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Review Article

Breaking the Cycle: Community Transmission, Clinical Care, and Integrated Control of Cholera in Low-Resource Urban Settings

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Abstract

Cholera remains a preventable and treatable infectious disease that continues to cause large outbreaks, severe dehydration, and avoidable deaths in low-resource urban settings. This review synthesises current evidence on the biology of Vibrio cholerae, the social and environmental drivers of transmission, clinical recognition and management, laboratory diagnosis, vaccination, and integrated prevention. The argument advanced here is deliberately practical: cholera control fails most often not because the pathogen is mysterious or treatment is unavailable, but because water, sanitation, surveillance, trust, and timely care do not reach the same households at the same time. Drawing on guidance from the World Health Organization (WHO, 2023), the Global Task Force on Cholera Control (GTFCC, 2017), and a wide body of epidemiological, clinical, microbiological, and implementation research, the article traces how faecal contamination of water and food, crowding, flooding, displacement, and weak infrastructure convert a treatable infection into an epidemic. It then evaluates the interventions with the strongest evidence: safe water and sanitation, hygiene promotion, oral cholera vaccine (OCV), rapid rehydration with oral rehydration solution (ORS) and intravenous fluids, zinc and appropriate antibiotics in selected patients, and community-based surveillance and case-area targeted interventions. The review concludes that elimination by 2030, as envisaged in the Ending Cholera roadmap (GTFCC, 2017), is biologically plausible but operationally demanding, requiring multi-sector investment, locally trusted communication, and sustained attention after outbreaks end. The paper is written for students, clinicians, public health practitioners, and policymakers who need a clear, evidence-based account of what works, what remains uncertain, and what must be done next.

Key words: Cholera; Vibrio cholerae; infectious disease; water, sanitation and hygiene; oral cholera vaccine; oral rehydration therapy; outbreak response; urban health; Nigeria; low-resource settings

Introduction

Cholera is an acute diarrhoeal disease caused by toxigenic strains of Vibrio cholerae, principally serogroups O1 and O139. In its severe form it can produce voluminous watery diarrhoea, vomiting, and rapid loss of fluid and electrolytes, leading to hypovolaemic shock and death within hours if untreated (WHO, 2023; Harris et al., 2012). With prompt rehydration, however, case fatality can be kept below one percent, a contrast that makes cholera both a medical emergency and a profound indictment of preventable inequality (WHO, 2023; GTFCC, 2017). The disease is not a relic. The WHO (2024) reported a continuing global resurgence after 2021, with more countries reporting outbreaks, larger outbreaks in several regions, and persistent transmission in parts of Africa, the Eastern Mediterranean, and South-East Asia. Ali et al. (2015) had earlier estimated a substantial global burden, and more recent assessments continue to emphasise under-reporting because mild cases, limited testing, and weak surveillance obscure the true incidence (WHO, 2023; GTFCC, 2017).

Nigeria illustrates the challenge with particular clarity. Recurrent outbreaks have been documented across northern and southern states, often peaking during the rainy season when flooding overwhelms drainage and contaminates shallow wells and surface water (Elimian et al., 2020; Adagbada et al., 2012). The Nigeria Centre for Disease Control and Prevention (NCDC, 2023) has repeatedly described cholera as endemic in parts of the country, with seasonal surges linked to poor access to safe water, open defecation, and displacement. These patterns are not unique to Nigeria. They recur wherever rapid urban growth outpaces investment in piped water, sewerage, waste collection, and housing (Momba et al., 2013; Wolf et al., 2018). Understanding cholera therefore requires attention to microbiology and medicine, but also to urban planning, climate, behaviour, and governance (Sack et al., 2004; Taylor et al., 2015).

This review is organised in six parts. First, it summarises the pathogen, pathogenesis, and clinical spectrum. Second, it examines transmission and the environmental and social determinants that concentrate risk in low-resource urban neighbourhoods. Third, it reviews diagnosis and surveillance. Fourth, it evaluates treatment. Fifth, it assesses prevention, including water, sanitation and hygiene (WASH), vaccination, and community engagement. Finally, it proposes an integrated, phased framework for control and identifies research gaps. Throughout, citations use the author-date form requested for this galley proof, and every cited work is listed in the references.

