Minireview Article

**Infectious Disease Burden in the Aftermath of War: Insights from Historical and Contemporary Perspectives**

**Abstract**

**Introduction:** Armed conflicts have long been catalysts for infectious disease outbreaks, from typhus during the Napoleonic wars to cholera in modern-day Yemen. These outbreaks are often driven by mass displacement, the collapse of health systems, and the breakdown of sanitation infrastructure.

**Methods:** This minireview examined literature from 1800 to 2023 to explore the link between armed conflict and infectious disease outbreaks. Using sources like PubMed, JSTOR, WHO, and ICRC reports, the study focused on major conflicts with significant epidemiological impact and reliable disease data. It analyzed the types of diseases reported, contributing factors (such as displacement and health system collapse), and public health responses. The aim was to identify recurring patterns and insights to guide future humanitarian and health strategies in conflict zones.

**Results:** Outbreaks of cholera, malaria, tuberculosis, and typhus were consistently reported during and after major conflicts. Common contributing factors included healthcare system disruption, population displacement, interrupted vaccination programs, and ecological changes. Recent conflicts in Syria, Yemen, Tigray, Myanmar, and Gaza demonstrate similar epidemiological patterns, despite advances in medical technology.

**Conclusion:** Infectious disease outbreaks are a predictable and recurring consequence of armed conflict. Strengthening health system resilience, enhancing early disease surveillance, and ensuring humanitarian access must be prioritized in modern conflict response strategies.

**Keywords:** Armed conflict, Infectious diseases, Health system disruption, Humanitarian response, Global health security, Epidemics in war zones, Disease surveillance

**Introduction**

Armed conflict is widely recognized as a major driver of morbidity and mortality. However, its indirect health effects—particularly the burden of infectious diseases—often surpass the immediate physical toll of violence. Historically, outbreaks of flu, typhus, cholera, and dysentery have closely followed military campaigns, frequently resulting in more deaths than combat itself (Google Books; Humphries et al., 2014). In the modern era, despite the availability of antibiotics, vaccines, and global surveillance systems, conflict-affected regions continue to experience the resurgence of infectious diseases that were previously under control ( Van Way C., 3rd ,2016; Kim J.H. et al., 2015) .

The mechanisms underlying these outbreaks are multifaceted yet consistently observed. The destruction of health infrastructure, mass displacement, disruption of immunization programs, malnutrition, and the collapse of water and sanitation systems collectively create ideal conditions for disease transmission (Aldous P, 2005). Compounding these factors, the breakdown of governance and health information systems often leads to inadequate surveillance and delayed responses to emerging health threats (Hyams, K. C. et al.,1995).

Although global health initiatives have achieved significant progress in areas such as polio eradication and expanded immunization coverage, armed conflicts—especially protracted civil wars and asymmetric warfare—remain uniquely disruptive (Goma Epidemiology Group,1995; Jefferson, 1993). In countries like Syria and Yemen, immunization systems that took decades to establish were dismantled within months ( Marzouk, S. et al., 2025 ; Ng, Q. X et al, 2020 ) . The resurgence of cholera in Yemen, diphtheria in Venezuela, and measles in Ukraine are not isolated incidents but part of a broader, recurring pattern in which war acts as a catalyst for epidemics (Guthmann, J. P, et al., 2006).

Understanding these dynamics is essential not only for effective humanitarian response but also for global health security. Infectious disease outbreaks originating in conflict zones can transcend borders, as demonstrated by the 2014–2016 Ebola outbreak in West Africa and the 2018 outbreak in the Democratic Republic of the Congo (Muyembe-Tamfum, J. J.et al,1999).Therefore, conflict zones should be viewed not as isolated crises but as critical frontlines in the global fight against infectious disease.

This review synthesizes historical and contemporary examples of war-associated infectious disease outbreaks to identify common drivers, recurring patterns, and policy failures. By integrating historical narratives with modern epidemiological data, we aim to inform more resilient, evidence-based approaches to health system preparedness and humanitarian response in conflict-affected settings.

**Methods**

We conducted a narrative review of literature spanning the period from 1800 to 2023, focusing on the relationship between armed conflict and infectious disease outbreaks. The literature search was done using combinations of keywords such as 'armed conflict,' 'infectious disease outbreaks,' 'health infrastructure collapse,' 'displacement,' and specific diseases like 'cholera,' 'measles,' and 'Ebola.' Sources were identified through searches of academic databases including **PubMed** and **JSTOR**, as well as institutional reports from the **World Health Organization (WHO)**, the **International Committee of the Red Cross (ICRC)**, and historical medical archives.

