Disaster Medicine and Public Health Preparedness

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A Decade of Reported Attacks on Health Care and Aid Workers Across 20 Conflict-Affected Settings (2016-2024): A Descriptive, Per-Capita Comparison Using Open-Source Incident Data

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Original Research

Cite this article: Mathew D and Rizek J (2026). A Decade of Reported Attacks on Health Care and Aid Workers Across 20 Conflict-Affected Settings (2016-2024): A Descriptive, Per-Capita Comparison Using Open-Source Incident Data. *Disaster Medicine and Public Health Preparedness*, **20**, e72, 1–6
https://doi.org/10.1017/dmp.2026.10336

Received: 04 October 2025
Revised: 04 February 2026
Accepted: 20 February 2026

Keywords:
conflict; humanitarian response; health workers; attacks on health care; international humanitarian law; disaster preparedness; public health

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Abstract

Background: Violence against health workers and health care facilities in conflict settings is a major public health concern, disrupting service delivery and undermining humanitarian response. While attacks on health care have been widely documented, standardized multicountry comparisons using consistent surveillance metrics remain limited.

Methods: A retrospective, descriptive observational analysis was conducted using incident-level, open-source records curated on the United Nations Humanitarian Data Exchange (HDX) from 2016 to 2024, covering 20 conflict-affected settings. Incidents involving harm to aid and health workers and attacks on health care facilities were summarized descriptively and standardized per capita to enable cross-setting comparison.

Results: Across the 20 settings, reported harm to health systems increased after 2021. PSE exhibited the highest per-capita burden, with 407 aid and health-worker fatalities and 420 reported attacks on health care facilities, while Ukraine recorded the highest absolute number of facility attacks (1,060). Myanmar demonstrated a distinct pattern characterized by large-scale arrests of health care workers following the 2021 military coup. Other settings demonstrated variable burdens and harm modalities, including personnel-lethal, infrastructure-destructive, and coercive patterns.

Conclusions: Reported attacks on health care in conflict settings are widespread and heterogeneous. This descriptive, per-capita comparison highlights variability in harm modalities across settings and identifies high-burden contexts that may warrant prioritization for surveillance strengthening, preparedness planning, and protection-focused operational coordination. Further research is needed to examine drivers, impacts on service delivery, and prevention strategies using attribution-aware, mixed-methods approaches.

Introduction

The protection of medical personnel, facilities, and transport is codified in the Geneva Conventions and their Additional Protocols as a core principle of International Humanitarian Law (IHL).[1,2] Despite these protections, reports of violence, obstruction, and intimidation directed at health systems in conflict settings have increased over the past decade, complicating humanitarian operations and undermining public health response capacity.[3–7] Attacks on health care disrupt service delivery, constrain access to care, and weaken health-system resilience during periods of acute need.

While prior studies have documented attacks on health care in specific conflicts, such as Syria and Ukraine, population-adjusted, multicounty comparisons remain limited. Existing research is often siloed by single settings, data systems, or definitional frameworks, limiting cross-setting comparability for preparedness planning, humanitarian coordination, and public health surveillance. At the same time, open-source incident surveillance systems (e.g., the Humanitarian Data Exchange [HDX], WHO Surveillance of Attacks on Healthcare [SSA], and the Safeguarding Health in Conflict Coalition [SHCC]) are increasingly used in practice, yet decision-makers lack transparent, reproducible approaches to compare reported harms across settings while accounting for definitional heterogeneity and underreporting.

The objective of this study is to provide a reproducible, descriptive, per-capita comparison of reported attacks on health care and harm to aid and health workers across 20 conflict-affected settings from 2016 to 2024 using open-source incident data. By standardizing reported fatalities, arrests/detentions, and attacks on health care facilities relative to population size, this analysis characterizes heterogeneity in harm modalities, personnel-lethal, infrastructure-destructive, and coercive, and identifies high-burden settings that may warrant prioritization[8,9] for surveillance strengthening and preparedness planning. This study is descriptive and non-attributive and does not assess causal mechanisms, legal responsibility, or intervention effectiveness.