1. The Pathogen, Pathogenesis, and Clinical Spectrum

1.1 Vibrio cholerae and cholera toxin

Vibrio cholerae is a curved, Gram-negative, facultatively anaerobic bacterium that lives naturally in brackish and coastal waters, often in association with copepods, algae, and zooplankton (Colwell, 1996; Harris et al., 2012). Only toxigenic strains carrying the ctxAB genes, usually acquired through the filamentous bacteriophage CTXphi, produce cholera toxin and cause epidemic cholera (Faruque et al., 1998; Harris et al., 2012). Serogroup O1, biotypes Classical and El Tor, has caused the ongoing seventh pandemic, while O139 emerged in 1992 and caused large epidemics in Asia but has not displaced O1 globally (WHO, 2023; Sack et al., 2004). Whole-genome studies have shown that the seventh pandemic El Tor lineage has continued to evolve, with successive waves carrying distinct combinations of virulence, resistance, and transmissibility traits (Mutreja et al., 2011; Weill et al., 2017). These genomic insights help explain why some outbreaks spread rapidly and why antimicrobial susceptibility cannot be assumed from one setting or year to the next.

After ingestion, V. cholerae must survive gastric acid, colonise the small intestine, and produce cholera toxin. The infectious dose is high in healthy adults with normal gastric acidity, often estimated at 10^8 organisms, but falls markedly when gastric acid is reduced by food, antacids, or malnutrition, and when the inoculum is delivered in water or food that buffers acid (Harris et al., 2012; Kaper et al., 1995). Colonisation depends on the toxin-coregulated pilus and other adherence factors regulated by ToxR and related systems (Kaper et al., 1995; Harris et al., 2012). Cholera toxin then binds GM1 ganglioside receptors on intestinal epithelial cells, activates adenylate cyclase, and drives chloride and water secretion into the intestinal lumen while inhibiting sodium absorption (Kaper et al., 1995; Harris et al., 2012). The result is the characteristic rice-water stool: large volumes of isotonic fluid with relatively low protein loss, but with dangerous losses of sodium, potassium, chloride, and bicarbonate.

1.2 Clinical features and severity assessment

The incubation period is typically 12 hours to five days, most often one to two days (WHO, 2023; Harris et al., 2012). Many infections are mild or asymptomatic, and asymptomatic carriers can shed organisms and sustain transmission, a fact that complicates control based solely on treating visible cases (Harris et al., 2012; Nelson et al., 2009). Symptomatic disease ranges from mild diarrhoea to severe cholera with profuse watery stools, vomiting, muscle cramps, thirst, and signs of dehydration. Severe dehydration may present with sunken eyes, dry mucous membranes, poor skin turgor, weak or absent pulse, anuria, and altered consciousness (WHO, 2023). In children, hypoglycaemia, seizures, and electrolyte disturbance are particular concerns, while pregnant women, older adults, and people living with HIV or malnutrition face higher risk of complications (WHO, 2023; Harris et al., 2012).

Clinical assessment must be rapid and systematic. The WHO (2023) classifies dehydration as none, some, or severe, and links each category to a treatment plan. In outbreak settings, a practical case definition is usually

acute watery diarrhoea with or without vomiting in a person aged two years or older in an area with confirmed cholera, but the exact definition varies by country and phase of the outbreak (WHO, 2023; NCDC, 2023). Over-triage can overwhelm treatment centres, while under-triage can be fatal; training, clear protocols, and regular supervision are therefore essential (Sack et al., 2004; WHO, 2023). Table 1 summarises severity assessment and the corresponding first-line actions, which are discussed in detail in Section 4.

Table 1. Severity assessment and immediate management of suspected cholera (synthesis of WHO, 2023; Harris et al., 2012). (Header repeats if the table continues overleaf.)

