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Shackelford, BB, Cronk, R, Behnke, N et al. (6 more authors) (2020) Environmental health in forced displacement: A systematic scoping review of the emergency phase. Science of The Total Environment, 714. 136553. ISSN 0048-9697

https://doi.org/10.1016/j.scitotenv.2020.136553

Environmental health in forced displacement: a systematic scoping review of the emergency phase

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Abstract

There are 70.8 million forcibly displaced people worldwide, including internally displaced persons, refugees, and asylum seekers. Since mortality rates are highest in the first six months of displacement, the provision of adequate services and infrastructure by relief organizations is critical in this "emergency phase." Environmental health provisions such as adequate water supply, excreta management, solid waste management, and vector control measures are among those essential services. We conducted a systematic scoping review of environmental health in the emergency phase of displacement (the six months following first displacement). A total of 122 publications, comprising 104 peer-reviewed and 18 grey literature publications, met the inclusion criteria. We extracted data relating to environmental health conditions and services, associated outcomes, and information concerning obstacles and recommendations for improving these conditions and services. Despite the fact that most displaced people live outside of camps, publications largely report findings for camps (n=73, 60%). Water supply (n=57, 47%) and excreta management (n=47, 39%) dominate the literature. Energy access (n=7, 6%), exposure to harsh weather from inadequate shelter (n=5, 4%), food hygiene and safety (n=4, 3%), indoor air quality (n=3, 3%), menstrual hygiene management (n=2, 2%), dental hygiene (n=2, 2%), and ambient air quality (n=1, 1%) are relatively understudied. The most common health outcome attributed to inadequate environmental conditions in the included publications is diarrhea (n=43, 35%). We found that organizations and governments often embrace their own standards, however we call for policymakers to adopt standards no less rigorous than Sphere for the emergency phase of displacement. Although other reviews examine water, sanitation, and hygiene interventions in emergencies, this is the first systematic review of environmental health more broadly in the first six months of displacement.

Keywords: refugee; internally displaced person (IDP); humanitarian; emergency; migration; WaSH

Acknowledgements: The authors thank Mary White (UNC Health Sciences librarian), Michelle Moffa, and Wilson Guo for their assistance in developing a search strategy, and Ashley Williams for helping categorize health outcomes.

I. Introduction

An estimated 70.8 million people are forcibly displaced from their homes because of persecution, violence, and/or natural disasters worldwide. The number of displaced people doubled between 1998 and 2018 (UNHCR 2019a), reportedly as a result of increasing political instability and weather extremes (Anon 2018). Eighty-five percent of refugees are hosted by low- or middle-income countries (LMICs), which are often unable to provide adequate services for their citizens (UNHCR 2018c). Most displaced persons live in urban slums or camps, which are characterized by inadequate environmental health conditions and services, such as poor sanitation, exacerbated by overcrowding (CDC 1992).

In emergencies, public health infrastructure is often absent and relief efforts are in the early stages, making forcibly displaced persons especially vulnerable (CDC 1992; Toole et al. 2001; Burkle Jr. 2007; UNHCR 2018d). Refugees, internally displaced persons (IDPs), and/or their host populations have an increased risk of mortality immediately after displacement, with mortality rates in the emergency phase up to 60 times the rate prior to displacement (Burkle Jr. 2007; Toole and Waldman 1990; Heudtlass et al. 2016; Toole and Waldman 1988). Approximately three-fourths of deaths in displacement are caused by communicable diseases, which spread easily in overcrowded settlements (Connolly et al. 2004). The main causes of death in the emergency phase of displacement, namely malaria, respiratory infections, and diarrhea, are all linked to inadequate environmental health conditions and services (CDC 1992; Shears and Lusty 1987; Dick and Simmonds 1983; Paquet and Hanquet 1998). Living in a displacement setting is the third most common risk factor for cholera (Griffith et al. 2006). Many of the non-communicable disease deaths are also environment-related. For example, Lahn and Graham (2015) estimate that 20,000 displaced people die every year from indoor air pollution emitted from cooking. Despite the implications of environmental health conditions and services for morbidity and mortality, there is little information on environmental health conditions and services in displacement settings (Cronk et al. 2015; Behnke et al. 2018).

Although other reviews study the efficacy of water, sanitation, and hygiene (WaSH) interventions in low- and middle-income countries in emergency settings (Yates et al. 2018; Ramesh et al. 2015; Taylor et al. 2015), there is little understanding of environmental health conditions and services more broadly (beyond WaSH) in the emergency phase of displacement. Therefore, we conducted a systematic scoping review (Peters et al. 2015) of peer-reviewed publications and grey literature reporting on environmental health in the emergency phase of displacement (six months after the first displacement) (UNHCR 2017), with five research objectives – to identify:

- What environmental health conditions (e.g. water access and quality, latrine access and use, crowding) and subsequent exposures do people face?
- Whether environmental health conditions are adequate according to Sphere Standards?

- What are the outcomes of environmental health conditions?
- What obstacles reportedly prevent improvements in environmental health conditions?
- What recommendations are made for improving environmental health conditions?

II. Methods

2.1 Definitions

According to the United Nations High Commissioner for Refugees (UNHCR), people who have left their place of origin due to conflict or disaster and have not been permanently resettled are forcibly displaced. In this review, we define refugees as those displaced outside of their country of origin, internally displaced persons (IDPs) as those displaced within their country of origin, and asylum-seekers as those who have not yet been granted refugee status. The 1951 Refugee Convention further specifies that a refugee must have a "well-founded fear of being persecuted because of his or her race, religion, nationality, membership of a particular social group or political opinion" (UNHCR 2018a).

We define environmental health conditions and services as water access and quality; access to and use of toilets; management of excreta disposal; population density and crowding; hygiene promotion; access to and use of hygiene items; menstrual hygiene management and incontinence resources; vector control at the household and settlement level; solid waste management at the household and settlement level; fomite cleanliness; drainage; energy access; exposure to weather; food hygiene and safety; indoor air quality; and outdoor air quality.

The phases of displacement are defined according to the UNHCR WaSH definitions: emergency (0-6 months since an influx), transitional (6 months – 2 years), or protracted (more than two years) (UNHCR 2017).

2.2 Search strategy and eligibility

We adapted the search strategy from a systematic review of environmental health conditions in homeless shelters (Moffa et al. 2018). Publications were identified through PubMed, Web of Science, Scopus, and EBSCOhost Global Health between September 23rd 2017 and October 12th 2017. The references of included literature reviews were searched for relevant publications. Grey literature was identified through displacement-relevant portals: DisasterLit, International Rescue Committee, United Nations Children's Fund (UNICEF) WaSH, the United Nations High Commissioner for Refugees (UNHCR), RAND, the Centers for Disease Control and Prevention (CDC) WaSH, the Water, Engineering, and Development Centre, International Committee of the Red Cross, and World Bank Water.

Publications were excluded based on the criteria outlined in Table 1. One of four independent reviewers screened the titles and abstracts of publications using Covidence (Melbourne, Australia). When duplicate publications were identified from different databases, reviewers evaluated only one. Two independent reviewers initially reviewed each full text. Publications excluded by both were removed and those included by both reviewers included. An additional independent reviewer adjudicated where the initial reviewers disagreed. The sources of included literature reviews were reviewed to ensure no publications were missed during the search process.

Table 1. Exclusion criteria for a systematic scoping review of environmental health in the emergency phase of displacement

Exclusion Criteria	**Sub criteria**
Wrong population	Single patient or household; Non-human migration (animal migration; pathogen/biological migration; epidemiological migration); Refugees/IDPs who have been permanently resettled; Not a displaced population
Wrong phase of displacement	Study took place more than six months after an influx
Wrong study type	News articles, letters to the editor, opinion pieces, or newsletters; Documents that do not provide new data or analysis
Not environmental health	---
Not in English	---
Wrong setting	Study subjects/participants permanently resettled; Study subjects/participants do not live in one general geographic area but are dispersed across many; Study subjects/participants impacted by persecution, conflict, or natural disaster, but not displaced
Full text inaccessible	---
Published before 1945 [a]	---

Wrong reason for displacement	Not forced migration (e.g. voluntary migration); Economically-driven migration
Does not meet the Accuracy, Authority, Coverage, Objectivity, Date, and Significance (AACODS) criteria for grey literature (Tyndall 2010)	---

[a] The Convention on the Status of Refugees was not established until 1951, however its negotiation began around 1945

2.3 Data extraction and synthesis

The following data were extracted from included publications: metadata (e.g. paper title, year of study, study type); contextual characteristics (e.g. study country/countries); population characteristics (e.g. origin of refugee/IDP population, reason for displacement); setting characteristics (e.g. setting establishment date, total setting population); environmental health conditions (e.g. water source(s), sanitation service(s), animal vector(s), crowding); environmental health exposures (e.g. toxins, risk factors, disease transmission route(s)); outcomes (e.g. health outcomes, environmental outcomes); proposed or implemented interventions (e.g. behavioral interventions, policy/governance interventions, infrastructure interventions); other major themes (e.g. climate/season/natural disaster, resilience, relevant country policies); obstacles to improvement; knowledge gaps; and recommendations.

Data extracted from publications were tabulated to synthesize findings (condensed extraction table in Supplementary Material). When applicable, data were compared to the Sphere Standards to assess the adequacy of conditions (The Sphere Project 2018b).

III. Results and discussion

3.1 Search results and publication characteristics

The search yielded 10,324 peer-reviewed and 100 grey literature papers (Figure 1). The bibliographies of included literature reviews provided an additional 20 publications that met the inclusion criteria. One hundred and twenty-two publications (104 peer-reviewed and 18 grey literature) were included. Metadata for included publications can be found in the Supplementary Material. Over half of

the publications (57%, n= 69) report on the emergency phase of displacement exclusively, while the remaining report on at least one other phase.

