

Displacement, dignity and disease: a systematic review of WASH gaps and infectious disease risk in conflict-affected displacement settings

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ABSTRACT

Armed conflict and forced displacement create conditions in which social and political determinants of health strongly shape exposure to infectious diseases. Water, sanitation, and hygiene (WASH) systems, essential to population health, are frequently disrupted or destroyed during conflict, generating environments of structural vulnerability. This systematic review examines how WASH deficiencies increase the risk of infectious diseases among conflict-affected displaced populations, drawing on the frameworks of structural violence and the political ecology of health. A systematic search identified 1,950 records, of which 29 studies met the inclusion criteria. Five cross-cutting domains emerged: WASH infrastructure and access; hygiene behaviour and social norms; infectious disease outbreaks; effectiveness of WASH-related interventions; and structural barriers and enablers to implementation. Findings revealed that inadequate WASH systems were consistently associated with cholera, diarrhoeal diseases, and reduced vaccine effectiveness. Hygiene behaviours were shaped not only by knowledge but also by social inequalities, gender roles, caregiving pressures, and trust in humanitarian actors. Overall, the findings show that WASH deprivation in displacement settings is not merely a technical failure but a socially and politically driven determinant of preventable disease, requiring long-term, inclusive, and locally led WASH systems to strengthen public health resilience.

Key words: WASH, Forced displacement, Conflicted-affected populations, Humanitarian response, Structural determinants of health

HIGHLIGHTS

- Synthesises evidence linking WASH failures in conflict-driven displacement.
- Reframes WASH deprivation as a structural and political determinant of public health risk.
- Identifies five key pathways connecting disrupted water, sanitation, and hygiene to disease vulnerability in displaced populations.
- Reveals governance and equity gaps that undermine effective WASH delivery and outbreak prevention.

INTRODUCTION

Despite unprecedented technological advances, expanded global connectivity, and significant investments in health systems, contemporary armed conflicts have increased in frequency and complexity. The 2020s witnessed record levels of organised violence, with substantial growth in both state-based and non-state conflicts (Pettersson & Eck 2018). This trend goes counter to expectations of global progress and highlights the growing mismatch between technological capacity and human vulnerability. In this context, it has become increasingly urgent to understand how conflict environments influence public health risks.

Forced displacement has increased sharply during this period. The UNHCR Global Trends Report reports 122.1 million forcibly displaced people by April 2025; an unprecedented figure. By the end of 2024, this included 73.5 million internally displaced persons (IDPs) and 42.7 million refugees. Sudan has become the world's largest displacement crisis (14.3 million), surpassing Syria, Afghanistan, and Ukraine. Contrary to common narratives in high-income settings, most displaced people remain geographically close to their countries of origin: 67% of refugees are hosted by neighbouring states, and low- and middle-income countries accommodate 73% of the global refugee population (UNHCR 2024).

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Conflict settings are consistently linked to the emergence and spread of infectious diseases (Marou *et al.* 2024). Disruption or destruction of water, sanitation, and hygiene (WASH) systems, one of the most common forms of infrastructure damage in conflict, dramatically increases the vulnerability of displaced populations to disease outbreaks. Overcrowded camps and informal settlements often lack sufficient water supplies, sanitation facilities, and hygiene services, creating conditions that promote cholera, typhoid, diarrhoeal diseases, and acute respiratory and skin infections (Kearney *et al.* 2024). These disruptions also undermine human dignity, disproportionately impacting women, children, older adults, and persons with disabilities. Evidence from Sudan, for example, shows that overwhelmed sanitation points have led to widespread open defecation and unsafe water use, significantly raising waterborne disease risks (ACAPS 2023). In an increasingly interconnected world, such outbreaks may also contribute to the re-emergence of vaccine-preventable diseases (Raslan *et al.* 2017; Mahase 2025).

Successful implementation of integrated WASH and health strategies requires sustained institutional commitment and meaningful collaboration among field practitioners, researchers, governments, humanitarian organisations, donors, and especially displaced communities. Fragmentation, unequal participation, and limited contextual adaptation still weaken the effectiveness of interventions. Furthermore, much of the current evidence consists of case-specific reports or heterogeneous grey literature, with limited systematic synthesis across settings. Academic studies often differ in methodological rigour, making comparison challenging and hindering the development of evidence-based policy and practice.

This systematic literature review addresses this gap by systematically examining how inadequate or disrupted WASH services contribute to infectious disease risks in conflict-driven displacement contexts. It aims to identify recurring patterns, geographic disparities, and neglected challenges. This synthesis is particularly timely given the ongoing large-scale crises worldwide (Khair 2023; Abbie Cheeseman 2025; Magdy 2025). In these settings, large-scale population movements occur in environments where WASH infrastructure is destroyed, inaccessible, or insufficient, creating acute public health emergencies.

As the World Health Organisation asserts, 'Access to safe water, sanitation and hygiene is not only a prerequisite for health, but a basic human right.' Yet, this right remains widely denied to millions affected by conflict. Strengthening WASH systems in displacement contexts is therefore not only a humanitarian imperative but also a vital component of disease prevention, resilience building, and long-term public health stability (WHO 2023a).

Although humanitarian agencies and academic institutions have produced valuable evidence, much of it is fragmented, context-specific, or methodologically inconsistent, which limits its usefulness for informing policy and coordinated action. To address this gap, the present study conducts a systematic review of the academic literature to investigate the role of WASH service deficiencies in fostering infectious disease outbreaks in conflict-induced displacement settings. By identifying recurring patterns, assessing intervention outcomes, and highlighting ongoing challenges, this review aims to provide an evidence-based foundation for bolstering WASH-health integration in humanitarian response and guiding future research and policy development.

This review is grounded in a conceptual framework that integrates theories of structural violence and the political ecology of health to explain how WASH deficiencies in conflict-driven displacement settings generate heightened infectious disease risk. Structural violence refers to social, political, and economic structures that systematically produce harm by limiting individuals' ability to meet basic needs (Farmer 2004). In displacement settings, conflict disrupts WASH systems, creating environments where safe water, sanitation, and hygiene are structurally inaccessible. These deficits are not random or accidental: they reflect deeper inequalities shaped by conflict actors, state fragility, humanitarian governance failures, and historical marginalisation. By applying a structural violence lens, WASH deprivation is understood not simply as a logistical failure but as an outcome of entrenched power asymmetries that restrict agency, undermine dignity, and amplify infectious disease exposure.

The political ecology of health considers disease distribution as the result of interactions among environmental conditions, political decisions, and social systems. Displacement settings often stem from conflict-driven environmental degradation, collapsed public utilities, and militarised control over resources. Limited access to water, damaged sanitation infrastructure, and overcrowded shelters are ecological outcomes of political processes (Whiteford *et al.* 2016). Outbreaks of infectious diseases, such as cholera and diarrhoeal illnesses, occur within this socio-environmental framework. This perspective highlights how governance failures, donor-driven priorities, and gaps in humanitarian coordination influence the ecology of WASH provision and determine who gains access to protection and who remains vulnerable.

