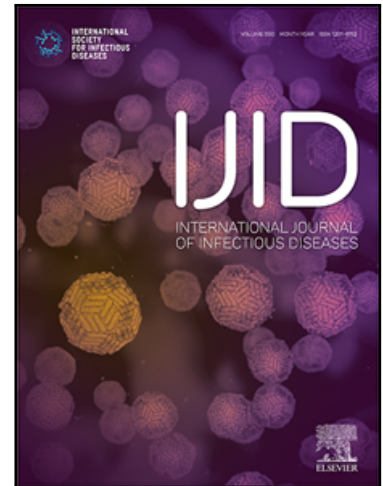


## Journal Pre-proof

How COVID-19 highlighted the need for infection prevention and control measures to become central to the global conversation: experience from the conflict settings of the Middle-East

Roula El Mouallem , Krystel Moussally , Anita Williams , Ernestina Repetto , Marilyne Menassa , Chiara Martino , Ghassan Abu Sittah

PII: S1201-9712(21)00668-8  
DOI: <https://doi.org/10.1016/j.ijid.2021.08.034>  
Reference: IJID 5646



To appear in: *International Journal of Infectious Diseases*

Received date: 15 June 2021  
Revised date: 13 August 2021  
Accepted date: 15 August 2021

Please cite this article as: Roula El Mouallem , Krystel Moussally , Anita Williams , Ernestina Repetto , Marilyne Menassa , Chiara Martino , Ghassan Abu Sittah , How COVID-19 highlighted the need for infection prevention and control measures to become central to the global conversation: experience from the conflict settings of the Middle-East, *International Journal of Infectious Diseases* (2021), doi: <https://doi.org/10.1016/j.ijid.2021.08.034>

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2021 Published by Elsevier Ltd on behalf of International Society for Infectious Diseases.  
This is an open access article under the CC BY-NC-ND license  
(<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

**How COVID-19 highlighted the need for infection prevention and control measures to become central to the global conversation: experience from the conflict settings of the Middle-East**

**Authors:** Roula El Mouallem,<sup>1,2</sup> Krystel Moussally,<sup>2,3</sup> Anita Williams,<sup>2,4</sup> Ernestina Repetto,<sup>1,2,5</sup> Marilyne Menassa,<sup>6,7</sup> Chiara Martino,<sup>1</sup> Ghassan Abu Sittah<sup>6</sup>

<sup>1</sup> Medical department, Operational Center Brussels, Médecins Sans Frontières, Brussels, Belgium

<sup>2</sup> Middle-East Medical Unit (MEMU), Lebanon branch office, Médecins Sans Frontières, Beirut, Lebanon

<sup>3</sup> Operations Department, Operational Centre Brussels, Médecins Sans Frontières, Brussels, Belgium

<sup>4</sup> Luxembourg Operational Research (LuxOR) Unit, Médecins Sans Frontières, Luxembourg, Luxembourg

<sup>5</sup> Infection Diseases Services, Saint-Jean Hospital, Brussels, Belgium

<sup>6</sup> Conflict Medicine Program, Global Health Institute, American University of Beirut, Beirut, Lebanon

<sup>7</sup> PhD Fellow, Institute of Social and Preventive Medicine, University of Bern, Switzerland

Corresponding Author:

Krystel Moussally

Full address: MSF Lebanon, Domtex building, Floor 5, Hamra main street, Beirut, Lebanon

Email address: [krystel.Moussally@msf.org](mailto:krystel.Moussally@msf.org)

Phone number: +961 81 313073

**Highlights:**

- Infection Prevention and Control (IPC) measures are deprioritized in conflicts.
- This is reflected in the Middle-East and highlighted by the covid-19 pandemic.
- IPC needs to be prioritized and become a core component of the medical curriculum.
- IPC needs to be offered necessary resources and be fed by contextualized evidence.

**Abstract**

The COVID-19 pandemic has managed to bring to the foreground, in just few months, the conversation around what Infection Prevention and Control (IPC) experts have been pushing for decades to control the spread of infections. Implementing the basics of IPC has been a challenge for all affected countries battling with an exponential COVID-19 curve of infection, preventing nosocomial transmission of the disease in highly-resourced and stable contexts but more so in the conflict context of the Middle-East. COVID-19 has created additional challenges to a long list of existing ones hindering the implementation of optimal IPC measures, necessary to break the chain of infection of both respiratory and non-respiratory infections, in those settings. This paper outlines and gives examples of the challenges faced across the Middle East conflict setting and serves as a call for action for IPC to be prioritized, given the needed resources, and fed with contextualized evidence.

**Keywords**

Infection Prevention Control, Conflict, Middle-East, Covid-19

The COVID-19 pandemic has managed to bring to the foreground, in just few months, the conversation around what Infection Prevention and Control (IPC) experts have been pushing for decades to control the spread of infections: wash your hands, clean touch surfaces, maximize ventilation, and apply precautions to break the chain of transmission (Allegranzi et al., 2017).

Implementing the basics of IPC has been a challenge for all affected countries battling with an exponential COVID-19 curve of infection, preventing nosocomial transmission of the disease in highly-resourced and stable contexts but more so in the conflict context of the Middle-East. COVID-19 has created additional challenges to a long list of existing ones hindering the implementation of optimal IPC measures, necessary to break the chain of infection of both respiratory and non-respiratory infections, in those settings.

