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SCOPING REVIEW

The epidemiological profile of incidence and mortality from epidemics in complex humanitarian emergencies from 1990 to 2022 – A scoping review

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Abstract

Aim: This study aimed to investigate the impact of communicable diseases with epidemic potential in complex emergency (CE) situations, focusing on the epidemiological profile of incidence and mortality and exploring underlying factors contributing to increased epidemic risks.

Methods: Using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Review (PRISMA-ScR) guidelines, we conducted a scoping review of articles published between 1990 and 2022. The search included terms related to complex emergencies, communicable diseases, outbreaks, and epidemics. We identified 92 epidemics related to CE occurring in 32 different countries.

Results: Communicable diseases like Shigellosis, Cholera, Measles, Meningococcal meningitis, Yellow Fever, and Malaria caused significant morbidity and mortality. Diarrhoeal diseases, particularly Cholera and Shigellosis, had the highest incidence rates. Shigella specifically had an incidence of 241.0 per 1000 (people at risk), with a mortality rate of 11.7 per 1000, while Cholera's incidence was 13.0 per 1000, with a mortality rate of 0.22 per 1000. Measles followed, with an incidence of 25.0 per 1000 and a mortality rate of 0.76 per 1000. Meningococcal Meningitis had an incidence rate of 1.3 per 1000 and a mortality rate of 0.13 per 1000. Despite their lower incidences, yellow fever at 0.8 per 1000 and malaria at 0.4 per 1000, their high case fatality rates of 20.1% and 0.4% remained concerning in CE. The qualitative synthesis reveals that factors such as water, sanitation, and hygiene, shelter and settlements, food and nutrition, and public health and healthcare in complex emergencies affect the risk of epidemics.

Conclusion: Epidemics during complex emergencies could potentially lead to a public health crisis. Between 1990 and 2022, there have been no statistically significant changes in the trend of incidence, mortality, or fatality rates of epidemic diseases in CE. It is crucial to understand that all epidemics identified in CE are fundamentally preventable.

KEYWORDS
armed conflict, communicable diseases, complex emergencies, epidemics, morbidity, mortality, refugees, risk factors

Sustainable Development Goals: Zero Hunger, Good Health and Well-being, Clean Water and Sanitation.

INTRODUCTION

The term *complex humanitarian emergency*, also known as a *complex emergency (CE)*, describes a multifaceted man-made disaster scenario. In CEs, civilian populations endure the compounded effects of civil or international conflicts or drastic societal restructuring efforts like genocide. Such crises precipitate violence, extensive population displacement, and the degradation of essential living conditions, including access to food, clean water, shelter, and sanitation. These factors collectively escalate public health crises and the potential for markedly increased mortality, either acutely or over prolonged periods [1–5]. Furthermore, in CEs, the breakdown or inadequacy of local authority responses necessitates the intervention of multisectoral external assistance.

The term CE originated in the 1970s, linked initially to conflicts in Mozambique and Sudan. Its usage expanded in the 1990s [6] with the rise in such emergencies, propelled by the end of the Cold War, the surge in civil conflicts [7, 8] and the effects of globalisation [9]. By 2022, the number of people requiring urgent humanitarian aid in CEs globally reached an unprecedented 274 million [10]; this number is the highest figure ever recorded so far due to the increase in the frequency of CEs and reflecting the increasing frequency and complexity of CEs over the past two decades [11]. Notably, CEs also occur in developed areas, as is the case of the present situation in the East and South of Ukraine [12].

Elements often present in CEs include difficulty accessing or providing help to those affected that are prevented by groups that are part of the conflict; security risk for humanitarian aid workers; need for multisectoral international assistance, including humanitarian aid, but also medium- and long-term actions, due to their tendency to become chronic and forgotten (forgotten crisis) [13]. Examples of the chronification, features and scale of the humanitarian needs of the CE are the cases of Haiti, Ethiopia and Afghanistan. Haiti has been a country in CE for decades. It is regularly exposed to natural disasters, climate change and recurring violent socioeconomic and political crises that have caused 30% of the population to need humanitarian assistance in 2022 [14].

In Ethiopia, while there has been development progress in the past decade, the combination of the recent escalation and brutal internal conflict with human rights abuses, the impact of climate change and the socio-economic impacts of COVID-19 deteriorated from humanitarian conditions and the country is in a situation of famine. In 2023 some 4.5 million internally displaced persons will require humanitarian assistance [15] and 25.9 million people needed humanitarian assistance. For its part, Afghanistan has endured decades of war, recurring natural disasters, chronic poverty, drought and food insecurity, which has caused 24.4 million of people, more than half of the country's population, to need external humanitarian aid [16].

The extent and intensity of the public health effects of CE make these situations one of the worst possible scenarios in which a population can be found [17]. Among the most important common impacts of all CE is the increase in communicable diseases, especially those with epidemic potential [18]. The intense effect of these diseases on the mortality of the affected population [19] usually requires public health actions that are a priority in CE.