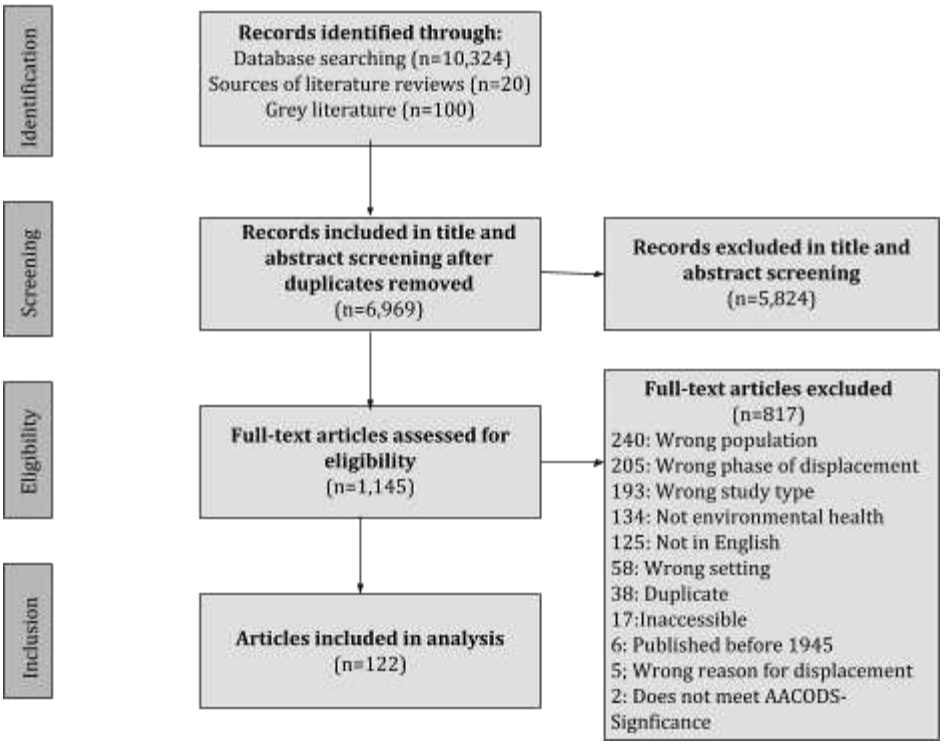

Figure 1. PRISMA flow diagram of a systematic scoping review on environmental health in the emergency phase of displacement

No included publications were published prior to 1972 (Figure 2). Publications about environmental health in the emergency phase of displacement prior to that date may be unavailable online, and/or such research may have been a low priority prior to the 1970s. Eight publications on health care in the Khmer refugee influx of 1979-1980 were published in 1983. More than half of publications (n=72, 59%) were published after the year 2000.

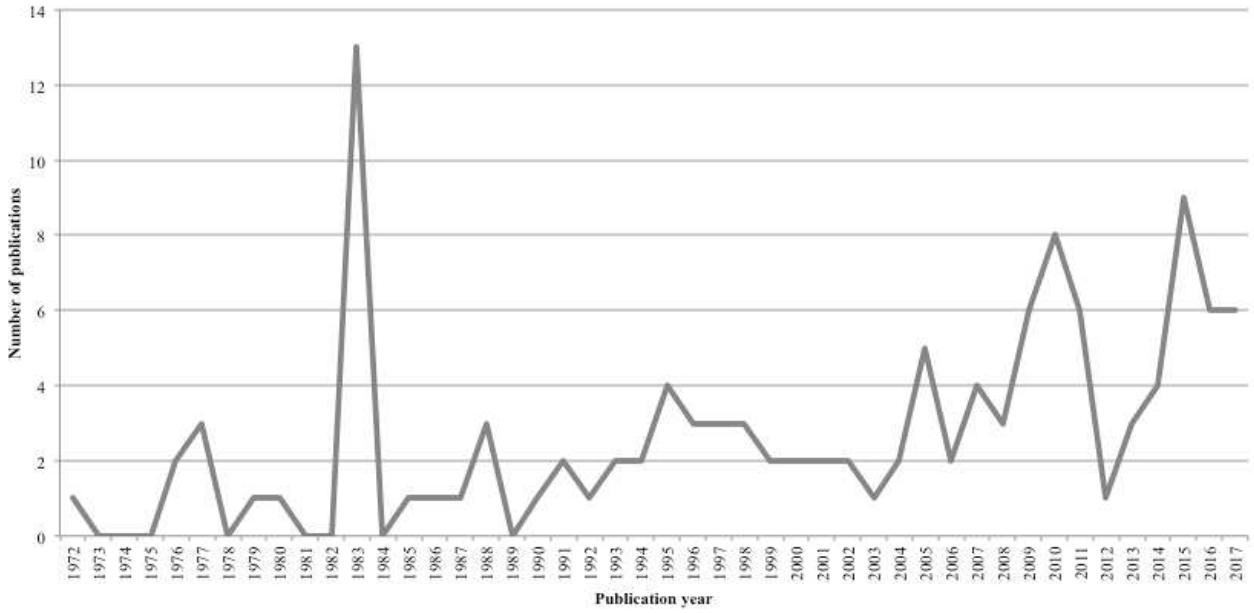

Figure 2. Publication year of publications included in a systematic scoping review on environmental health in the emergency phase of displacement

Ninety-two (75%) publications specify a study population (Table 2). Two-thirds (n=81, 66%) are cross-sectional. All nine ecological publications (7%) are longitudinal. Five of the ecological publications compare several displacement settings (Toole and Waldman 1988; CDC 1994; Bissell 1983; Cronin et al. 2008; Cronin et al. 2009). One (1%) is a cohort study (Husain et al. 2015) and one (1%) a controlled trial (Flachenber 2014).

Thirty publications (25%) do not specify a study population (Table 2). Of these, twenty (16%) are literature reviews with data on displaced people. Nine (7%) of the literature reviews focus on health outcomes (Connolly et al. 2004; Dick and Simmonds 1983; Paquet and Hanquet 1998; Jafari et al. 2011; Kalipeni and Oppong 1998; Kamel 1997; Kimbrough et al. 2012; Lam et al. 2015; Shears 1991), three (3%) on cholera (Griffith et al. 2006; Naidoo and Patric 2002; Rebaudet et al. 2013), and two (2%) on cooking and fuel (Barbieri et al. 2017; Caniato et al. 2017). Six publications (5%) are policy briefs that recommend or describe policies on how to manage camps (Aligne et al. 2009), camp size (Cosgrave 1996), selecting a camp site (Swenson 1983), sanitation (Baghri and Reed 1998), cash-based WaSH interventions (UNHCR 2016a), and WaSH monitoring (Cronk et al. 2015). Four publications (3%) are technical guidelines, providing recommendations for designing physical systems, including drainage (Ajibade et al. 2017; Tota-Maharaj 2016) and sanitation systems (Paul 2005; Fenner et al. 2007).

Table 2. Study type of included publications in a systematic scoping review on environmental health in the emergency phase of displacement (n=122)

Study type	**Count**	**Proportion**
Study population specified	92	75%
Cross-sectional (quantitative or qualitative)	*81*	*66%*
Longitudinal ecological	*9*	*7%*
Controlled trial	*1*	*1%*
Cohort	*1*	*1%*
Does not specify a study population	30	25%
Literature review	*20*	*16%*
Policy brief	*6*	*5%*
Technical guidance	*4*	*3%*

Table 3 shows the displaced population types of included studies that specified a study population. Eighty-six publications (93%) report on one type of displaced population, with refugees the most common (n=59, 64%). IDP populations are studied less (n=38, 41%) than refugee populations, although there are approximately 15.4 million more IDPs than refugees worldwide (UNHCR 2019a). The remaining publications report on settings for both refugees and IDPs (n=6, 7%) or settings for both refugees and asylum seekers (n=2, 2%) (Mellou et al. 2017; Jalili et al. 2013). Seven publications (8%) misclassify IDPs or asylum seekers as refugees, according to the UNHCR definitions.

Table 3. Displaced population types in a systematic scoping review on environmental health in the emergency phase of displacement [b]

Population	**Count of publications with a study population specified (%)**
Refugees	59 (64%)
Internally Displaced People	38 (41%)
Asylum Seekers	3 (3%)

[b] Sum of publications is not 92 because some (n=8, 9%) report on settlements with several categories of displaced people

Table 4 shows reported reasons for displacement. Seven publications (8%) do not specify a reason. The most common reported reason is conflict (n=61, 66%). Natural disaster was the second most common (n=24, 26%), and earthquakes were the most common natural disaster type (n=12, 13%). The majority (n=49, 83%) of the 59 publications on refugee settings report conflict-driven displacement, while the majority of the 38 publications on IDP settings (n=37, 97%) report displacement due to a natural disaster.

Table 4. Reported reasons for displacement in a systematic scoping review on environmental health in the emergency phase of displacement

Reason for displacement	**Count of publications with a study population specified (%)**
Not specified	7 (8%)
Conflict	61 (66%)
Natural disaster *Earthquake (n=12, 13%)* *Tsunami (n=5, 5%)* *Drought (n=2, 2%)* *Hurricane (n=2, 2%)* *Famine (n=1, 1%)* *Flooding from monsoon (n=1, 1%)* *Landslide (n=1, 1%)*	24 (26%)
Closure of another camp	2 (2%)
Weather extremes	1 (1%)
Accidental explosion	1 (1%)

The Khmer refugee influx to Thailand in 1979-1980 (n=10, 11%) and the Rwandan refugee influx to the Democratic Republic of Congo (DRC) in 1994 (n=6, 7%) are the most documented displacement events. Four publications (4%) study the environmental health conditions of IDPs after the 2004 tsunami in Indonesia and Sri Lanka (Lim et al. 2005; Fernando et al. 2009; WHO 2005; Lee et al. 2005), with four more publications (4%) reporting on environmental health conditions following the 2010 Haiti earthquake (Cullen and Ivers 2010; Broach et al. 2010; Patel et al. 2011; Giardina et al. 2016). Several notable crises are understudied. Only one publication (1%) concerns the displacement from

Hurricane Mitch (Campanella 1999), the second most deadly hurricane in history (NOAA 2012). There are no publications on some of the largest IDP crises in the world (UNHCR 2019a), namely Colombia or Syria.

Sub-Saharan Africa is the most represented region in the included literature (n=25, 27%) (Table 5 and expanded table in Supplementary Materials). It also hosts more refugees than any other Sustainable Development Goal region, with more than 35% of the world's refugee population but only 14% of the world's total population (UNHCR 2019a). Included publications report on displacement settings in 38 countries. Thailand (n=12, 13%) is the most studied host country followed by present-day DRC (n=11, 12%). Oceania is the least studied region, with two publications (2%) reporting on Vietnamese populations in Guam in 1977 (Shaw 1977; Arnow et al. 1977). Seven publications (8%) report on environmental health in multiple countries; three (3%) study conditions globally (Lahn and Graham 2015; Cronin et al. 2008; UNHCR 2008a), one (1%) studies settlements in six Sub-Saharan African countries (Cronin et al. 2009), and four (4%) study two countries (Toole and Waldman 1988; CDC 1994; Thomas et al. 1986; Domres and Mang 1997).

Table 5. Sustainable Development Goal region of publications included in a systematic scoping review on environmental health in the emergency phase of displacement

Sustainable Development Goal Region	**Number of countries/ territories represented**	**Count of publications with a study population specified (%)**
Global	---	3 (3%)
Sub-Saharan Africa	13	25 (27%)
Eastern and Southeastern Asia	6	20 (22%)
Northern Africa and Western Asia	4	13 (14%)
Central and Southern Asia	4	12 (13%)
Europe and North America	6	8 (98.6%)
Latin America and the Caribbean	4	7 (87.6%)
Oceania	1	2 (2.2%)

Most publications concern LMICs (n=79, 86%), which currently host 85% of the world's refugees and about 84% of the world's total population (UNHCR 2018c). Fourteen percent of

publications (n=13) concern displacement settings in high-income countries. Few publications (3%, n=3) study multiple countries across multiple income classifications.