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Methods

Access Dates

All data collection and extraction were conducted in January 2025. All sources were last accessed in January 2025; updates released after this date are not included in counts, rates, or comparisons.

Data Sources and Definitions

A retrospective, descriptive observational analysis was conducted using incident-level, open-source records downloaded from the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) Humanitarian Data Exchange (HDX), which was used as the primary repository because it consolidates and maintains consistent incident-level exports from the Safeguarding Health in Conflict Coalition (SHCC) and WHO Surveillance System for Attacks on Health Care (WHO-SSA) feeds. Records spanned January 1, 2016, to December 31, 2024, and covered 20 conflict-affected settings.10 Outcomes included reported fatalities among aid and health workers, arrests or detentions of health care personnel, and physical attacks on health care facilities and assets (including hospitals, clinics, and ambulances).

To preserve fidelity to source reporting, original incident taxonomies were retained. Where incidents referred to "aid workers" more broadly than licensed health care personnel, events were categorized as reported without reclassification. Because open-source surveillance systems differ in scope and definitions, reported categories may include heterogeneous roles and do not determine legal status, attribution, or compliance with IHL.

HDX was selected as the analytic dataset because it provides standardized, downloadable, incident-level records across multiple countries using a consistent extraction framework, enabling reproducible cross-setting comparisons. Other surveillance systems (including WHO Surveillance of Attacks on Healthcare and the Safeguarding Health in Conflict Coalition) were referenced for contextual validation where relevant but were not jointly analyzed to avoid inconsistent case definitions and duplication.

Population denominators were obtained from World Bank 2023 country population estimates and applied uniformly to compute per-million rates for cross-sectional comparability within the 2016-2024 study window.[10] This study used only publicly available, de-identified secondary data and involved no interaction with human subjects; therefore, it met criteria for Exemption Category 4 under the U.S. Common Rule (45 CFR 46.104[d][4]), and institutional review board review and informed consent were not required.

Data Preparation and Quality Assurance

Incident tables were cleaned and aggregated using Microsoft Excel 365. Data preparation included standardization of variable names, removal of duplicate records, derivation of year variables from incident dates, and harmonization of country names to World Bank conventions (e.g., "Central African Republic"). Country-level totals for the 2016-2024 period were calculated using conditional summation functions, and population denominators were joined to incident tables to generate per-capita indicators.

Analysis and Visualization

Counts and per-capita rates were summarized descriptively. Comparative visualizations included bar charts of per-capita outcomes, a scatter plot comparing facility attacks per million population with aid and health-worker fatalities per million population, and an annual global time-series plot of reported facility attacks. PSE and Ukraine were identified as statistical outliers due to markedly elevated counts and rates and are reported explicitly for interpretive clarity. No inferential modeling or causal analysis was performed.

Results

Across 20 conflict-affected settings from 2016 through 2024, reported harm to health systems increased after 2021. PSE demonstrated a high per-capita burden of reported harm, driven by aid worker and health care personnel fatalities and repeated attacks on health care facilities within a relatively small population base.[6] Ukraine, in contrast, was characterized by sustained, high-volume attacks on health care facilities occurring across a larger population and geographic territory.[6] Myanmar demonstrated a distinct pattern in which arrests and detentions of health care personnel predominated following the 2021 military coup.[6]

Across the cohort, per-capita fatality rates were highest in PSE and Lebanon, with elevated rates also observed in Syria and Libya (Table 2). Facility-attack rates were highest in PSE, Ukraine, and Syria, while arrests and detentions were concentrated in Myanmar relative to other settings (Table 2). Moderate burdens across one or more indicators were observed in the Democratic Republic of the Congo, South Sudan, the Central African Republic, Somalia, and Burkina Faso. In contrast, large-population settings such as Mexico and Pakistan exhibited lower per-capita rates despite nontrivial incident counts (Tables 1-2). Collectively, these findings indicate heterogeneity in harm modalities across settings, including personnel-lethal, infrastructure-focused, and coercive patterns.

