

Strengthening Water Quality Monitoring to Prevent and Respond to Cholera Outbreaks

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Session Objectives

- 1. Review examples of water quality monitoring in outbreaks
- 2. Pilot of water quality monitoring as a cholera prevention measure
- 3. Discussion points

Water Quality Monitoring Examples

- 1. Water quality rapid assessments during an outbreak response
 - Ethiopia
 - Malawi
- 2. Set-up water quality monitoring system during an outbreak response
 - Mozambique
- 3. Establish regular water quality monitoring in cholera hotspots as a preventative measure
 - Zanzibar



1. Water Quality Rapid Assessment – Jijiga, Ethiopia

Background

- Jan-Jul 2017, 33,993 cholera cases in Somali Region
 - > 1,000 cases in Jijiga City
- At the start of outbreak Jijiga <u>not chlorinating</u> the water reservoirs, water trucks, or donkey carts
- CDC, WHO, UNICEF worked with RWB to train staff to chlorinate the water reservoirs, water trucks, and donkey carts
- No updated information on chlorination levels around Jijiga City after interventions started
- FRC rapid assessment conducted in June ~ 1 month after chlorination interventions started in Jijiga



Water Quality Rapid Assessment – Jijiga, Ethiopia

Objective

 Assess chlorination levels to identify gaps and better target WASH cholera activities

Methods

- 9 WASH Cluster organizations
- Tested water points in 20 kebeles of Jijiga
- Tested samples from trucks, tapstands, donkey carts, birkats, and HHs

Sampling point	Total number of samples (<i>N</i>)	Samples with detectable FRC (<i>n</i>)	Samples with FRC between 0.1–0.5 mg/L (n)	Samples with FRC between 0.6–1.0 mg/L (<i>n</i>)	Samples with FRC >1.0 mg/L (n)
Water points chlorination					
Tapstand – piped network	36	86% (31)	47% (17)	36% (13)	3% (1)
Donkey cart	47	60% (28)	47% (22)	13% (6)	0% (0)
Truck – filling station	3	100% (3)	67% (2)	33% (1)	0% (0)
Undergroun d tank (Birkat) – piped network*	11	45% (5)	36% (4)	9% (1)	0% (0)
Total	97	69% (67)			
Household le					
Household Jerry can	61	62% (38)	43% (26)	16% (10)	3% (2)



Water Quality Rapid Assessment Results – Jijiga



Journal of Water, Sanitation and Hygiene for Development. 2020;10(3):596-602. doi:10.2166/washdev.2020.146

- Spatial distribution of FRC data collected during assessment
- Data used to find 5 additional donkey cart filling stations in the north of Jijiga within the red circle.
- Decentralized chlorination was implemented at these points.
- Next Step: Created a monitoring system to regularly monitor FRC levels at targeted points

Date of Download: 12/03/2023

1. Water Quality Rapid Assessment – Lilongwe, Malawi

- Ongoing cholera outbreak in Malawi since March 2022
 - > 50,000 cases and > 1,600 deaths
- Lilongwe city not affected until late 2022
 - As of March 2023, more than 11,000 cases and 535 deaths
- Piped water network serves ~70% of the city
- Alternative sources commonly used
 → boreholes and shallow wells



Water Quality Rapid Assessment – Lilongwe, Malawi

Objectives

 To assess chlorine levels in piped water network and microbiological water quality of alternative water sources in cholera affected areas of Lilongwe

Methods

- Worked with Lilongwe Water Board, Central Lab of the Ministry of Water & Sanitation, and the Lilongwe DEHO in Feb 2023
- Tested water points in 12 cholera affected areas (admin level 2) of Lilongwe
- Tested FRC from piped network: household taps, and kiosks
- Microbiological testing at boreholes and shallow wells



Water Quality Rapid Assessment Results – Lilongwe, Malawi

Malawi Ministry of Water and Sanitation





- Created Excel dashboard that can be updated with using Kobo Collect Query
- 50/50 piped water taps tested for chlorine had detectable FRC