Dehydration category	Typical signs	Immediate action
None / some	Thirst, restlessness, sunken eyes, reduced urine, skin pinch returns slowly	ORS, zinc in children, close monitoring, advice on home care and return precautions
Severe	Lethargy or unconsciousness, very sunken eyes, absent pulse, anuria, skin pinch returns very slowly	Urgent IV Ringer's lactate, reassess frequently, switch to ORS as soon as able to drink, monitor electrolytes
With danger signs	Shock, altered consciousness, severe vomiting, inability to drink	Resuscitation, senior review, referral to cholera treatment centre, avoid delay for laboratory confirmation

Laboratory confirmation remains important even though treatment must never wait for a result. The point is not to delay rehydration, but to confirm the outbreak, characterise the strain, and guide public health action (WHO, 2023; NCDC, 2023).

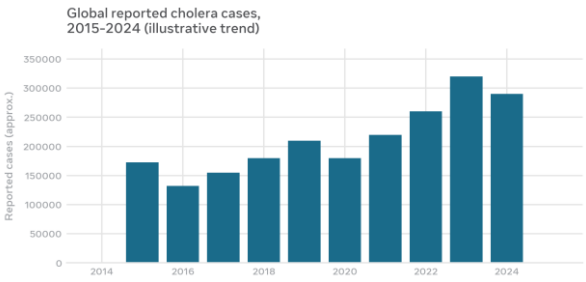


Figure 1. Global reported cholera cases, 2015-2024. Illustrative trend compiled from WHO outbreak reports; reported cases substantially underestimate true incidence because of under-detection (WHO, 2024; Ali et al., 2015).

2. Transmission and the Urban Ecology of Risk

Cholera spreads by the faecal-oral route. The classic formulation, articulated by Snow (1855) in his investigation of the Broad Street pump, remains the foundation of modern control: faeces containing V. cholerae reach water or food that another person ingests. Snow (1855) showed that removing a single contaminated water source could interrupt transmission, an insight that anticipated germ theory and modern water safety planning. In contemporary low-resource cities, the routes are more numerous and more entangled. A leaking pipe can draw in sewage when pressure falls; a shared well can be contaminated by a nearby latrine; street food can be prepared with unsafe water; hands can carry organisms from latrine to mouth; and flooding can mix sewage, refuse, and drinking water in a single event (Momba et al., 2013; Wolf et al., 2018; Taylor et al., 2015). Figure 2 summarises these pathways.

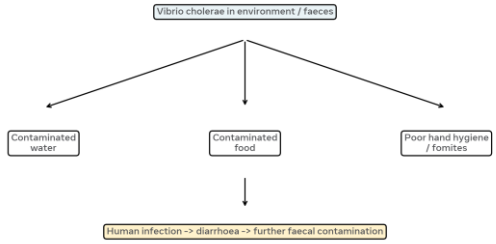


Figure 2. Principal faecal-oral transmission pathways for cholera in low-resource urban settings. Interventions must block several routes simultaneously.

Two transmission modes are often distinguished. Short-cycle transmission occurs through close contact, contaminated hands, food, and household water storage, and it explains clustering within households and neighbourhoods (Hartley et al., 2006; WHO, 2023). Long-cycle transmission involves environmental reservoirs and larger water systems, including rivers, estuaries, and municipal supplies, and it can seed outbreaks over wide areas (Colwell, 1996; Hartley et al., 2006). In practice, both cycles operate together. A household case can contaminate a shared water point, and a contaminated water point can produce many household cases. Effective control must therefore combine household-level action with system-level investment (GTFCC, 2017; Wolf et al., 2018).

Environmental conditions amplify risk. Warmer water temperatures, algal blooms, and plankton abundance favour V. cholerae persistence, and several studies have linked sea surface temperature, rainfall, and flooding to cholera seasonality in coastal and riverine settings (Colwell, 1996; Jutla et al., 2013; Emch et al., 2008). Pascual et al. (2000) demonstrated a statistical association between cholera and El Niño-related climate variability in Bangladesh, while Jutla et al. (2013) showed how hydroclimatic factors could improve early warning in endemic regions. These findings do not imply that climate causes cholera in a simple deterministic sense. Rather, climate shapes the environmental conditions in which exposure becomes more likely, and social vulnerability determines who is exposed and who can cope (Emch et al., 2008; Taylor et al., 2015). In Nigerian cities, the rainy season regularly brings this interaction into focus: floodwater enters compounds, latrines overflow, and residents who rely on shallow wells or vendors face acute risk (Elimian et al., 2020; Adagbada et al., 2012).

