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Perspective Piece

Refugee Crisis: Why Scientists and Scholars Need to Step Up

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The ongoing armed conflict in Ukraine and the humanitarian crisis in Afghanistan, along with protracted crises in several other parts of the world, have once again highlighted the need not just for global solidarity along with financial and material aid, but also the necessity of new and robust research to address emerging global health challenges. Communities displaced by conflict and persecution, whether across international borders or within a country, present a great multifaceted challenge and a moral imperative of our time. While recent global events have again brought to attention the issue of forced displacement, this is not a new issue. In 2020, the United Nations High Commissioner for Refugees reported 90.1 million people of concern worldwide. Among these were 20.6 million refugees and large numbers of internally displaced (IDPs) and stateless persons.[1] Although there has been an increase in news reports about the recent crisis in Europe, other communities of the world, particularly in the global south, have continued to suffer from displacement due to conflict and persecution.

Forced displacement predisposes migrants to negative health outcomes due to many socioeconomic determinants including exposure to infection and injury during displacement, poor living conditions ranging from inadequate housing to exposure to environmental hazards, racism, exclusion, and painful financial burdens. These challenges are not simply present during the initial period of forced displacement, but instead many of them manifest over time. While multilateral organizations and domestic institutions continue to work with displaced populations, their approach is often rooted in emergency care that requires immediate attention. However, communities are often displaced for years (and sometimes decades), and mid- and long-term health challenges do not get adequate attention, resulting in poor health outcomes among those who are displaced. We believe that fundamental research in sciences and engineering has a critical role to play in addressing these challenges—a role that *has not been* adequately played by scholars and researchers up to now. It is critical that this fundamental discovery-based research incorporates multidisciplinary perspectives that include ethics, humanities, and social sciences, such that the appropriate environmental, social, and cultural contexts are incorporated in any solution. In addition, translation of research and discovery into functional solutions requires an interdisciplinary team, spanning ethical policy and law to engineering and economics.

Long-term health consequences of displacement are hard to track given the temporariness associated with forced displacement, the fact that displaced communities may repeatedly be on the move, and the resulting lack of health records and care along the way. This will also be highly contextual, given the cause of flight, prior health conditions, and the health system of the host location.[2] One particular consequence that often is neglected is the increased risk of infectious diseases, particularly antimicrobial-resistant bacterial infections. High-density housing, malnutrition, unsafe water, sanitation and hygiene, lack of access to quality care, and improper and increased use of antibiotics may all add up to the perfect storm.[3] Recent estimates suggest that antimicrobial resistance (AMR) may account for more annual global deaths than malaria or HIV infection.[4] With increases in global conflicts and humanitarian crises, the number of AMR-related deaths is likely going to increase. Unfortunately, conflict-driven displacement and the emergence of new pathogens because of conflict have gotten limited attention, resulting in gaps in both disease understanding and the identification of appropriate treatment strategies. The environmental impact of conflict and its role in infectious diseases is even less studied.[5] For example, multidrug-resistant *Acinetobacter baumannii* infections have co-occurred with conflict. After *A. baumannii* infections were found in American soldiers returning from Iraq, the organism was termed "Iraqibacter." However, *A. baumannii* outbreaks have been documented to coincide with instances of conflict before and after the Iraq war. The common association with conflict has led to the hypothesis that the presence of heavy metal residues from explosives and weapons promotes the development and selection of new resistance patterns, and coupled with poor infrastructure, environmental contamination, and lack of quality care can lead to widespread infection.[6] This opens up important new areas of research to study the potential role of heavy metals from modern weapons in driving AMR, particularly in war zones where metal residues and shrapnel stay well after wars have ended. The short- and long-term impacts on disease exposure among communities that come back to their homes that have been ravaged by war remain unknown. An additional consideration in understanding how multidrug-resistant bacterial infections develop during conflict is to examine treatment practices and guidelines for combat-related injuries. Older practices have included expanded coverage for Gram-negative bacterial infections, which included adding a fluoroquinolone or aminoglycoside to posttraumatic antibiotic prophylaxis. However, there is evidence that this policy fails to reduce infections and instead may increase the selection of drug-resistant organisms.[7]

Communities that are forced to move often end up living in inhospitable environments, including urban slums and informal settlements. These environments can carry an increased risk of drug-resistant bacterial infection outbreaks and also harbor environmental hazards that exacerbate noncommunicable diseases. In tandem, these factors can lead to worsened health outcomes. Limited information about the role of inhospitable environments on bacterial colonization and the microbiome leaves open questions about the effectiveness of certain antibiotics. Another challenge is the lack of accessible

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and appropriate technologies and diagnostics for both rational antibiotic choice and accurate surveillance. For example, in Yemen, which has been in conflict since 2015 and has been described as the world's largest humanitarian crisis, with over 3 million IDPs, a survey of prescribers found that, in most cases, antibiotic susceptibility testing was not performed to inform antibiotic choice.[8] Indeed, while innovation and diagnostics play a central role in disease management, frontline clinics often have limited diagnostic capacity. This gap has started to be recognized, for example, Médecins Sans Frontières has recently been establishing clinical bacteriology laboratories in low-resource settings, including Yemen.[9]

History tells us that, without long-term solutions, we can lose precious lives quickly and for prolonged periods of time. Vulnerable displaced communities have been made even more vulnerable during the COVID-19 pandemic, due to poor access to basic medical services and diagnostics, and these communities often have high rates of underlying predisposing medical conditions, low vaccination rates, and unavoidable obstacles to social distancing or access to clean water. With limited resources, managing the COVID-19 pandemic also has to be balanced with the cost of other essential health services.[10] This includes mental health, for which problems have been exacerbated in displaced populations due to the COVID-19 pandemic.[11] There is often a limit to the global attention span, as we see headlines discussed one week and overlooked a few weeks later. As with COVID-19 diverting resources within a population, a new global crisis can divert resources among populations. However, with global interest and the issue of displacement currently again at the forefront, it is time to take steps to break the habit of focusing only on immediate and short-term solutions, and rather to also work on more long-term solutions.[10]

The challenge of improving the health of displaced populations does not have clear and easy solutions, but we can identify many important and pressing research questions that can help inform the development of long-term solutions and interventions. As mentioned earlier, there are important areas of discovery, such as investigating the development of resistant pathogens in areas of conflict and in displaced communities, and modeling of the emergence of resistant pathogens that considers biological, social, financial, and environmental contexts. However, the issue of AMR is only one of many that require a systems-level, multidisciplinary analysis. In the absence of robust research and discovery, we are likely to fall back on band-aid solutions while underlying global health problems grow. To avoid this outcome, it is essential that we work across academic disciplines and domains, and critically analyze, and when necessary replace, existing solutions through rigorous research—just as we would do for any public health challenge facing communities living in high-resource settings.

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