

Spatial-temporal patterns and typology of attacks against healthcare in the Occupied Palestinian Territory

Sarah Aly¹, Tushara Surapaneni¹, Mohammad Subeh², Qinyi Wang³, Daniel Andersen³, Hani Mowafi¹ and Danielle N Poole³

¹Department of Emergency Medicine, Yale University School of Medicine, New Haven, CT, USA (Correspondence to Sarah Aly: sarah.aly@yale.edu).

²Emergency Department, El Camino Health, Mountain View, CA, USA. ³Yale Humanitarian Research Laboratory, Yale School of Public Health, New Haven, CT, USA.

Abstract

Background: Healthcare infrastructure, personnel and persons seeking healthcare are protected under international humanitarian law. However, attacks on healthcare are increasingly a part of modern armed conflicts, including in the Occupied Palestinian Territory (oPt).

Aim: To quantify and characterize reported attacks on healthcare in the West Bank and Gaza and correlate reported attacks involving explosives with publicly available data.

Methods: This retrospective study analysed publicly available and geolocated health facility and weapons data from 7 October 2023 to 30 June 2024. Reports of attacks on healthcare were categorized by location, outcome and typology. Z-test and Chi-square analyses were conducted to compare attack types between Gaza and the West Bank using R software, and geospatial analyses were conducted using ArcGIS Pro software.

Results: A total of 1280 attacks on healthcare were reported in the oPt during the study period, of which 1052 were included in the analysis. Most of the attacks occurred in Gaza (78.3%), followed by the West Bank (21.7%). The typology of these attacks varied. There was a significant difference between the types of attacks in Gaza and West Bank ($P < 0.05$), but no significant association between type of weapon used and type of attack in Gaza ($|R| < 2$). The hotspots of attacks in Gaza were around al-Shifa, Nasser and al-Awda hospitals.

Conclusion: There was a high burden of attacks on healthcare in the oPt during the study period. The differences in types of attacks between Gaza and the West Bank highlight the need for context-specific interventions in the two territories. There is an urgent need for actions to end the use of 2000-lb MK-84 bombs in densely populated areas and near health facilities, in addition to calls for adherence to the international humanitarian law during armed conflicts.

Keywords: healthcare access, healthcare attacks, international humanitarian law, geospatial data, West Bank, Gaza

Citation: Aly S, Surapaneni T, Subeh M, Wang Q, Andersen D, Mowafi H, Poole DN. Spatial-temporal patterns and typology of attacks against healthcare in the Occupied Palestinian Territory. *East Mediterr Health J.* 2025;31(2):59–67. <https://doi.org/10.26719/2025.31.2.59>.

Received: 17/10/2024; Accepted: 08/01/2025

Copyright: © Authors 2025; Licensee: World Health Organization. EMHJ is an open access journal. All papers published in EMHJ are available under the Creative Commons Attribution Non-Commercial ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo>).

Background

Healthcare is a protected entity under international humanitarian law (IHL) and measures must be taken to avoid damage to both healthcare infrastructure and personnel. However, attacks on healthcare have been increasingly reported in modern conflicts (1–3), including in Syria, Sudan, Ukraine, and Myanmar (4). Attacks on healthcare attributed to the Israeli military in the Occupied Palestinian Territory (oPt) have been a long time occurrence (5–7). The Report of the Independent International Commission of Inquiry on the Occupied Palestinian Territory, including East Jerusalem, and Israel submitted to the United Nations (UN) General Assembly in September 2024 highlights widespread and systematic reports of attacks on healthcare workers, medical transport and healthcare facilities since the beginning of the current war on 7 October 2023 (8). As of 9 October 2024, only 17 of Gaza's 36 hospitals were partially functional, with 19 hospitals reported to be out of service (9). Less than half of Gaza's primary health centres remained operational

or partially operational (9). Significant damage to road infrastructure, electricity networks and water supply in the West Bank caused by Israeli attacks since 28 August 2024 has made it difficult for local and humanitarian actors to deliver care (10).

Attacks on healthcare have profound short- and long-term effects. In addition to delayed, reduced, or unavailable access to care, insecurity due to attacks limit the ability of humanitarian agencies to transport supplies and personnel to support healthcare services. Such attacks can have a “long tail” with prolonged periods of diminished health system capacity because rebuilding healthcare infrastructure and workforce takes years.

We have begun to see some of these effects in Gaza. Destruction of the health system has resulted in the dramatic decline of polio vaccine coverage and subsequently the first known case of poliovirus in Gaza since the 1970s. Although poliovirus has been detected intermittently in sewage over the decades, high rates of vaccination had resulted in no cases of polio in Gaza (11,12). Poliovirus vaccination coverage in Gaza was 99%

in 2022, but children were unable to receive vaccination as a result of the insecurity caused by Israel's attacks in Gaza (13).

Understanding the types of attacks on healthcare is important in providing useful information for policy and humanitarian actors. Therefore, as already done for conflicts in Ukraine (14), Syria (15) and North East Ethiopia (16), this study aimed to characterize Israel's attacks on healthcare across the oPt between 7 October 2023 and 30 June 2024, including types of weapons used, where the attacks occurred and the patterns of the types of attacks, so that targeted interventions may be taken to safeguard healthcare. The study:

- analysed the types of weapons used in reported attacks and explored potential associations between weapon type and attack type in Gaza;
- assessed patterns in the proportions of types of attacks on healthcare, highlighting distinctions between Gaza and the West Bank;
- assessed temporal patterns in types of attacks on healthcare in Gaza and the West Bank;
- identified geographic hotspots of healthcare attacks in Gaza; and
- evaluated the effects on healthcare infrastructure and personnel of detonating Mark-84 bombs close to healthcare facilities in Gaza.