The objectives of this work is to identify and study the impact of communicable disases with epidemic potential in a CE situation in terms of the epidemiological profile of incidence and mortality and also explore the underlying factors that increase the risk of epidemics.

METHODS

This study is a scoping review following the PRISMA–ScR framework [20, 21]. For CE, the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) definition were utilized: '*multifaceted humanitarian crisis in a country, region or society where there is a total or considerable breakdown of authority resulting from internal or external conflict and which requires a multi-sectoral, international response that goes beyond the mandate or capacity of any agency and/or the ongoing United Nations country program*' [22]. In addition, the definition of communicable disease was also referred to as: '*An illness due to a specific infectious agent or its toxic products that arises through transmission of that agent or its products from an infected person, animal, or reservoir to a susceptible host, either directly or indirectly through an intermediate plant or animal host, vector, or the inanimate environment*' [23]. Our protocol was drafted and revised by the research team and members of the Unit for Research in Emergency and Disasters and was disseminated through emails to solicit additional feedback. The final protocol was not made publicly available.

Eligibility criteria

The population of interest encompassed countries or populations that experienced CE from 1990 to 2022. Our intervention focused on reported epidemics of communicable diseases. Comparison group was not included, as it was not pertinent to our study's objectives. The primary outcome of our investigation was the epidemiological profile of these epidemics, encompassing average duration, incidence, mortality and case fatality rates of the diseases reported during the CEs within the specified timeframe.

Inclusion criteria

CEs that reported epidemics of communicable diseases between 1990 and 2022 were included. We observed a distinct shift in the nature of CEs after the Cold War era, which spanned from the late 1940s to the late 1980s [24], with the Rwandan CE emerging as one of the first significant

post-Cold War CEs. In order to ensure a comprehensive analysis, our research included literature in multiple languages: English, French, Spanish and Russian. Grey literature and published peer-reviewed journal articles were also included.

Exclusion criteria

The exclusion criteria for our scoping review encompassed articles where the full text was not accessible, publications dated before 1990, articles discussing epidemics of communicable diseases in disaster scenarios not related to CEs and articles written in languages apart from English, French, Spanish and Russian.

Search strategy and data sources

The search was performed in June 2023 using keywords: [[Complex Emergency OR humanitarian emergency]] AND [[communicable disease] OR [outbreak] OR [epidemic]] AND [[cholera] OR [dysentery] OR [measles]].

This scoping review encompassed databases such as Scopus, Medline, Embase and the International Bibliography of Social Sciences (IBSS). Complementing this, we also explored relevant websites of key emergency and humanitarian aid organisations, including ReliefWeb (UNOCHA), the World Health Organization, the United Nations High Commissioner for Refugees and Medecins Sans Frontières, IFRC and UNICEF to gather pertinent data.

Study selection

Two authors independently searched the database and their findings were compared at the end of the process. Any discrepancies that arose were resolved by the last author. All identified articles and documents in the bibliographic databases were initially screened by their titles and abstracts, adhering to our set inclusion and exclusion criteria. Full text was obtained for the selected articles and documents and screened.

Data extraction

For the articles included in this review, data on the type of epidemic and the causative agents were gathered. Additionally, information on the duration of each epidemic in weeks, the number of reported cases, incidence rates, death counts, mortality rates and case fatality rates were collected. Data were pooled in a Microsoft Excel Spreadsheet.

Data analysis and synthesis

Due to the heterogeneous nature of the documents found, quantitative analysis and qualitative thematic synthesis were conducted [25]. The quantitative analysis included using average duration of epidemics, incidence rate (new cases per 1000 people at risk in a specific time period), mortality rate (deaths from a specific disease per 1000 people at risk) and lethality or case fatality rate (percentage of deaths among cases of a specific disease). Using a random effect model, the statistics were extracted and combined to determine the average value. Time trends were analysed using linear regression. The graphs depicting incidence and mortality rates were plotted on logarithmic scales to enhance data visualisation. All analyses and graph plotting were conducted using IBM SPSS Statistics 23.

After completing the quantitative analysis, the qualitative thematic synthesis was led by the first author. This process involved a detailed examination and discussion of the factors contributing to the increased risk of epidemics in complex emergencies, particularly focusing on each causative agent.

RESULTS

The PRISMA flow diagram in Figure 1 illustrates our literature review, which encompassed 153 documents (93 articles and 60 reports) from 1990 to 2022. This review identified 92 epidemics across 32 countries experiencing complex emergencies (CE). Sudan emerged as the most impacted, with 14.1% of these epidemics, followed by Niger at 10.8%, South Sudan at 7.6%, the Democratic Republic of the Congo at 6.5% and Chad, Ethiopia, Haiti and Tanzania each at 5.4%, with Afghanistan accounting for 4.3%.

