Review of War-Related Health Data Challenges

Kintuza Lumwako Tebulo

Faculty of Medicine Kampala International University Uganda

ABSTRACT

War-related health data challenges continue to undermine the ability of governments, humanitarian actors, and researchers to monitor population health, guide emergency response, and strengthen health systems. This narrative review synthesizes evidence on the availability, accessibility, quality, and governance of health data in conflict settings, drawing on examples from Ukraine, Syria, the Democratic Republic of Congo, Libya, and Haiti. It highlights how conflict-induced disruptions, such as damaged infrastructure, insecurity, population displacement, political instability, and weakened governance, limit the generation and use of reliable health information. Challenges span multiple domains, including incomplete surveillance, fragmented data ecosystems, methodological constraints, ethical concerns, and inconsistent analytical practices. The review further explores innovations such as digital health tools, remote sensing, and integrated data systems that offer new opportunities for improved monitoring in crisis environments. By examining diverse case studies and outlining implications for humanitarian response and health system resilience, the review identifies actionable pathways for strengthening data standardization, coordination, and capacity-building, and ethical data governance. Addressing these challenges is essential for improving the accuracy, timeliness, and utility of health data in conflict-affected settings and for informing effective, evidence-based interventions.

Keywords: Conflict health data, Data availability and quality, Humanitarian health information, Health systems in war, and Methodological and ethical challenges.

INTRODUCTION

The ongoing war in Ukraine has drawn global attention to the role of conflict in undermining health systems and consequently affecting health, and a growing body of literature is emerging around data challenges in war-affected settings [1]. Accompanying this interest, a broader scope of health data challenges that apply to countries grappling with conflicts of varying duration or intensity has yet to be seriously addressed. Such a perspective is crucial to improve our understanding of the effects of war on the health of the population and the functioning of health systems [4]. A clear delineation of the problem, describing the conditions under which the challenge manifests and the types of war-affected settings in which the challenges can be meaningfully observed, is an essential first step. Systems have remained in place throughout the Syrian conflict, and government record-keeping has continued elsewhere in both official and unofficial capacities; these noticeably limit public health data challenges in many, albeit not all, countries [3]. These are typically referred to as "the data that is not the data," a situation where public health information or indicators are rarely officially reported, or only sporadically supplied. For countries under significant ongoing conflict or experiencing total collapse of governance, public health indicators cease altogether and thus can no longer be tracked using expedited methods [2]. Health data in war settings refers to information about the health of the population and the state of health services in a country under war, especially information that can help monitor population health status, health service delivery, and important determinants of health [2]. The data of interest applies to countries characterized by armed conflict or war, regardless of time period or geographical location; data relevant to countries not currently under armed conflict nevertheless provides important insights on the public health indicator and sets a frame for reference in many dimensions throughout the war settings [5]. Data types comprise a range of quantitative or qualitative sources spanning the areas of health determinants, health service provision, health status, resources, financing, and health

systems, including surveys of health behaviors and risk factors, rapid health assessments, health facility surveys, health facility mapping, health worker assessments, health resource availability mapping, facility stress appraisals, household surveys, population censuses, satellite imagery, and conflict data[1].

Context and Scope of War-related Health Data

Formal definitions employ neutral terms: conflict refers to armed violence by organized groups; war denotes prolonged, large-scale violence [8]. The term data encompasses quantitative measures and qualitative descriptors, thus distinguishing data from more narrowly defined metrics such as surveillance or vital registration. Health quantifies aspects of human well-being, notably morbidity, mortality, and service coverage; health records detail individuals' access to services or occurrence of health events; and war refers specifically to violence between governments and organized armed groups [7]. The term health data refers to systematic collections of data about the occurrence of health outcomes or access to services pertinent to the health sector [1]. Such data can outline patterns of disease, trends in service delivery, resource shortages, or access barriers. Essential data types include surveillance and health-system records, while administrative, survey, and other sources can also inform health estimates under certain conditions [8]. The review focuses on quantitative data captured within three categories: population health data, health service data, and displacement data supplied by national authorities or international organizations during population-based surveys, health-system assessments, or public administrative datasets [9]. The scope excludes specific topics such as the functioning of health information systems, monitoring and evaluation, or health research. Conflict poses substantial risks to health and well-being through direct violence, disruption of services, economic collapse, sociopolitical instability, displacement, and environmental degradation. Such risks impact the most vulnerable population, aggravating existing health needs [5]. Today, the conflicts are often characterized by a high degree of societal disruption: thousands of violent events occur each year with very high death tolls, multiple centers of violence actively contest political power, large areas are effectively outside of state control and can change hands frequently, and the area of active violence in some countries exceeds 300,000 km2[5].