Several settings exhibited mixed harm profiles. Syria, Yemen, Haiti, Ethiopia, Sudan, and the Democratic Republic of the Congo demonstrated combinations of direct violence against personnel and recurrent attacks on health care infrastructure. In Haiti, episodic increases in urban violence coincided with facility impacts and risks to ambulance operations, whereas in Syria and Yemen cumulative infrastructure damage persisted with intermittent escalation. Pakistan, Somalia, South Sudan, Niger, Mali, Mozambique, Libya, Iraq, Lebanon, Mexico, and the Central African Republic contributed additional incident volumes with variability across fatalities, arrests, and facility attacks. When interpreted alongside Table 1 (total counts) and Table 2 (per-capita rates), these patterns underscore variation in the predominant forms of reported harm across settings.

Among the ten highest-burden settings by combined indicators, PSE recorded 407 aid and health-worker fatalities, 12 arrests, and 420 reported attacks on health care facilities during the 2016-2024 period, while Ukraine recorded 320 fatalities, 30 arrests, and 1,060 facility attacks. Myanmar's profile was dominated by arrests of health care workers (n = 500), alongside 45 fatalities and 60 facility attacks. Haiti, Syria, Yemen, Afghanistan, Ethiopia, Sudan, and the Democratic Republic of the Congo comprised the remainder of the top-ten group, with differing distributions across fatalities, arrests, and facility attacks. These absolute counts corresponded to marked per-capita differences, with PSE exceeding 78 health-worker deaths per million population compared with approximately 8 per million in Ukraine, as seen in Figures 1 and 2.[5,6,12–14]

Limitations

This study relies on secondary, open-source incident data compiled within the Humanitarian Data Exchange (HDX), which imposes structural constraints on data completeness and comparability.[1,3,13]

https://doi.org/10.1017/dmp.2026.10336 Published online by Cambridge University Press

Table 1. Country totals for aid-worker harm and facility impacts (2016-2024)

Country	Fatalities	Arrests	Facilities damaged	Facilities destroyed	Facility attacks
Burkina Faso	41	6	35	45	80
Central African Republic	25	26	9	21	30
Democratic Republic of the Congo	119	47	56	124	180
Ethiopia	31	22	37	81	118
Gaza (PSE)	407	377	198	262	460
Haiti	6	1	9	11	20
Iraq	18	2	6	10	16
Lebanon	412	0	194	220	414
Libya	72	6	14	26	40
Mali	25	10	15	23	38
Mexico	43	15	6	6	12
Mozambique	3	0	11	29	40
Myanmar	142	836	268	420	688
Niger	18	2	6	10	16
Pakistan	53	92	2	4	6
Somalia	49	2	22	22	44
South Sudan	69	32	7	9	16
Syria	394	100	415	505	920
Ukraine	261	34	966	94	1,060
Yemen	18	2	6	10	16

Note: Totals aggregated from HDX incident-level data (2016-2024).[8]

Table 2. Per-capita indicators by country (2016-2024) using World Bank 2023 populations

Country	Population (WB 2023)	Fatalities	Fatals/1M	Arrests	Arrests/1M	Facility attacks	Facility/1M
Burkina Faso	23,025,776	41	1.78	6	0.26	80	3.47
Central African Republic	5,152,421	25	4.85	26	5.05	30	5.82
Democratic Republic of the Congo	102,262,812	119	1.16	47	0.46	180	1.76
Ethiopia	128,691,692	31	0.24	22	0.17	118	0.92
Gaza (PSE)	5,165,775	407	78.79	377	72.98	460	89.05
Haiti	11,724,763	6	0.51	1	0.09	20	1.71
Iraq	44,483,348	18	0.40	2	0.04	16	0.36
Lebanon	5,296,768	412	77.78	0	0.00	414	78.16
Libya	6,811,551	72	10.57	6	0.88	40	5.87
Mali	23,769,127	25	1.05	10	0.42	38	1.60
Mexico	129,199,373	43	0.33	15	0.12	12	0.09
Mozambique	33,891,145	3	0.09	0	0.00	40	1.18
Myanmar	54,296,438	142	2.62	836	15.40	688	12.67
Niger	27,284,615	18	0.66	2	0.07	16	0.59
Pakistan	247,504,495	53	0.21	92	0.37	6	0.02
Somalia	18,358,615	49	2.67	2	0.11	44	2.40
South Sudan	11,483,374	69	6.01	32	2.79	16	1.39
Syria	23,594,623	394	16.70	100	4.24	920	38.99
Ukraine	37,732,836	261	6.92	34	0.90	2,120	56.18
Yemen	39,390,799	18	0.46	2	0.05	16	0.41