Publications most frequently report on refugee camp conditions (n=48, 52%), with multiple refugee camps (n=27, 29%) more common than one refugee camp (n=21, 23%) (Table 6). Most refugees (60%) live outside of camps (UNHCR 2019a), however only 17 percent of publications (n=16) report on settings outside of camps. Publications also report on environmental health conditions and outcomes in displacement health clinics (n=3, 3%) in Pakistan, Haiti, and the DRC (Dowell et al. 1995; CDC 2010; Ahmed 2015), asylum seeker centers in several European countries (n=2, 2%) (Jalili et al. 2013; Angeletti et al. 2016), a refugee transit center in Greece (Georgakopoulou et al. 2016) (n=1, 1%), and a detention center in Puerto Rico (Brody and Loriaux 2003) (n=1, 1%).

Table 6. Displacement settings in a systematic scoping review on environmental health in the emergency phase of displacement

Setting	**Count of publications with a study population specified (%)**
Refugee camp *One (n=21, 23%)* *Multiple (n=27, 29%)*	48 (52%)
IDP camp *One (n=13, 14%)* *Multiple (n=12, 13%)*	25 (27%)
Out-of-camp *Unspecified (n=13, 14%)* *Health clinic(s) (n=3, 3%)*	16 (17%)
Asylum-seeker center	2 (2%)
Refugee transit center	1 (1%)
Detention center	1 (1%)

3.2 Environmental health conditions and services

The included literature assesses a variety of environmental health conditions and services in the emergency phase of displacement (Table 7 and expanded table in Supplementary Materials).

Table 7. Environmental health conditions and services in a systematic scoping review on environmental health in the emergency phase of displacement

Environmental health condition	**Count of publications reporting on environmental health condition (%)**
Water supply *Access and water quantity (n=46, 38%)* *Water quality (n=26, 21%)*	57 (47%)
Excreta management *Access to and use of toilets (n=33, 27%)* *Management of excreta collection, transport, and disposal (n=21, 17%)*	47 (39%)
Population density	29 (24%)
Bodily hygiene behaviors and resources *Hygiene promotion (n=16, 13%)* *Access and use of hygiene items (n=19, 16%)* *Menstrual hygiene management (n=2, 2%)* *Dental hygiene (n=2, 2%)*	26 (21%)
Vector control *Vector control at settlement level (n=13, 11%)* *Household and personal actions to control vectors (n=6, 5%)*	18 (15%)
Solid waste management *Solid waste management systems at settlement level (n=13, 11%)* *Household and personal actions to safely manage solid waste (n=4, 3%)*	18 (15%)
Fomite cleanliness	11 (9%)

Drainage	8 (7%)
Energy access	7 (6%)
Exposure to harsh weather	5 (4%)
Food hygiene and safety	4 (3%)
Indoor air quality	3 (3%)
Outdoor air quality	1 (1%)
Radiation exposure	1 (1%)

Water supply

Water supply is the most commonly studied environmental condition or service (n=57, 47%). Groundwater from a borehole or well (n=12, 9.8%) is the most commonly reported source of water, followed by surface water (n=6, 5%), and rainwater harvesting (n=2, 2%). The studied displaced populations also rely on water trucking (n=9, 7%), water bladders (flexible water storage containers made of rubber or plastic) (n=8, 7%), piped water (n=8, 7%), water bottles (n=4, 3%), and standpipes/ tap stands (n=3, 3%) for water delivery. Husain et al. (2015) is the only publication to report on the Sphere Standard for household access to water fetching and storage containers. They found that the average person in an Ethiopian refugee camp had access to two water containers.

Measures of access and water quantity reported in the literature include the number of liters of water per person per day (L/P/D), the percent of household income spent on water, the availability of water fetching and storage containers, the distance to the water point, and the queuing time at water sources. Twenty-one publications (17%) report water shortages and/or water availability that is less than the Sphere Standard of 15 L/P/D in displacement settings. Eight publications (7%) report that at least the Sphere Standard of water supply was available to displaced persons. However, publications report different methods for calculating L/P/D; some researchers used a bulk –supply method (measuring the total volume fetched at a settlement-level using a meter and dividing by the estimated population), while others used a household supply method (measuring the total volume of water fetching containers at a household-level and diving by the household size). The household supply method may be more accurate since the bulk-supply method does not account for leakage.

Domres and Mang (1997) is the only publication to report the cost of water for displaced population. They found that Rwandan refugees in the DRC received free water, thereby meeting the Sphere Standard of less than five percent of household income being spent on water.

Three publications report on the distance between dwellings and water points (Cronin et al. 2008; McKenzie and de la Haye 1996; UNHCR 2008b). Cronin et al. (2008) and UNHCR (2008) report that some of the displaced population lived within the Sphere Standard of 500 meters to a water point, and McKenzie and de la Haye (1996) found that all refugees in a camp in the DRC were within the Standard.

Three publications report on queuing time at water sources for displaced populations. Cullen and Ivers (2010) and Husain et al. (2015) found their study populations were able to obtain water within the Sphere Standard of 30 minutes, however UNHCR (2008) found that none of their study populations were able to access water in that time.

Measures of water quality are reported in several publications. Kumamaru et al. (2013) report Somali IDPs were using a water source that was not meeting the Sphere Standards for unchlorinated water quality (less than 10 colony-forming units of *Escherichia coli* per 100 milliliters and less than five Nephelometric Turbidity Units) prior to the provision of Poly-Glu technology. Two publications report that displaced people received water that met the Sphere Standard for chlorinated water, or greater than or equal to 0.2 to 0.5 milligrams of free residual chlorine per liter at the point of delivery (Ali et al. 2015; Shaw 1977).

Excreta management

Excreta management is discussed in 47 publications (39%). Twenty-two (18%) report an inadequate number of toilets for the displaced population, reportedly leading to long lines and open defecation. Eight publications (7%) report that the Sphere Standard for toilet quantity (less than 20 persons per latrine) was met. However, one publication report that refugees felt there were insufficient latrines although the Standard was met (Hydroconseil 2017). Three publications (3%) report that no resources (potty, scoop, or nappies) were provided to manage child feces; these are inadequate conditions according to the Sphere Standard (Atuyambe et al. 2011; Kanamori et al. 2011; UNHCR 2008b).

Latrine design can impact use in displaced populations. Publications report latrines were not used because of poor lighting (Arnow et al. 1977) and culturally inappropriate designs (Shaw 1977). Conversely, human-centered design, such as toilets adapted for the disabled (Giardina et al. 2016), culturally appropriate toilets (Gans 2009), and separate toilets for males and females (Bile et al. 2010), reportedly encouraged latrine use.

The location of latrines is important in settlement planning. According to Reed (2012), latrines should be at least 30 meters from any water source to prevent contamination. However, no dwelling

should be more than 50 meters from a shared toilet according to the Sphere Standard. UNHCR (2008) found that all three studied settlements in Sub-Saharan Africa were meeting this standard.

It is especially difficult for aid agencies to manage feces in rainy seasons, when impermeable soils and poor drainage can cause latrines to overflow (Goma Epidemiology Group 1995a; Seaman 1972; Ali et al. 2015). Six publications (5%) report that no attempt was made to manage feces in camps, increasing public health risks. Two publications (2%) report that latrines were desludged and feces was moved off-site (Fernando et al. 2009) or incinerated (Shaw 1977). Kumamaru et al. (2013) found that inadequate management of animal feces, including a lack of fencing, resulted in contamination of a water source used by Somali IDPs.

Population density

Data on population density are reported in nearly a quarter of publications (n=29, 24%). Of the publications reporting on population density, almost all (n=28, 23%) report their study settlements were "crowded". Three publications (3%) report quantitative measures to reinforce their claim, concluding that their study populations had less than 45 square-meters per person, which is the Sphere Standard for camp-type settlements (Ahoua et al. 2006; Bjorgo 2000; Seaman 1972).

Bodily hygiene

Bodily hygiene behaviors and resources are discussed in twenty-six publications (21%). Five (4%) report on handwashing behaviors in displaced people. Flachenber (2014) and Husain et al. (2015) collected the data by observation, while the other publications concern self-reported behaviors. Three publications (3%) report that some of the population practiced inadequate handwashing (without soap and water). Hydroconseil (2017) and Lee et al. (2005) conclude that their entire study populations washed their hands adequately and inadequately respectively.

Four publications (3%) attribute inadequate hygiene practices to a lack of knowledge among the study population. Publications report that organizations used print material (Shaw 1977; Georgakopoulou et al. 2016; CDC 2005), radio broadcasts (Nasir Khisro and Rahman 2010; Holck et al. 1983), and text messages (Giardina et al. 2016) to disseminate hygiene messages. There were no hygiene education activities in two South Sudanese IDP camps prior to a controlled trial to assess the efficacy of hygiene promoters. After hygiene promoters were introduced in one camp, researchers observed that the hygiene practices and use of WaSH resources were better than those of the IDPs in the camp without hygiene promoters (Flachenber 2014).

Nasir Khisro and Rahman (2010) conclude that poor hygiene practices were due to a lack of resources in their study population. Similarly, three publications (3%) report insufficient handwashing facilities (Giardina et al. 2016; CDC 2005; Zweighaft et al. 1977). In lieu of formal handwashing

facilities, handwashing bags (HWB) were provided in refugee camps in Ethiopia. Husain et al. (2015) conclude HWBs are an effective intervention when accompanied by soap and hygiene messaging. Five publications (4%) report shortages of soap, defined as less than 250 grams per person per month (the Sphere Standard) (Bradt and Drummond 2008; Greco et al. 1993; Husain et al. 2015; Kanamori et al. 2011; McKenzie and de la Haye 1996). However, in one case, refugees in Ethiopia were given soap but did not like its smell (Husain et al. 2015). Four publications (3%) report that bathing facilities were inadequate, exceeding the Sphere Standard of less than 50 people per bathing facility (Cullen and Ivers 2010; Giardina et al. 2016; Khan and Munshi 1983; Bradt and Drummond 2008). Two publications (2%) report poor oral hygiene among refugees (Suzuki et al. 2011; Brown et al. 1988), but do not describe the availability of resources to practice good oral hygiene (e.g. toothbrushes and toothpaste).

Two publications (2%) report on menstrual hygiene management (MHM). MHM materials were distributed to beneficiary IDPs in Pakistan (Nasir Khisro and Rahman 2010) and were reported to be in short supply for Rwandan refugees in Goma, DRC (McKenzie and de la Haye 1996).

No publications report on the Sphere Standard for incontinence resources for displaced populations.