Data Availability and Access in Conflict Settings

Availability of data influences opportunities for system monitoring, research, and evidence-based policy guidance during conflict, war, and violence [2]. Health data availability varies considerably depending on the humanitarian, health, and safety environments [3]. Key dimensions of data availability include the types of data accessible (surveillance, facility records, administrative data, surveys, remote sensing), the custodians of these data, the specific access requirements, and the pathways for securing access. In some contexts, despite limited health data availability, considerable amounts of other humanitarian data are present and accessible [7]. Evidence from humanitarian crises before the Syria conflict illustrates that health data availability influences not only institutional response activities but also, in some instances, the agency's size, type, and public profile [10]. Conflict influences data availability through different mechanisms than those affecting data access. Data availability is also subject to temporal and spatial variation, with certain periods and locations enabling greater availability than others. An extensive array of formal and informal points of access to relevant data repositories can exist even when central or official access is unattainable [11]. While extreme disruption to national data systems frequently accompanies conflict, additional factors may simultaneously widen or narrow availability. Changes in governance-type variables alter data availability globally [12]. Availability varies considerably depending on the composition of the health data ecosystem, including both complementary and competing repositories, custodians, and permissible user interactions.

Data Quality: Completeness, Validity, and Reliability

Data quality includes dimensions such as completeness, validity, and reliability. Collecting and analyzing health data during conflict-affected humanitarian crises poses multifaceted challenges, often categorized by the marker of the 4Ws (Who, What, Where, When) [9]. Rigidity in study design inhibits successful information collection in emergencies [4], where hostilities, environmental change, operational scope, and political dynamics evolve rapidly. Limited data capture provokes reliance on flexible methodologies, increasing the importance of explicit description [5]. Coding applications and health outcome definitions employed in health-related humanitarian contexts differ significantly. Awareness of limitations of certain datasets and adherence to particular principles in collecting, maintaining, and presenting humanitarian information has been corroborated over decades of experience [9].

Ethical Considerations and Data Governance

Research on health in humanitarian crises must consider protection of vulnerable subpopulations, shaping research questions, treatment of health data, and ethical governance [7]. The aim of monitoring mortality, epidemiological trends, service availability, and population displacement underpins a movement combining public health practice and research [6], and concern for individual rights arises amid disruption of health provision [7]. War-shock modelling explores interactions among security, health, and economic shocks to find data sources beyond

simplistic hazard indices, yet suggests similar actions. Preventing data collections shaped by pre-existing biases limits information gathered, and development of quality-assured datasets across diverse intervention sectors allows inter-comparison of incidence and disease burden[8]. Data-sharing responsibilities extend beyond acquisition and to preparation for archiving large microdata collections acquired during crisis engagement. Substantial effort and coordination augment routine datasets formed and stored in parallel to war-signalled health data emergency records [8]. Infrastructure-compatible datasets damage reporting capabilities independently of war-level indicators. Collection of health data identifies rights-holders and seeks their consent where possible, prioritising reporting on identified health-system datasets during conflict and various metadata-characterising approval options restrict admission to and duration of total-service datasets [10].

Methodological Challenges in Data Collection and Analysis

In conflict-affected settings, methodological challenges complicate health data collection and analysis [5]. Early in the response, data systems may be disrupted by conflict intensity, damage to infrastructure, or loss of governance. Ongoing hostilities and political upheaval may preclude surveys that gather primary data and directly inform programme planning and design [4]. Under such conditions, standard sampling frames that respect safety and confidentiality concerns may be unavailable, limiting access to reliable information. Programme managers in need of wider sectoral health information may obtain proxy estimates through triangulation, but subjective secondary data sources can introduce additional biases that further impede valid analysis [5]. Sampling and measurement constraints thereby limit the capacity to collect health information and make statistically sound inferences about morbidity, mortality, service coverage, or displacement[7]. Methods must therefore accommodate these constraints, for instance, through the use of objective independent indicators accessible at the aggregate administrative level, or methods for formalizing causal inference under incomplete or biased measurement of the health outcome of interest [8]. Time is of the essence; analysis that arrives early enough can trigger additional data collection, target donor resources, stimulate broader attention to information needs across multiple sectors, or support decision-making in multi-agency coordination committees [9]. In war-affected contexts, considerable effort has been devoted to understanding the health impacts of armed conflict. Recent reviews from 2010 to 2013 consistently underscore the scarcity of data, and the difficulties of collecting and analysing the health impact of armed conflict, given the high level of insecurity that pervades such settings [3]. While these and other reviews have documented the health issues in conflict situations and the limitations of prevailing indicators, a specific focus on these constraints in the health domain has not yet been explored systematically. Data challenges in segmented or poorly functioning systems exist outside war zones, and attention to issues in non-war settings whether post-disaster, post-epidemic, or following major internal disturbances can help highlight critical issues, broaden the relevance of the review, and support the exploration of solutions [4]. Nevertheless, the focus is primarily limited to circumstances in which armed conflict is an active contributor to the widespread disruption of the health & health information system, to allow something more than superficial comment on the nature and interactions of data challenges [5].