Note: Rates per 1,000,000 population using 2023 World Bank denominators.[11]

https://doi.org/10.1017/dmp.2026.10336 Published online by Cambridge University Press

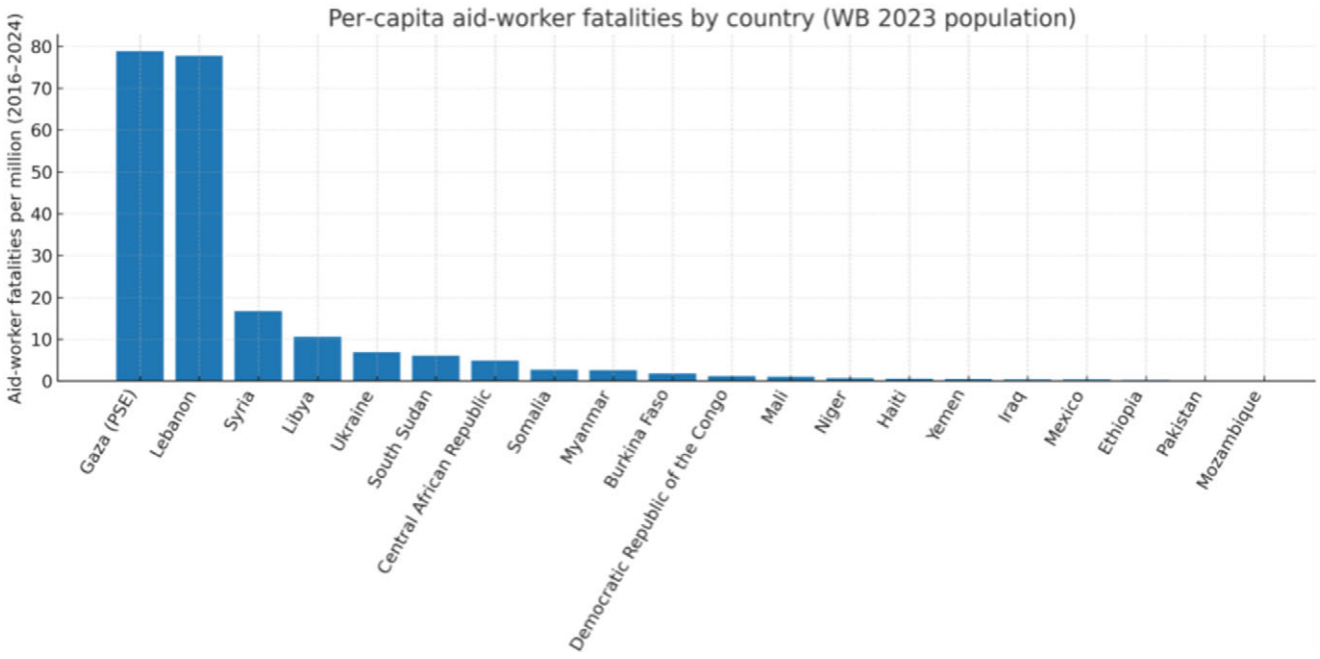


Figure 1. Per-capita aid-worker fatalities by country (2016-2024) using 2023 World Bank populations.

