improvement strategy for laboratory monitoring of the response should be implemented, including improvements to the capacity to transport specimens.
3. **Yemen-specific recommendation:** A data monitoring plan to improve data collection and identification of challenges at the field level should be implemented jointly by partners. The plan should include training, job-aids, quality control procedures, and guidelines that can be widely understood at the field level.

### COORDINATION AND PREPAREDNESS

4. **Global and Yemen-specific recommendation:** The mandates, roles, and reporting lines of the various coordination structures including the clusters, cholera task force, and incident management system (IMS) urgently require clarification, harmonization, and agreement by the government(s) and partners. Furthermore, according to the WHO's Emergency Response Framework and to ensure a clear mandate, in the future the IMS should be implemented at the beginning of the epidemic, and much earlier than during the peak of the second wave as occurred in Yemen.
5. **Global and Yemen-specific recommendation:** A small set of rapid response teams (RRTs) should be pre-emptively trained and placed on standby to respond to cholera (and other outbreaks), enabling the early targeting of a localized response and containment when there are few case clusters at the beginning or end of the epidemic. In a large-scale cholera outbreak in a crisis-affected country with few decentralized public health resources, health and WASH rapid response teams should be implemented as quickly as possible to support early investigation and response.
6. **Global and Yemen-specific recommendation:** Supervision to improve knowledge, data, and quality of care in more remote areas, by considering various technological solutions (e.g., similar to those used in telemedicine), working closely with national non-governmental organization (NGOs), and by employing third party monitoring (TPM) of data collection, laboratory practices, and quality of practices, needs to be expanded and funded. In Yemen specifically, TPM results from UNICEF need to be examined in order to understand the minimum standards of monitoring and supervision that are achievable even if results cannot be delivered to the country office in real time.

### CASE MANAGEMENT

7. **Global and Yemen-specific recommendation:** Diarrhea treatment center (DTC) and oral rehydration corner (ORC) networks should be mapped according to population and epidemiological needs, particularly in the second and third zones. Smaller treatment units with less bed capacity should be considered for locations closer to communities.

8. **Global and Yemen-specific recommendation:** Cholera preparedness and response plans need to consider contexts with a high burden of acute malnutrition and cholera, and take into account protocols, data, health infrastructure, expertise and materials for managing children affected by both cholera and severe acute malnutrition.
9. **Yemen-specific recommendation:** Build up the function of the health RRTs to provide basic supervision and monitoring of DTCs and ORCs in their catchment area.

## WASH

10. **Global recommendation:** For early control of the epidemic and throughout the outbreak, focus is needed on a strategy providing decentralized, targeted WASH responses to interrupt transmission related to confirmed and suspected cholera cases (case and community- and/or household-based interventions). For example, WASH rapid response teams could be linked to substantive cholera-specific actions such as chlorination in hotspots and hygiene promotion.
11. **Yemen-specific recommendation:** Consider the appropriate role of all partners in a response, including agency, government, INGOs, NNGOs, and private sector. In particular, consider alternative approaches to the provision of remote support, such as video-based trainings, ensuring a help-desk feature for their field staff with rapid turnaround on technical questions, more proactive remote support, and the development of implementing partner relationships with local NGOs and associations where feasible.
12. **Yemen-specific recommendation:** Donors, the WASH cluster, and the Ministry of Water should strategize and complete as much rapid work on water supply and sanitation infrastructure as possible. These efforts should occur while simultaneously advocating and partnering with large bilateral and multilateral donors (e.g., World Bank) on repairing and maintaining infrastructure for medium to long-term prevention of water-borne diseases. This can be facilitated by ensuring there are WASH specialists trained on infrastructure repairs, operations, and maintenance able to work in Yemen.

## INTEGRATED HEALTH AND WASH RESPONSE

13. **Global and Yemen-specific recommendation:** Planning should always be integrated between the health and WASH sectors on the following strategies and interventions: (a) decentralized health and WASH RRTs that share epidemiological data, target their responses, and integrate their responses; (b) joint planning of oral cholera vaccination (OCV) among the MoPHP, WHO, UNICEF, and health and WASH clusters; (c) the provision of infection, prevention, and control in health facilities; and (d) water quality surveillance in support of epidemiological surveillance.
14. **Yemen-specific recommendation:** Given the severe insecurity and remote context in much of Yemen, decentralization of care with community-based approaches to treatment, referral and WASH should be the focus in rural and remote areas: (a) placing ORCs within a one hour walk of communities as a minimum standard (and supporting transport to diarrhea treatment centers); (b) organizing cross-agency community health networks and developing capacities for community-based surveillance, referral to care, staffing of ORCs, and social mobilization and health and hygiene promotion; and (c) strengthening the roles of international agencies and INGOs as technical advisors to NNGOs who may have more access to communities.
15. **Yemen-specific recommendation:** The response needs to assure that the model for remote technical assistance is effective, accessible, and timely. Major technical bodies should provide cholera-specific, multi-day training modules for mixed groups of frontline public health staff from NNGOs and INGOs in Amman or Djibouti to improve the understanding of a cholera-specific response. In addition, a minimum set of standardized practices and measures should be developed for agency-level remote monitoring and supervision of the cholera response.



**16. Global recommendation:** After-action reviews of practice after a cholera outbreak should be standard practice for each responding organization. An after-action review for each agency (UN, INGOs, NNGOs, etc.) after the first wave would have been beneficial for identifying gaps and weaknesses in preparedness that required resolution before the second wave occurred.

**17. Global and Yemen-specific recommendation:** NGOs should develop remote monitoring processes (e.g., field procedures, tools and checklists, accountability mechanisms) for assuring the quality and scale of intervention in remote and insecure sites. For cholera, this could mean rigorous procedures for use of free residual chlorine as a monitoring indicator and providing TPM on a systematic basis for monitoring care in DTCs and ORCs.

### ORAL CHOLERA VACCINATION

**18. Global recommendation:** Different scenarios for OCV according to varying contexts should be integrated ahead of time into national cholera preparedness plans in general. This is especially important for ‘fragile’ countries where there is a possibility of humanitarian emergencies developing or continuing.

**19. Global and Yemen-specific recommendation:** In complex and insecure environments like Yemen, smaller, geographically-targeted OCV campaigns should be anticipated and planned.

### INSECURITY

**20. Yemen-specific recommendation:** Attacks on health, water and sanitation infrastructure should be terminated. The UN should adopt a stronger stance on the protection of both health facilities as well as water and sanitation infrastructure. Besides proactively sharing the locations with the Saudi-led Coalition, monitoring and documenting attacks against this infrastructure using a geo-located database system with systematic reporting should be undertaken.



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