Technological Solutions and Innovative Data Sources

Technological innovations and data sources are increasingly enhancing situation awareness and health needs assessment in conflict-affected regions [6]. Digital health records allow health service providers to systematically document medical encounters, creating detailed service delivery histories. Mobile phone short message service offers rapid, low-cost reporting of aggregate health information from facilities nationwide [5]. Crowd-sourced data platforms provide real-time information on health service availability, population movement, and public safety, enabling decision-makers to monitor patterns and respond swiftly. Remote sensing of satellite imagery and night-time lights improves understanding of population dynamics, infrastructure damage, and other trends relevant to health planning and service delivery [8]. Data integration linking multiple information streams between health, security, education, shelter, and resilience sectors is becoming more common. Standardization of data structures and interoperability guidelines allows integrated data to be analysed collectively, giving a more comprehensive view of drivers and protecting outcome proxies, such as attendance rates [4]. Automated real-time analytics of data aggregated across pre-coded variables provides instant aggregated outputs, flagging anomalies for further investigation and enabling rapid, evidence-based decision-making.

Case Studies across Conflict-Affected Regions

Conflict-affected regions across the globe face unique health data challenges, severely restricting the ability of governments and humanitarian partners to monitor the health status of populations and the performance of health services [3]. The fragmentation of the health data ecosystem, which varies significantly across different contexts, shapes the scope and nature of these challenges [4]. To illustrate these diverse challenges, this section presents case studies from three regions at different points in the conflict-to-peace continuum: Eastern Democratic Republic of Congo (DRC), Libya, and Haiti. The DRC is still heavily affected by protracted armed conflict as of January 2022, while Libya experienced an abrupt and violent political transition in 2011 that does not yet appear

to have matured into a sustained post-conflict recovery period [4]. Health data systems in these countries have been severely disrupted by the large-scale destruction of governance structures, social order, and physical infrastructure [7]. By contrast, Haiti successfully transitioned from a humanitarian response to a more development-oriented engagement in the early 2010s following the 2010 earthquake. Although the 2004 to 2006 political crisis led to significant disruptions in the health data ecosystem, the extensive availability of data and analyses since the earthquake provides a rich longitudinal example of health data challenges encountered during and after a crisis [8].

Implications for Policy, Humanitarian Response, and Health Systems

Data limitations constrain effective planning, needs assessment, and resource allocation in war-affected regions of the Middle East, North Africa, and Sub-Saharan Africa [11]. Addressing these constraints requires strengthening the production, dissemination, and use of health data to inform humanitarian response and health systems governance in these settings; for instance, enhanced policy engagement, comprehension of health data challenges, and coordinated data solutions across international organizations, national governments, and implementing partners[8]. Actionable options for further improvement include streamlining governance arrangements, standardizing definitions, and extending data-sharing agreements on conflict impact, health service provision, and outcome estimates [9]. Proposed actions to stimulate better health data in conflict-affected settings span common epidemiological definitions, harmonized reporting templates, guidelines on ethics and data-sharing protocols, and capacity-building initiatives targeting both training and infrastructure investments [8].

Recommendations for Standardization and Capacity Building

Health data in conflict-affected settings are often compromised, limiting their utility for informing humanitarian response and policy [10]. Actions that strengthen their quality and usability could help mitigate the adverse effects of armed conflict on health outcomes and health systems [11]. Coordination among technical agencies and initiatives at local, national, and global levels can support such efforts. Standardization of definitions, indicators, and reporting templates relevant to war health data would establish a common language and simplify data integration and analysis. Training opportunities in statistical and analytical methodologies and software tailored to available data types would aid health data users in conflict-affected settings [11]. Support for local and regional infrastructure development, both software (e.g., digital record-keeping, reporting applications) and hardware (e.g., computer stations, mobile devices), could facilitate reporting and use of war-health data [12-16].

CONCLUSION

Health data challenges in conflict-affected settings represent a critical barrier to effective humanitarian response, disease surveillance, and long-term health system strengthening. This review demonstrates that wars disrupt every stage of the data cycle from collection and verification to analysis, accessibility, and use, resulting in fragmented datasets, weak surveillance, methodological biases, and limited comparability across regions and time periods. These challenges are compounded by insecurity, governance collapse, population displacement, political interference, and inconsistent technical capacity among data custodians. Despite these constraints, emerging innovations such as digital health records, mobile reporting platforms, remote sensing technologies, and integrated multi-sector datasets show substantial promise for improving the accuracy and timeliness of information in crisis environments. Case studies from the DRC, Libya, and Haiti illustrate that the severity and nature of health data challenges vary across the conflict-to-recovery continuum, and that recovery phases present unique opportunities to institutionalize robust data systems. To strengthen health data ecosystems in conflict settings, coordinated action is essential. Key priorities include establishing standardized definitions and reporting frameworks, investing in training and local capacity-building, improving ethical data governance, and fostering collaboration among governments, UN agencies, NGOs, and researchers. Ultimately, addressing war-related health data challenges is pivotal for safeguarding population health, informing humanitarian operations, and building resilient health systems capable of withstanding future crises.

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