Vector control

Eighteen publications (15%) discuss vectors and/or vector control interventions. Ten (8%) note a high density of mosquitos in their study setting. Vector control measures are reported, including: pesticide application and mosquito repellent (n=7, 6%), pest control traps (McKenzie and de la Haye 1996), and mosquito bed nets (Atuyambe et al. 2011). Bradt and Drummond (2008) found no bed nets in their study site.

Solid waste management

Eighteen publications (15%) report on solid waste pollution and/or management interventions (SWM), including providing rubbish bins (n=3, 3%) and workers to clear camps of waste (n=1, 1%). Solid waste pollution is reported in settings with no SWM services (Flachenber 2014; Bradt and Drummond 2008; Ryan 1976; Biswas and Tortajada Quiroz 1996), including an urban area of Lebanon where refugees could not afford the municipal waste service (Hydroconseil 2017). Resources for corpse disposal were provided in four camps in Burundi and Rwanda (CDC 1994), while Domres and Mang (1997) and Yao et al. (2009) report that corpses were improperly buried during the 1994 Goma cholera outbreak and the 2008 Sichuan earthquake, respectively.

Fomite cleanliness

Eleven publications (9%) report soiled fomites and/or cleaning interventions. Crowded displacement settlements often have a scarcity of personal items, such as towels and clothing. As a result,

displaced people commonly share these items, facilitating the transmission of pathogens on fomites (Zweighaft et al. 1977; Kim et al. 2007). Two publications report that displaced people did not have more than one set of culturally and climate appropriate clothing per person (the Sphere Standard) (Greco et al. 1993; Lim et al. 2005). Giardina et al. (2016) report insufficient laundry facilities in Haiti, preventing IDPs from laundering their clothes.

Drainage

Eight publications (7%) discuss standing water, flooding, and/or drainage interventions. Three publications (3%) report drainage systems in their study settings (Shaw 1977; Nothdurft 1983; Glass et al. 1980).

Energy access

Seven publications (6%) report on energy access and interventions in connection to environmental health. The most common source of fuel for individuals in all stages of displacement is firewood (Lahn and Graham 2015). Bradt and Drummond (2008) report that a stable electricity source was available for medical and administrative functions for a refugee camp in Indonesia, but not for the displaced people themselves.

Exposure to harsh weather

Inadequate shelter from cold weather and/ or the sun is reported in five publications (4%).

Food hygiene and safety

Four publications (3%) report on food hygiene and safety. Three (3%) note poor food hygiene practices, including undercooking food and a lack of refrigeration (Lee et al. 2005; Holck et al. 1983; Bollag 1979), while one (1%) concludes that food hygiene was sufficient in four IDP camps in Iraq (Katraschuk et al. 2016).

Indoor air quality

Three publications (3%) study indoor air quality in the emergency phase of displacement, each of which report poor air flow in shelters (Lim et al. 2005; Kanamori et al. 2011; Xiong et al. 2010). No publications contain primary data on the impact of cook stoves on indoor air quality in the emergency phase of displacement.

Outdoor air quality

Yao et al. (2009) is the only publication (1%) to discuss outdoor air quality, reporting high levels of endotoxin and (1,3)-beta-d-glucans in bio aerosols 11 days after an earthquake in China.

Radiation exposure

One publication (1%) reports that after an earthquake and subsequent tsunami in Japan, displaced people were exposed to radiation from a damaged nuclear power plant (Kanamori et al. 2011).

Adequacy of environmental conditions and services

Environmental health indicators aligned with the Sphere Standards are reported by publications 106 times. Publications most commonly report on the Standards related to water quantity, toilet availability, and the presence of soap and water at handwashing stations (Table 8 and expanded table in Supplementary Materials). Indicators that did not meet the Sphere Standards (n=76) are reported twice as much indicators that did meet the Sphere Standards (n=30). This may reflect the inadequacy of environmental conditions in the emergency phase of displacement, or merely that data showing inadequate conditions may be more likely to be published.

Table 8. The adequacy of environmental health conditions and services according to the Sphere Standards in a systematic scoping review on environmental health in the emergency phase of displacement

Sphere Standards	**Count of publications reporting Sphere Standard met (%)**	**Count of publications reporting Sphere Standard not met (%)**
Water supply standards		
At least 15 liters of water per person per day	8 (7%)	21 (17%)
Five percent or less of household income spent on water	1 (1%)	0 (0%)
Less than 500 meters from any household to water point	3 (3%)	2 (2%)
Less than 30 minutes of queuing time	2 (2%)	1 (1%)
Less than 10 colony-forming units of *Escherichia coli* per 100 milliliters at point of delivery (unchlorinated water)	1 (1%)	1 (1%)
0.2–0.5 milligrams of free residual chlorine per liter at point of delivery of delivery (chlorinated water)	2 (2%)	0% (0)
Turbidity of less than 5 Nephelometric Turbidity Units	1 (1%)	1 (1%)
Two water containers per household (10–20 liters; one for collection, one for storage)	1 (1%)	1 (1%)
Excreta management standards		

Minimum 1 toilet per 20 people	8 (7%)	22 (18%)
Maximum 50 meters between dwelling and shared toilet	1 (1%)	0 (0%)
Potty, scoop or nappies to dispose of children's feces	0 (0%)	3 (3%)
Population density standards		
45 square meters for each person in camp-type settlements	0 (0%)	3 (3%)
Bodily hygiene behaviors and resources standards		
Soap and water at a handwashing station (one station per shared toilet or one per household)	1 (1%)	9 (7%)
No more than 50 people per bathing facility	0 (0%)	4 (3%)
250 grams of soap for bathing per person per month	0 (0%)	5 (4%)
Vector control standards		
Long-lasting insecticide-treated nets where needed	1 (1%)	1 (1%)
Fomite cleanliness standards		
Minimum two full sets of clothing per person, in the right size and appropriate to culture, season and climate, and adapted to any particular needs	0 (0%)	2 (2%)

3.3 Outcomes of environmental health conditions and exposures

Table 9 shows inadequate environmental conditions and exposures reported in the literature, and health outcomes the authors attributed to them. No rigorous epidemiological publications containing primary data were identified.

Table 9. Environmental health conditions, resulting exposures, and attributed health outcomes in a systematic scoping review on environmental health in the emergency phase of displacement

Environmental condition (risk factor)	**Reported exposure**	**Attributed health outcome(s)**
Inadequate toilet access (open defecation)	Parasitic worms	Intestinal worms in Pakistani IDPs (Ahmed et al. 2015)
Crowding	Rubeola virus microbes	Measles in Cambodian refugees in Vietnam (Ryan 1976)
	Sarcoptes scabiei var. Hominis	Scabies in Bangladeshi refugees in India (Bedi 1976)
	Vibrio cholerae microbes	Cholera in displaced Africans (Naidoo and Patric 2002)
	Hepatitis A virus microbes	Hepatitis A in asylum seekers and refugees in Greece (Mellou et al. 2017)
	Pediculus humanus capitis	Pediculosis in Albanian refugees in Italy (Greco et al. 1993)
	Pneumonia microbes	Pneumonia in Japanese IDPs (Suzuki et al. 2011)
Inadequate bodily hygiene	Phlebotomine sand flies	Cutaneous leishmaniasis in Syrian refugees in Turkey (Inci et al. 2015)
Inadequate oral hygiene	Various bacteria	Gingivitis in Ethiopian refugees in Somalia (Brown et al. 1988)
	Pneumonia microbes	Pneumonia in Japanese IDPs (Suzuki et al. 2011)
Scarcity of bed nets	Female Anopheles infected by Plasmodium	Malaria in Timorese people in Indonesia (Bradt and Drummond 2008)
Being unable to afford mosquito repellent	Female Anopheles infected by Plasmodium	Malaria in Burmese refugees in Thailand (McGready et al. 2010)
Using R&C spray (for scabies and lice)	Phenothrin	Gynecomastia in Haitian refugees in Puerto Rico (Brody and Loriaux 2003)

Spending time outside	Phlebotomine sand flies	Cutaneous leishmaniasis in Syrian refugees in Turkey (Inci et al. 2015)
Inadequate shelter/ poor ventilation	Cold weather	Hypothermia in Kurdish infant refugees in Iraq (Yip and Sharp 1993)
		Pneumonia in Japanese IDPs (Suzuki et al. 2011)
	Insecticide	Acute conjunctivitis in Chinese school children IDPs (Xiong et al. 2010)
	Dust	Non-communicable acute respiratory diseases in Sri Lankan IDPs (Lim et al. 2005)

The literature review by Yates et al. (2018) found that most publications studying WaSH interventions found them to be effective in reducing disease transmission and that their success was determined by "program design and beneficiary preferences." Several publications reported the difference in morbidity or mortality after the provision of a water supply, but did not control for other factors. For example, during the 1991 Kurdish refugee crisis, nearly 10% of the infant population died within the first month of the crisis, and three-quarters (73%) of the deaths were attributed to diarrheal disease. Once refugees were evacuated to camps with better WaSH conditions, the mortality rate dropped dramatically (Yip and Sharp 1993). Similarly, the incidence of diarrhea declined from 6,000 to 1,000 cases per day in a population of displaced people in the DRC ten days after the supply of water increased (Scawthorn 2000). Nasir Khisro and Rahman (2010) attribute the reduction in diarrhea and typhoid among Pakistani IDPs to WaSH infrastructure, hygiene kits, and hygiene education. Sencan et al. (2004) compared the prevalence of hepatitis A and hepatitis E in two study regions after a series of earthquakes in Turkey; the region that received piped water and household toilets sooner after the earthquakes had a lower prevalence of the diseases.

Globally, displaced families rely primarily on firewood for energy, including safely cooking and boiling water (Lahn and Graham 2015). However, demand for firewood can lead to deforestation in host communities, as occurred in the DRC during the first three weeks of the Rwandan refugee crisis, where the South Kivu and Goma regions lost 10,000 acres of forest land (Biswas and Tortajada Quiroz 1996; Biswas and Tortajada Quiroz 1995).

3.4 Environment-related health outcomes

Communicable diseases are of special concern to displaced populations and dominate the literature on environmental health in the emergency phase of displacement (Figure 3 and expanded table in Supplementary Material).