- 19/21 shallow wells sampled > 100 cfu/100ml for fecal coliforms
- 3/10 boreholes sampled > 100 cfu/100ml for fecal coliforms
- Data shared with WASH implementing partners on the importance of chlorination of alternative water sources

Water Quality in Malawi – Next Steps

- Supporting UNICEF and the Ministry of Water & Sanitation to conduct similar rapid assessments in other cholera affected districts of Malawi
 - Rapid assessment in Blantyre conducted in March of 2023, which highlighted gaps in FRC in piped network in cholera affected areas
- In conjunction with rapid assessments, conduct training of District Water Office staff to continue chlorine monitoring of piped networks in affected districts

2. Outbreak Water Quality Monitoring – Mozambique

Background

- March 15th, 2019 \rightarrow Cyclone Idai landed in Beira
- 387,165 persons affected
 - Damage to the piped network
 - Water provision stopped for 1 week
 - Piped network in Beira and Dondo provides water for 60% of the population with over 60,000 connections (FIPAG)
- Cholera outbreak declared on March 27th
 - Sofala province- 6,682 cases by end of April



*Global Alliance Against Cholera

Water Quality Monitoring- Beira & Dondo

- Limited data on water quality monitoring after cyclone
- Perceptions that piped water was not safe after cyclone
- Cholera outbreak HHWT (Certeza) distributed
- Objective: ensure drinking water supplies met standards during a cholera outbreak
 - piped network
 - accommodation centers
- CRA proposed daily monitoring with the Provincial Health Directorate (DPS), FIPAG, UNICEF, CDC, USAID (BHA)



Methods

- Monitored <u>daily</u> to start
- Free residual chlorine (FRC) tested; Turbidity also tested as an indicator for potential breaks in network
- Mobile phone-based data collection
- Piped network in Beira and Dondo, 41 points
 - Near water treatment plant
 - Before and after chlorine boosting stations
- Accommodation centers (n=18)
 - Trucked water and piped network sources
- CDC trained DPS and CRA to analyze and report results
- Data and results shared daily with partners
- Presented to the Cholera Taskforce





Example daily report



Beira and Dondo - Piped Network Results

Daily FRC levels

- Shows the daily fluctuations of number of readings and FRC levels
 - Some weekend days larger number of readings at 0 mg/L
 - Staffing shortages

Beira and Dondo- Piped Network Results

- From May 4 -June 14: 1,080 samples collected from the 41 points
 - 87% of samples had FRC ≥ 0.1 mg/L
 - 46% of the samples had FRC = 0.5 1.0 mg/L
 - Median FRC = 0.4 mg/L

	Total	Water	Number of				
	Visits	Available for	Samples (%)	Samples	Samples (%)	Samples (%)	Samples (%)
		Sampling		(%)			
			< 0.1	0.1 - < 0.2	0.2 - < 0.5	0.5 - 1.0	> 1.0
			mg/L	mg/L	mg/L	mg/L	mg/L
Piped	1,189	1,080 (91%)	142 (13%)	126 (12%)	316 (29%)	495 (46%)	1 (0.01%)
Network							

Beira and Dondo- Accommodation Center Results



- 131 samples from bladders or tanks filled by water trucks
- The quality of water delivered by truck was better and improved over time
- 47 from samples from new piped network connections
- FRC from samples from the piped network points remained low
 - New connections further away from distribution centers
- 26% of piped water samples had detectable FRC versus 90% from trucked water samples

Beira and Dondo - Accommodation Center Results

- 73% of the 177 samples collected had FRC ≥ 0.1 mg/L
- 39% of the samples had FRC = 0.5 1.0 mg/L
- Median FRC = 0.3 mg/L