Out of the 92 studied epidemics, 31 (33.6%) were of Meningococcal Meningitis, 28 (30.4%) of Cholera, 17 (18.4%) of Measles, 5 (5.4%) of Shigellosis, 3 (3.2%) of Malaria, 3 (3.2%) of Yellow Fever and 5 (8.7%) of other diseases such as Dengue or Kala-Azar. Table 1, Figures 2–5, summarises the characteristics of the epidemics' duration, incidence, mortality and case fatality rate according to the disease.

Between 1990 and 2022, there have been at least 3,197,693 cases of cholera and 268,511 cases of Shigellosis in epidemics that occurred in CE. The incidence rate of cholera has been 13.0 per 1000 population at risk in CE (95% CI: 5–20) and the incidence rate of Shigellosis has been 241.0 per 1000 (95% CI: 7–476), as shown in Figure 3. At least 35,259 people have died from epidemics of both diseases in areas of CE. Among them, 23,909 deaths (31.9%) were caused by cholera and 11,350 deaths (15.1%) were attributed to Shigellosis.

The mortality rate from Shigellosis epidemics was 11.7 per 1000 (95% CI: 0.5–24.0) and for cholera, it was 0.22 per 1000 (95% CI: 0.0–0.3). These rates have been traditionally high in some severe CE [19, 26] responsible for up to 70% of mortality, for instance, in 1991 among the 400,000 Kurdish refugees in camps on the border with Turkey [27, 28]; or 85% in 1994 among the 800,000 Rwandan refugees in North Kivu (Democratic Republic of the Congo) [29], as shown in Figures 4 and 5.

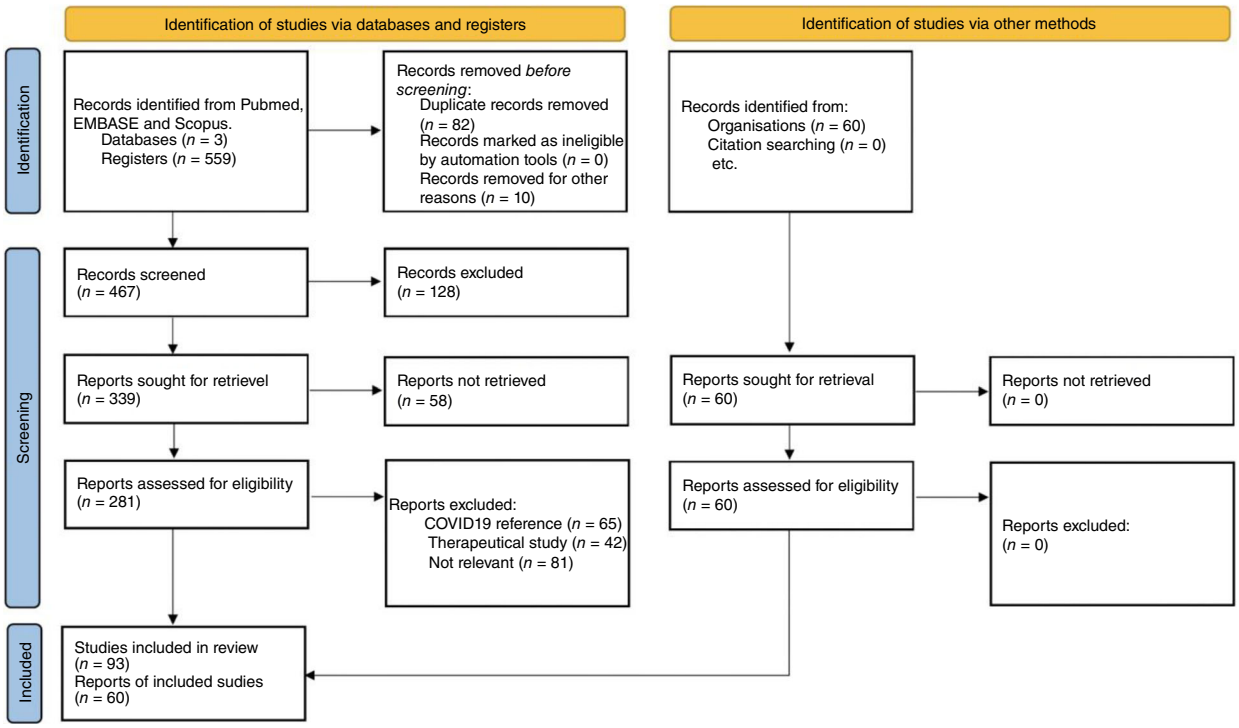

FIGURE 1 The PRISMA flowchart for the scoping review, which incorporated a total of 93 articles and 60 reports for the final analysis.

TABLE 1 Averages of duration, incidence, mortality and case fatality rate of epidemics in CE, 1990–2022.