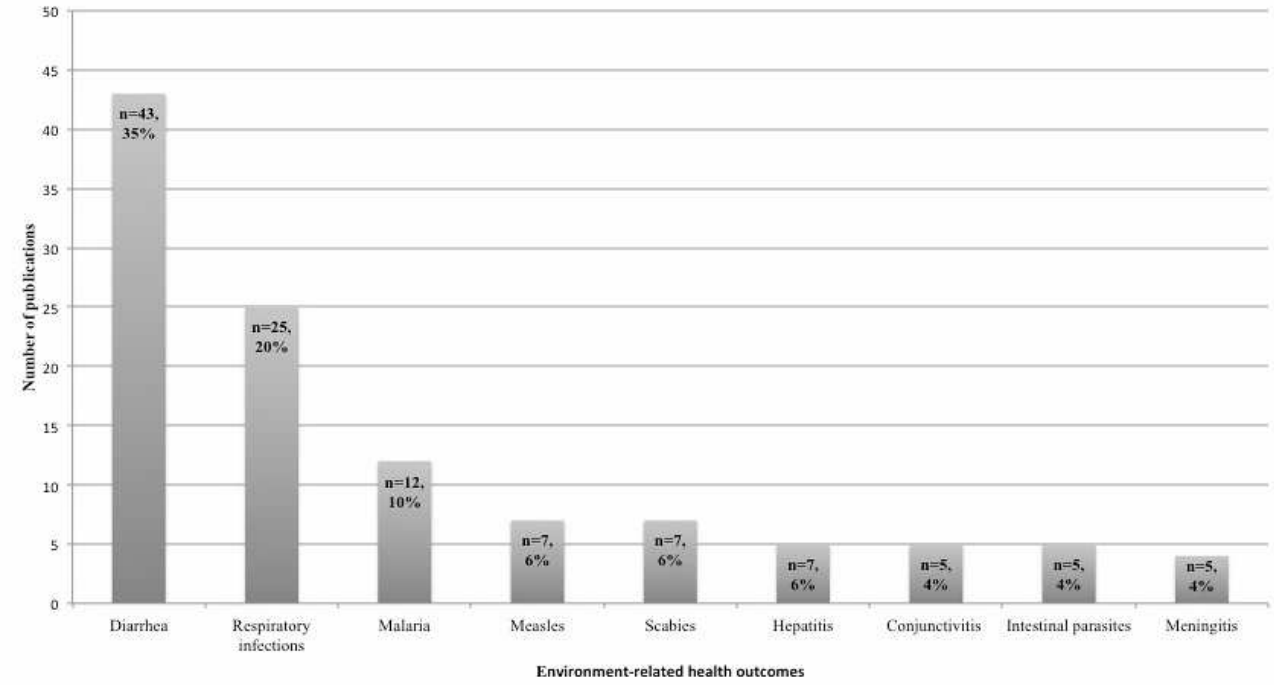

Figure 3. Environment-related communicable health outcomes in a systematic scoping review on environmental health in the emergency phase of displacement

Diarrhea, reported by 43 publications (35%), is the most common condition in the literature, including conditions such as dysentery (n=8, 7%) and cholera (n=7, 6%). Five publications (4%) report the prevalence of intestinal parasites (Jalili et al. 2013; Broach et al. 2010; Shaw 1977; Ahmed et al. 2015; Ito and Egwunyenga 2015). The most common pathogen reported to be diagnosed in displaced people was *Shigella* (n=4, 3%).

Respiratory health outcomes are the second most common condition-type reported (n=26, 21%), including pneumonia (n=7, 6%) and tuberculosis (n=5, 4%).

Cutaneous health outcomes are reported in seven publications (6%), with scabies reported in all of them.

Eye infections are reported in six publications (5%), mainly conjunctivitis (n=5, 4%).

Less commonly reported environment-related health outcomes include typhoid (Bollag 1979; Nasir Khisro and Rahman 2010), leptospirosis (Campanella 1999; McGready et al. 2010), dengue (Lee et al. 2005; McGready et al. 2010), adenovirus (Mohamed et al. 2014; Zweighaft et al. 1977), Staphylococcus infections (Shaw 1977; Zweighaft et al. 1977), encephalitis (Eriksen et al. 1983; Lee et al. 2005), norovirus (CDC 2005), diphtheria (Katraschuk et al. 2016), polio (Horan and Preblud 1983), louse-borne relapsing fever (Brown et al. 1988), Rickettsia (McGready et al. 2010), smallpox (Seaman 1972), chickenpox (Seaman 1972), influenza (Mohamed et al. 2014), pediculosis (Greco et al. 1993), and cutaneous leishmaniasis (Inci et al. 2015). It is unclear if these conditions are less frequently reported due to their lower prevalence, or if they are more difficult to diagnose.

Antimicrobial resistance is a theme in the included literature. All tested Shigella isolates from refugees in Greece were multidrug resistant (Georgakopoulou et al. 2016). Desenclos et al. (1988) found that multidrug resistance was present in 52.3% of *Escherichia coli* isolates from Ethiopian IDPs. Angeletti et al. (2016) found strains of "unusual gram-negative bacteria" resistant to carbapenems, extended-spectrum beta-lactamases, and methicillin in refugees in Italy. In the 1994 Goma cholera outbreak, the strains of *Vibrio cholerae* were resistant to normal drugs used for treating cholera (Siddique et al. 1995). Drug resistance makes disease outbreaks worse. Leslie et al. (2009) attributed a high incidence of malaria in a refugee camp in Pakistan to a high-level of resistance to an antimalarial drug.

3.5 Obstacles and recommendations for improving environmental health conditions in the emergency phase of displacement

Obstacles that hinder adequate environmental health conditions in the emergency stage of displacement are identified in the literature. Publications also provide recommendations for practitioners, policy makers, and researchers are provided for overcoming these obstacles.

Practitioners and response implementation

Since displaced people often come to host communities without warning, there is often insufficient time for adequate preparation (Greco et al. 1993). Security concerns and monsoon season can complicate accessing areas most in need of aid (Stars Orbit Consultants and Management Development 2010; Khan and Munshi 1983; Bradt and Drummond 2008; Ahoua et al. 2006; Kim et al. 2007). The transient presence of relief organizations in the emergency phase hinders coordination and therefore service delivery (CDC 1994; Baghri and Reed 1998; Ajibade et al. 2017; Lim et al. 2005; Broach et al. 2010; CDC 2010; Hydroconseil 2017; Nothdurft 1983). Nevertheless, the quick provision of services is essential since "an emergency situation [can] develop into a possible catastrophe … and break the normal rules applied to long-term sustainable development" (Paul 2005).

Providing clean water and waste disposal to prevent the spread of communicable disease often costs less than medical care that is required without the appropriate environmental health services in disaster relief (Paulozzi 1980). It may be difficult to persuade stakeholders to invest in more expensive, durable solutions since displacement is largely regarded to be a temporary arrangement. However, displacement is most often protracted, with over 80% of refugee crises lasting more than 10 years (Crawford et al. 2015). In the unlikely event that a displacement situation does not outlast the emergency stage, long-term planning in the early stages of displacement could still be beneficial because durable environmental health infrastructure can be integrated into the host community in the future, given the sizes of the displaced and hosting populations are comparable and the settlement is not too remote (Lahn and Graham 2015; Milton et al. 2017).

In the event that the camp site can be chosen before an influx arrives, it should preferably have a water source, adequate slope for drainage, and soil with high permeability as it is typically difficult to manage fecal sludge (Swenson 1983; Domres and Mang 1997).

Several publications recommend selecting simple water treatment systems (Bradt and Drummond 2008) that require few external inputs, such as chemicals and fuels, given the logistical difficulties in displacement areas (Hartung 1986). Sanitation recommendations include providing printed materials showing good latrine construction (McKenzie and de la Haye 1996; UNHCR 2019b), establishing latrine maintenance teams (Bradt and Drummond 2008), and providing lighted latrines separated by gender (Atuyambe et al. 2011). Recommendations for hygiene include paying hygiene promoters (Flachenber 2014), broadcasting hygiene messages on the radio (Bradt and Drummond 2008), and providing soap or alcohol-based sanitizers (Kanamori et al. 2011). Beliefs about hygiene practices can be difficult to change (Giardina et al. 2016; Atuyambe et al. 2011; Bollag 1979). For example, many IDPs in South Sudan were unwilling to change their hygiene behaviors, explaining “why should I take care of this, I’m going to leave in two days” (Flachenber 2014). Therefore, beneficiaries should be included early in intervention planning to ensure these beliefs are effectively identified, considered, and addressed (Baghri and Reed 1998; Bradt and Drummond 2008).

Vector control recommendations include the provision of chemically treated bed nets (UNHCR 2008b; Bradt and Drummond 2008), screened latrine ventilation pipes (UNHCR 2008b), and prepositioning larvicide (Bradt and Drummond 2008) for mosquitoes. Giving priority to the disposal of corpses reduces the prevalence of rodent vectors (Fernando et al. 2009; UNHCR 2008b).

Exposure to indoor airborne pollutants from cook stoves and to pathogens from poor food hygiene can be reduced by upgrading cooking technology or centralizing cooking efforts (Barbieri et al. 2017).

To prepare for infectious disease outbreaks, publications recommend improved health information systems and microbiological surveillance of displaced people seeking medical treatment. However, estimating disease incidence relies on population numbers that are often dynamic and difficult to estimate (CDC 1994; CDC 2010; Goma Epidemiology Group 1995b; Bradt and Drummond 2008; Daley et al. 2001). Practitioners should ensure burial sites are safe, culturally appropriate, and dignified (The Sphere Project 2018b). Whenever possible, one burial site should be established in order to accurately track mortality surveillance data (CDC 1991).

During an outbreak, healthcare facilities in displacement settings often become overcrowded. Additional infections can result from absent or poorly implemented infectious disease protocols. Patients may be prematurely discharged without adequate clinical case management (Burkle Jr. 2007; Cronin et al. 2008; Tota-Maharaj 2016; Mellou et al. 2017; Angeletti et al. 2016; Bradt and Drummond 2008; Nothdurft 1983; Yao et al. 2009; Mahalanabis et al. 1973). Without strict adherence to personal protective equipment protocols, relief workers may contract diseases when performing their duties, further decreasing the number of available trained personnel (Baghri and Reed 1998; Arnow et al. 1977; CDC 2005; Zweighaft et al. 1977). After a displacement event, traumatized families often do not want to be separated. Therefore, strict isolation protocols must be developed and enforced for ill persons to prevent further transmission (CDC 2005).

Donors

LMICs bear the majority of the burden of hosting displaced people and require funding to improve environmental health conditions to international standards (Giardina et al. 2016; Milton et al. 2017; Atuyambe et al. 2011). The Goma Epidemiology Group (1995) recommends that donors invest resources in relief organizations instead of the host governments, who could be involved in the conflict and/or make politically motivated investments. However, this implies that relief organizations are never politically motivated and runs counter to the current movement to strengthen the capacity of host countries to respond.

Researchers

This review reveals important weaknesses in the evidence about the emergency phase of displacement; most of the data are cross-sectional (n=80, 66%). Although it can be difficult to set up rigorous studies during the emergency phase of displacement, and this is sometimes perceived to be unethical (O'Mathúna and Siriwardhana 2017), it is possible for researchers to adopt suitable procedures to provide stronger evidence (Hunt et al. 2016).

3.6 Limitations

A limitation of this study is that only English publications were included. As a result, this review may over represent conditions in displacement settings easily accessible to the Anglophone world.