Together, structural violence and political ecology offer an explanatory model that extends beyond technical factors in WASH and disease. This framework helps interpret the findings in this review by framing WASH failures as socially constructed, politically influenced, and structurally patterned phenomena that affect infectious disease outcomes. It also

highlights the importance of interventions that address not only technical shortcomings but also the deeper structural and political factors that perpetuate WASH inequalities in conflict-affected displacement settings [Figure 1](#).

METHODS

Search strategy

The review protocol was developed a priori to define the research question, eligibility criteria, search strategy, screening process, data extraction framework, and thematic synthesis approach prior to study selection. Specifically, this review employed a systematic literature review methodology guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Grey literature, including reports from UN agencies, NGOs, and global coordination bodies, was not included in the formal evidence pool but was used in the discussion to contextualise the findings, triangulate observations, and identify policy-practice gaps. This approach is consistent with established systematic review practice in humanitarian research, where peer-reviewed evidence is synthesised systematically while grey literature provides essential contextual understanding. A comprehensive search strategy was developed to identify studies examining the relationship between WASH deficiencies and infectious disease risks in conflict-driven displacement settings. The search was conducted in PubMed, Scopus, and Web of Science. Boolean search strings combined terms related to WASH, conflict, displacement, and infectious disease, such as: ('WASH' OR 'water sanitation hygiene' OR 'clean water' OR 'latrines') AND ('conflict' OR 'war' OR 'armed violence') AND ('displacement' OR 'refugees' OR 'IDPs' OR 'internally displaced persons') AND ('infectious disease' OR 'cholera' OR 'diarrhoea' OR 'typhoid' OR 'outbreak' OR 'gastrointestinal diseases' OR 'fungal infections').

Eligibility criteria

Search terms were adapted as necessary for each database while maintaining the same conceptual structure focused on WASH, conflict, displacement, and infectious disease outcomes. Database searches were conducted between 1 June 2025 and 11 July 2025. The 2015–2025 timeframe was selected to capture contemporary evidence and reflect recent conflict dynamics (e.g., Syria, Yemen, South Sudan, Ukraine, Gaza). Titles and abstracts were screened against predefined eligibility criteria, followed by full-text assessment of potentially relevant studies.

Studies were included if they:

- were published in English between 1 January 2015 and 11 July 2025;
- focused on conflict-affected displaced populations, including refugees, asylum seekers, or internally displaced persons (IDPs);

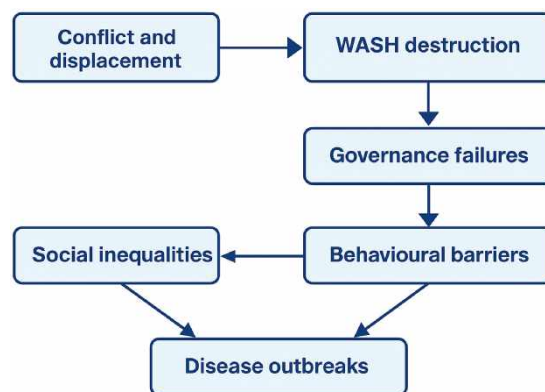


Figure 1 | Conceptual model illustrating the pathways through which conflict and displacement generate WASH system breakdown and increase infectious disease risk. This model integrates concepts from structural violence and political ecology of health to demonstrate how armed conflict and forced displacement lead to the destruction or disruption of water, sanitation, and hygiene (WASH) services. Governance failures, such as fragmented coordination, short-term humanitarian responses, and limited state capacity, further impair the system's functionality. Behavioural barriers emerge when social norms, stressors, and environmental constraints hinder hygiene practices despite the availability of materials. Social inequalities related to gender, disability, age, and socioeconomic status intersect with these structural issues, creating unequal exposure and access to WASH services. These interconnected factors heighten vulnerability and contribute to recurrent outbreaks of infectious diseases in displaced populations.

- examined water, sanitation, and hygiene (WASH) conditions or interventions;
- reported infectious disease outcomes, outbreak risks, or public health implications linked to WASH conditions.

Studies were excluded if they:

- were unrelated to conflict or displacement settings;
- focused exclusively on engineering or infrastructural aspects without public health relevance;
- were editorials, commentaries, conference abstracts, or opinion pieces;
- did not explicitly address infectious disease outcomes or WASH-related health risks.

The initial search, titles and abstracts screened against the eligibility criteria, and the final studies selected for the final synthesis are reported in [Figure 2](#).

Study selection and data extraction

Following database searching, all references were imported into EndNote® ([The EndNote Team 2013](#)) and duplicates were removed prior to screening. Titles and abstracts were screened against the eligibility criteria, followed by full-text assessment of potentially relevant articles. Screening and full-text review were performed by the first author. Uncertainties were resolved through discussion among the authors. Reasons for exclusion during full-text review were documented and are summarised in Supplementary Data 1. Data extraction was performed using a standardised extraction template developed for this review. Extracted information included study design, setting, population, WASH components, infectious disease outcomes, intervention characteristics, and key findings. Extracted study characteristics are summarised in Supplementary Data 2.

Due to substantial heterogeneity in study designs, intervention types, outcome measures, and contextual settings, quantitative meta-analysis was not considered appropriate. A thematic synthesis approach was therefore adopted to identify recurring patterns, shared barriers, intervention strategies, and cross-cutting themes across studies. Thematic synthesis

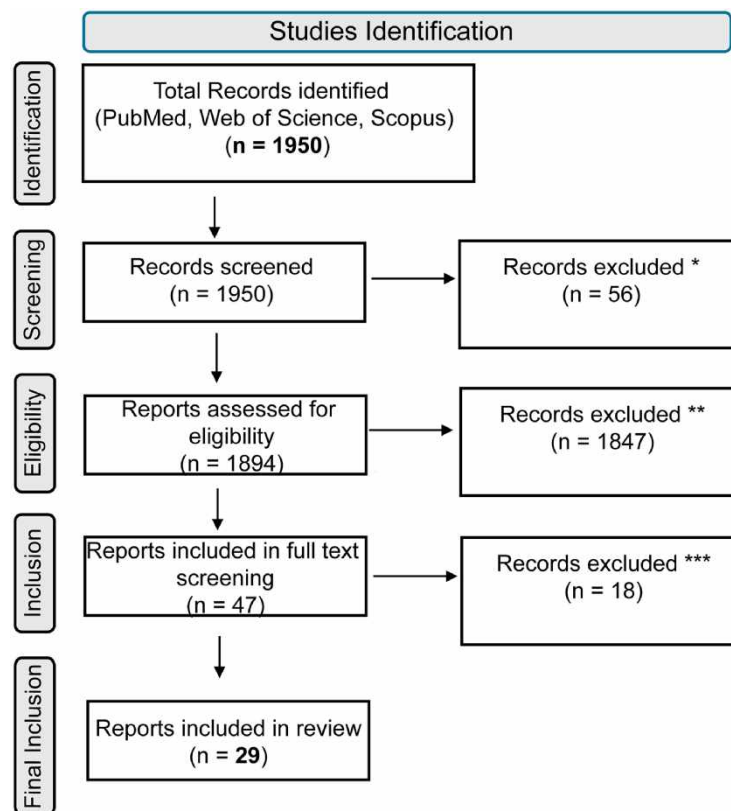


Figure 2 | PRISMA Flow Chart. *Excluded as non-accessible, conference proceedings or abstracts; **Excluded as unrelated to conflict, WASH, or infectious diseases; *** Excluded after abstract or full text review as not relevant to WASH and/or infectious diseases in conflict-displaced settings.

followed the principles described by Thomas and colleagues (Thomas & Harden 2008). Findings from included studies were coded inductively, grouped into descriptive categories, and subsequently organised into higher-order analytical themes through iterative comparison and discussion among the authors.