	Total	Water	Number of				
	Visits	Available for	Samples (%)				
		Sampling					
			< 0.1	0.1 - < 0.2	0.2 - < 0.5	0.5 - 1.0	> 1.0
			mg/L	mg/L	mg/L	mg/L	mg/L
Accommodation	184	177 (96%)	47 (27%)	16 (9%)	45 (25%)	69 (39%)	0 (0%)
Centers							

Pemba

- After Cyclone Kenneth landed, a similar water quality monitoring program was implemented
- Piped network provided 30% of the population drinking water (FIPAG)
- 30 points in the piped network included
 - Network supplied water to different areas of the city each day
 - Data collection sites varied daily



Results and Conclusions

- Water quality monitoring identified several trends that helped FIPAG to improve chlorination
 - Areas with consistently low FRC levels \rightarrow booster chlorination
 - Inconsistent FRC data over time identified new line breaks
 - Irregularity of FRC levels highlighted issues with staffing
 - Weekends = fewer staff for treatment
 - At accommodation centers, identified lower levels of chlorination in piped network water
 - Monitoring identified locations not receiving sufficient water (Pemba neighborhoods)
- Once the first system in Beira was set-up easy to replicate a second system in Pemba



3. Establish regular water quality monitoring in cholera hotspots– Zanzibar

Background

- Zanzibar has identified cholera hotspots and actively working on Cholera Elimination plan
- Zanzibar experienced 17
 major cholera outbreaks
 between 1978 and 2008
- The latest outbreak lasted three years, ending in 2017
- Project started in August 2021



Prevention Example- Zanzibar

- ~60% of Zanzibar can access piped network
- No regular water quality monitoring system in place
- Collaboration with ZAWA (water utility), UNICEF, CDC, and MoH-Z

Objectives

 Pilot a routine water quality monitoring system in an endemic setting



Methods

- Mapped all ZAWA tanks
- Started in the 5 districts with cholera hotspots
 - Selected 43 sampling points
 - Near treatment tanks
 - Further down pipeline
 - Ends of network lines
- Points sampled weekly
 - FRC, turbidity
- In 2023, expanded to 10 districts → 79 sampling points



Zanzibar Piped Network Results

- Took ~7 weeks to start monitoring in the 5 districts
- First, increased the number of samples with FRC ≥ 0.2 mg/L in the system
- Next, worked to increase number of samples with FRC ≥ 0.5 mg/L



Zanzibar Piped Network Results

- From Sept 29th 2021 -Present: 4,009 samples collected weekly from 43-79 points
 - 76% of samples had FRC ≥ 0.1 mg/L
 - 35% of the samples had FRC = 0.5 1.0 mg/L

	Total	Water	Number of				
	Visits	Available	Samples (%)				
		for					
		Sampling	<0.1	0.1 - < 0.2	0.2 - < 0.5	0.5 - 1.0	> 1.0
		8	mg/L	mg/L	mg/L	mg/L	mg/L
Piped Network	4009	3355 (84%)	812 (24%)	27 (1%)	1277 (38%)	1188 (35%)	51 (2%)

How the Results are Used

- Results identify gaps in chlorination of piped supplies
 - Ex: HTH shortages, inadequate dosing, staffing changes, difficulties pumping water to fill tanks
- Remedial action is taken to ensure piped water is treated regularly
 - Hiring new staff, fixing hardware at tanks, adjusting dosing



Summary

- Rapid water quality assessments can help inform outbreak response
- Community-level water quality monitoring systems can be set-up quickly during outbreaks
 - Allow for real time reporting and response
- Can be easily replicated in other hotspots
- Routine water quality monitoring system can be used a cholera prevention measure in cholera hotspots



Discussion Points

- Focus was mostly on treated water supplies. When should we include microbiological testing?
 - Included in Malawi
 - Not included in Beira
- Scaling up centralized chlorination while also distributing HHWT products can be complicated
 - As chlorination of the piped network scaled-up in Beira more complicated on how/where to distribute Certeza
- How can we transition to sustained monitoring systems?
- Development of CDC water quality guidance document