Methods

This was a retrospective, observational study of publicly available data from Insecurity Insight and previously verified geolocated healthcare facility data as well as heavy weaponry data detailing attacks on healthcare (17,18,19). The analysis covered the period 7 October 2023 to 30 June 2024 and included all verified healthcare facilities and personnel working in the oPt. At the beginning of the study, WHO had identified 36 hospitals and 131 primary health centres in Gaza (9) and the International Trade Commission had identified 58 hospitals and 605 primary health centres in the West Bank (20).

Attacks on healthcare are defined by WHO as “any act of verbal or physical violence, threat of violence or other psychological violence, or obstruction that interferes with the availability, access and delivery of curative and/or preventive health services” (21). In accordance with this definition, Insecurity Insight incidents of violence against healthcare include: bombings, looting, robberies, hijackings, gunfire, forced closure of facilities, violent searching of facilities, arson, chemical attack, cyberattack, abduction of healthcare workers, denial or delay of healthcare services, assault, forcing staff to act against their ethics, execution, torture, violent demonstrations, administrative harassment, obstruction, sexual violence, psychological violence, and the threat of violence.

Insecurity Insight obtains its data from many sources, including reports by its partners, network

organizations and the media. It has a dedicated team that identifies additional incidents reported by UN agencies and other sources. For the oPt, reports of casualties by the Ministry of Health are used (these are only included if Insecurity Insight matched the name to a specific date and location of death) (22). At the time the dataset was accessed in August 2024, it included details of attacks, such as dates, geocoordinates, infrastructure types, weapons used, and perpetrators, covering the period 7 October 2023 to 30 June 2024.

Geographic boundaries and geolocation data

To create maps of the study area using geographic information system, open-access shapefiles of the boundaries of the West Bank and Gaza were downloaded from Humanitarian Data Exchange (23). The coordinates of healthcare facility locations were obtained from 4 open-source databases: OpenStreetMap (24), United Nations Office for the Coordination of Humanitarian Affairs (25), WHO Health Cluster (26), and Google Maps (27). These databases were cross-referenced to generate a comprehensive dataset of healthcare facility locations in Gaza, as previously detailed (18).

Mark-84 bomb detonation data

Coordinates of 2000-lb Mark-84 (MK-84) bombs detonated in Gaza between 7 October and 17 November 2023 were obtained from a publicly available data source (19). The dataset included the collation of coordinates of MK-84 bombs identified by CNN and New York Times satellite imagery investigations. MK-84s are colloquially referred to as “bunker buster bombs” and are produced for the US Department of Defence (19). Once detonated, steel fragments from the bomb's casing have a lethal range up to 360 meters and a damage and injury range of 800 meters from the initial explosion (19).

Data analysis

Data of attacks on healthcare were extracted into Microsoft Excel (28), which included 1280 attacks. Attacks reported in East Jerusalem and reports of attacks without location information were excluded (n = 59). Reported attacks were quantified and characterized by location, typology, type of weapon reported, if used, and stratified by region in the oPt. Attacks in which the type of weapon used was not reported were excluded (n = 169). Weapons were categorized as explosives (aerial bombs – all types, artillery, mortar, rocket, shelling, missile, and unspecified explosives) or non-explosive weapons (arson, firearms, fist and foot, stones, sticks, gravel, tasers, and live and rubber bullets).

The types of attacks were classified into 6 as follows:

1. Attacks on healthcare infrastructure (attacks on health facilities leading to damage or destruction).
2. Attacks on healthcare transport (destruction, damage or hijacking of health transport).

3. Obstruction of healthcare services (forceful entry into healthcare facilities, occupation of healthcare facilities, vicinity of healthcare facilities affected, access being denied or obstructed, looting/theft/robbery/burglary of healthcare supplies).
4. Physical attacks on healthcare workers (killing, injury, physical or sexual assault).
5. Arrest of healthcare workers (kidnapping or arrest).
6. Psychological attacks on healthcare workers (threatening).

Statistical analyses were conducted using R Software (29). A Z-test was conducted to compare the proportions of attack types between Gaza and the West Bank. Attack data were categorized by type and coded as "1" if an event occurred within a category and "0" if it did not occur. Proportions were calculated for each type based on total attacks by region, and statistical significance was determined at $|Z| > 1.96$ ($P < 0.05$). Chi-square test was conducted to assess the association between weapon type and attack type in Gaza, with standardized residuals identifying the largest contributors (significance threshold: $|R| > 2$).

Maps of healthcare attacks were created using ArcGIS Pro (30) to visualize the locations of facilities and attacks (31). Hotspot analysis was performed using the optimized hotspot analysis tool in ArcGIS Pro. The tool uses a Getis-Ord G_i^* statistic to determine how coordinate density and neighbouring values deviate from the overall average, producing a Z score and P value. Areas with 99% confidence suggest the chance that clustering occurred by random is 1 in 100.

The spatial relationship of MK-84 bomb craters and attacks on healthcare in Gaza between 7 October 2023 and 17 November 2023 from the Insecurity Insight dataset was also analysed using ArcGIS Pro. Attacks within 800 meters of an MK-84 bomb crater that resulted in injury to a healthcare worker, facility damage and/or facility destruction were visualized alongside attacks located within 360 meters of an MK-84 bomb crater that resulted in the death of at least one healthcare worker. MK-84 bomb craters located within 360 and 800 m of a healthcare facility were mapped separately.