Epidemic	*n* (%)	Duration weeks (CI 95%)	Cases (CI 95%)	Incident rate × 10^3 (CI 95%)	Death (CI 95%)	Mortality rate × 10^3 (CI 95%)	Case fatality rate (%) (CI 95%)
Meningitis	31 (33.6)	17.8 (15.3–20.4)	9511.5 (1893.5–17,129.1)	1.3 (0.0–2)	977.4 (165.0–1789.8)	0.13 (0.0–0.2)	11.6 (8.7–14.5)
Cholera	28 (30.4)	29.3 (21.6–37.1)	80,701.6 (4737.2–166,140.5)	13.0 (5–20)	710.9 (147.0–1274.9)	0.22 (0.0–0.3)	2.1 (1.4-2.8)
Measles	17 (18.4)	41.1 (33.6–48.6)	16,249.0 (4419.1–28,079.0)	25.0 (5–56)	206.7 (24.1–389.4)	0.76 (0.4–1.9)	2.2 (0.7–3.6)
Shigellosis	5 (5.4)	14.6 (5.0–24.3)	76,096.4 (56,842.7–209,035.7)	241.0 (7–476)	3783.3 (2886.3–10,453.0)	11.7 (0.5–24.0)	4.4 (3.4–5.4)
Yellow Fever	3 (3.2)	19.0 (4.8–33.1)	1526.6 (666.6–3719.9)	0.8 (0.3–2)	182.3 (16.7–381.4)	0.01 (0.0–0.04)	20.1 (8.2–32.1)
Malaria	3 (3.2)	28.0 (20.0–35.9)	15,870.5 15,385.9–16,355.0)	0.4 (0.04–0.8	73.0 (27.2–118.7)	0.001 (0.001–0.002)	0.4 (0.1–0.7)
Other	5 (5.4)	–	–	–			–

Note: Others: dengue and kala-azar.
Abbreviation: CI, confidence intervals.

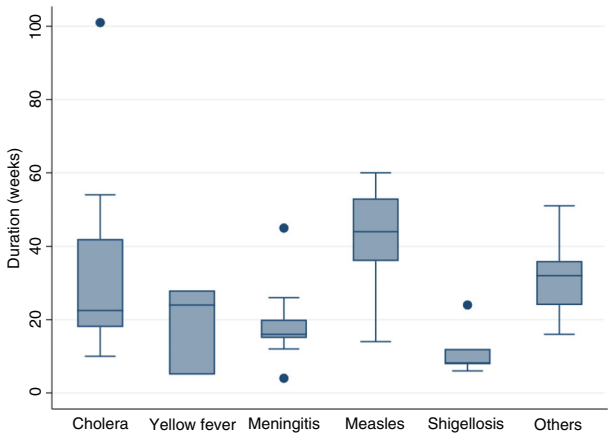

FIGURE 2 Characteristics of the duration distributions of epidemics in CE by disease.

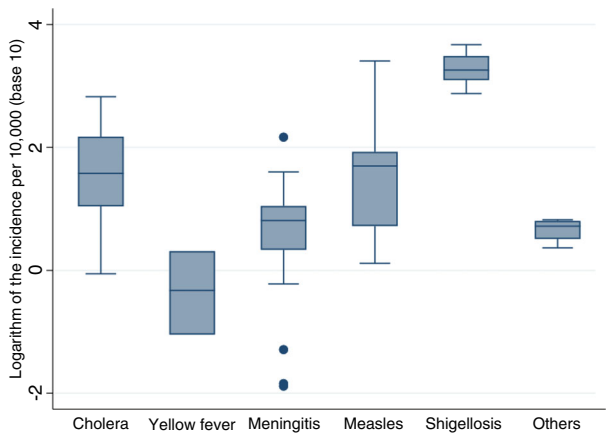

FIGURE 3 Epidemic incidence rates per 10,000 populations at risk in CE by disease, with the graphs plotted on logarithmic scales.

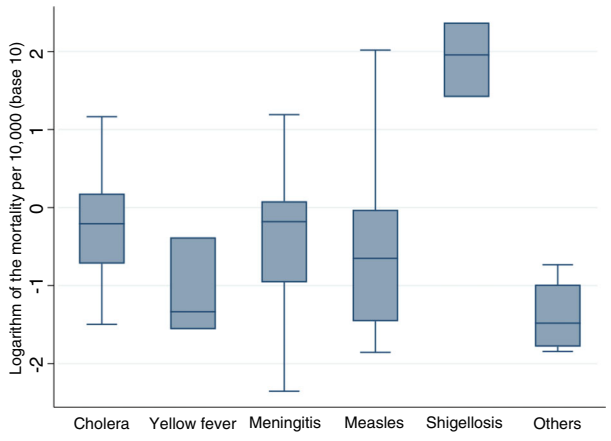

FIGURE 4 Characteristics of the mortality rate distributions of epidemics in CE by disease.