While this literature review mostly analyzed peer-reviewed literature (n=104, 85%), humanitarian organizations often publish key findings through grey literature. Due to the large number of international humanitarian organizations, the authors were unable to search all of their websites for grey literature, potentially resulting in some literature not being included.

IV. Conclusion

We identify several gaps in the evidence base for environmental health in the emergency phase of displacement. The available literature largely focuses on refugees, despite the fact that there are approximately 15.4 million more IDPs than refugees worldwide. No studies took place in some of the countries with the highest burdens of displaced people, such as Colombia or Syria (UNHCR 2019a).

There are few data (n=16, 13%) available on the environmental health of displaced people living outside of camps, which constitute 60% of refugees worldwide (UNHCR 2019a). This reflects the difficulties identifying out-of-camp displaced people who are often unregistered and dispersed throughout a larger geographic area.

The Sphere Standards were created to provide universal guidelines for humanitarian response (The Sphere Project 2018a). However, host governments and organizations often enforce their own standards (Giardina et al. 2016; UNHCR 2017). We conclude that no standard less rigorous than the Sphere Standards should be embraced in the emergency phase, however more rigorous standards may be appropriate after the first six months of displacement.

L/P/D is one of the most commonly reported upon Sphere Standards in the emergency phase of displacement. However, we found different methodologies are used in the included literature to calculate this indicator. Researchers should avoid using the bulk-supply method to measure L/P/D since it does not account for leakage and relies upon dynamic population estimates.

Environmental health needs are often related and should therefore be addressed holistically. For example, without energy access families are unable to practice good food hygiene or boil their water. Although UNHCR and UNICEF coordinate WaSH actions in refugee and IDP settings respectively, no organization is designated to lead the response for other environmental health conditions. Therefore, we conclude the humanitarian sector should therefore consider expanding WaSH response to include other aspects of environmental health.

Although other literature reviews examine WaSH interventions in humanitarian crises (Ramesh et al. 2015; Yates et al. 2017; Yates et al. 2018; De Buck et al. 2015), this is the first review to assess environmental health conditions, exposures, and outcomes in the emergency phase of displacement (six months after the first displacement). The existing literature for the emergency phase of displacement is focused on water, sanitation, crowding, and hygiene and largely neglects other environmental health conditions. Less than five percent of the included publications report on the exposure to weather from inadequate shelter, food hygiene and safety, or menstrual hygiene management. Lahn and Graham (2015) estimate based on worldwide mortality rates that 20,000 displaced people die each year from indoor air pollution emitted from cooking, but none of the included publications contain primary data on air pollution exposure from cook stoves in the emergency phase.

A clean environment is a human right. As evidenced by this review, displacement status too often determines access to adequate and equitable environmental health services. Anyone can be impacted by conflict or disaster. Durable and effective environmental health infrastructure is essential for public health, as we do not know whether future beneficiaries will be others or ourselves.

Bibliography

Ahmed, S.S. 2015. A Study of Maintaining and Improving the WASH Services Provided by Local and International Agencies in Selected Refugee Camps in Kurdistan Region, IRAQ. *European Journal of Sustainable Development* 5(3).

Ahmed, W., Ahmad, M., Rafatullah, Shah, F. and Sajadullah 2015. Pervasiveness of intestinal protozoan and worm incursion in IDP's (North Waziristan agency, KPK-Pakistan) children of 6-16 years. *The Journal of the Pakistan Medical Association* 65(9), pp. 943–945.

Ahoua, L., Tamrat, A., Duroch, F., Grais, R.F. and Brown, V. 2006. High mortality in an internally displaced population in Ituri, Democratic Republic of Congo, 2005: results of a rapid assessment under difficult conditions. *Global Public Health* 1(3), pp. 195–204.

Ajibade, O.O., Tota-Maharaj, K. and Clarke, B. 2017. A Simplified Guide to Surface Water Drainage Systems for Refugee Camps and Internally Displaced Persons (IDP) Temporary Settlements.

Ali, S.I., Ali, S.S. and Fesselet, J.-F. 2015. Effectiveness of emergency water treatment practices in refugee camps in South Sudan. *Bulletin of the World Health Organization* 93(8), pp. 550–558.

Aligne, F., Dréo, J. and Mattioli, J. 2009. AMETRINE: a humanitarian camp management system. In: Duncan, K. and Brebbia, C. A. eds. *Disaster Management and Human Health Risk*. WIT transactions on the built environment. Southampton, UK: WIT Press, pp. 77–86.

Angeletti, S., Ceccarelli, G., Vita, S., et al. 2016. Unusual microorganisms and antimicrobial resistances in a group of Syrian migrants: Sentinel surveillance data from an asylum seekers centre in Italy. *Travel Medicine and Infectious Disease* 14(2), pp. 115–122.

Anon 2018. Global Report on Internal Displacement (GRID).

Arnow, A.P., Hierholzer, J.C., Higbee, J. and Harris, D.H. 1977. Acute hemorrhagic conjunctivitis: a mixed virus outbreak among Vietnamese refugees on Guam. *American Journal of Epidemiology* 105(1), pp. 68–74.

Atuyambe, L.M., Ediau, M., Orach, C.G., Musenero, M. and Bazeyo, W. 2011. Land slide disaster in eastern Uganda: rapid assessment of water, sanitation and hygiene situation in Bulucheke camp, Bududa district. *Environmental Health: A Global Access Science Source* 10, p. 38.

Baghri and Reed 1998. Emergency sanitation in refugee camps.

Barbieri, J., Riva, F. and Colombo, E. 2017. Cooking in refugee camps and informal settlements: A review of available technologies and impacts on the socio-economic and environmental perspective. *Sustainable Energy Technologies and Assessments* 22, pp. 194–207.

Bedi, T.R. 1976. Human Scabies - A Continuing Problem. *Indian Journal of Dermatology, Venereology and Leprology* 42(5), pp. 235–240.

Behnke, N., Cronk, R., Snel, M., et al. 2018. Improving environmental conditions for involuntarily displaced populations: water, sanitation, and hygiene in orphanages, prisons, and refugee and IDP settlements. *Journal of water, sanitation, and hygiene for development: a journal of the International Water Association*.

Bile, K.M., Shadoul, A.F., Raaijmakers, H., Altaf, S. and Shabib, K. 2010. Learning through crisis: development and implementation of a health cluster strategy for internally displaced persons. *Eastern Mediterranean Health Journal* 16 Suppl, pp. S82-90.

Bissell, R.A. 1983. Delayed-impact infectious disease after a natural disaster. *The Journal of Emergency Medicine* 1(1), pp. 59–66.

Biswas, A.K. and Tortajada Quiroz, C. 1996. Environmental impacts of refugees: a case study. *Impact Assessment* 14(1), pp. 21–39.

Biswas, A.K. and Tortajada Quiroz, C. 1995. Rwandan refugees and the environment in Zaire. *Ecodecision* (16), pp. 73–75.

Bjorgo, E. 2000. Refugee camp mapping using very high spatial resolution satellite sensor images. *Geocarto international* 15(2), pp. 79–88.

Blanchet, K., Ramesh, A., Frison, S., et al. 2017. Evidence on public health interventions in humanitarian crises. *The Lancet* 390(10109), pp. 2287–2296.

Bollag, U. 1979. Practical evaluation of a pilot immunization campaign against typhoid fever in a Cambodian refugee camp. *Disasters* 3(4), pp. 413–415.

Bradt, D.A. and Drummond, C.M. 2008. Delayed recognition of excess mortality in West Timor. *Emergency Medicine Australasia* 20(1), pp. 70–77.

Broach, J.P., McNamara, M. and Harrison, K. 2010. Ambulatory care by disaster responders in the tent camps of Port-au-Prince, Haiti, January 2010. *Disaster Medicine and Public Health Preparedness* 4(2), pp. 116–121.

Brody, S.A. and Loriaux, D.L. 2003. Epidemic of gynecomastia among Haitian refugees: exposure to an environmental antiandrogen. *Endocrine Practice* 9(5), pp. 370–375.

Brown, V., Larouze, B., Desve, G., et al. 1988. Clinical presentation of louse-borne relapsing fever among Ethiopian refugees in northern Somalia. *Annals of tropical medicine and parasitology* 82(5), pp. 499–502.

Burkle Jr., F.M. 2007. War, Refugees, Migration, and Public Health: Do Infectious Diseases Matter? In: Apostolopoulos, Y. and Sonmez, S. eds. *Population Mobility and Infectious Disease*. New York: Springer, pp. 159–176.

Campanella, N. 1999. Infectious diseases and natural disasters: the effects of Hurricane Mitch over Villanueva municipal area, Nicaragua. *Public health reviews* 27(4), pp. 311–319.

Caniato, M., Carliez, D. and Thulstrup, A. 2017. Challenges and opportunities of new energy schemes for food security in humanitarian contexts: A selective review. *Sustainable Energy Technologies and Assessments* 22, pp. 208–219.

CDC 1992. Famine-affected, refugee, and displaced populations: recommendations for public health issues. *MMWR. Recommendations and Reports: Morbidity and Mortality Weekly Report* 41(RR-13), pp. 1–76.

CDC 1994. Health status of displaced persons following Civil War--Burundi, December 1993-January 1994. *MMWR. Morbidity and Mortality Weekly Report* 43(38), pp. 701–703.

CDC 1991. International Notes Public Health Consequences of Acute Displacement of Iraqi Citizens -- March-May 1991. *MMWR. Morbidity and Mortality Weekly Report* 40(26), pp. 443–446.

CDC 2005. Norovirus outbreak among evacuees from Hurricane Katrina--Houston, Texas, September 2005. *MMWR. Morbidity and Mortality Weekly Report* 54(40), pp. 1016–1018.

CDC 2010. Rapid establishment of an internally displaced persons' disease surveillance system after an earthquake --- Haiti, 2010. *MMWR. Morbidity and Mortality Weekly Report* 59(30), pp. 939–945.

Connolly, M.A., Gayer, M., Ryan, M.J., Salama, P., Spiegel, P. and Heymann, D.L. 2004. Communicable diseases in complex emergencies: impact and challenges. *The Lancet* 364(9449), pp. 1974–1983.

Cosgrave, J. 1996. Refugee density and dependence: practical implications of camp size. *Disasters* 20(3), pp. 261–270.

Crawford, N., Cosgrave, J., Haysom, S. and Walicki, N. 2015. Protracted displacement: uncertain paths to self-reliance in exile. *Overseas Development Institute*.

Cronin, A.A., Shrestha, D., Cornier, N., Abdalla, F., Ezard, N. and Aramburu, C. 2008. A review of water and sanitation provision in refugee camps in association with selected health and nutrition indicators--the need for integrated service provision. *Journal of Water and Health* 6(1), pp. 1–13.