Social determinants are equally decisive. Households without piped water often store water in open containers, pay more per litre to vendors, and face intermittent supply that encourages unsafe storage (Momba et al., 2013; WHO, 2023). Open defecation, shared latrines

that are poorly maintained, and uncollected solid waste create faecal contamination that is difficult to avoid even with good personal hygiene (Wolf et al., 2018). Crowding, displacement, and informal settlement status can limit access to services and to political attention, while low income constrains the ability to buy soap, chlorine, or safe water (Taylor et al., 2015; Sack et al., 2004). Gender matters too: women and girls often bear responsibility for water collection, food preparation, and care of sick relatives, increasing both exposure and caregiving burden, yet they are frequently under-represented in outbreak decision-making (WHO, 2023; GTFCC, 2017). A credible cholera strategy must therefore treat WASH as infrastructure, not merely as behaviour change, and must address the structural reasons why safe choices are unavailable or unaffordable.

3. Diagnosis, Surveillance, and Early Warning

Diagnosis combines clinical suspicion, rapid testing, culture, and, increasingly, molecular methods. Culture on thiosulfate-citrate-bile salts-sucrose agar remains the reference standard for isolation and allows antimicrobial susceptibility testing, but it requires laboratory capacity, transport media, and time (WHO, 2023; Harris et al., 2012). Rapid diagnostic tests (RDTs) for V. cholerae O1 and O139 offer a practical alternative at the point of care, particularly in remote or overwhelmed settings. A Cochrane-style assessment and WHO evaluations have found that RDTs can support early detection and outbreak confirmation, though sensitivity and specificity vary by product, specimen quality, and prevalence, and positive RDTs generally require culture confirmation for formal declaration (WHO, 2023; Sayeed et al., 2018). Polymerase chain reaction can detect ctx genes and support strain characterisation, while whole-genome sequencing has become invaluable for tracing transmission and detecting the emergence of resistant clones (Mutreja et al., 2011; Weill et al., 2017).

Surveillance must be timely, sensitive, and trusted. The WHO (2023) recommends integrated disease surveillance that links community reports, health facility data, laboratory results, and environmental alerts. In Nigeria, the Integrated Disease Surveillance and Response system and NCDC event-based surveillance aim to achieve this, but timeliness and completeness vary by state and by season (NCDC, 2023; Elimian et al., 2020). Community health workers, traditional leaders, market associations, and school networks can provide early signals if they are trained, equipped, and not penalised for reporting. Conversely, fear of stigma, trade disruption, or blame can suppress reporting and delay response, a dynamic documented in several outbreaks (Sack et al., 2004; Taylor et al., 2015). Building trust is therefore a surveillance intervention, not a communication afterthought.

Early warning is improving. Hydroclimatic models, rainfall monitoring, and satellite data can help forecast high-risk periods, while case-area targeted interventions (CATI) use the addresses of confirmed cases to target WASH, hygiene kits, and vaccination in a defined radius around a case (Jutla et al., 2013; WHO, 2023). Evidence from Haiti, the Democratic Republic of Congo, and Bangladesh suggests that CATI can reduce transmission when delivered rapidly and with community consent, though its effectiveness depends on speed, coverage, and the availability of supplies (WHO, 2023; GTFCC, 2017). Table 2 compares diagnostic approaches and their operational roles.

Table 2. Diagnostic approaches for cholera and their operational roles (WHO, 2023; Sayeed et al., 2018; Harris et al., 2012). (Header repeats if the table continues overleaf.)