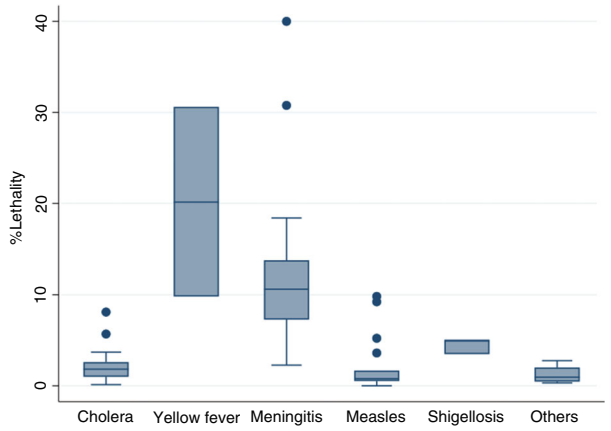

FIGURE 5 Characteristics of the lethality or case fatality rate distributions of epidemics in CE by disease.

The case fatality rate of cholera epidemics has been 2.1% (95% CI: 1.4–2.8) and for Shigellosis, it has been 4.4% (95% CI: 3.4–5.4). In terms of trends, the incidence rate, mortality rate and case fatality rates of cholera and shigellosis epidemics that occurred in CE between 1990 and 2022 have remained constant and with no statistically significant changes.

Under normal conditions, the incidence rate of cholera is usually around 1.2 per 1000. However, CE settings with displaced populations can reach as high as 15.0 (in our findings, it was 13.0). Similarly, the case fatality rate, typically lower than 5.0% (in our findings, it was 2.1%), can also escalate to high levels, as seen in Goma (Democratic Republic of the Congo) in 1994, which reached 40%. These mortality and case fatality rates are preventable with proper preparation, control measures and environmental sanitation [30]. Adequate preparedness and sanitation measures are essential in avoiding such high levels of morbidity and mortality during cholera epidemics [31, 32].

Shigellosis can also be severe in CE, especially among young children, the elderly and malnourished individuals. Similar to cholera, CE presents a high risk of overcrowding, poor sanitation and limited access to safe drinking water. Therefore, in the event of an epidemic, up to one-third of the at-risk population may become infected. Our incidence rate has been 241 per 1000. However, in some shigella dysenteriae type 1 epidemics occurring since 1991 in CE settings such as Malawi, Nepal, Kenya, Bangladesh, Burundi, Rwanda, Tanzania, Zaire and Sierra Leone [33], the incidence rates have been even higher, reaching 320 among Rwandan refugees in Rwanda in 1993 or 400 among Rwandan refugees in North Kivu (Democratic Republic of the Congo) in 1994, the case fatality rate is usually around 4%.

Between 1990 and 2022, 276,234 cases of Measles have occurred in epidemics in CE with an average incidence rate of 25 per 1000 (95% CI: 5–56). Measles epidemics have been the third leading cause of death from communicable diseases in CE, after diarrhoeal diseases, with an average mortality rate of 0.76 per thousand (95% CI: 0.4–1.9) and a case fatality rate of 2.2% (95% CI: 0.7–3.6). In terms of trends, the incidence rate, mortality rate and fatality rate of Measles in CE have slightly increased during the studied period but those increases was not statistically significant throughout the historical series studied.

From 1990 to 2022, there were a minimum of 275,835 documented Meningitis cases across 31 epidemics in CE. The incidence rate stood at 1.3 per 1000 (95% CI: 0.0–2). In CEs, Meningitis outbreaks exhibited the third highest mortality rate, following diarrhoeal diseases and measles and the second-highest case fatality rate, surpassed only by Yellow Fever. Our scoping review found the average mortality rate for Meningitis epidemics to be 0.13 per thousand (95% CI: 0.0–0.2) and an average case fatality rate of 11.6% (95% CI: 8.7–14.5). Although there was a slight decrease in the incidence rate across the studied period, this change was not statistically significant. Similarly, increases in mortality and fatality rates were observed but were not statistically significant. The predominant causative agents of epidemic meningitis during CEs were meningococci serogroups A and C, followed by the increasingly prevalent serogroup W135 in sub-Saharan Africa. Notable meningitis epidemics were recorded in Uganda, Malawi, Ethiopia, Burundi, Rwanda, the Democratic Republic of the Congo and Tanzania.

Regions most impacted by CE often coincide with those experiencing the highest incidence of Malaria [34, 35]. Between 1990 and 2022, there have been 2,831,741 cases of malaria in epidemics reported in CE areas, with an incidence rate of 0.4 per 1000 (95% CI: 0.04–0.8). However, the mortality and case fatality rate for Malaria have been relatively low, at 0.001 per thousand (95% CI: 0.001–0.002) and 0.4% (95% CI: 0.1–0.7) respectively. During the studied period, the incidence rate, mortality rate and fatality rate of Malaria epidemics in CE have not undergone statistically significant changes.