Cronin, A.A., Shrestha, D., Spiegel, P., Gore, F. and Hering, H. 2009. Quantifying the burden of disease associated with inadequate provision of water and sanitation in selected sub-Saharan refugee camps. *Journal of Water and Health* 7(4), pp. 557–568.

Cronk, R., Slaymaker, T. and Bartram, J. 2015. Monitoring drinking water, sanitation, and hygiene in non-household settings: Priorities for policy and practice. *International Journal of Hygiene and Environmental Health* 218(8), pp. 694–703.

Cullen, K.A. and Ivers, L.C. 2010. Human rights assessment in Parc Jean Marie Vincent, Port-au-Prince, Haiti. *Health and Human Rights* 12(2), pp. 61–72.

Daley, W.R., Karpati, A. and Sheik, M. 2001. Needs assessment of the displaced population following the August 1999 earthquake in Turkey. *Disasters* 25(1), pp. 67–75.

De Buck, E., Borra, V., De Weerdt, E., Vande Veegaete, A. and Vandekerckhove, P. 2015. A systematic review of the amount of water per person per day needed to prevent morbidity and mortality in (post-) disaster settings. *Plos One* 10(5), p. e0126395.

Desenclos, J.C., Zergabachew, A., Desmoulins, B., Chouteau, L., Desve, G. and Admassu, M. 1988. Clinical, microbiological and antibiotic susceptibility patterns of diarrhoea in Korem, Ethiopia. The Journal of tropical medicine and hygiene 91(6), pp. 296–301.

Dick, B. and Simmonds, S. 1983. Refugee health care: Similar but different? *Disasters* 7(4), pp. 291–303.

Domres, B. and Mang, A. 1997. The flight from Rwanda in 1994: what were (are) the priorities? *Prehospital and disaster medicine: the official journal of the National Association of EMS Physicians and the World Association for Emergency and Disaster Medicine in association with the Acute Care Foundation* 12(1), pp. 47–51.

Dowell, S.F., Toko, A., Sita, C., Piarroux, R., Duerr, A. and Woodruff, B.A. 1995. Health and nutrition in centers for unaccompanied refugee children. Experience from the 1994 Rwandan refugee crisis. *The Journal of the American Medical Association* 273(22), pp. 1802–1806.

Eriksen, H., Thousig, O. and Grabe, M. 1983. Measles Outbreak, Khao I-Dang Refugee Camp, Thailand. In: Allegra, D. T., Nieburg, P., Grabe, M., et al. eds. *Emergency Refugee Health Care -- A Chronicle of the Khmer Refugee-Assistance Operation 1979-1980*. pp. 49–55.

Fenner, R.A., Guthrie, P.M. and Piano, E. 2007. Process selection for sanitation systems and wastewater treatment in refugee camps during disaster-relief situations. *Water and Environment Journal* 21(4), pp. 252–264.

Fernando, W.B.G., Gunapala, A.H. and Jayantha, W.A. 2009. Water supply and sanitation needs in a disaster – Lessons learned through the tsunami disaster in Sri Lanka. *Desalination* 248(1–3), pp. 14–21.

Flachenber, F. 2014. Hygiene promotion in emergencies: a fortuitous comparison — the case of Bentiu IDP camps, Unity state, South Sudan. In: Shaw, R. J., Anh, N. V., and Dang, T. H. eds. *Sustainable water and sanitation services for all in a fast changing world*. WEDC, Loughborough University.

Gans, D. 2009. Were Our Customs Really Beautiful? Designing Refugee Camp Toilets. In: Gershenson, O. and Penner, B. eds. *Ladies and Gents: Public Toilets and Gender*. Temple University Press.

Georgakopoulou, T., Mandilara, G., Mellou, K., et al. 2016. Resistant Shigella strains in refugees, August-October 2015, Greece. *Epidemiology and Infection* 144(11), pp. 2415–2419.

Giardina, D., Sorlini, S. and Rondi, L. 2016. *Sanitation Response in Emergencies: Lessons Learnt from Practitioners in Post-Earthquake Haiti*. Environmental Engineering & Management Journal (EEMJ).

Glass, R.I., Cates, W., Nieburg, P., et al. 1980. Rapid assessment of health status and preventive-medicine needs of newly arrived Kampuchean refugees, Sa Kaeo, Thailand. *The Lancet* 1(8173), pp. 868–872.

Goma Epidemiology Group 1995a. Public health impact of Rwandan refugee crisis: what happened in Goma, Zaire, in July, 1994?. *The Lancet* 345(8946), pp. 339–344.

Goma Epidemiology Group 1995b. Public health impact of Rwandan refugee crisis: what happened in Goma, Zaire, in July, 1994? *The Lancet*, pp. 339–344.

Greco, D., Caputo, S.L., Binkin, N., Panatta, M., Squarcione, S. and Germinario, C. 1993. Health response to a large and rapid influx of Albanian refugees in southern Italy, 1991. *Disasters* 17(1), pp. 61–69.

Griffith, D.C., Kelly-Hope, L.A. and Miller, M.A. 2006. Review of reported cholera outbreaks worldwide, 1995-2005. *The American Journal of Tropical Medicine and Hygiene* 75(5), pp. 973–977.

Hartung, H. 1986. Appropriate water technology in Somalia's refugee camps. In: Ince, M. ed. *Water and Sanitation in Africa*. WEDC, Loughborough University.

Heudtlass, P., Speybroeck, N. and Guha-Sapir, D. 2016. Excess mortality in refugees, internally displaced persons and resident populations in complex humanitarian emergencies (1998-2012) - insights from operational data. *Conflict and health* 10, p. 15.

Holck, S.E., Preblud, S.R. and John, B. 1983. Cholera in Two Kampuchean Refugee Camps. In: Allegra, D. T., Nieburg, P., Grabe, M., et al. eds. *Emergency Refugee Health Care -- A Chronicle of the Khmer Refugee-Assistance Operation 1979-1980*. pp. 57–60.

Horan, J.M. and Preblud, S.R. 1983. Poliomyelitis in the Khao I-Dang Holding Center, February-March 1980. In: Allegra, D. T., Nieburg, P., Grabe, M., et al. eds. *Emergency Refugee Health Care -- A Chronicle of the Khmer Refugee-Assistance Operation 1979-1980*. pp. 71–73.

Hunt, M., Tansey, C.M., Anderson, J., et al. 2016. The challenge of timely, responsive and rigorous ethics review of disaster research: views of research ethics committee members. *Plos One* 11(6), p. e0157142.

Husain, F., Hardy, C., Zekele, L., Clatworthy, D., Blanton, C. and Handzel, T. 2015. A pilot study of a portable hand washing station for recently displaced refugees during an acute emergency in Benishangul-Gumuz Regional State, Ethiopia. *Conflict and health* 9(1), p. 26.

Hydroconseil 2017. Evaluation of the Water, Sanitation and Hygiene (WASH) Programme within the UNICEF Country Programme in Lebanon (2013-2016).

Inci, R., Ozturk, P., Mulayim, M.K., Ozyurt, K., Alatas, E.T. and Inci, M.F. 2015. Effect of the Syrian civil war on prevalence of cutaneous leishmaniasis in southeastern Anatolia, Turkey. *Medical Science Monitor* 21, pp. 2100–2104.

Ito, E.E. and Egwunyenga, A.O. 2015. Schistosomiasis: The Aftermath of 2012 floods in delta state, Southern Nigeria. *International Medical Journal* 22(4), pp. 218–223.

Jafari, N., Shahsanai, A., Memarzadeh, M. and Loghmani, A. 2011. Prevention of communicable diseases after disaster: A review. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences* 16(7), pp. 956–962.

Jalili, N., Blazekova, M. and Hupkova, H. 2013. Occurrence of intestinal parasites among Refugee seekers from Humenné Refugee Camp in Slovakia. In: Cozma, V. ed. *Medimond International Proceedings*. Bologna (Italy): Editografica.

Kalipeni, E. and Oppong, J. 1998. The refugee crisis in Africa and implications for health and disease: a political ecology approach. *Social Science & Medicine* 46(12), pp. 1637–1653.

Kamel, W.W. 1997. Health dilemmas at the borders--a global challenge. *World health forum* 18(1), pp. 9–16.

Kanamori, H., Kunishima, H., Tokuda, K. and Kaku, M. 2011. Infection Control Campaign at Evacuation Centers in Miyagi Prefecture after the Great East Japan Earthquake. *Infection Control and Hospital Epidemiology* 32(08), pp. 824–826.

Katraschuk, C., Dudova, Z., Krcmery, V., et al. 2016. Situation analysis in 3,503 refugees from Mosul to Dohuk and Healthcare in an UNHCR refugee camp in Dohuk. *Clinical Social Work and Health Intervention* 7(3), pp. 42–44.

Khan, M.U. and Munshi, M.H. 1983. Clinical illnesses and causes of death in a Burmese refugee camp in Bangladesh. *International Journal of Epidemiology* 12(4), pp. 460–464.

Kimbrough, W., Saliba, V., Dahab, M., Haskew, C. and Checchi, F. 2012. The burden of tuberculosis in crisis-affected populations: a systematic review. *The Lancet Infectious Diseases* 12(12), pp. 950–965.

Kim, G., Torbay, R. and Lawry, L. 2007. Basic health, women's health, and mental health among internally displaced persons in Nyala Province, South Darfur, Sudan. *American Journal of Public Health* 97(2), pp. 353–361.

Kumamaru, K., Khayre, O. and Ito, C. 2013. Improving access to safe water for internally displaced persons (IDPs) in a fragile state, Somalia. In: Delivering water, sanitation, and hygiene services in an uncertain environment. WEDC, Loughborough University.

Lahn, G. and Graham, O. 2015. Heat, Light and Power for Refugees: Saving Lives, Reducing Costs. *Chatham House Report for the Moving Energy Initiative*.

Lam, E., McCarthy, A. and Brennan, M. 2015. Vaccine-preventable diseases in humanitarian emergencies among refugee and internally-displaced populations. *Human vaccines & immunotherapeutics* 11(11), pp. 2627–2636.

Lee, V.J., Low, E., Ng, Y.Y. and Teo, C. 2005. Disaster relief and initial response to the earthquake and tsunami in Meulaboh, Indonesia. *Annals of the Academy of Medicine, Singapore* 34(9), pp. 586–590.

Lim, J.H., Yoon, D., Jung, G., Joo Kim, W. and Lee, H.-C.S. 2005. Medical needs of tsunami disaster refugee camps. *Family Medicine* 37(6), pp. 422–428.

Mahalanabis, D., Choudhuri, A.B., Bagchi, N.G., Bhattacharya, A.K. and Simpson, T.W. 1973. Oral fluid therapy of cholera among Bangladesh refugees. *The Johns Hopkins medical journal* 132(4), pp. 197–205.

McGready, R., Ashley, E.A., Wuthiekanun, V., et al. 2010. Arthropod borne disease: the leading cause of fever in pregnancy on the Thai-Burmese border. *PLoS Neglected Tropical Diseases* 4(11), p. e888.