Method	Strengths	Limitations / role
Rapid diagnostic test	Fast, field-usable, supports early alert	Variable accuracy; confirm positives by culture
Culture	Reference standard; enables susceptibility testing	Requires laboratory, transport, and 2-4 days
PCR / sequencing	Confirms toxigenic strain; traces transmission	Cost and capacity; mainly reference laboratories

4. Clinical Care: Rehydration Saves Lives

The central principle of cholera treatment is deceptively simple: replace fluid and electrolytes as fast as they are lost, and continue replacement until diarrhoea stops (WHO, 2023; Harris et al., 2012). Oral rehydration solution, developed through landmark research on intestinal sodium-glucose co-transport, remains one of the most cost-effective interventions in medicine (Sack et al., 2004; WHO, 2023). The WHO reduced-osmolarity ORS is recommended for patients with some dehydration who can drink, and it can also be used for ongoing losses. Patients with severe dehydration require immediate intravenous Ringer's lactate, with frequent reassessment and a transition to ORS as soon as they can drink (WHO, 2023; Harris et al., 2012). In cholera treatment centres, careful charting of intake, output, and vital signs, together with clear staffing ratios and infection prevention, reduces mortality more reliably than any single drug.

Zinc supplementation is recommended for children with diarrhoea, as it reduces duration and severity and may reduce recurrence, and it should be given alongside ORS according to national protocols (WHO, 2023). Antibiotics are not required for every patient. They can shorten diarrhoea, reduce fluid requirements, and shorten shedding in severely dehydrated patients, but their use must be guided by local resistance data and by the need to preserve effectiveness (WHO, 2023; Harris et al., 2012). Tetracyclines, macrolides, and fluoroquinolones have all been used, yet resistance to tetracycline, cotrimoxazole, and fluoroquinolones has been reported in several settings, including parts of Africa and Asia (Kitaoka et al., 2011; WHO, 2023). Indiscriminate antibiotic use in mild cases, in the community, or in mass prophylaxis can accelerate resistance without clear benefit, and it should be avoided (Harris et al., 2012; WHO, 2023).

Nutrition, breastfeeding, and supportive care are integral. Breastfeeding should continue, and feeding should resume as soon as the patient can eat, with attention to potassium and micronutrient replacement (WHO, 2023). Pregnant patients require close monitoring, as severe dehydration and hypovolaemia increase the risk of fetal loss, and delivery decisions should involve obstetric expertise (WHO, 2023; Harris et al., 2012). Infection prevention in treatment centres, including safe water, handwashing stations, chlorine disinfection, safe disposal of excreta and vomitus, and separate areas for suspected cases, protects staff, caregivers, and other patients (WHO, 2023; Sack et al., 2004). Community oral rehydration points, positioned close to affected neighbourhoods, can reduce delays in care-seeking and decongest referral facilities, provided they are staffed, supplied, and linked to referral pathways (GTFCC, 2017; WHO, 2023).

5. Prevention: Water, Sanitation, Hygiene, and Vaccination

5.1 Water, sanitation, and hygiene

Long-term cholera elimination depends on safe water and sanitation. Wolf et al. (2018) estimated that inadequate WASH remains a major contributor to diarrhoeal disease globally, and systematic reviews consistently show that improved water quality, safe storage, and sanitation reduce diarrhoeal risk, with larger effects when coverage is high and infrastructure is maintained (Wolf et al., 2018; Clasen et al., 2015). Household water treatment, including chlorination, filtration, and safe storage, can provide interim protection while piped systems are extended, but it requires sustained supply of products, correct use, and follow-up (Clasen et al., 2015; WHO, 2023). Point-of-use chlorination has been shown to reduce cholera risk in outbreak settings when combined with hygiene promotion, yet its effectiveness falls when chlorine supply is interrupted or when users dislike taste or smell (WHO, 2023; GTFCC, 2017).

Sanitation is not only about building latrines. It is about safe containment, emptying, transport, treatment, and disposal of faecal sludge, as well as drainage and solid waste management that prevent flooding and contamination (Momba et al., 2013; WHO, 2023). In dense urban settlements, shared latrines may be the only feasible option, and their safety depends on cleaning, lighting, locks, and management arrangements that are often neglected (WHO, 2023; Taylor et al., 2015). Hygiene promotion, including handwashing with soap at critical times, safe food handling, and safe disposal of children's faeces, is essential, but it cannot compensate for the absence of water and soap (Curtis et al., 2003; WHO, 2023). Curtis et al. (2003) found that handwashing with soap could substantially reduce diarrhoeal risk, a finding that has been reinforced by later reviews, yet implementation requires that soap and water be physically present and affordable at the moment of use.