Malaria has caused significant morbidity and mortality in areas experiencing CE where the disease is endemic, such

as Thailand, eastern Sudan, Somalia, Kenya, Malawi, Zimbabwe, Burundi, Rwanda, Zaire, the Democratic Republic of the Congo and Afghanistan [36–38]. In Africa 30% of malaria-related deaths occur in countries affected by CE [39]. Mortality rates can be particularly high in CE settings where refugees from areas of low endemicity pass through regions of high endemicity (i.e. Cambodian refugees in Thailand in 1979, Ethiopian refugees in the highlands of eastern Sudan in 1985, or Rwandans in Zaire to the highlands in 1994). Similar incidents occurred during civil unrest in Tajikistan in 1992–1993, where over 100,000 people fled to Afghanistan, reintroducing malaria upon their return in 1994, leading to an outbreak and reestablishing *Plasmodium falciparum* malaria in Tajikistan for the first time in 35 years [40, 41].

Malaria was nearly eliminated in Afghanistan in the 1960s and 1970s through aggressive vector control programs. However, the civil unrest that began in 1979 has left the country in a state of CE practically since then and the disease has resurged. Despite over 50% of the population now living in endemic areas [42], control activities were reintroduced in the late 1990s, leading to a reduction in malaria cases. However, significant changes in malaria incidence in EC settings in Africa have not been observed. For example, the epidemic that occurred during the CE in Burundi in 2000 and 2001 affected 7 out of 17 provinces and resulted in more than 2.8 million cases in a country with a population of 7 million [43].

Despite declines in malaria incidence in CE with refugees in several countries, malaria remains a significant cause of mortality among children younger than 5 years of age [44]. Further progress in malaria control is necessary to further reduce malaria incidence and mortality among refugees and achieve global goals in malaria control and elimination.

Overall, between 1990 and 2022, there have been no statistically significant changes in the trends of incidence, mortality, or lethality rates of epidemic diseases in CEs. Epidemic mortality rates CEs are highest in sub-Saharan Africa, a trend influenced by the region's lower developmental levels and resource availability, coupled with the increased frequency and intensity of CEs in this area.

Qualitative synthesis

The qualitative synthesis of our scoping review on epidemics in CE from 1990 to 2022 identified key themes such as diarrhoeal diseases, caused by shigellosis and cholera; respiratory infections with etiological agents like measles and meningococci serogroups A and C; and vector-borne diseases including malaria, yellow fever, dengue and kala-azar. Our exploration into the factors that increase the risk of epidemics in CEs highlighted four main themes: water, sanitation, and hygiene; shelter and settlements; food and nutrition; and public health and healthcare, as shown in Figure 6.

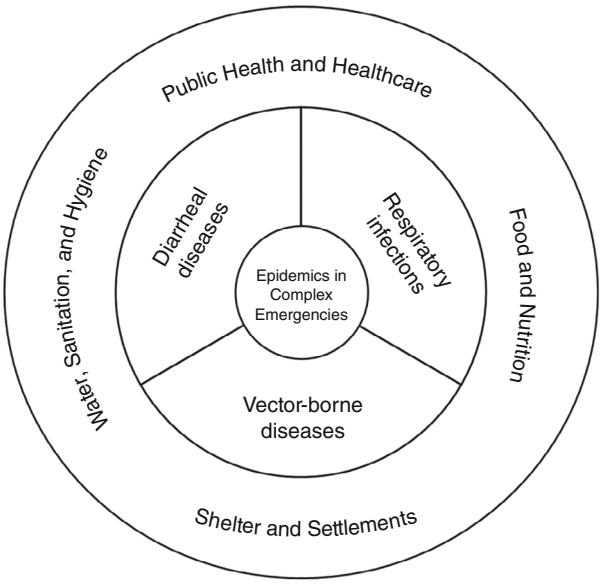

FIGURE 6 Shows the outcome of qualitative synthesis of underlying factors that increased the risk of epidemics in CE from 1990 to 2022.

Water, sanitation, and hygiene

The poor water, sanitation, and hygiene during CE significantly exacerbate the risk of diarrhoeal diseases. For example, In July 1994, the arrival of 500,000–800,000 Rwandan refugees in North Kivu, Zaire, led to a crisis where nearly 50,000 refugees died within the first month, resulting in an average daily crude mortality rate of 20–35 per 10,000, associated with outbreak of diarrhoea diseases due to lack of water, sanitation, and hygiene [45].

In refugee camps across various countries, including Malawi, Zimbabwe, Swaziland, Nepal, Bangladesh, Turkey, Afghanistan, Burundi, and Zaire, the outbreaks of diarrhoeal diseases have been closely linked to several key factors. Inadequate water quality and insufficient water supply are prime contributors. Inadequate supply of potable water can lead to waterborne disease outbreaks. Limited or contaminated water sources, insufficient water storage, and poor water quality control contribute to the spread of diseases [46].