Ethics approval

Ethics approval was not required for this study because the data analysed were obtained from publicly available sources.

Results

Typology of attacks on healthcare

Insecurity Insight reported 1280 attacks on healthcare in the oPt from 7 October 2023 to 30 June 2024, of which 1052 were included in our analysis. Most of the attacks occurred in Gaza (78.3%), followed by the West

Bank (21.7%). Proportions of each kind of attack were calculated for each region. Overall, 50.4% of the attacks in Gaza involved physical healthcare infrastructure, while 49.6% of the attacks involved healthcare workers. Conversely, in the West Bank, 25.7% of the attacks involved physical healthcare infrastructure while 74.3% involved healthcare workers.

A Z-test was conducted to determine if there was a significant difference in the proportions of types of attacks between the 2 regions.

In Gaza, 65.8% of attacks involved explosive weapons, while 95.8% in the West Bank involved non-explosive weapons. A Pearson Chi-squared test ($\chi^2 = 14.9$, $P = 0.011$) indicated a possible association between weapon type and attack type in Gaza. Standardized residuals showed a significant result only for facility damage ($R = -2.32$), suggesting that such attacks occurred less often than expected with non-explosive weapons, with no significant associations for other outcomes ($|R| < 2$).

Temporal patterns of attacks on healthcare

Between November 2023 and April 2024 there was a decrease in the proportion of attacks involving explosive weapons, with a surge in such attacks coinciding with the Israeli military incursion into Rafah on 6 May 2024 (Figure 1). The type of weapon remained consistent during the entire study period in the West Bank.

There was a change in the types of attacks in Gaza during the study period. Obstruction of healthcare became a larger proportion of attacks during the later part of the study period. The 3-month moving average reveals that the proportion of attacks on healthcare infrastructure increased from 15.4% between October and December 2023 to 20.9% between April and June 2024. The outcomes of attacks fluctuated in the West Bank. There were several peaks of reported arrests of healthcare workers in Gaza, which coincided with sieges on hospitals (Figure 2).

Table 1. Z-scores of differences in proportions of attacks between Gaza and the West Bank from 7 October 2023 to 30 June 2024

Types of attacks	Z Score	P value
Attacks on healthcare infrastructure	4.77	< 0.001
Attacks on healthcare transport	-2.96	0.003
Obstruction of health care services	4.57	< 0.001
Physical attacks on healthcare workers	0.62	0.533
Arrest of healthcare workers	-3.95	< 0.001
Psychological attacks on healthcare workers	-6.25	< 0.001

Positive values indicate higher proportions of attacks for Gaza while negative values indicate higher proportion of attacks for the West Bank.

Figure 1. Typology of weapons used in reported attacks on healthcare shown as 7-day moving averages in the West Bank and Gaza from 7 October 2023 to 30 June 2024

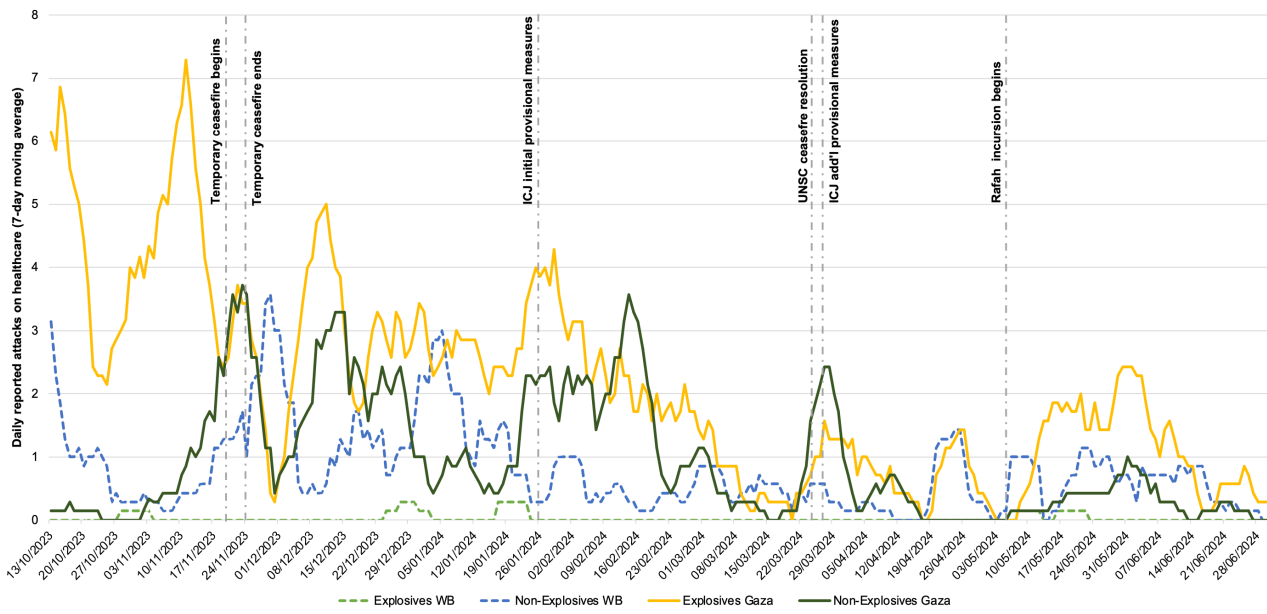
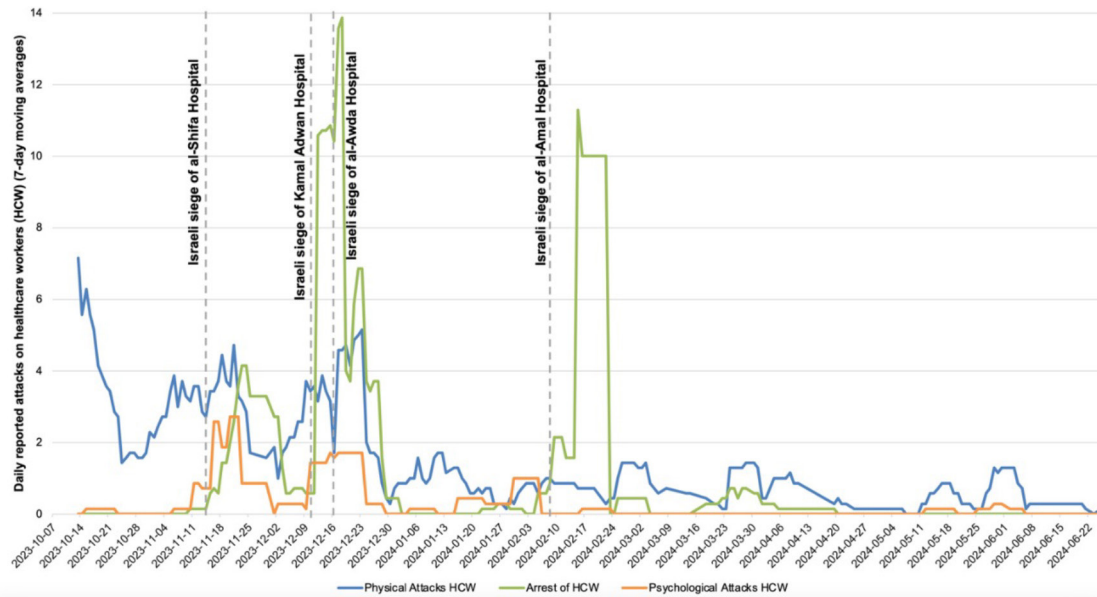