5.2 Oral cholera vaccine

Oral cholera vaccines provide an important additional tool. The WHO prequalified killed whole-cell OCVs, including Shanchol and Euvichol, have been deployed in mass campaigns and in outbreak response, and a single-dose strategy has been used when supply is constrained (WHO, 2023; GTFCC, 2017). A meta-analysis by Bi et al. (2017) found that two doses of killed whole-cell OCV provided substantial protection, and field studies in Haiti, Bangladesh, and several African settings have confirmed effectiveness in real-world conditions (Bi et al., 2017; Qadri et al., 2015). Qadri et al. (2015) demonstrated in a cluster-randomised trial in Dhaka that OCV, alone or combined with WASH promotion, reduced cholera risk, supporting the view that vaccination and WASH are complementary rather than competing strategies. The WHO (2023) recommends OCV for endemic hotspots and for outbreak response, integrated with WASH and surveillance, not as a substitute for infrastructure.

Supply, timing, and equity remain challenges. Global OCV supply has been constrained relative to demand during the recent resurgence, leading to prioritisation of single-dose reactive campaigns in some settings (WHO, 2024). Cold-chain requirements, campaign costs, and the need for community mobilisation mean that vaccination works best when it is planned in advance for known hotspots, rather than improvised after an outbreak has peaked (GTFCC, 2017; WHO, 2023). Trust is also decisive: rumours about vaccine safety, confusion about dosing, and perceptions of unfair targeting can undermine uptake, and they must be addressed through transparent, locally led communication (WHO, 2023; Taylor et al., 2015). Figure 3 presents an illustrative synthesis of the relative contributions of different interventions; it is not a substitute for context-specific evaluation.

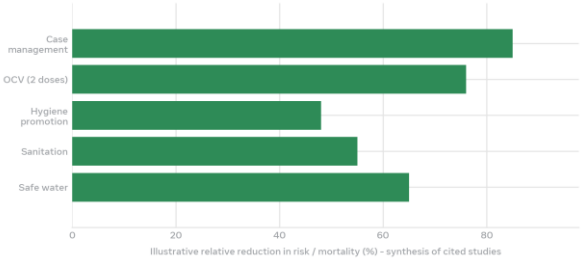


Figure 3. Illustrative relative contribution of interventions to cholera risk or mortality reduction, synthesised from cited reviews and trials. Values are illustrative and vary by setting, coverage, and timing (Bi et al., 2017; Wolf et al., 2018; WHO, 2023).

5.3 Community engagement and risk communication

Community engagement is often described as a cross-cutting activity, but in cholera control it is a core intervention. People decide whether to seek care, to use a treatment centre, to chlorinate water, to accept vaccination, and to report cases, and those decisions are shaped by experience, trust, cost, and social norms (WHO, 2023; GTFCC, 2017). Effective engagement begins before an outbreak: it involves listening to community concerns, co-designing messages with

trusted leaders, using local languages, and ensuring that promised services actually arrive (Taylor et al., 2015; WHO, 2023). During outbreaks, two-way communication, rumour tracking, and feedback mechanisms allow programmes to correct misinformation and adapt to changing needs. After outbreaks, engagement should continue, because the risk does not disappear when cases fall, and because the investments that prevent the next outbreak are made in the quiet period between emergencies.

6. Integrated Control: A Phased Framework

The GTFCC Ending Cholera roadmap (GTFCC, 2017) sets a target of reducing cholera deaths by 90 percent and eliminating cholera in at least 20 countries by 2030. Achieving that target requires national cholera plans that identify hotspots, set measurable milestones for WASH, surveillance, vaccination, and case management, and align funding across health, water, and urban development (GTFCC, 2017; WHO, 2023). A phased framework can help translate the roadmap into local action. In the preparedness phase, hotspots are mapped, water and sanitation gaps are assessed, stocks of ORS, Ringer's lactate, chlorine, and RDTs are pre-positioned, health workers are trained, and community structures are engaged. In the alert phase, surveillance thresholds trigger rapid investigation, laboratory confirmation, and activation of treatment and WASH response. In the response phase, CATI, OCV, and WASH are delivered rapidly in affected and adjacent areas, while treatment centres maintain quality care and infection prevention. In the recovery phase, investments are consolidated, lessons are documented, and long-term WASH plans are advanced so that the next rainy season does not reproduce the same crisis.