Quality appraisal

During synthesis, recurring themes were compared against study quality assessments to determine whether conclusions were consistently supported across studies of varying methodological quality. Methodological quality was assessed using the Critical Appraisal Skills Programme (CASP) checklist <https://casp-uk.net/casp-tools-checklists/>. Each study was evaluated across ten core criteria, with one point assigned for each criterion adequately addressed, generating a maximum possible score of 10. For interpretive purposes, studies scoring 8–10 were considered high quality, 5–7 moderate quality, and below 5 low quality. These scores were not used as exclusion criteria but were used to support critical interpretation of the evidence base and assess the robustness of recurring themes across studies. Specifically, to facilitate interpretation, studies with higher CASP scores were considered to demonstrate stronger methodological rigour and transparency, while lower-scoring studies were interpreted more cautiously during thematic synthesis. Thematic conclusions were derived from patterns observed across multiple studies rather than from individual study findings alone. A detailed summary of appraisal outcomes is presented in Supplementary Data 3.

RESULTS

A total of 29 peer-reviewed studies, published between 2015 and 2025, met the inclusion criteria and were incorporated into the final synthesis (Figure 2 and Table 1). The included studies represented a broad geographical distribution across conflict-affected displacement settings. Uganda ($n = 3$) and Nigeria ($n = 3$) were the most frequently represented countries, followed by Bangladesh ($n = 2$), Ethiopia ($n = 2$), Iraq ($n = 2$), Kenya ($n = 2$), and South Sudan ($n = 2$). Single studies were identified from DR Congo ($n = 1$), Somalia ($n = 1$), Thailand ($n = 1$), Mozambique ($n = 1$), Palestine ($n = 1$), Sudan ($n = 1$), and the Thai Myanmar border ($n = 1$), while several studies examined multiple conflict settings or broader global displacement contexts ($n = 6$). Study designs were heterogeneous: the majority employed cross-sectional or survey-based approaches, while others used qualitative interviews, modelling, outbreak investigations, or programme evaluations. Key WASH components examined included hand hygiene ($n = 14$), water access and sanitation infrastructure ($n = 11$), and cholera vaccination or outbreak control measures ($n = 6$). The most frequently reported infectious disease outcomes were cholera, diarrhoeal diseases, and other hygiene-related infections. Study quality varied across the dataset, as assessed using the CASP checklist. Findings were therefore synthesised thematically to identify recurring patterns, shared challenges, and common intervention approaches across diverse conflict-driven displacement contexts. Due to the heterogeneity in study designs and outcome measures, a quantitative meta-analysis was not feasible, so a thematic synthesis was conducted following the principles previously proposed (Popay *et al.* 2006; Thomas & Harden 2008).

Across the included studies, several recurring WASH deficiencies consistently emerged, particularly inadequate sanitation infrastructure, limited access to safe water, insufficient handwashing facilities, overcrowding, and poor hygiene practices. These conditions were most associated with cholera outbreaks, diarrhoeal diseases, and other hygiene-related infectious diseases. Studies further demonstrated that fragmented governance, insecurity, population density, and limited community engagement frequently undermined the effectiveness and sustainability of WASH interventions in displacement settings. Conversely, multicomponent interventions combining infrastructure support, hygiene promotion, and community participation were generally associated with improved public health outcomes and reduced outbreak risk. A high-level review of CASP scores indicated that low-quality studies did not drive the findings of this synthesis. Studies with lower CASP scores contributed contextual observations but did not serve as the sole basis for any thematic conclusion. This ensured that the analytical themes were grounded primarily in evidence from moderate- to high-quality studies. Quality appraisal revealed considerable variation in methodological rigour across the included studies. An overall quality synthesis score table is provided in Supplementary Data 4. Five studies were classified as high quality (CASP score ≥ 8.0), fourteen as moderate quality (6.0–7.5), and ten as low quality (< 6.0). High-quality studies were predominantly qualitative investigations and systematic reviews that demonstrated clear research aims, robust data collection procedures, and rigorous analytical approaches. Lower scores were commonly associated with emergency response reports, policy commentaries, modelling studies, and descriptive outbreak analyses, where methodological details, recruitment strategies, ethical considerations, and analytical procedures were often insufficiently reported. Nevertheless, even studies with lower methodological scores

Table 1 | Characteristics of studies included in the systematic review ($n = 29$)

Study	Region	Design	Population	WASH Focus	Main Disease Outcome
Phillips <i>et al.</i> (2015)	South Sudan	Cross-sectional	Refugees	Handwashing practices	General infection risk
Nyoka <i>et al.</i> (2017)	Kenya	Cross-sectional	Refugees	Sanitation practices	Sanitation-related disease
Blum <i>et al.</i> (2019)	DR Congo	Qualitative evaluation	IDPs	Handwashing behaviour	Hygiene-related illness
Kalid <i>et al.</i> (2019)	Somalia	Cross-sectional	IDPs and caregivers	Feeding and hygiene practices	Nutritional and hygiene-related illness
Havumaki <i>et al.</i> (2019)	Thailand	Modelling study	Refugees	Cholera vaccination	Cholera
Ngwa <i>et al.</i> (2020b)	Nigeria	Emergency response report	IDPs	Emergency WASH response	Cholera
Ngwa <i>et al.</i> (2020a)	Nigeria	Cluster survey	IDPs	Vaccination and WASH context	Cholera
Zangana <i>et al.</i> (2020)	Iraq	Cross-sectional	IDPs	Handwashing determinants	Infection prevention
Namara <i>et al.</i> (2020)	Uganda	Cross-sectional	South Sudanese refugees	Handwashing facility access	Disease prevention
Kisera <i>et al.</i> (2020)	Kenya	Cross-sectional	Refugees	Water and sanitation	Cholera
Watson <i>et al.</i> (2020)	Iraq	Qualitative multi-method	IDPs	Handwashing motivators	Hygiene-related illness
Als <i>et al.</i> (2020)	Multiple conflict settings	Systematic review	Women and children in conflict	WASH intervention delivery	Mixed WASH outcomes
Hassan & Nellums (2021)	Global displacement settings	Policy commentary	Displaced populations	Cholera and WASH neglect	Cholera
Thorseth <i>et al.</i> (2021)	Ethiopia	Pilot intervention study	IDPs	Modified hygiene kits	Handwashing-related disease prevention
Bwire <i>et al.</i> (2021)	Uganda	Cholera risk analysis	Refugees	Water and sanitation	Cholera
Hajat <i>et al.</i> (2022)	Gaza Strip, Palestine	Modelling study	Conflict-affected population	Water access and climate impact	Diarrhoeal disease burden
di Gennaro <i>et al.</i> (2022)	Mozambique	Cross-sectional survey	IDPs	KAP on WASH	Cholera
White <i>et al.</i> (2022)	Northern Iraq	Qualitative case study	IDPs	Hygiene behaviour	Hygiene-related disease risk
Calderón-Villarreal <i>et al.</i> (2022)	Bangladesh, Kenya, Uganda, South Sudan, Zimbabwe	Quantitative cross-sectional	Refugees	Water, sanitation and hygiene access	Access inequalities
Charnley <i>et al.</i> (2022)	Nigeria and DR Congo	Ecological analysis	Conflict-affected populations	Water-related disease	Cholera outbreaks
	Thai–Myanmar border	Mixed methods		Handwashing	

(Continued.)