Conflicts were selected based on three primary criteria:

1. **Global or regional scale**,
2. **Epidemiological significance**, and
3. **Availability of reliable data** on infectious disease patterns during or following the conflict.

For each selected conflict, we extracted qualitative and quantitative data on:

* The types of infectious diseases reported,
* Causative mechanisms (e.g., population displacement, destruction of health infrastructure, collapse of sanitation systems), and
* Public health response efforts, where documented.

The goal of this review was to identify recurring trends, underlying drivers, and policy-relevant insights that could inform future humanitarian and public health strategies in conflict-affected settings.

**Results**

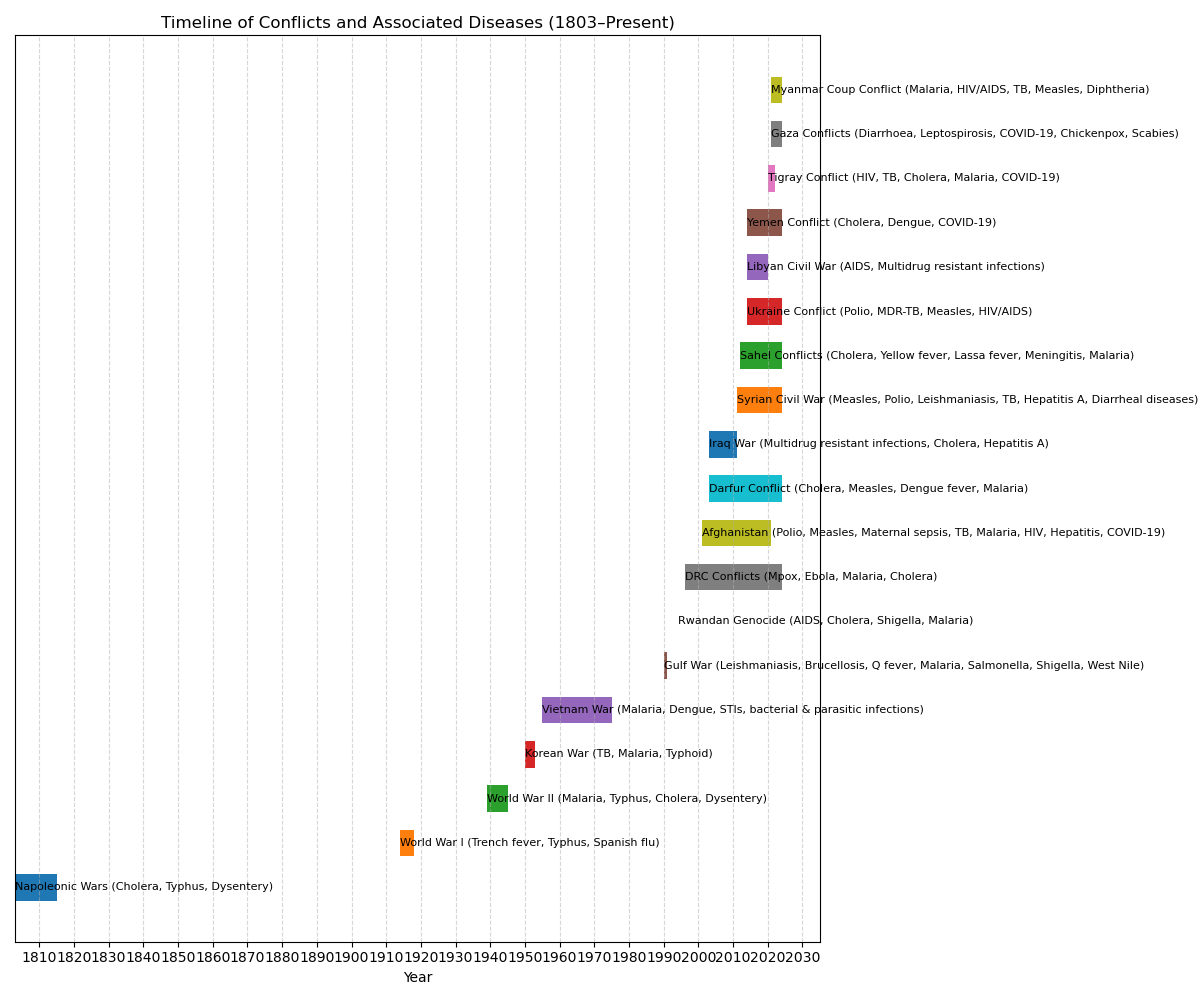
A total of 20 major conflicts spanning from the early 19th century to the present were included in this review. Across these settings, infectious disease outbreaks were a consistent and often devastating consequence of war. Diseases such as cholera, tuberculosis, malaria, and typhus appeared repeatedly, regardless of geographic or temporal context. Notably, while historical conflicts were marked by diseases like typhus and dysentery due to poor hygiene and overcrowding, modern conflicts have seen the resurgence of vaccine-preventable diseases such as measles and diphtheria, often linked to the collapse of immunization systems.