Figure 2. Reported attacks on healthcare workers shown as 7-day moving averages in Gaza from 7 October 2023 to 30 June 2024



Spatial patterns of attacks on healthcare

Figure 3 shows the locations of attacks, mapped by weapon type, on healthcare between 7 October 2023 to 30 June 2024. In Gaza, clusters of explosive attacks with 95–99% confidence levels occurred around Al-Shifa Hospital, Nasser Hospital and Al-Awda Hospital.

Mark-84 bomb crater spatial analysis

Insecurity Insight recorded 189 explosive attacks on healthcare in Gaza between 7 October 2023 and 17

November 2023, making 90.9% of the total attacks during this period. Of those, 59 out of 81 attacks (72.8%) resulting in healthcare worker injury, facility damage and/or facility destruction were located within the expected range of building damage or bodily injury (800 m) of an MK-84 bomb crater.

There were 63 explosive attacks which resulted in the death of at least one healthcare worker (33.3%) between 7 October 2023 and 17 November 2023. In total, 24 of the 97 healthcare workers reported killed in explosive attacks

Figure 3. Locations of reported explosive and non-explosive attacks on healthcare in Gaza (left) and the West Bank (right) between 7 October 2023 and 30 June 2024. Scales corresponding to each figure are shown.

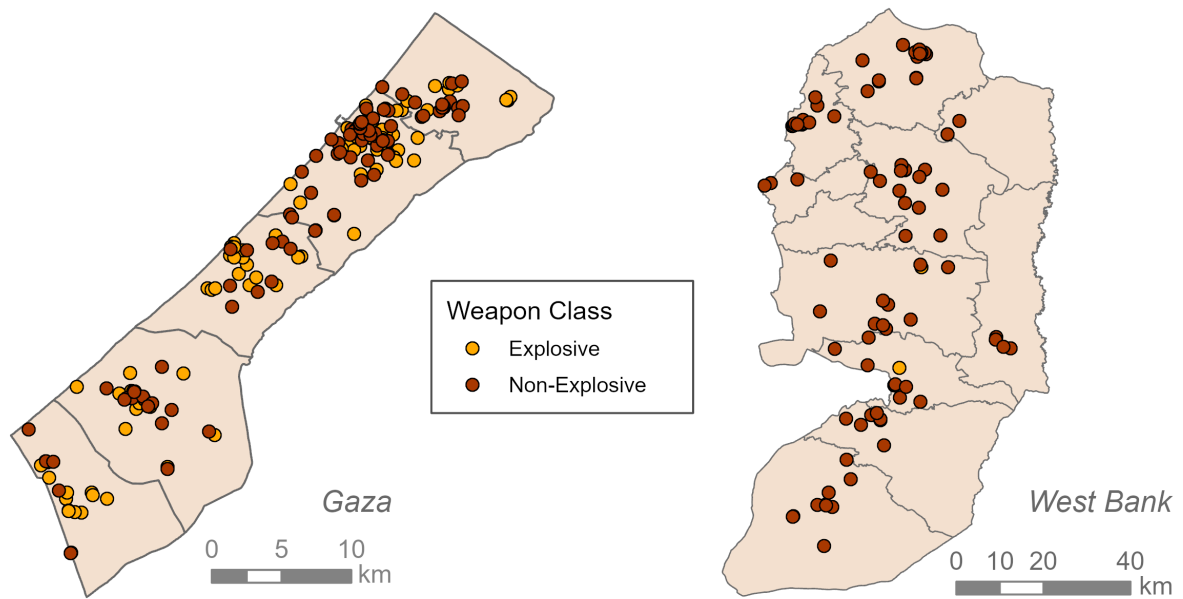
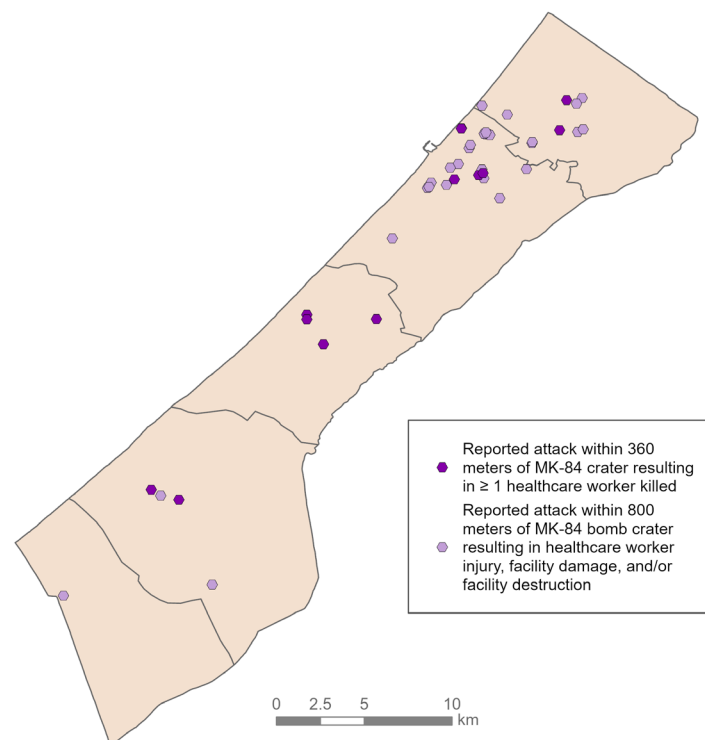