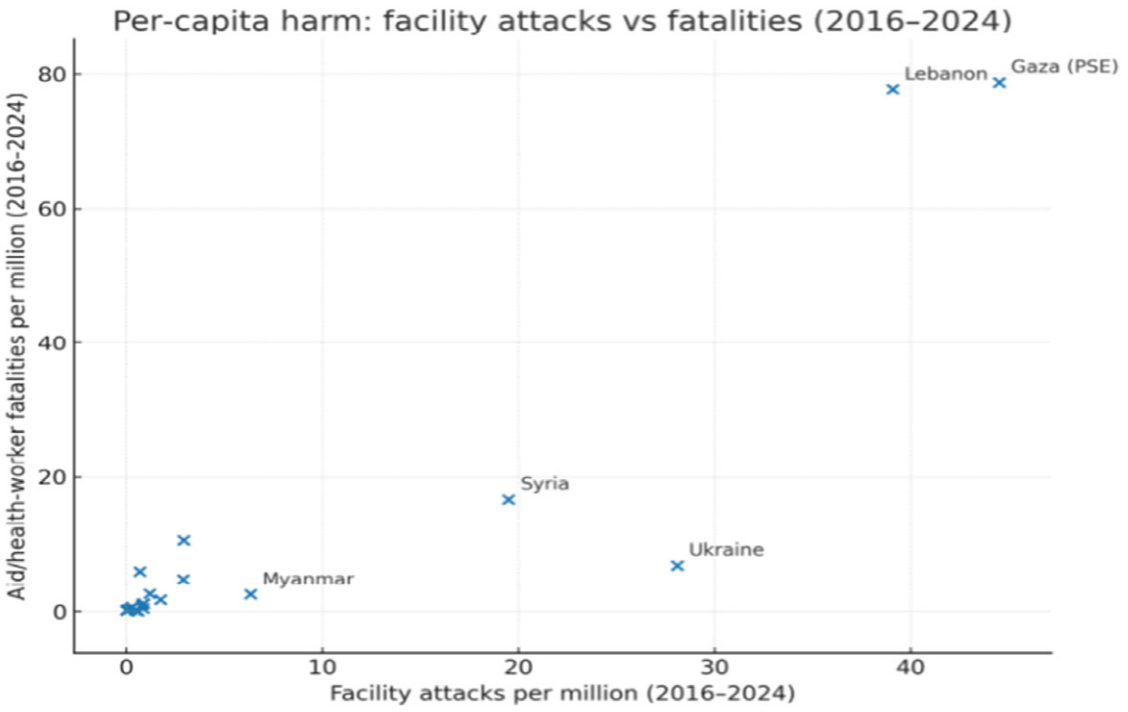


Figure 2. Per-capita correlation between facility attacks and fatalities (2016-2024); labels shown for PSE, Ukraine, and Myanmar.

Documentation of incidents depends on third-party reporting practices that vary by source, geography, and period of conflict intensity. As a result, gaps in reporting may reflect constraints in observation or access rather than the absence of harm. Reporting may be incomplete, inconsistent across settings, and influenced by temporal factors, including fluctuations in media coverage, humanitarian access, and organizational reporting capacity during specific crises. Incident verification varies across sources, introducing the potential for both false positives and false negatives.

Differences in source methodology and verification thresholds introduce uncertainty in incident classification and aggregation. Although de-duplication efforts are undertaken within contributing datasets, inconsistencies in event definitions and reporting granularity may affect the precision of cross-setting comparisons. Events may therefore be subject to misclassification or uneven categorization across contexts.

Population-based normalization was performed using fixed 2023 national population estimates to facilitate standardized cross-

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sectional comparison. This approach does not account for forced displacement, excess mortality, or population movement associated with conflict dynamics, which may distort denominators and influence per-capita estimates. Accordingly, calculated rates should be interpreted as relative indicators for comparative assessment rather than exact measures of population-level risk.

Selection bias is also likely, as incidents receiving international attention are more readily documented, while events occurring in inaccessible, insecure, or lower-profile settings may be underreported. In addition, the use of constant 2023 population denominators enabled standardized cross-sectional comparison across settings but did not account for demographic changes over the study period. As a result, per-capita estimates should be interpreted as comparative indicators rather than precise measures of temporal risk. Collectively, these limitations suggest that the magnitude of reported harm may be underestimated in some contexts and overrepresented in others, warranting cautious interpretation of findings.[5,6]

This analysis is descriptive and observational in scope. It does not evaluate causal pathways, responsibility, intent, or compliance with international legal standards, nor does it quantify the functional impact of reported incidents on health service availability or outcomes. Consequently, findings reflect patterns of reported events rather than a comprehensive accounting of harm to health systems.