Several recurring mechanisms were identified across conflicts that contributed to the emergence and spread of infectious diseases. Chief among these were the destruction of healthcare infrastructure, mass displacement of populations, and the collapse of water, sanitation, and hygiene (WASH) systems. In nearly every case, these factors created conditions conducive to disease transmission, particularly in overcrowded refugee camps and urban areas with limited access to clean water or medical care. For instance, the cholera epidemic in Yemen was exacerbated by the breakdown of sanitation infrastructure and restricted humanitarian access (Ng, Q. X. et al., 2020). Similarly, the resurgence of tuberculosis in the Korean war and leishmaniasis in Gulf and Syria reflected the long-term consequences of disrupted health services and weakened disease surveillance systems (Kim J.H. et al., 2015; Hyams, K. C. et al., 1995; Marzouk, S. et al., 2025).

Vaccine-preventable diseases emerged as a particularly troubling trend in both protracted and newly erupted conflicts. The collapse of immunization programs in Syria and Ukraine led to the re-emergence of diseases such as measles, diphtheria, and polio—many of which had been previously controlled or eliminated in these regions (Marzouk, S. et al., 2025; Khetsuriani et al., 2017) . In Syria, for example, measles reappeared after decades of absence, coinciding with the breakdown of routine childhood vaccination services (Marzouk, S. et al., 2025). Similarly, in Ukraine, the disruption of healthcare services and the exodus of health workers contributed to a resurgence of measles and multidrug-resistant tuberculosis (MDR-TB) (Khetsuriani et al., 2017).

Underreported conflicts in regions such as Myanmar, Afghanistan, and the Sahel also revealed significant infectious disease burdens, despite limited international attention. In Myanmar, the post-coup collapse of public health infrastructure and persecution of healthcare workers have led to a resurgence of malaria and measles (Lwin et al., 2022) . Afghanistan, following the 2021 regime change, has seen rising cases of polio and maternal sepsis, exacerbated by the withdrawal of NGOs and restrictions on female healthcare access( Islam, Z. et al., 2022) . Meanwhile, the Sahel region continues to experience outbreaks of zoonotic and climate-sensitive diseases such as Lassa fever and meningitis, driven by ecological stress, displacement, and under-resourced health systems (Al-Saidi et al., 2022).

Figure 1 presents a timeline visualization of these conflicts, with bars representing the duration of each conflict. Table 1 summarizes major global conflicts from 1803 to the present, highlighting the main infectious diseases associated with each conflict, the contributing environmental and social factors, and the relevant references. The table is organized chronologically to illustrate the evolution of conflict-related disease burdens over time. Additional conflicts—including Myanmar, Afghanistan, and the Sahel region—illustrate underreported yet significant outbreaks of vaccine-preventable and zoonotic diseases.