In addition, the sanitation facilities in the refugee camps are often inadequate and poorly maintained. The compounding issue of overcrowding exacerbates these conditions. Poor sanitation facilities and practices can lead to faecal–oral disease transmission. Inadequate containment of human excreta, improper management of wastewater and solid waste and lack of proper sanitation infrastructure which are commonly observed during CE, pose significant risk factors.

A crucial aspect that aggravates these conditions during CE is the lack of basic hygiene supplies, such as soap, which is essential for preventing communicable disease transmission. The synergism of poor water, sanitation, and hygiene factors creates a conducive environment for the spread of

diarrhoeal diseases, highlighting the need for targeted interventions in this sector in CEs [47].

Food and nutrition

In CE, factors such as acute or chronic malnutrition and micronutrient deficiencies increase the population's vulnerability to communicable diseases. These issues often stem from limited availability and access to food due to decreased food production, adverse climatic conditions like droughts, the strategic military use of hunger as a warfare tactic, or ecocide, which thretend the food stability during CE. Furthermore, food can serve as a vector for pathogens. In CE, neglecting basic food safety principles in food utilisation can lead to the spread of diarrhoeal disease.

Malnutrition during CE, often occurring alongside communicable diseases, was the primary cause of illness and death. The highest excess morbidity and mortality occurred in the acute phase of the CE, where mortality rates significantly exceeded the baseline for the affected populations. Over three-quarters of the deaths were attributed to communicable diseases [19]. Even with the developments in public nutrition targeting malnutrition amidst CE over the past decades, the prevalance of malnutrition continues to persist at elevated levels in such contexts [48].

The combination of micronutrient deficiencies, such as Vitamin A deficiency, with a Measles infection, can result in a potentially fatal outcome, which is commonly seen in CE settings [49, 50]. Measles epidemics have been on the rise in conflict-affected countries. For example, in the Democratic Republic of Congo [51], Afghanistan [52], Somalia, Bangladesh, Sudan, Nepal, Zimbabwe and East Timor [53]. Measles has been responsible for up to 53% of all deaths in some of these regions [54]. Measles, either alone or in combination with acute malnutrition, causes 22% of deaths among children under 5 years of age and 17% of deaths among children aged 5–14 years [55].

Shelter and settlement

In CE, shelter and settlement conditions significantly influence the risk of epidemics. Crowded living spaces can heighten the spread of infectious diseases, while poor ventilation exacerbates respiratory conditions [56]. Additionally, infestations and humidity levels contribute to disease vectors and respiratory health challenges, respectively. In addition, inadequate temperature control can provoke a range of extreme temperature-related health problems [57], and exposure to environmental contaminants due to substandard shelter conditions can lead to poisoning and chronic health conditions [58].

The highest mortality rates in CEs were seen in cases involving significant population displacements, like in Sudan, Ethiopia, and Somalia during the 1990s. The affected populations, typically rural and impoverished, live in densely populated camps with poor living conditions resulting in a further increase in suceptability and spreading of infectious disease. For example, studies by Isidore et al. found that in addition to vaccination status and nutritional health, persistent determinants influencing measles transmission, morbidity, and mortality include living conditions, movements of refugees and security and protection during CE [49]. Our scoping review consistently identifies overcrowding as a prevalent risk factor across all the communicable diseases analysed.

Public health and healthcare

CEs have progressively targeted the civilian populations, leading to elevated mortality rates, extensive violations of human rights, mass displacement and migration, and, in certain nations, the complete collapse of governmental structures [5]. This has precipitated the breakdown of both public health infrastructure and healthcare delivery systems. In the other hand, the emphasis in epidemiological monitoring and the comprehensive vaccination programs have mitigated the prevalence of Meningitis, which persists in regions afflicted by CE. Compared to the 1990s, both the mortality and case fatality rates associated with the disease have notably declined [59].

Public health infectious disease prevention and control

The disruption of the **epidemiologic triangle** occurs as a result of the breakdown in public health infrastructure and health services during CE. Therefore, infectious agent surveillance, case confirmation, isolation, and treatment cannot be carried out properly due to the collapse of public health infrastructure and healthcare system and services [60–64], allowing for the spread of the **infectious agent**. During CE, physical and mental health stressors, coupled with diminished access to preventive medicines and compromised vaccination efforts due to refugee influxes and disruptions in vaccination campaigns, collectively weaken **host** immunity and exacerbate the severity of infections [65–68]. Lastly, the extreme **environments** resulting from CE, exemplified by the dire circumstances in refugee camps where sustaining personal, environmental, and food hygiene is unfeasible, foster the pathways for infectious disease transmission [18].