Table 1 | Continued

Study	Region	Design	Population	WASH Focus	Main Disease Outcome
Pooseesod <i>et al.</i> (2023)			Caregivers of young children		General infectious risk
Qayum <i>et al.</i> (2023)	Bangladesh (Cox's Bazar)	Coverage evaluation survey	Forcibly displaced Myanmar nationals	Cholera vaccination and sanitation	Cholera
Gulumbe <i>et al.</i> (2023)	Northern Nigeria	Thematic review	General population	Water scarcity	Cholera
Tesfay <i>et al.</i> (2024)	South Sudan	LQAS survey	IDPs	WASH monitoring indicators	Outbreak prevention
Winkler <i>et al.</i> (2024)	Ethiopia	Outbreak analysis	Refugees	Cholera response	Cholera
Sifullah <i>et al.</i> (2024)	Bangladesh	Cross-sectional study	Camp residents	Water, hygiene and sanitation practices	Diarrhoeal diseases
Galli <i>et al.</i> (2024)	Multiple conflict settings	Cluster RCT protocol	Displaced and host communities	Hand hygiene programme	Infection prevention
Aceng <i>et al.</i> (2025)	Uganda	Descriptive study	Refugees	Water crisis and sanitation	Cholera
Asmally <i>et al.</i> (2025)	Sudan	Cross-sectional study	Conflict-affected communities	Water, sanitation and hygiene	Waterborne disease risk

Abbreviations: IDPs, internally displaced persons; KAP, knowledge, attitudes and practices; LQAS, Lot Quality Assurance Sampling; RCT, randomised controlled trial.

provided important contextual evidence regarding WASH challenges and infectious disease risks in conflict-affected displacement settings. The strongest and most recurrent themes, including WASH infrastructure collapse, cholera and diarrhoeal disease risk, hygiene behaviour barriers, and governance failures, were supported primarily by studies assessed as moderate or high quality. Lower-scoring studies contributed useful contextual information but did not independently determine any major analytical theme.

Through inductive coding and iterative comparison, findings were grouped into five overarching themes that captured the breadth of evidence across settings: WASH infrastructure in displaced settings; WASH and infectious disease outbreaks; Hygiene behaviour and handwashing practices; Effectiveness of WASH-related interventions; Barriers and enablers to WASH implementation in conflict contexts. Each theme is presented below, with illustrative evidence and key insights drawn from the included studies. The recurring WASH deficiencies, associated infectious disease outcomes, and key implementation challenges identified across the included studies are summarised in [Table 2](#).

WASH infrastructures in displaced settings

Refugees often encounter significant barriers to accessing water, sanitation, and hygiene (WASH) services. Despite this, there is limited research specifically addressing WASH access among refugee populations (e.g., focusing on specific issues such as menstrual health services). Some of the analysed studies aimed to quantitatively assess WASH access in refugee camps, focusing on critical deficiencies in water and sanitation infrastructure within both formal refugee camps and informal IDP settlements. Calderón-Villarreal *et al.* identified significant disparities in WASH access across 21 refugee camps in 5 countries, with service levels varying significantly by geography. Specifically, inequalities in access to WASH services were found across refugee camps in Bangladesh, Kenya, South Sudan, Uganda, and Zimbabwe. While most camps had good access to improved water, there were notable gaps in hygiene, sanitation, privacy, waste disposal, menstrual health materials, and sanitation-related resources. The Female WASH Access Index, used in this study, effectively highlighted disparities in WASH access among households with women of reproductive age. Lower access was especially evident in households with elderly or disabled members, no reproductive-aged women, or fewer than four people (Calderón-Villarreal *et al.* 2022). Similarly, studies conducted in Kenya and Uganda also showed that a significant incidence of infectious disease can be linked to non-functional or poorly maintained WASH infrastructures. Sub-Saharan Africa has continuously recorded the highest number of cholera cases and case fatality rates. Most cases adversely impact children, and refugee camps are

Table 2 | Summary of recurring WASH deficiencies associated with infectious disease risks, and implementation challenges across the included studies

Recurring WASH Deficiency or Challenge	Associated Infectious Disease Outcomes	Key Structural and Implementation Challenge	Representative Studies
Inadequate sanitation infrastructure	Cholera, diarrhoeal diseases, faecal–oral transmission	Poor latrine access, open defecation, overcrowding	Bwire <i>et al.</i> (2021), Kisera <i>et al.</i> (2020), Asmally <i>et al.</i> (2025)
Limited access to handwashing facilities	Hygiene-related infections, increased outbreak risk	Lack of soap, insufficient facilities, inconsistent hygiene practices	Namara <i>et al.</i> (2020), Phillips <i>et al.</i> (2015), Thorseth <i>et al.</i> (2021)
Unsafe or insufficient water supply	Cholera, waterborne diseases, diarrhoeal illness	Contaminated water sources, water scarcity, damaged infrastructure	Aceng <i>et al.</i> (2025), Hajat <i>et al.</i> (2022), Gulumbe <i>et al.</i> (2023)
Overcrowding in displacement camps	Increased infectious disease transmission	High population density, inadequate WASH coverage	Ngwa <i>et al.</i> (2020b), Winkler <i>et al.</i> (2024)
Weak hygiene behaviour uptake	General infectious disease risk	Limited behaviour change communication, cultural and social barriers	Watson <i>et al.</i> (2020), Poosesod <i>et al.</i> (2023), Zangana <i>et al.</i> (2020)
Governance and coordination failures	Delayed outbreak response and reduced intervention effectiveness	Fragmented coordination, insecurity, funding limitations	Charnley <i>et al.</i> (2022), Gulumbe <i>et al.</i> (2023), Asmally <i>et al.</i> (2025)
Limited inclusion of vulnerable populations	Unequal exposure to WASH-related disease risk	Disability exclusion, gender inequities, inadequate inclusive planning	Calderón-Villarreal <i>et al.</i> (2022), Als <i>et al.</i> (2020)
Inadequate integration between WASH and public health systems	Reduced outbreak preparedness and intervention sustainability	Weak surveillance integration, limited multisectoral planning	Ngwa <i>et al.</i> (2020a), WHO (2023b)

well-documented foci for cholera outbreaks (Kisera *et al.* 2020). In Uganda, multiple studies have reported a clear trend of increasing cholera outbreaks in refugee camps linked to deficiencies in WASH facilities and implementation. For example, a national review of cholera surveillance data covering 2016–2019, focusing on refugee settlements and reception centres, showed that seven outbreaks occurred across five refugee settlements and one reception centre during the 4 years, resulting in 1,495 reported cases and 30 deaths signalling critical failures in WASH infrastructure, particularly in clean water supply, sanitation facilities, and hygiene practices (Bwire *et al.* 2021). A further cross-sectional study assessed the availability of functional handwashing facilities among 312 South Sudanese refugees in the Rhino Camp settlement and found that only 23.1% of households had a functional handwashing facility, despite living in a densely populated refugee setting with heightened risk for infectious disease transmission. Thus, identifying a clear infrastructure gap that threatens the effectiveness of hygiene promotion efforts and contributes to elevated public health risks (Namara *et al.* 2020).