**Figure 1: *Timeline of Conflicts and Associated Diseases***

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| Conflict | Years | Main Diseases | Contributing Factors | References |
| Napoleonic Wars | 1803–1815 | Cholera, Typhus, Dysentery | Overcrowding, lice, poor sanitation | Google Books |
| World War I | 1914–1918 | Trench fever, Typhus, Spanish flu pandemic | Trench warfare, troop movement, no vaccination | Humphries et al., 2014 |
| World War II | 1939–1945 | Malaria, Typhus, Cholera, Dysentery | Refugee crises, hospital collapse | Van Way C., 3rd ,2016 |
| Korean War | 1950–1953 | TB,Malaria, Typhoid | Cold climate, displacement, malnutrition | Kim J.H. et al., 2015 |
| Vietnam War | 1955–1975 | Malaria, Dengue,Sexually transmitted infections, Various bacterial and parasitic infections | Jungle terrain, herbicides, antibiotics misuse | Aldous P, 2005 |
| Gulf War | 1990–1991 | Leishmaniasis, Brucellosis,Campylobacter jejuni, Coxiella burnetii (Q fever), Malaria, Nontyphoid Salmonella, Shigella, and West Nile virus. | Vector exposure, poor camp hygiene | Hyams, K. C. et al.,1995 |
| Rwandan Genocide | 1994 | HIV/AIDS, Cholera, Shigella, Malaria | Refugee camps, water contamination | Goma Epidemiology Group,1995 |
| Darfur Conflict | 2003–present | Cholera, Measles, Dengue fever, and Malaria | Rainy season, poor hygiene | Guthmann, J. P, et al., 2006 |
| Iraq War | 2003–2011 | Multidrug resistant bacteria infections, Cholera, Hepatitis A | Urban decay, infrastructure failure | Cholera in Iraq – update,2024 |
| Libyan Civil War | 2014–2020 | HIV/AIDS, Multidrug resistant bacteria infections | Vaccination gaps, fragmented governance | Devi, S.,2021 |
| Syrian Civil War | 2011–present | Measles, Polio, Cutaneous leishmaniasis, Tuberculosis, Hepatitis A, and Diarrheal diseases | Health system collapse, displacement | Marzouk, S. et al., 2025 |
| Yemen Conflict | 2014–present | Cholera, Dengue, COVID-19 | Famine, health collapse, WASH failure | Ng, Q. X et al, 2020 |
| Tigray Conflict | 2020–2022 | HIV/AIDS, TB, Cholera, Malaria, COVID-19 | Aid blockade, food insecurity | MSF 2022 |
| DRC Conflicts | 1996–present | Mpox, Ebola, Malaria, Cholera | Deforestation, displacement | Muyembe-Tamfum, J. J.et al,1999 |
| Ukraine Conflict | 2014–present | Polio, MDR-TB, Measles, HIV/AIDS | Vaccine gaps, health worker exodus | Khetsuriani et al., 2017 |
| Gaza Conflicts | 2021-Ongoing | Diarrhoea, Leptospirosis, COVID-19, Chickenpox, Scabies | Blockade, water crisis, overcrowding | OPT Situation report,2021 |
| Myanmar Coup Conflict | 2021–present | Malaria ,HIV/AIDS, TB, Measles, Diphtheria | Health worker persecution, COVID collapse | Lwin et al., 2022 |
| Afghanistan | 2001-2021 | Polio, Measles, Maternal sepsis, Tuberculosis, Malaria, HIV/AIDS, Hepatitis,COVID-19 pandemic. | NGO withdrawal, gender restrictions | Islam, Z et al., 2022 |
| Sahel Conflicts | 2012-present | Cholera, Yellow fever, Lassa fever, Meningitis, Malaria | Heat stress, displacement, ecological pressure | Al-Saidi et al., 2022 |

***Table 1. Summary of Major Conflicts (1803–Present), Associated Diseases, and Contributing Factors***

**Discussion**

This review underscores the persistent and often predictable relationship between armed conflict and the outbreak of infectious diseases. Across centuries and continents, wars have repeatedly generated conditions conducive to disease transmission—namely displacement, overcrowding, unsanitary environments, and disrupted health services (Van Way C., 3rd ,2016; Aldous P, 2005; Jefferson, 1993).Despite advances in medical technology and global health systems, these structural vulnerabilities remain largely unaddressed in conflict settings.

**Displacement and Camp Conditions**

Refugee and internally displaced persons (IDP) camps are consistently identified as hotspots for infectious disease outbreaks. Historical and contemporary examples—including Goma (1994), Darfur (2004), and Northern Syria (2017)—demonstrate how inadequate access to clean water, sewage systems, and healthcare services facilitates the spread of cholera, hepatitis A and E, and acute respiratory infections (ARIs). Overcrowding in these camps further exacerbates the transmission of tuberculosis and measles (Goma Epidemiology Group,1995; Marzouk, S. et al., 2025 , Guthmann, J. P, et al., 2006) .

**Immunisation Collapse**

The collapse of immunisation systems due to health worker displacement and disrupted vaccine supply chains has led to the resurgence of vaccine-preventable diseases. Diphtheria re-emerged in Syria and Yemen, while polio returned in Ukraine and Afghanistan—regions where immunisation gaps were widened by instability and conflict (Marzouk, S. et al., 2025 ; Ng, Q. X et al, 2020 ; Khetsuriani et al., 2017, Islam, Z et al., 2022).These reversals highlight the fragility of public health gains in the face of war.