Figure 4. Reported explosive attacks on healthcare resulting in facility damage, facility destruction, and injury and death of healthcare workers which were located within lethal range (360 m) and damage range (800 m) of MK-84 bomb craters between 7 October 2023 and 17 November 2023 in Gaza



(24.7%) between 7 October and 17 November 2023 in the Insecurity Insight dataset were within lethal range (360 m) of an MK-84 bomb crater (Figure 4).

Discussion

International humanitarian law offers special protection for healthcare, however, the first 9 months of Israel's war in Gaza were characterized by widespread attacks on healthcare. These attacks most commonly involved explosive weapons, like the ones reported in Ukraine (14) and Syria (15). During the study period, attacks on healthcare decreased across the oPt, which may be a reflection of the increased attention to IHL but may also be a reflection of the widespread destruction caused by Israel's aerial assault on Gaza in the first months of the war. As of July 2024, 82% of Northern Gaza's infrastructure had been destroyed (32). In Rafah, approximately 58% of buildings had been destroyed (32). By May 2024, 76% of buildings in Khan Younis had been destroyed (32).

Our geospatial analysis revealed the dire consequences of using MK-84 weapons in proximity to healthcare facilities. An international embargo on this type of weapon may prevent further loss of lives and damage to health infrastructure. Their current use in high density urban areas reflects disregard for the protection of healthcare as stipulated by IHL. Given their origin in the United States of America (USA), we urge USA leaders to halt their supply to Israel to ensure protection of healthcare facilities.

Statistical analysis highlights regional differences in the types of attacks on healthcare in the West Bank and Gaza. In Gaza, attacks predominantly caused damage and destruction of healthcare facilities and obstructed healthcare services. Thus, interventions should focus on diplomatic pressure through international monitoring to ensure protection of healthcare infrastructure. Lifting the current siege on Gaza is needed to repair and fortify damaged facilities. An arms embargo may also be necessary to decrease the use of destructive weapons against and in the vicinity of healthcare facilities.

Arrests and threats to healthcare workers and attacks on healthcare transportation were more common in the West Bank. Interventions should prioritize coordination between organizations to ensure that ambulances can safely navigate humanitarian corridors. Security training is critical to protect healthcare workers from arrest and harassment.

A functional healthcare system not only safeguards the health of populations, but is also important for tracking health outcomes, including mortality. The scale of Israel's attacks in Gaza has resulted in an overwhelmed healthcare system, with a greater proportion of unidentified people killed over the course of the war (33). In the West Bank, reports reveal difficulty in delivering healthcare because of the attacks (10). Broader strategies in the oPt should include engaging international legal entities such as the International Court of Justice (ICJ) and the International Criminal

Court to ensure compliance with IHL. South Africa's ICJ submission, accusing Israel of genocide, highlighted attacks on Gaza's healthcare system (34). While the ICJ response did not explicitly address these attacks, it has called for an end to Israel's military campaign and for unrestricted medical aid to prevent further loss of lives (35).

Strengths and limitations of the study

This analysis has several strengths and limitations. Insecurity Insight relies on reports from UN agencies, non-government organizations, academic centres focused on protecting healthcare, and the media, which may not capture all attacks. Some attacks may not be reported in media for security reasons. Insecurity Insight's verification methods exclude reports that have insufficient details. For example, their data reported 210 healthcare worker deaths during the study period, while reports from Healthcare Workers Watch, an initiative led by Palestinian healthcare professionals to bring attention to attacks on healthcare facilities and workers across the oPt, reported 466 healthcare workers killed between 7 October 2023 and 14 June 2024 (36). This figure is corroborated by a report by Medical Aid for Palestinians that 500 healthcare workers were killed between 7 October 2023 and 26 June 2024 (37). These reporting limitations may have underestimated the overall burden of attacks on healthcare in the oPt.