Asmally *et al.* conducted a cross-sectional survey of 784 participants across 33 villages during a medical mission in South Kordofan. It assessed the quality and availability of drinking water, sanitation behaviours, and hygiene practices in regions heavily impacted by ongoing conflict. Results from this study were quite alarming, showing that 68% rely on tube wells and boreholes, which are commonly within a 30-minute walking distance of their primary location. Additionally, high microbial and chemical pollutants were found in the analysed samples. Over 41% of young children's faeces were discarded outdoors, a clear indicator of inadequate sanitation. The study highlighted how conflict damage to infrastructure in South Kordofan, Sudan, severely undermined WASH delivery, exacerbating vulnerability among displaced populations (Asmally *et al.* 2025).

Taken together, these studies indicate that inadequate sanitation, unreliable water access, and poorly maintained hygiene facilities are recurring structural deficiencies across displacement settings. Although contexts differ, the evidence consistently demonstrates that WASH infrastructure failures contribute substantially to infectious disease vulnerability and outbreak risk. Importantly, these findings were consistently supported by studies assessed as moderate to high quality using the CASP framework

WASH and infectious diseases outbreaks

From the analysed studies, it is evident that there is a clear relationship between a lack of WASH infrastructure or the presence of non-functional or poorly maintained systems and the occurrence of infectious disease outbreaks. Displacement settings with inadequate water and sanitation services often become breeding grounds for faecal-oral diseases such as cholera, typhoid, and acute diarrhoea, particularly when combined with environmental degradation, overcrowding, and limited public health oversight. Modelling studies predicted that WASH-deficient conditions, combined with climate change and population density in camps, could significantly increase the burden of contagious diseases, thereby establishing a clear link between poor WASH services and heightened epidemic risk (Havumaki *et al.* 2019; Hajat *et al.* 2022). On the same note, studies in Ethiopia (Winkler *et al.* 2024), Mozambique (Di Gennaro *et al.* 2022), and Nigeria (Ngwa *et al.* 2020b) indicate how WASH system inefficiency, together with overcrowding and inadequate coordination, triggered or worsened cholera outbreaks.

Particular attention needs to be reserved for the effect of WASH inefficiencies not only on infectious disease outbreaks, but also on the inefficient implementation of vaccination strategies; Ngwa *et al.* observed that during a reactive cholera vaccination campaign in Borno, Nigeria, poor sanitation conditions and the absence of clean water severely reduced the long-term efficacy of the intervention. Without adequate hygiene and safe water, oral cholera vaccines cannot provide complete protection, as repeated exposure to pathogens persists (Ngwa *et al.* 2020a). Vulnerable individuals (e.g., children, immunocompromised patients, etc.) remain disproportionately affected in such contexts, and recurrent outbreaks place additional strain on already fragile health systems, diverting resources from other essential care. These findings emphasise the importance of integrating WASH infrastructure development with disease surveillance, outbreak response planning, and vaccine delivery strategies in displacement settings (WHO 2023b).

Collectively, the evidence supports a strong association between WASH deficiencies and infectious disease outbreaks in displacement settings. Cholera, diarrhoeal disease, and other waterborne infections repeatedly emerged where overcrowding, inadequate sanitation, and limited access to safe water coincided with weak outbreak preparedness and response systems. Evidence linking WASH deficiencies to cholera and diarrhoeal disease outbreaks was supported primarily by moderate- and high-quality CASP studies.

Hygiene behaviour and handwashing practices

Behavioural factors consistently emerged as a central theme across multiple studies examining hygiene promotion in displacement settings. While several interventions succeeded in providing soap and hygiene materials, access alone did not guarantee effective or sustained handwashing practices. As shown by Phillips *et al.* and Zangana *et al.*, the presence of soap in refugee and internally displaced persons (IDP) camps was not a sufficient condition to ensure proper hygiene. Gaps persisted in hygiene knowledge, motivation to wash hands at critical times, and cultural acceptance of hygiene behaviours. It is therefore essential to enforce a more targeted and sustained hygiene education (Phillips *et al.* 2015; Zangana *et al.* 2020). However, it is necessary to note that hygiene education and knowledge are not the only factors to consider when it comes to hygiene behaviour. Studies using qualitative and mixed-methods approaches have found that social norms, caregiving demands, and environmental barriers often hinder handwashing, even when knowledge is available (Poosesod *et al.* 2023). Similarly, Watson *et al.* investigated hygiene motivations among children in Northern Iraq and showed how peer influence, emotional cues, and infrastructural access shape behaviour (Watson *et al.* 2020). These studies emphasise that hygiene practices are grounded in complex socio-cultural and environmental contexts, not just individual awareness or willingness.

Taken together, the evidence strongly suggests that hygiene interventions in displacement settings must go beyond one-size-fits-all or purely standardised approaches. While distributing hygiene kits, including items such as soap, buckets, and menstrual hygiene products, remains an essential initial step, providing materials alone is not enough to achieve lasting improvements in hygiene practices. For these interventions to be truly effective, they must be supported by strong behaviour change communication strategies tailored to the specific social, cultural, and psychological contexts of the affected populations. This includes community-led approaches that enable displaced populations to co-design hygiene solutions. Interventions should also address barriers such as cultural norms, knowledge gaps, and daily stressors. Interventions should also be flexible enough to adapt to changing needs over time, especially in long-term displacement settings where people may remain for months or even years. In such environments, fostering lasting behaviour change becomes particularly complex and requires ongoing engagement, trust-building, and reinforcement. Sustainable impact will therefore rely not only

on the availability of hygiene materials but also on creating enabling environments that support habit formation and intrinsic motivation. This involves addressing the underlying factors of hygiene behaviour, such as gender roles, caregiving responsibilities, infrastructural limitations, and perceptions of cleanliness, while ensuring the availability of functional, accessible, and private hygiene facilities. Ultimately, hygiene promotion in displacement settings should be approached as an integrated community-centred process that reflect the lived experiences and needs of displaced populations (Cronin *et al.* 2008; Curtis *et al.* 2011).

Across studies, hygiene behaviour was shaped not only by knowledge and resource availability but also by social norms, caregiving responsibilities, environmental constraints, and cultural factors. These findings suggest that effective hygiene promotion requires context-specific and community-centred approaches rather than reliance on material provision alone. Importantly, these findings were supported primarily by studies assessed as moderate to high quality using the CASP framework, strengthening confidence in the conclusion that hygiene behaviour is shaped by social, cultural, and environmental factors beyond simple access to hygiene materials.