McKenzie, S. and de la Haye, R. 1996. Oxfam in Goma — a public-health learning experience. *Waterlines* 15(1), pp. 14–20.

Mellou, K., Chrisostomou, A., Sideroglou, T., et al. 2017. Hepatitis A among refugees, asylum seekers and migrants living in hosting facilities, Greece, April to December 2016. *Euro Surveillance* 22(4).

Milton, A.H., Rahman, M., Hussain, S., et al. 2017. Trapped in statelessness: Rohingya refugees in Bangladesh. *International Journal of Environmental Research and Public Health* 14(8).

Moffa, M., Cronk, R., Fejfar, D., Dancausse, S., Padilla, L.A. and Bartram, J. 2018. A systematic scoping review of environmental health conditions and hygiene behaviors in homeless shelters. *International Journal of Hygiene and Environmental Health* 222(3), pp. 335–346.

Mohamed, A.H., Dalal, W., Nyoka, R., et al. 2014. Health care utilization for acute illnesses in an urban setting with a refugee population in Nairobi, Kenya: a cross-sectional survey. *BMC Health Services Research* 14, p. 200.

Naidoo, A. and Patric, K. 2002. Cholera: a continuous epidemic in Africa. *The Journal of the Royal Society for the Promotion of Health* 122(2), pp. 89–94.

Nasir Khisro, S.S. and Rahman, A.U. 2010. Assessing and addressing hygiene issues of internally displaced persons of Swat, Buner and Dir. In: The Hague, The Netherlands: IRC.

NOAA 2012. Mitch: The Deadliest Atlantic Hurricane Since 1780 [Online]. Available at: https://web.archive.org/web/20120717103126/http://lwf.ncdc.noaa.gov/oa/reports/mitch/mitch.html [Accessed: 1 February 2019].

Nothdurft, H. 1983. Organization of Sakaeo Refugee Center, October 1979 - January 1980. In: Allegra, D. T., Nieburg, P., Grabe, M., et al. eds. *Emergency Refugee Health Care -- A Chronicle of the Khmer Refugee-Assistance Operation 1979-1980*. pp. 11–13.

O'Mathúna, D. and Siriwardhana, C. 2017. Research ethics and evidence for humanitarian health. *The Lancet* 390(10109), pp. 2228–2229.

Paquet, C. and Hanquet, G. 1998. Control of infectious diseases in refugee and displaced populations in developing countries. *Bulletin de l'Institut Pasteur* 96(1), pp. 3–14.

Patel, D., Brooks, N. and Bastable, A. 2011. Excreta disposal in emergencies: Bag and Peepoo trials with internally displaced people in Port-au-Prince. *Waterlines* 30(1), pp. 61–77.

Paulozzi, L.J. 1980. Great Myths in Disaster Relief: EPIDEMICS. *Journal of Environmental Health* 43(3), pp. 140–143.

Paul, P. 2005. Proposals for a rapidly deployable emergency sanitation treatment system.

Peters, M.D.J., Godfrey, C.M., Khalil, H., McInerney, P., Parker, D. and Soares, C.B. 2015. Guidance for conducting systematic scoping reviews. *International journal of evidence-based healthcare* 13(3), pp. 141–146.

Ramesh, A., Blanchet, K., Ensink, J.H.J. and Roberts, B. 2015. Evidence on the effectiveness of water, sanitation, and hygiene (WASH) interventions on health outcomes in humanitarian crises: A systematic review. *Plos One* 10(9), p. e0124688.

Rebaudet, S., Sudre, B., Faucher, B. and Piarroux, R. 2013. Environmental determinants of cholera outbreaks in inland Africa: a systematic review of main transmission foci and propagation routes. *The Journal of Infectious Diseases* 208 Suppl 1, pp. S46-54.

Reed, B. 2012. Latrine slabs: an engineer's guide.

Ryan, B. 1976. Severe measles in Vietnam. *The Medical Journal of Australia* 1(11), pp. 353–355.

Scawthorn, C. 2000. Reliability-based design of water supply systems. *IWA Publishing*.

Seaman, J.A. 1972. Relief work in a refugee camp for Bangladesh refugees in India. *The Lancet* 2(7782), pp. 866–870.

Sencan, I., Sahin, I., Kaya, D., Oksuz, S. and Yildirim, M. 2004. Assessment of HAV and HEV seroprevalence in children living in post-earthquake camps from Düzce, Turkey. European Journal of Epidemiology 19(5), pp. 461–465.

Shaw, R. 1977. Preventive medicine in the Vietnamese refugee camps on Guam. *Military Medicine* 142(1), pp. 19–28.

Shears, P. 1991. Epidemiology and infection in famine and disasters. *Epidemiology and Infection* 107(2), pp. 241–251.

Shears, P. and Lusty, T. 1987. Communicable disease epidemiology following migration: studies from the African famine. *The International migration review* 21(3), pp. 783–795.

Siddique, A.K., Salam, A., Islam, M.S., et al. 1995. Why treatment centres failed to prevent cholera deaths among Rwandan refugees in Goma, Zaire. *The Lancet* 345(8946), pp. 359–361.

Stars Orbit Consultants and Management Development 2010. Emergency Water Supply to un-served/underserved/ Vulnerable Areas in Baghdad and the IDPs.

Suzuki, M., Uwano, C., Ohrui, T., et al. 2011. Shelter-acquired pneumonia after a catastrophic earthquake in Japan. *Journal of the American Geriatrics Society* 59(10), pp. 1968–1970.

Swenson, R. 1983. Environmental Health Issues in Refugee Camps in Emergency Refugee Health Care. In: Allegra, D. T., Nieburg, P., Grabe, M., et al. eds. *Emergency Refugee Health Care -- A Chronicle of the Khmer Refugee-Assistance Operation 1979-1980*. pp. 119–120.

Taylor, D.L., Kahawita, T.M., Cairncross, S. and Ensink, J.H.J. 2015. The impact of water, sanitation and hygiene interventions to control cholera: A systematic review. *Plos One* 10(8), p. e0135676.

The Sphere Project 2018a. Introduction to the Sphere Handbook [Online]. Available at: http://www.spherehandbook.org/en/introduction-2/ [Accessed: 10 September 2018].

The Sphere Project 2018b. The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response [Online]. Available at: https://www.spherestandards.org/handbook-2018/ [Accessed: 18 October 2019].

Thomas, E.G., Hayes, A., Hoover, N.J. and Lloyd, N.D.W. 1986. Refugee water supplies in Somalia and Sudan. In: *Water and sanitation at mid-Decade*. WEDC, Loughborough University.

Toole, M.J. and Waldman, R.J. 1988. An analysis of mortality trends among refugee populations in Somalia, Sudan, and Thailand. *Bulletin of the World Health Organization* 66(2), pp. 237–247.

Toole, M.J. and Waldman, R.J. 1990. Prevention of excess mortality in refugee and displaced populations in developing countries. *The Journal of the American Medical Association* 263(24), pp. 3296–3302.

Toole, M.J., Waldman, R.J. and Ziwi, A. 2001. Complex Emergencies. In: Merson, M. H., Black, R. E., and Mills, A. J. eds. *International Public Health: Diseases, Programs, Systems, and Policies*. Maryland: Aspen Publishers, pp. 445–511.

Tota-Maharaj, K. 2016. WASH in Emergencies Problem Exploration Report: Surface Water Drainage.

Tyndall, J. 2010. The AACODS checklist.

UNHCR 2018a. 1951 Convention relating to the Status of Refugees and the 1967 Protocol.

UNHCR 2018b. Africa [Online]. Available at: https://www.unhcr.org/africa.html [Accessed: 23 January 2019].

UNHCR 2008a. A Guidance for UNHCR Field Operations on Water and Sanitation Services [Online]. Available at: http://www.unhcr.org/en-us/publications/operations/49d080df2/guidance-unhcr-field-operations-water-sanitation-services-2008.html [Accessed: 18 May 2018].

UNHCR 2008b. A Guidance for UNHCR Field Operations on Water and Sanitation Services [Online]. Available at: https://www.unhcr.org/en-us/publications/operations/49d080df2/guidance-unhcr-field-operations-water-sanitation-services-2008.html [Accessed: 28 December 2018].

UNHCR 2016a. Cash Based Interventions for WASH Programmes in Refugee Settings.

UNHCR 2016b. Frequently asked questions on climate change and disaster displacement [Online]. Available at: https://www.unhcr.org/news/latest/2016/11/581f52dc4/frequently-asked-questions-climate-change-disaster-displacement.html [Accessed: 23 November 2018].

UNHCR 2018c. Global Trends: Forced Displacement in 2017.

UNHCR 2018d. UNHCR Public Health 2018 Annual Global Overview.

UNHCR 2019a. Global Trends: Forced Displacement in 2018.

UNHCR 2017. UNHCR WASH Manual for Refugee Settings [Online]. Available at: http://wash.unhcr.org/unhcr-wash-manual-for-refugee-settings/ [Accessed: 26 February 2018].

UNHCR 2019b. WASH Technical Designs [Online]. Available at: http://wash.unhcr.org/wash-tech-designs/?slg=wpdmpro&mdf_cat=-1&page_mdf=1295 [Accessed: 2 April 2019].

WHO 2005. Epidemic-prone disease surveillance and response after the tsunami in Aceh Province, Indonesia. *Releve Epidemiologique Hebdomadaire* 80(18), pp. 160–164.

Xiong, H.Y., Lin, H., Xvi, H., et al. 2010. Post-earthquake outbreak of insecticide-associated conjunctivitis in a primary school of Lixian district, China: An epidemiological investigation. *Public Health* 124(6), pp. 332–338.

Yao, M., Zhu, T., Li, K., et al. 2009. Onsite infectious agents and toxins monitoring in 12 May Sichuan earthquake affected areas. *Journal of Environmental Monitoring* 11(11), pp. 1993–2001.

Yates, T., Allen, J., Joseph, M.L. and Lantagne, D. 2017. Short-term WASH interventions in emergency response: A systematic review. *International Initiative for Impact Evaluation*.

Yates, T., Vujcic, J.A., Joseph, M.L., Gallandat, K. and Lantagne, D. 2018. Efficacy and effectiveness of water, sanitation, and hygiene interventions in emergencies in low- and middle-income countries: a systematic review. *Waterlines* 37(1), pp. 31–65.

Yip, R. and Sharp, T.W. 1993. Acute malnutrition and high childhood mortality related to diarrhea. Lessons from the 1991 Kurdish refugee crisis. *The Journal of the American Medical Association* 270(5), pp. 587–590.

Zweighaft, R.M., Hierholzer, J.C. and Bryan, J.A. 1977. Epidemic keratoconjunctivitis at a Vietnamese refugee camp in Florida. *American Journal of Epidemiology* 106(5), pp. 399–407.