The geospatial analysis also has limitations. It did not account for temporal clustering of attacks or changes in healthcare functionality in the oPt during the study period. It also did not include field hospitals, repurposed buildings or shelters providing medical care. Limited data on weapon specifics likely contributed to an underestimation of the impact of Israel's attacks on healthcare. Triangulating the known radiuses of MK-84 bombs partially addressed this issue, however, this could not be done for other weapons. Recent updates by Insecurity Insight have removed geocoordinate information, thus limiting study reproducibility.

Despite these limitations, the study presents strong evidence of widespread attacks on healthcare across the oPt and highlights the urgent need to scale-up protection of healthcare during the current war.

Conclusion

There has been a high burden of attacks on healthcare across the oPt during the first nine months of the current war. The use of MK-84 bombs has resulted in the killing and injury of healthcare workers, as well as damage and destruction of healthcare facilities. The destruction of healthcare facilities does not only endanger the health of Palestinians, it also undermines the overall effectiveness of the Palestinian healthcare system, with short- and long-term adverse health outcomes for Palestinians. Mass casualty events, seen frequently in both the West Bank and Gaza since 7 October 2023, place additional

strain on already limited medical resources, exacerbating challenges in healthcare delivery. The resultant healthcare crisis across the oPt requires immediate action to ensure

the safety of healthcare workers and facilities including a permanent ceasefire, arms embargo against Israel, or other deconfliction methods.

Acknowledgements

The authors extend their heartfelt gratitude to Shakoor Hajat and Zeina Jamaluddine for their invaluable contributions and insightful guidance regarding the statistical analysis for this study. Their expertise and thoughtful feedback have significantly enriched the quality and depth of the work.

Funding: None.

Conflict of interest: None declared.

Modèles spatio-temporels et typologie des attaques contre les soins de santé dans le Territoire palestinien occupé

Résumé

Contexte: Les infrastructures de santé, le personnel et les demandeurs de soins sont protégés en vertu du droit humanitaire international. Cependant, les attaques visant les soins de santé font de plus en plus partie des conflits armés modernes, y compris dans le Territoire palestinien occupé.

Objectifs: Quantifier et caractériser les attaques contre les soins de santé notifiées en Cisjordanie et à Gaza, et corrélérer les attaques impliquant des explosifs avec les données publiquement disponibles.

Méthodes: La présente étude rétrospective a analysé les données géolocalisées relatives aux établissements de santé et aux armes publiquement disponibles, couvrant la période du 7 octobre 2023 au 30 juin 2024. Les rapports d'attaques contre les soins de santé ont été classifiés par emplacement, résultat et typologie. Des tests Z et du chi carré ont été réalisés pour comparer les types d'attaques entre la Cisjordanie et Gaza en utilisant le logiciel R, tandis que des analyses géospatiales ont été effectuées à l'aide du logiciel ArcGIS Pro.

Résultats: Pendant la période étudiée, un total de 1280 attaques contre les soins de santé ont été notifiées dans le Territoire palestinien occupé, dont 1052 ont été incluses dans l'analyse. La majorité des attaques ont eu lieu dans la bande de Gaza (78,3 %), suivi de la Cisjordanie (21,7 %). La typologie de ces attaques variait. Une différence importante a été observée entre les types d'attaques à la Cisjordanie et Gaza ($p < 0,05$), mais aucune association significative n'a été trouvée entre le genre d'arme utilisée et le type d'attaque à Gaza ($|R| < 2$). Les principaux points d'attaque se trouvaient autour des hôpitaux al-Shifa, Nasser et al-Awda.

Conclusion: Il y a eu une forte pression d'attaques sur les soins de santé dans le Territoire palestinien occupé durant la période étudiée. Les différences de types d'attaques entre la Cisjordanie et Gaza soulignent la nécessité d'interventions spécifiques au contexte dans ces deux territoires. Il est urgent de prendre des mesures pour mettre fin à l'utilisation de bombes MK-84 de 2000 livres (900 kg) qui provoquent des cratères dans les zones densément peuplées et à proximité des établissements de santé, et de lancer des appels en faveur du respect du droit humanitaire international pendant les conflits armés.

الأنماط المكانية والزمانية وتصنيف الهجمات على مرافق الرعاية الصحية في الأرض الفلسطينية المحتلة

سارة علي، تاشارا سوراباني، محمد صبح، كيني وانج، دانييل أندرسن، هاني موافي، دانييل ن. بول

الخلاصة

الخلفية: يحمي القانون الدولي الإنساني البنية الأساسية للرعاية الصحية والعاملين فيها والأشخاص الذين يسعون إلى الحصول عليها. بيد أن الهجمات على مرافق الرعاية الصحية باتت على نحو متزايد جزءاً من النزاعات المسلحة الحديثة، بما في ذلك تلك الدائرة في الأرض الفلسطينية المحتلة.

الأهداف: هدفت هذه الدراسة إلى تحديد حجم الهجمات المُبلغ عنها على مرافق الرعاية الصحية في الضفة الغربية وغزة وتوصيفها، وتوضيح العلاقة المتبادلة بين الهجمات المُبلغ عنها التي تنطوي على استخدام المتفجرات والبيانات المتاحة علناً.