Effectiveness of WASH-related interventions

Several studies assessed the efficacy of targeted WASH interventions to improve health outcomes and reduce disease transmission in displacement settings. These interventions ranged from distributing modified hygiene kits to implementing oral cholera vaccination (OCV) campaigns, often tailored to local needs and logistical constraints. For example, Thorseth *et al.* conducted a pilot study among internally displaced persons in Ethiopia. The study demonstrated that modifying hygiene kits by including culturally relevant materials and providing practical usage guidance resulted in significantly improved handwashing behaviours (Thorseth *et al.* 2021). Similarly, Qayum *et al.* highlighted the feasibility and effectiveness of mass OCV campaigns in emergency and displacement settings. The authors underscored the importance of community mobilisation and context-specific delivery strategies to ensure high coverage in vulnerable populations (Qayum *et al.* 2023). Importantly, studies that used a multicomponent approach, incorporating hygiene promotion, infrastructure improvements, and behaviour change communication, consistently reported greater effectiveness than isolated efforts. For example, Galli *et al.* presented a protocol for a cluster-randomised controlled trial to evaluate a comprehensive hand hygiene and well-being programme in schools and healthcare centres in protracted conflict settings. Their approach integrated hardware (e.g. water tanks and handwashing stations) with software components such as hygiene education and staff training (Galli *et al.* 2024). While not yet implemented, the protocol developed by Galli *et al.* outlines a multicomponent WASH intervention combining infrastructure, hand hygiene promotion, and psychosocial well-being, designed for protracted conflict settings (Galli *et al.* 2024).

Ngwa *et al.* assessed a cholera outbreak response in Nigeria, emphasising how prompt, coordinated, and multi-sectoral interventions, covering health services, water and sanitation (WASH), risk communication, and community engagement, were essential in controlling the epidemic. Their analysis highlighted that collaborative efforts among government agencies, international partners, and local stakeholders substantially improved case management, lowered transmission, and strengthened outbreak preparedness and resilience in affected communities (Ngwa *et al.* 2020b).

Overall, the most substantial evidence supports multi-component, community-engaged WASH interventions. Protocols such as the Galli *et al.* cluster-RCT (Galli *et al.* 2024) and the operational response described by Ngwa *et al.* (2020b) illustrate how programmes combining infrastructure upgrades, hygiene promotion, and participatory approaches achieve the most durable improvements in both behaviour and disease outcomes. These interventions represent current best practice and offer a model for future humanitarian WASH programming.

Overall, interventions were most effective when they combined infrastructure improvements with hygiene promotion, behaviour change strategies, and community engagement. The evidence therefore supports integrated and multi-sectoral approaches as the most promising pathway for reducing infectious disease risk in displacement settings. Evidence for integrated, multi-component interventions was largely derived from studies with moderate to high CASP scores, suggesting that the observed benefits are supported by methodologically robust evidence.

Barriers and enablers in conflict settings

Across multiple studies, persistent challenges such as armed conflict, political instability, limited funding, inadequate infrastructure, and weak governance were identified as critical obstacles to both the delivery and sustainability of WASH interventions. Charnley *et al.* examined the relationship between conflict intensity and cholera outbreaks in Nigeria and

the DRC, showing how protracted insecurity, displacement, and lack of coordination directly contributed to delayed WASH responses and uncontrolled disease spread (Charnley *et al.* 2022). Asmally *et al.* in a study of South Kordofan, Sudan, highlighted how active conflict and infrastructure collapse not only prevented a consistent water supply but also compromised humanitarian access to affected populations (Asmally *et al.* 2025). Gulumbe and coworkers demonstrated that conflict-induced water scarcity in Northern Nigeria directly worsened cholera outbreaks, emphasising how insecurity not only damages infrastructure but also disrupts the environmental conditions necessary for WASH functionality (Gulumbe *et al.* 2023).

Alongside physical barriers, administrative fragmentation, overlapping mandates among agencies, and donor constraints, these factors frequently delayed the deployment of urgently needed services. Several reports indicated that WASH activities were often considered secondary to food, shelter, and clinical care, despite their essential role in infection prevention. In complex emergencies, even when funding is available, logistical bottlenecks, such as damaged roads, lack of safe zones for operations, and staff shortages, often hinder the timely implementation of planned interventions. Interestingly, a subset of studies described the conditions under which WASH programmes succeeded despite adversity. Evidence from Uganda (Aceng *et al.* 2025) and Bangladesh (Qayum *et al.* 2023) showed that multi-sectoral coordination, host community collaboration, and strong local leadership were critical enablers of programme effectiveness. Programmes that involved community health volunteers, relied on bottom-up planning, and built trust with displaced persons were more likely to succeed. The integration of WASH planning with public health, education, and social services further enhanced programme reach and sustainability. Nyoka and colleagues examined sanitation practices in Kenya's Kakuma refugee camp. They found that, despite the availability of infrastructure, negative perceptions and maintenance challenges frequently hindered usage, especially among women and young people. These findings emphasise the importance of combining hardware provision with behavioural engagement and ongoing maintenance strategies (Nyoka *et al.* 2017).

These findings highlight that resilient WASH delivery in conflict settings requires more than just materials and infrastructure. It depends on political will, inter-agency cooperation, and meaningful participation of affected populations. Where these enabling factors exist, even resource-limited environments can support impactful, sustainable WASH programmes that reduce health risks and restore dignity during crises (Niederberger & Glanville-Wallis 2019).

The evidence suggests that programme success depends not only on resource availability but also on governance quality, local leadership, inter-agency coordination, and community participation. These factors frequently determined whether WASH interventions achieved sustainable health benefits despite challenging humanitarian conditions. The recurring barriers and enabling factors identified across studies were consistently observed in moderate- and high-quality studies, indicating that governance, coordination, and community participation are robust determinants of WASH programme effectiveness in displacement settings.

DISCUSSION

This systematic review identified five interconnected domains through which WASH deficiencies influence the risk of infectious diseases in conflict-affected displacement settings. Across regions, inadequate or disrupted WASH systems, whether due to infrastructural collapse, overcrowding, or resource constraints, consistently increased vulnerability to cholera, diarrhoeal diseases, and other hygiene-related infections. Findings show that disease transmission is not solely due to inadequate infrastructure. Behavioural, sociocultural, and political factors play a key role in shaping exposure risk and the success of interventions. For example, studies from Iraq, Somalia, and the DRC indicated that gender norms, caregiving roles, and social cohesion strongly affected hygiene practices, even when soap and facilities were available. Importantly, multi-component interventions that combine infrastructure, hygiene promotion, and community engagement were consistently more successful than responses focused only on hardware. Nevertheless, insecurity, weak governance, fragmented coordination, and short-term humanitarian funding often hindered both implementation and sustainability. Overall, the evidence points to a broader, structural conclusion: WASH in displacement settings should therefore be viewed not only as a technical service, but also as a social and political determinant of health linked to dignity, protection, and equity.