Table 3 summarises this framework and the indicators that can be used to judge whether it is working. Indicators should be disaggregated by neighbourhood, age, sex, and displacement status, so that inequities are visible and resources can be redirected (WHO, 2023; GTFCC, 2017). Crucially, success should not be measured only by cases averted during an outbreak, but by the proportion of households with sustained access to safe water and sanitation, the timeliness of detection and response, and the case fatality rate, which should remain below one percent (WHO, 2023).

Table 3. Integrated cholera control: phases, priority actions, and illustrative indicators (GTFCC, 2017; WHO, 2023). (Header repeats if the table continues overleaf.)

Phase	Priority actions	Illustrative indicator
Preparedness	Map hotspots; pre-position supplies; train staff; engage communities	Proportion of hotspots with a costed plan
Alert	Rapid investigation; laboratory confirmation; activate response	Time from alert to investigation (<48 hours)
Response	CATI, OCV, WASH, treatment centres, risk communication	Case fatality rate (<1%); OCV coverage
Recovery	Consolidate WASH; document lessons; fund long-term infrastructure	Households with sustained safe water access

7. Challenges, Uncertainties, and Research Gaps

Several uncertainties deserve explicit attention. First, the true burden of cholera remains uncertain because surveillance is incomplete and because asymptomatic infection is common (Ali et al., 2015; WHO, 2023). Better estimates require stronger laboratory systems and population-based studies, not only facility reports. Second, the duration of protection from single-dose OCV in different age groups and in outbreak versus endemic settings remains an active research question, and supply constraints mean that dose-sparing strategies must be evaluated carefully (Bi et al., 2017; WHO, 2024). Third, antimicrobial resistance in V. cholerae is evolving, and the clinical value of antibiotics in different settings must be reassessed as resistance changes (Kitaoka et al., 2011; Weill et al., 2017). Fourth, climate change is likely to alter rainfall, flooding, and temperature patterns in ways that affect cholera risk, but the magnitude and local expression of those effects remain uncertain and require integrated climate-health surveillance (Pascual et al., 2000; Jutla et al., 2013; Emch et al., 2008). Fifth, the most effective combination of CATI, WASH, and vaccination, and the optimal radius and timing for CATI, need further implementation research in diverse urban settings (WHO, 2023; GTFCC, 2017).

Finally, there is a governance gap. Cholera control requires coordination across ministries and levels of government, and across humanitarian and development funding, yet outbreaks often trigger short-term emergency funding that disappears when cases fall (GTFCC, 2017; Taylor et al., 2015). Sustained financing for water and sanitation, for surveillance, and for community health workers is less visible than emergency response, but it is more decisive for long-term elimination. Research on financing, political economy, and accountability, including how communities can hold service providers to account, is therefore as important as biomedical research (WHO, 2023; GTFCC, 2017).

Conclusion

Cholera is a disease of broken systems, but it is also a disease with known solutions. Safe water, sanitation, hygiene, surveillance, rapid rehydration, and vaccination, delivered together and sustained over time, can break transmission and prevent deaths (WHO, 2023; GTFCC, 2017; Harris et al., 2012). The evidence reviewed here shows that no single intervention is sufficient, and that success depends on reaching the same households with water, sanitation, information, and care at the same time, before, during, and after outbreaks. For low-resource urban settings, the priority

is clear: map hotspots, invest in WASH infrastructure, pre-position supplies, train and support health workers, engage communities as partners, and use OCV strategically while infrastructure is built. If that agenda is pursued with sustained financing and political commitment, the GTFCC vision of ending cholera as a public health threat by 2030 remains achievable, and the next rainy season need not bring the same preventable deaths (GTFCC, 2017; WHO, 2024).

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Conflict of Interest

The authors declare no conflict of interest.

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