طرق البحث: حللت هذه الدراسة الاسترجاعية بيانات المرافق الصحية والأسلحة المتاحة علناً والمحددة الموقع في الفترة من 7 أكتوبر/تشرين الأول 2023 إلى 30 يونيو/حزيران 2024. وقد صُنفت تقارير الهجمات على مرافق الرعاية الصحية حسب الموقع والحصيلة والتصنيف. وأجريت تحليلات اختبار Z واختبار مربع كاي لمقارنة أنواع الهجمات بين غزة والضفة الغربية باستخدام برمجية R، وأجريت تحليلات جغرافية مكانية باستخدام برمجية ArcGIS Pro.

النتائج: أُبلغ عن وقوع ما مجموعه 1280 هجوماً على مرافق الرعاية الصحية في الأرض الفلسطينية المحتلة (غزة 76.5%، والضفة الغربية 18.9%، والقدس الشرقية وأماكن غير معروفة 4.6%) خلال الفترة المشمولة بالدراسة. وقد تبين تصنيف هذه الهجمات؛ إذ كان ثمة فرق كبير بين أنواع الهجمات في غزة والضفة الغربية (قيمة الاحتمال > 0.05)، ولكن لم يكن ثمة ارتباط يُعتد به بين نوع السلاح المستخدم ونوع الهجوم في غزة (معامل الارتباط $|R| > 0.2$). وكانت البؤر الساخنة للهجمات حول مجمع الشفاء الطبي ومجمع ناصر الطبي ومستشفى العودة.

الاستنتاجات: شهدت الفترة المشمولة بالدراسة عبئاً جسيماً من الهجمات على مرافق الرعاية الصحية في الأرض الفلسطينية المحتلة. وتؤكد الاختلافات في أنواع الهجمات بين غزة والضفة الغربية على الحاجة إلى تدخلات محددة السياق في هاتين المنطقتين. وثمة حاجة مُلحة إلى اتخاذ إجراءات لوضع حد لاستخدام القنابل التي يبلغ وزنها 2000 رطل في المناطق المكتظة بالسكان وبالقرب من المرافق الصحية، بالإضافة إلى دعوات إلى الامتثال للقانون الدولي الإنساني أثناء النزاعات المسلحة.

References

1. Mahase E. Violence against health staff in conflict zones reached record high in 2023. *BMJ*. 2024;385:q1140. doi: 10.1136/bmj.q1140.
2. Mukhtar S, Rana W, Mukhtar S. Trends of violence against health care workers and facilities: understanding the unheard. *J Clin Med Kaz*. 2024;21(1):86–92. DOI: 10.1186/s13031-021-00372-7.
3. Keenan K, Reiss P, Boffi R. Violence against healthcare in conflict: a systematic review of the literature and agenda for future research. *Conflict Health* 2021;15(1):25. doi: 10.1186/s13031-021-00372-7.
4. Blanchet K, Rubenstein L, Taithe B, Fast L. Have attacks on healthcare become the new normal? a public health call to action for armed conflicts before it is too late. *Conflict and Health*. 2023;17(1):56. DOI: 10.1186/s13031-023-00411-5.
5. Mahase E. Gaza: Israeli airstrikes kill doctors and damage healthcare facilities. *BMJ*. 2021 May 20;373:n1300. doi: 10.1136/bmj.n1300.
6. Amnesty International. Mounting evidence of deliberate attacks on Gaza health workers by Israeli army. News, 7 August 2014. <https://www.amnesty.org/en/latest/news/2014/08/mounting-evidence-deliberate-attacks-gaza-health-workers-israeli-army/>.
7. Medical Aid for Palestinians. Infographic: Attacks on medical facilities and personnel in the West Bank and Gaza. News, 1 October 2017. <https://www.map.org.uk/news/archive/post/627-infographic-attacks-on-medical-facilities-and-personnel-in-the-west-bank-and-gaza>.
8. OHCHR. UN Commission finds war crimes and crimes against humanity in Israeli attacks on Gaza health facilities and treatment of detainees, hostages. Press Releases, 10 October 2024. <https://www.ohchr.org/en/press-releases/2024/10/un-commission-finds-war-crimes-and-crimes-against-humanity-israeli-attacks>.
9. United Nations Office for the Coordination of Humanitarian Affairs. Reported impact snapshot | Gaza Strip. oPt Home, 9 October 2024. <http://www.ochaopt.org/content/reported-impact-snapshot-gaza-strip-9-october-2024>.
10. Médecins Sans Frontières. West Bank: Access to medical care at risk as Israeli incursions gain in intensity. Press Release, 5 September 2024. <https://www.msf.org/west-bank-access-medical-care-risk-israeli-incursions-gain-intensity>.
11. Goldblum N, Gerichter CB, Tulchinsky TH, Melnick JL. Poliomyelitis control in Israel, the West Bank and Gaza Strip: changing strategies with the goal of eradication in an endemic area. *Bull World Health Organ*. 1994;72(5):783–96. <https://pubmed.ncbi.nlm.nih.gov/7955030/>.
12. Tulchinsky TH, Ramlawi A, Abdeen Z, Grotto I, Flahault A. Polio lessons 2013: Israel, the West Bank, and Gaza. *The Lancet* 2013;382(9905):1611–2. DOI: 10.1016/S0140-6736(13)61706-1.
13. Reuters. Polio returns to Gaza: what do we know? Reuters News, September 1, 2024. <https://www.reuters.com/business/health-care-pharmaceuticals/what-is-known-about-polios-return-gaza-strip-2024-08-30/>.
14. Kim HJ, Bruni E, Gorodetska G, Van den Bergh R, Bezer L, Artykutsa S, Andriamiseza N, Habicht J. Typology and implications of verified attacks on health care in Ukraine in the first 18 months of war. *PLOS Glob Public Health* 2024;4(3):e0003064. DOI: 10.1371/journal.pgph.0003064.
15. Ri S, Blair AH, Kim CJ, Haar RJ. Attacks on healthcare facilities as an indicator of violence against civilians in Syria: An exploratory analysis of open-source data. *PLoS One* 2019;14(6):e0217905. DOI: 10.1371/journal.pone.0217905.
16. Arage MW, Kumsa H, Asfaw MS, Kassaw AT, Dagnew EM, Tunta A, Kassahun WK, Addisu A, Yigzaw M, Hailu T, Tenaw LA. Exploring the health consequences of armed conflict: the perspective of Northeast Ethiopia, 2022: a qualitative study. *BMC Public Health* 2023;23(1):1259. DOI: 10.1186/s12889-023-16983-z.
17. United Nations Office for the Coordination of Humanitarian Affairs. State of Palestine (PSE): Attacks on aid operations, education, health care and IDP/refugee camps, and conflict-related sexual violence (CRSV) and explosive weapons incident data Geneva: United Nations Office for the Coordination of Humanitarian Affairs. <https://data.humdata.org/dataset/opt-violent-and-threatening-incidents-against-healthcare>.
18. Poole DN, Andersen D, Raymond NA, Grace R, Smith T, Khoshnood K, et al. Damage to medical complexes in the Gaza Strip during the Israel–Hamas war: a geospatial analysis. *BMJ Global Health* 2024;9(4):e014768. DOI: 10.1136/bmjgh-2023-014768.