Interpretation of the findings was informed by the CASP appraisal. The most consistent themes identified in this review, including inadequate WASH infrastructure, increased cholera and diarrhoeal disease risk, behavioural barriers to hygiene uptake, and governance-related implementation challenges, were supported across multiple studies assessed as moderate or high quality. Lower-scoring studies generally reinforced these patterns but were interpreted more cautiously and used

primarily to provide contextual insight. This strengthens confidence that the principal conclusions reflect robust, recurring patterns in the evidence base rather than findings from isolated studies. The evidence remains geographically uneven. Most included studies originated from sub-Saharan Africa, with fewer studies from South Asia, the Middle East, Southeast Asia, Latin America, North Africa, or European displacement settings. This limits generalisability and highlights the need for comparative studies in underrepresented conflict-affected regions.

Multi-component interventions combining infrastructure, hygiene promotion, and community participation were more effective than single-focus responses. This aligns with humanitarian evidence showing that community consultation, behavioural adaptation, and sustained feedback mechanisms improve acceptability (Niederberger & Glanville-Wallis 2019; Yates *et al.* 2023). However, insecurity, weak governance, supply chain disruption, and fragmented agency mandates continue to limit programme effectiveness in displacement settings (UNICEF 2023; UNHCR 2024).

These findings are consistent with WHO, Sphere, UNHCR, and humanitarian WASH guidance, which position WASH as essential to outbreak prevention, dignity, and survival in emergencies (Sphere 2018; Harvey *et al.* 2019; WHO 2023b). However, this review shows that implementation often remains fragmented and inequitable. Even where infrastructure is present, facilities may be poorly maintained, inaccessible, or unsupported by effective hygiene promotion and community engagement.

Notably, this systematic review extends the academic literature by synthesising studies from underrepresented regions and linking WASH failures not only to cholera outbreaks but also to vaccine underperformance, weakened community trust, and broader system fragility. This aligns with UNHCR's (2024) WASH Strategy, which emphasises the need for 'equitable and safe access to WASH services as a fundamental prerequisite for refugee health.' However, while UNHCR focuses on implementation across refugee camps, findings from this review highlight that IDPs, particularly in informal or conflict-ridden settlements, often face even greater neglect, as noted by studies in Sudan, Somalia, and South Kordofan (Kalid *et al.* 2019; Asmally *et al.* 2025).

Overall, this review affirms that global WASH standards are well established, but implementation in conflict-driven displacement settings remains fragmented, reactive, and inequitable. Across studies, WASH facilities were frequently present but poorly maintained, inaccessible, or unsupported by effective behavioural interventions. This reinforces the need for integrated, equity-focused, and community-led WASH responses.

Climate-related water scarcity may further intensify the risk of WASH-related diseases in conflict settings. For example, modelling from Gaza suggests that climate-induced water scarcity could worsen diarrhoeal disease burden in already WASH-deficient areas (Hajat *et al.* 2022). Climate-adaptive WASH planning should therefore be integrated into humanitarian response.

WASH should be embedded within national public health systems. Ministries of health, national disaster authorities, and humanitarian coordination bodies should incorporate WASH within national disease surveillance systems, outbreak response protocols, and health facility design requirements. Evidence from previous cholera and COVID-19 responses suggests that delayed or partial WASH integration can undermine health outcomes and prolong outbreaks, particularly in overcrowded displacement settings (Ngwa *et al.* 2020a; Winkler *et al.* 2024).

From an operational perspective, humanitarian WASH responses should align with established international standards, particularly the Sphere Standards, which emphasise hygiene promotion, safe water access, sanitation, waste management, vector control, and WASH in healthcare settings and outbreaks (Sphere 2018). Effective implementation requires multisectoral coordination, routine monitoring, community engagement, and integration with health, shelter, nutrition, and protection services.

The human right to safe drinking water and sanitation provides a legal and ethical basis for prioritising WASH among displaced populations (United Nations General Assembly Resolution 2010). Dignified WASH access, including private latrines, menstrual hygiene materials, and culturally appropriate bathing spaces, is also central to psychosocial wellbeing and protection (Hajat *et al.* 2022; White *et al.* 2022).

The policy implication is clear: WASH should be treated as a core public health intervention in humanitarian settings, not as a secondary logistical service. Achieving this requires political commitment, cross-sectoral leadership, and accountability mechanisms that prioritise coverage, quality, equity, and sustainability.

The findings of this review have important implications for multiple stakeholder groups. Governments should integrate WASH indicators into disease surveillance systems, outbreak preparedness plans, and national emergency response frameworks, while ensuring that displaced populations are explicitly included in national WASH and public health policies.

Humanitarian agencies should prioritise integrated, community-led, and inclusive WASH programming that combines infrastructure improvements with hygiene promotion, behaviour change strategies, and meaningful community participation. Donors should move beyond short-term output-based funding models and support longer-term investments that strengthen local capacity, sustainability, monitoring systems, and inter-agency coordination. Researchers should prioritise implementation science, longitudinal evaluations, and comparative studies in underrepresented displacement settings, while placing greater emphasis on disability inclusion, gender-responsive programming, climate resilience, and the integration of WASH with infectious disease surveillance and outbreak prevention systems.

Equity and inclusion in WASH services

Despite a growing body of international frameworks affirming that water, sanitation, and hygiene (WASH) services are universal rights, this systematic review and supporting grey literature demonstrate that access remains highly unequal in conflict-driven displacement settings. Vulnerable groups, including women, girls, persons with disabilities, elderly populations, and those with chronic illnesses, often encounter systemic barriers to safe, dignified, and reliable WASH access. These disparities expose fundamental flaws in how WASH interventions are designed, implemented, and overseen. Addressing these gaps requires a decisive shift towards equity-based policy and inclusive practices.

Several studies included in this systematic review highlighted humanitarian actors' failure to adapt WASH programming to the specific needs of targeted population groups. These findings support evidence from the grey literature. For example, the UNHCR Age, Gender and Diversity (AGD) Policy recognises that humanitarian responses frequently default to 'one-size-fits-all' models, failing to consider the intersecting vulnerabilities of displaced people (UNHCR 2018).

Similarly, the Global WASH Cluster's Technical Guidance on Disability Inclusion (UNICEF 2020) warns that the design of latrines, bathing shelters, and handwashing facilities often excludes persons with mobility, visual, or cognitive impairments, effectively denying them safe access. Interestingly, less than 10% of emergency WASH interventions reviewed in 2020–21 had meaningful gender or disability disaggregation in planning or monitoring phases (Lantagne *et al.* 2021); substantial shortcomings in inclusive planning and monitoring. From a policy perspective, this exclusion persists partly due to inadequate data systems. Most reviewed studies lacked disaggregated data (e.g. by gender, age, and disability), limiting equity analysis. This hampers both the ability to develop inclusive services and the capacity to monitor equity in real time. A 2020 assessment by the Joint Monitoring Programme (WHO/UNICEF 2020) also noted that national and humanitarian WASH reports often combine all camp residents under broad indicators, obscuring gaps that disproportionately affect minority or vulnerable groups (World Health Organization and United Nations Children's Fund 2021).