Discussion

These cross-country comparisons demonstrate substantial heterogeneity in reported harm to health systems across conflict-affected settings. Differences between per-capita and absolute burdens illustrate how population size, geography, and conflict dynamics shape the apparent scale of harm. These findings highlight variability in harm modalities that is relevant for humanitarian health operations and public health preparedness.[12] From a public health perspective, heterogeneity in harm modalities has implications for preparedness assumptions, surveillance priorities, and operational coordination. Settings characterized by high per-capita fatality burdens may experience disproportionate strain on already limited health-system capacity, whereas contexts dominated by infrastructure damage or coercive actions against personnel may face prolonged service disruption and workforce depletion. These distinctions are relevant for humanitarian actors, ministries of health, and supporting partners planning for continuity of care, staff protection, and emergency response in conflict-affected environments.[3,6,7]

International humanitarian law provides the legal framework governing the protection of medical personnel and facilities in armed conflict. Medical units retain protection unless they are used to commit acts harmful to the enemy outside their humanitarian function. Allegations of misuse, whether substantiated or not, may influence operational decision-making and perceptions of medical neutrality, with potential downstream effects on humanitarian access and public health operations.[15] This analysis does not assess legal compliance or attribution but situates reported patterns of harm within the broader operational context in which health care is delivered during conflict.

The findings are consistent with prior literature documenting limitations of open-source surveillance in conflict settings, including underreporting, inconsistent verification, and differential media and organizational access.[3,5,7] Use of constant 2023 population denominators enabled standardized cross-sectional comparison across settings but did not capture demographic changes over time. As a result, observed per-capita rates should be interpreted as comparative indicators rather than precise measures of temporal risk.

Implications for Public Health and Humanitarian Response

These descriptive findings underscore the importance of evidence-informed approaches to protecting health workers and health care infrastructure in conflict settings. Variation in harm modalities across settings highlights the need for preparedness strategies that account for differing risks to personnel, facilities, and service continuity. From a public health perspective, integrating health-care-in-danger considerations into humanitarian health planning may support more realistic contingency planning, workforce protection strategies, and continuity-of-care efforts during conflict-related emergencies.

Reported incident data also highlight the role of surveillance systems in informing preparedness and coordination. Strengthening interoperability and consistency among existing incident reporting platforms, such as WHO Surveillance of Attacks on Healthcare, the Safeguarding Health in Conflict Coalition, and the Humanitarian Data Exchange, may improve situational awareness and support comparative assessment across settings. For humanitarian agencies, ministries of health, and international partners, these data may assist in prioritizing surveillance strengthening, coordination for deconfliction, and alignment with established protection frameworks, without presuming attribution or intervention effectiveness.

This analysis does not identify perpetrators or assess causal mechanisms underlying reported harms. Future research should integrate open-source surveillance with qualitative fieldwork, service-delivery impact assessments, and attribution-aware legal and operational analyses to better understand drivers of harm and evaluate prevention and mitigation strategies. Such approaches would enable stronger evidence-based guidance while preserving the descriptive role of incident surveillance in conflict-affected settings.[5,6,9,10]

Conclusions

This study examined reported harm to health systems across 20 conflict-affected settings using a comparative surveillance approach. The analysis shows that patterns of harm differ markedly across contexts, with variation in both the scale of reported incidents and the forms they take against health care personnel and infrastructure. These findings indicate that protecting health systems during armed conflict requires context-sensitive preparedness, surveillance, and coordination strategies rather than uniform assumptions about risk.

AI statement. AI (Grammarly) was utilized for spelling, grammar, and plagiarism review.

Author disclaimer. The views expressed are those of the authors and do not necessarily reflect the official policy or position of any affiliated institutions.

Author contribution. DM designed the study, conducted data analysis, and drafted the manuscript. JR conceived and designed the study, contributed to data verification, humanitarian context interpretation, and critical manuscript review. Both authors approved the final version.

Funding statement. None declared.

Competing interests. None.

https://doi.org/10.1017/dmp.2026.10336 Published online by Cambridge University Press

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