Antimicrobial Resistance in War Zones: The Gaza Crisis

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Accepted
January 30, 2026

Published Online
April 28, 2026

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Abstract

Introduction. Antimicrobial resistance (AMR) poses a growing threat to global health, particularly in conditions that facilitate disease transmission. Conditions in the Gaza Strip caused by armed conflict, including poor sanitation, overcrowding, and significant damage to healthcare infrastructure, hinder effective infection control measures, and may facilitate the rapid spread of resistant pathogens.

Methods. This paper reviewed existing literature and reports on the ongoing conflict in Gaza and its relationship to the spread of AMR.

Results. The review identified significant implications of AMR in conflict settings for both the health and economic sectors while considering the ethical and political challenges of international intervention.

Conclusion. Potential measures to limit the spread of AMR in war zones include vaccination campaigns, strengthened humanitarian aid, and antimicrobial stewardship initiatives. Improved international cooperation may help to address the spread of AMR in conflict settings and its broader global health implications.

Keywords: antimicrobial resistance; war zones; Gaza; armed conflict; humanitarian aid

Introduction

Antimicrobial resistance (AMR) represents one of the most urgent challenges in global health [1]. AMR refers to adaptations developed by microorganisms in response to antimicrobial exposure, allowing them to survive subsequent use of antimicrobials. This limits the efficacy of these drugs and can increase the length and severity of previously treatable infections [1,2]. The recent surge in AMR has had serious domestic and global repercussions in multiple sectors, with AMR killing more people annually than armed conflict [2,3]. Over the next few decades, it is predicted that AMR will trigger a rise in global healthcare expenditures and a dramatic fall in economic output [4]. This will be especially detrimental to low-income countries and potentially lead to a substantial increase in extreme poverty around the globe [4]. In response, the World Health Organization (WHO) has proposed a critical global action plan (GAP) to limit its spread [5]. Despite these efforts, conditions favourable to disease transmission, particularly in war zones, have spread AMR pathogens at an alarming rate [6,7]. The conflict in Gaza epitomizes this issue, impeding the implementation of the GAP and posing both immediate and long-term threats to the health of the population [6-8].

The Gaza Crisis

The escalation of hostilities between Israel and Palestine on October 7, 2023 has promoted the emergence and spread of AMR pathogens by damaging healthcare facilities, eliminating sanitation infrastructure, and hindering infection prevention and control (IPC) measures [6-9]. Gaza's population is left vulnerable to disease from high stress and food insecurity, which depress the immune system and increase susceptibility to infection [6,8]. Moreover, the bombings in the Gaza Strip have led to the destruction of healthcare and sanitation infrastructure, causing the death of over 1,000 healthcare workers and leaving only a fraction of their original 36 hospitals in a state of partial functionality [10]. Due to the high casualty rate, hospitals

are overcrowded, and patients often receive treatment on hospital floors, leading to the spread of multidrug-resistant nosocomial infections [7,10]. Many other factors contribute to the development and spread of AMR in Gaza, including the lack of medical supplies, such as antibiotics, and the absence of functional microbiological laboratories, limiting accurate diagnosis and antimicrobial stewardship, and creating ideal conditions for the emergence and spread of AMR [7]. This threatens to worsen the already catastrophic toll of the war, with repercussions that will extend long into the future as resistant pathogens can persist in the environment, leading to new outbreaks [11]. Antimicrobial-resistant pathogens, also known as "superbugs," may also be spread to both refugees and humanitarian workers, allowing for transmission beyond the site of conflict. The proliferation of AMR in Gaza is a regional problem with global implications, posing a major threat to the future of public health.

Proposed Solutions

Prompt and effective action is critical to limiting the global repercussions of AMR in Gaza. Despite the development of WHO's GAP, there is a lack of a framework to guide the surveillance and management of AMR in warzones [5]. Global and national studies have demonstrated the effectiveness of vaccines in decreasing infection rates, treatment failure, and cumulative costs due to AMR [12]. Vaccines can be implemented on a national level through pre-existing immunization programs, creating an effective solution using existing infrastructure [13]. However, it is important to note that the adoption of this approach will be particularly challenging in conflict settings such as the Gaza Strip where health systems have been severely disrupted. Given the high risk of outbreaks in these regions, mass vaccination campaigns could also be implemented to prevent infections and hinder the spread of AMR. The WHO and UNICEF have already conducted a successful campaign against polio in Gaza, after the virus re-emerged in the summer of 2024 [14]. Additionally, education of healthcare workers regarding IPC and antimicrobial stewardship protocols is a vital component of managing AMR that suffers when resources are stretched thin [5,15]. Developing a framework to maintain education and IPC protocols in healthcare amidst war could be highly effective in preventing hospital-acquired AMR. This would likely depend on international funding providing support for healthcare workers and facilities in Gaza. Hindering the spread of pathogens outside of hospitals requires the implementation of stronger sanitation and waste-management infrastructure, which translates to universal access to clean water, sanitation, and hygiene. These strategies not only address AMR in war but may also be used as preventative measures in areas at high risk for conflict to alleviate the burden of AMR if war arises.

The actions outlined above are vital but can only be implemented with transnational cooperation and funding. An internationally recognized framework for addressing AMR in warzones is critical for regions such as Gaza. Improving AMR and epidemiological surveillance around the globe would give us a better understanding of existing resistant strains and their spread within war zones, acting as a basis for the creation of informed policies by transnational humanitarian organizations.

Ethical and Political Challenges

Despite the necessity of combating AMR, these efforts come with significant ethical and political challenges. In the heat of the Gaza crisis, resources were extremely limited, leading to the prioritization of life-threatening injuries over interventions to reduce AMR [7]. Furthermore, lower- and lower-middle-income countries such as Palestine largely rely on humanitarian aid to fund health campaigns [16]. The United States' withdrawal from the WHO initiated on January 20, 2025, threatened to deplete the funding the organization needs to provide this crucial aid [17,18]. In addition to financial constraints, humanitarian supplies and workers were prevented from entering the region by the Israeli blockade on the Gaza Strip [19]. Even when these barriers were temporarily overcome, humanitarian operations faced serious ethical challenges, as many aid workers lost their lives during the war [20]. These difficulties in providing vital humanitarian aid further emphasized the need for international cooperation in addressing the Gaza crisis. Despite the current ceasefire, the potential implications of the war for the AMR situation may have long-term national and global health repercussions.

Conclusion

When proposing global and regional responses to AMR, transnational authorities must consider the public health implications of conditions in war zones. Limited resources in regions experiencing conflict leave many countries reliant on humanitarian aid to fulfil basic needs, underscoring the importance of international funding and a clear framework for action. Increased emphasis on vaccine campaigns, antimicrobial stewardship, surveillance, and sanitation measures is necessary to address the immediate and long-term implications of the Gaza crisis on AMR in the region. Without prompt international action, there could be devastating repercussions both within and beyond Gaza's borders.

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AI Statement

The authors declare that AI was not used in this article.