To bridge this implementation gap, policy frameworks must require disaggregated needs assessments as a foundation for programme design. National emergency plans and donor requirements should link funding to demonstrated attention to inclusion, for example, by demanding WASH partners to report separately on access for women and girls, persons with disabilities, and other at-risk groups (Cluster 2022). Additionally, training modules for field WASH actors should incorporate human rights principles and practical design adaptations for inclusive service delivery. This includes low-cost, scalable modifications such as wider latrine doors, handrails, non-slip surfaces, and menstrual hygiene support mechanisms (Jones & Wilbur 2014). Additionally, design and implementation should have a proactive community engagement, particularly with marginalised groups who are often underrepresented in WASH decision-making.

Yet, many humanitarian responses rely on top-down delivery models that fail to consult communities until after infrastructure has been installed. The policy implications are significant. If humanitarian WASH services are to be truly rights-based, they must meet not only universal standards of access but also standards of usability and dignity. Furthermore, inclusion directly affects public health effectiveness. Limited access for specific groups increases the risk of secondary transmission, hampers herd immunity in vaccination campaigns, and reduces overall resilience to outbreaks. For example, if people with disabilities cannot access handwashing facilities or if caregivers lack knowledge about hygiene practices for children, gaps in disease prevention arise that threaten the entire community.

Governance and accountability

Building on earlier findings on systemic barriers, this section focuses on governance and accountability gaps.

Accountability is a pressing concern. In many emergencies, no single actor bears complete responsibility for ensuring universal WASH coverage or for enforcing minimum standards. This vacuum of accountability is worsened by short funding cycles, staff turnover, and a reliance on external support contractors.

A critical issue to consider is that displacement-affected countries often operate with parallel systems, one run by humanitarian actors, the other by overstretched public institutions, leading to duplication, gaps in coverage, and missed opportunities for localisation. According to WHO and UNICEF, less than 25% of national WASH response plans in fragile states include formal integration with national health surveillance systems (UNICEF 2023; WHO 2023b).

To address these challenges, several practical and policy-level shifts are needed: specifically, WASH coverage, quality, and community feedback should be reported on centralised platforms, such as the UN OCHA Humanitarian Data Exchange (Affairs). User satisfaction surveys and community audits should become standard, and not optional, to ensure real-time accountability. Additionally, shared responsibilities and leadership skills should be enforced. In other words, there should be a lead coordinated agency with the authority to enforce minimum standards, not just to provide guidelines and recommendations. Interestingly, a clear positive value has been demonstrated for real-time WASH monitoring, showing that such tools can strengthen accountability mechanisms and guide evidence-based improvements in humanitarian settings (Tesfay *et al.* 2024).

Capacity building

International actors should commit to transferring coordination roles to local NGOs, public health agencies, and community networks over time. This requires investment in local capacity, training, financing, and systems support, rather than assuming local actors can absorb these roles without long-term assistance.

Finally, and very importantly, donor policies should actively monitor and promote these policy shifts. In emergencies and humanitarian crises, funding mechanisms often prioritise rapid output delivery over planned, scheduled, and rational strategic coordination, which can have a much greater long-term impact. At the same time, political will, perhaps the most crucial factor, is essential to shift the focus from WASH services as mere logistical accessories to public health services that are vital for promoting health, disease prevention, safety, human dignity, and resilience. WASH inefficiency in displacement settings is not a technical issue, but a systemic one with deep roots in the political system.

Future research should move beyond descriptive assessments of WASH conditions and prioritise implementation-focused studies that evaluate how effective interventions can be sustained in protracted displacement settings. Longitudinal studies are needed to better understand the long-term health impacts of WASH deficiencies and the durability of intervention outcomes. Comparative research across underrepresented regions, including Latin America, North Africa, and European displacement contexts, would strengthen the generalisability of the evidence base. Greater attention should also be given to disability inclusion, gender-responsive programming, climate resilience, and the integration of WASH with disease surveillance and outbreak preparedness systems. From an implementation perspective, translating evidence into practice will require stronger coordination between governments, humanitarian agencies, donors, and affected communities. Sustainable implementation pathways should prioritise local capacity building, community participation, integrated WASH-health planning, and accountability mechanisms that support long-term service delivery beyond the emergency phase. Embedding WASH indicators within public health monitoring systems and strengthening links between humanitarian and national institutions may further improve preparedness, response capacity, and resilience in conflict-affected displacement settings.

This review has several important strengths and limitations. First, the review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure methodological transparency and replicability. Additionally, by including only peer-reviewed academic sources, the review maintained a high threshold for methodological reliability. It ensured that conclusions were drawn from evidence subjected to scholarly scrutiny, with only studies reviewed by experts in the field being included. Another strength is the thematic synthesis of findings across diverse contexts, which enabled broader insights into WASH delivery, behavioural uptake, health outcomes, and structural barriers.

Grey literature was excluded from the formal synthesis, potentially limiting operational insights from humanitarian field reports. Grey literature often contains firsthand field reports, rapid assessments, and practitioner reflections that can enrich understanding, especially in rapidly evolving or under-researched crises. While such sources were referenced in the interpretation and discussion, their exclusion from the primary evidence pool introduces a degree of publication bias. Another limitation lies in the language and accessibility restrictions: only studies published in English were reviewed, potentially excluding relevant evidence from non-English-speaking contexts, particularly in Francophone West Africa and Latin America. This may have led to an underrepresentation of WASH challenges and solutions that are highly context-specific but not published in international journals. As previously mentioned, heterogeneity in design and outcomes precluded meta-analysis; thematic synthesis was therefore appropriate. The thematic analysis approach used within this review is

particularly suited to complex public health topics, such as WASH in conflict-driven displacement, where interventions are shaped by contextual, infrastructural, and behavioural factors that cannot be meaningfully aggregated through quantitative pooling. However, while thematic synthesis enhances conceptual depth and policy relevance, it does not allow quantification of intervention effectiveness or causal inference, which remain limitations of this review.

In conclusion, while this review benefits from strong methodological transparency, thematic depth, and contextual insight, it also faces scope-related constraints that reflect wider challenges in humanitarian research. Future reviews should incorporate validated grey literature, foster linguistic inclusivity, and advocate for standardised, disaggregated, and equity-sensitive data collection in WASH studies.

CONCLUSION

This review confirms that WASH deficiencies substantially increase the risk of infectious diseases in conflict-related displacement. Findings also reveal that health outcomes are influenced not only by infrastructure but also by governance, community involvement, and broader social determinants of health. Integrated WASH interventions were consistently more effective than hardware-only approaches.

The concentration of evidence from sub-Saharan Africa highlights a significant research gap. It emphasises the need for comparative studies in Latin America, the Middle East, and other conflict-affected regions.

As displacement becomes a structural reality, WASH must be recognised as a strategic pillar of global health security and human dignity. Findings have significant implications for public health policy, humanitarian programming, and future research. National and international actors must invest in inclusive, anticipatory, and locally led WASH systems. This means mandating disaggregated needs assessments, integrating WASH data into public health surveillance, ensuring coordination with national ministries and health actors, and developing funding models that support long-term outcomes rather than short-term deliverables.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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