19. Kunichoff D, Mills D, Asi Y, Abdulrahim S, Wispelwey B, Tanous O, et al. Are hospitals collateral damage? Assessing geospatial proximity of 2000 lb bomb detonations to hospital facilities in the Gaza Strip from October 7 to November 17, 2023. *PLOS Global Public Health* 2024;4(10):e0003178. DOI: 10.1371/journal.pgph.0003178.
20. International Trade Administration. West Bank healthcare sector & medical device registration 2024 overview. Washington DC: International Trade Administration, 2024. <https://www.trade.gov/market-intelligence/west-bank-healthcare-sector-medical-device-registration-2024-overview>.
21. World Health Organization. Attacks on Health Care: Three-year analysis of SSA data (2018-2020). Geneva: World Health Organization, 2024. [https://www.who.int/data/stories/attacks-on-health-care-three-year-analysis-of-ssa-data-\(2018-2020\)](https://www.who.int/data/stories/attacks-on-health-care-three-year-analysis-of-ssa-data-(2018-2020)).
22. Insecurity Insight. Definitions and methodologies. Insecurity Insight, 2019. <https://insecurityinsight.org/methodology-and-definitions>.
23. United Nations Office for the Coordination of Humanitarian Affairs. State of Palestine - Subnational administrative boundaries. Geneva: United Nations Office for the Coordination of Humanitarian Affairs, 2024. <https://data.humdata.org/dataset/cod-ab-pse>.
24. OpenStreetMap. <https://www.openstreetmap.org/>.
25. United Nations Office for the Coordination of Humanitarian Affairs. State of Palestine - Health facilities. Geneva: United Nations Office for the Coordination of Humanitarian Affairs, 2024. <https://data.humdata.org/dataset/state-of-palestine-health-o-?>
26. Global Health Cluster. occupied Palestinian territory. Geneva: Global Health Cluster, n.d. <https://healthcluster.who.int/countries-and-regions/occupied-palestinian-territory>.
27. Google Maps. <https://www.google.com/maps>.
28. Microsoft Store. Excel. <https://www.microsoft.com/en-us/microsoft-365/p/excel/cfq7ttcopbmf>.
29. R: The R project for statistical computing. <https://www.r-project.org/>.
30. esri. ArcGIS Pro geoprocessing tool reference. <https://pro.arcgis.com/en/pro-app/latest/tool-reference/>.
31. esri. Optimized hot spot analysis (spatial statistics). esri, n.d. <https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/optimized-hot-spot-analysis.htm>.
32. Unitar. UNOSAT Gaza Strip 8th Comprehensive Damage Assessment. Turin: Unitar, 31 Jul 2024. <https://unosat.org/products/3904>.
33. Khatib R, McKee M, Yusuf S. Counting the dead in Gaza: difficult but essential. *Lancet* 2024;404(10449):237–238. DOI: 10.1016/S0140-6736(24)01229-1.
34. International Court of Justice. Application of the Convention on the Prevention and Punishment of the Crime of Genocide in the Gaza Strip (South Africa v. Israel). Request for modification of the Order of 28 March 2024. The Hague: International Court of Justice, 2024. <https://www.icj-cij.org/case/192>.
35. International Court of Justice Application of the Convention on the Prevention and Punishment of the Crime of Genocide in the Gaza Strip (South Africa v. Israel) - Provisional measures. The Hague: International Court of Justice, 2024. <https://www.icj-cij.org/case/192/provisional-measures>.
36. Healthcare Workers Watch. Update #19 Killed HCWs in Palestine – June 14, 2024. Updates, June 14, 2024. <https://healthcare-workerswatch.org/publications/updates/killed-healthcare-workers-in-palestine-june-14-2024/>.
37. Medical Aid for Palestinians. 500 healthcare workers killed during Israel's military assault on Gaza. News, 26 June 2024. <https://www.map.org.uk/news/archive/post/1598-500-healthcare-workers-killed-during-israelas-military-assault-on-gaza>.