**Ecological and Environmental Factors**

Conflict-driven ecological disruption plays a significant role in disease emergence. Deforestation in the Democratic Republic of the Congo (DRC) and herbicide use during the Vietnam War altered ecosystems and facilitated vector proliferation and zoonotic spillovers. In eastern DRC, recent deforestation linked to artisanal mining has coincided with Ebola resurgence, underscoring the environmental dimensions of conflict-related disease risk (Muyembe-Tamfum, J. J.et al,1999).

**Targeting of Health Systems**

Deliberate attacks on healthcare infrastructure have become a hallmark of modern warfare. Between 2016 and 2021, the World Health Organization’s Surveillance System for Attacks on Healthcare (SSA) recorded over 1,000 incidents, with Syria, Palestine, and Yemen among the most affected (WHO SSA, 2021) . These attacks not only violate international humanitarian law but also cripple local disease surveillance and response capabilities.

**Climate and Conflict Synergy**

The intersection of climate change and conflict is increasingly evident in disease dynamics. In South Sudan, seasonal flooding of IDP camps drives recurring cholera epidemics (Joseph L.-H. Tsui et al., 2024) . In the Sahel, climate-induced migration exacerbates both armed conflict and outbreaks of Lassa fever and meningitis(Lwin et al., 2022; Truppa C et al.,2023) . These compound crises demand integrated, climate-adapted health responses that address both environmental and political drivers.

**Antimicrobial Resistance**

Conflict zones are emerging hotspots for antimicrobial resistance (AMR), driven by unsupervised antibiotic use and lack of diagnostic capacity. Studies from Syria and Iraq have identified multidrug-resistant strains of *Klebsiella* and *Acinetobacter*, which are often untreatable in field hospitals . This trend poses a growing threat to global health security (Weidman-Grunewald, E. ,2018).

**Innovations in Surveillance**

Despite these challenges, technological innovations offer new opportunities for disease monitoring and response. Portable genomic sequencing tools have been deployed in Ebola outbreaks, while mobility prediction algorithms have been used to anticipate IDP movements in Afghanistan. However, these tools remain underfunded and unevenly deployed, limiting their potential impact( Quick J et al.,2016).

**Recommendations**

From the typhus epidemics of the Napoleonic Wars to the COVID-19 waves in Gaza, armed conflict has consistently served as a catalyst for infectious disease outbreaks. These recurring crises do not reflect a failure of medical knowledge or technological capacity, but rather a failure of policy, preparedness, and political will. The conditions that drive epidemics in conflict zones—displacement, infrastructure collapse, immunisation disruption, and ecological degradation—are well understood and, in many cases, preventable.

To break this cycle, conflict-affected health responses must move beyond reactive measures and embrace proactive, systems-based strategies. Key recommendations include:

* **Expanding early warning surveillance systems**, such as the WHO’s Early Warning, Alert and Response System (EWARS), to detect and respond to outbreaks in real time.
* **Ensuring continuity of immunisation services** during crises through mobile clinics, cold chain protection, and community-based delivery.
* **Prioritising water, sanitation, and hygiene (WASH) infrastructure** in displacement settings to prevent waterborne and respiratory infections.
* **Embedding public health planning into post-conflict reconstruction and peace-building efforts**, ensuring that health systems are not only restored but made more resilient.

Investing in public health systems before, during, and after conflict is not optional—it is a prerequisite for epidemic prevention and global health security. As conflicts become increasingly protracted and complex, the integration of health into humanitarian, development, and peace agendas is more urgent than ever.

**Conclusion**

Infectious diseases during wartime are both foreseeable and persistent. Armed conflicts can devastate healthcare infrastructure, displace populations, and facilitate the proliferation of diseases. 19th-century epidemics are interconnected with global health crises, warfare, and public health issues. This minireview necessitates robust and flexible health systems capable of enduring conflict. This entails safeguarding medical infrastructure, healthcare personnel, and essential services in volatile environments.

Priority must also be given to disease epidemic early warning systems. Rapid detection and response can mitigate infection risks. These monitoring programs can be enhanced through technology, community networks, and global collaboration. Ultimately, humanitarian access must remain unobstructed. Prolonged delays in assistance can adversely affect public health. Crisis response must prioritize humanitarian principles and medical assistance. Public health preparedness is crucial for conflict resolution. Coordination can avert health emergencies from exacerbating human strife.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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