Healthcare delivery

CEs have rendered access to healthcare and the delivery of healthcare services complicated [69]. A recent systematic review on the challenges of providing healthcare in complex emergencies by Seyedin et al. identified key challenges, including those related to the healthcare workforce, healthcare infrastructure, service organisation and access to

information. In addition, exposure to violence and conflict for both patients and healthcare providers, mobility restrictions, resource limitations, inadequate infrastructure, interrupted or episodic care, and lack of registration, to name just a few, have been identified as some common barriers experienced by vulnerable groups in CE [63]. In response to these challenges, the World Health Organization (WHO) is intensifying its efforts to systematically collect and analyse data on the incidence and types of attacks on healthcare services, even amid the COVID-19 pandemic and within the context of CEs [70].

DISCUSSION

CE generates a high number of victims, and a significant portion of deaths is closely linked to the occurrence of epidemics of communicable diseases, particularly diarrhoeal diseases and respiratory diseases. Vector-borne diseases have less impact on CE but can cause rapid and highly lethal spikes during such emergencies.

Hence, it is essential to implement continuous epidemiological surveillance systems during CEs to reduce mortality arising from epidemics. The combination of active and passive epidemiological surveillance and active case detection significantly reduces the number of deaths [38]. For example, during the 2000–2001 measles outbreak among Burundian refugees in Tanzania, the rapid detection of cases and timely action resulting from the combined surveillance efforts led to no deaths occurring.

Continuous epidemiological surveillance systems have been shown to be essential in CE, as they reduce mortality and case fatality rates. The excess morbidity and mortality caused by communicable diseases in CE can largely be prevented when interventions are based on proper analysis, focusing on indicators proven to be associated with mortality [71, 72]. These interventions should be selected based on evidence of outcomes [32], their availability, and implementation according to intervention standards [73].

In addition to the humanitarian duty of protecting the health of populations in CE, there are several justifications for prioritising intervention on communicable diseases in such situations. Firstly, CE can facilitate the reemergence of previously controlled diseases (e.g., malaria or trypanosomiasis), the development of antimicrobial drug resistance due to inappropriate and incomplete use, and the absence of regulatory controls (e.g., bacillary dysentery and multidrug-resistant tuberculosis).

Secondly, when outbreaks of epidemics are not promptly detected, responded to and contained in countries experiencing epidemics, it poses a constant threat to neighbouring countries and the entire world [74]. Thirdly, countries in CE are potential areas for the emergence of new diseases due to delays in detecting and characterising new pathogens and their widespread transmission before control measures can be implemented (e.g., monkeypox in the Democratic Republic of the Congo).

Therefore, it warrants emphasis that obstructing humanitarian aid and relief in CEs constitutes a violation of international law [75]. Furthermore, any blockade impeding such aid and relief, precipitating a decline in health conditions and destabilising the epidemiological triangle, which leads to disease outbreaks and epidemics, ought to be regarded as an act of war atrocity.

Research in CEs is a growing area and is gaining interest from implementing actors, donors, and governments, but undertaking research in EC poses important challenges [76], requiring work in remote and challenging environments while upholding ethical considerations. Despite these hurdles, advances in survey methodologies and surveillance systems have been made, yet continued improvement in these areas remains a pressing objective for the future. Additionally, certain under-researched domains warrant further exploration. The overarching aim persists in addressing crucial inquiries with the ultimate goal of substantially enhancing the health outcomes of affected populations [77].

Limitations

A common limitation of the CE studies is the low quality of the demographic and health data available, particularly relevant to the difficulty in obtaining data on the denominator of the indicators (population at risk). During CE, acquiring information can be a challenging and risky task. In the past, obtaining dependable information was a struggle due to poor collection methods, population displacement, inaccessibility, or the lack of available resources. Additionally, in CE, where ethnic tensions and political turmoil lead to high mortality rates, information can be politically sensitive and subject to under or over-reporting.

Almost 40% of the documents used in our study were not articles published in scientific journals, but field reports from different organisations and agencies, which reveals the difficulty of transferring information from the field to the world of academia and scientific publications.

CONCLUSION

Our scoping review delineated the epidemiological profile of epidemics that have the potential to lead to public health crises during CEs. Identified epidemics that occurred during CE between 1990 to 2022 include meningococcal meningitis, cholera, measles, shigellosis, malaria, yellow fever and other diseases such as dengue, and kala-azar. There have been no statistically significant changes in the trend of incidence, mortality, or fatality rates of epidemic diseases in CE. The highest mortality from epidemics in CE occurs in sub-Saharan Africa.

Emphasis should be placed on disaster management within CEs, especially in the preparedness, responding to

and mitigating the factors that increase the risk of epidemics, such as water, sanitation and hygiene, shelter and settlements, food and nutrition, and public health and healthcare, even with the challenges and barriers inherent in CEs. Most importantly, it must be recognised that all the epidemics identified in CE are, in essence, preventable.

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