In conflict and highly insecure contexts, such as Iraq, Syria, Yemen and Gaza, saving lives is the first priority. While implementing, maintaining and following good quality IPC standards should remain a priority to avoid spreading infections, it might not be possible practically. In these contexts, saving lives might take place in partially collapsed, ill-equipped facilities or buildings, makeshift camps, temporary set-ups, or even in caves, all of which do not allow for optimal IPC standards, despite best efforts. In such situations, transmission-based

precautions and the isolation of patients are often not possible and sterile conditions cannot be achieved (Médecins Sans Frontières, 2017). For instance, during the 2017 offensive on Mosul, Iraq, Médecins Sans Frontières (MSF) set up a mobile surgical trailer to perform emergency surgical interventions, which made implementing IPC extremely demanding. The narrow space of a trailer did not allow maintenance of an optimal aseptic field in the operating room. This challenged operating without the surgeons touching non-sterile areas in the aim of preventing potential cross-contamination. In Yemen, MSF operates in a tented field hospital in one of our projects in Taiz, making it impossible to install a proper ventilation system and uses a less than optimal method of air-conditioning. While these kinds of situations did not change with the COVID-19 pandemic, the centrality of the IPC message in reducing transmission and deaths from infections has come to the forefront. Even when implementation of transmission-based precautions is possible, it may come at an unattainably high cost, forcing alternative, less ideal options to be sought. For example, re-usable personal protective equipment (PPE) is cheaper than disposable PPE and provides adequate protection to patients, care-takers and to healthcare workers, but is not best practice and can impact the risk of transmission if not handled properly. However, it is sometimes the only affordable one (Kilinc Balci, 2016). For example, one of the only ways for MSF to sustain our IPC activities at a certain level in Mosul was the use of re-usable face shields and coveralls by the treating teams. COVID-19's increased demands on IPC supplies have heightened this challenge. In Mosul, MSF started early enough in the response to ensure local manufacture of PPE and face shields. In Syria, an increase of up to 5000% in the cost of PPE and hand sanitizer was reported by April-2020 (United Nations Office for the Coordination of Humanitarian Affairs and World Health Organization, 2020).

In addition to high costs, restrictions on supply and tight regulations on importation, coupled with potentially suboptimal quality of available items in conflict settings impedes IPC; the needed IPC materials are often de-prioritized against medicines and other lifesaving items. In Gaza, disinfection material such as chlorine, needed for adequate decontamination of water, is subject to heavy restrictions by the Israeli government from entering the country (Israel Ministry of Defense, 2013). With the COVID-19 pandemic, getting these supplies into Gaza has been even more problematic with few alternatives available. In Yemen, wracked by prolonged conflict, a recent aerial attack on a hospital run by MSF hit the supply warehouse where IPC consumables were stored, exacerbating an already limited supply chain in the country (Médecins Sans Frontières, 2019).

The lack of sufficient water is also a concern for IPC measures, and the reality is that in some conflict contexts even the basics of clean water are not available. In Gaza, the water supply system has a level of microbiological contamination with total and faecal coliforms or other organisms as high as 76% depending on the area and the type of water sample analysed (Abuzerr et al., 2019). This situation becomes even worse in active conflict settings where people's houses or private facilities can turn into "hospitals", where insufficient disinfection of the effluent contaminated water can enter the public water supply system potentially contributing to an increased risk of infection. To address this, in a hospital in Gaza, MSF performs chlorination of water with regular testing at facility level to monitor the quality. In other projects, such as in Yemen, we use water pumps and reverse osmosis systems for sterilization to mitigate the lack of clean water. This type of equipment might not be possible in other local structures due to lack of resources.

The supply of electricity is also essential for running of sterilization equipment and water pumps. In conflict settings, the shortage of electricity is frequent and alternatives such as generators or solar panels might not be available, or were destroyed; the resulting power interruptions or complete lack of electricity seriously challenges attempts at IPC.

In addition to the contextual challenges of conflict settings, the loss of skilled health professionals creates a vacuum in expertise and an increased urgency to train existing professionals with the needed skills. In Syria, since the beginning of the conflict in 2011, hundreds of health professionals have been killed, imprisoned, tortured, or they emigrated (Tsurkov and Jukhadar, 2020). In this situation, finding well-trained IPC professionals becomes a constant struggle. Furthermore, IPC professionals' knowledge and practices must adapt to the shifting ecology of war and this is not always possible. Training and building the capacities of non-IPC experts to lead IPC responses becomes crucial.

The COVID-19 pandemic has severely exacerbated the situation and there have been urgent calls for support for IPC implementation across all health facilities in conflict settings. IPC-related inquiries have mushroomed from the teams operating at the frontline, which has resulted in a myriad of training initiatives on IPC procedures and guidelines based on the evolving evidence to ensure that quality IPC measures are effectively put in place in these settings (Médecins Sans Frontières, 2020). This reflects the urgent need for developing quality remote IPC training for local staff specifically tailored for conflict contexts at a time when importing international experts for direct field support will not be possible in the foreseeable future.

More so, the nature of war injuries creates serious challenges for IPC. The weapons used in recent warfare cause massive tissue destruction increasing the likelihood of infection

(Moriscot et al., 2021); multidrug resistant (MDR) organisms (or “superbugs”) are far more frequently found in these wounds. These superbugs, in the presence of suboptimal IPC practices, can easily be transmitted to others in the hospital and into the community (Bazzi et al., 2020; Fily et al., 2019). In the MSF-supported hospital in Gaza between December-2018 and May-2021 more than 60% (74/117) of positive bone biopsies cultured from admitted patients with war-wounds were MDR infections, with the most prevalent being *Staphylococcus aureus* and MDR Enterobacteriaceae. In Mosul, 80% of the patients admitted in the MSF tertiary orthopaedic centre between April-2018 and December-2019 had an MDR infection with *Staphylococcus aureus* the most isolated pathogen in bone and tissue samples. This highlights the critical need for quality IPC measures to prevent cross-contamination and infection transmission outside the hospital ward.

The chaos of conflict settings severely limits the implementation of IPC, and the standard IPC protocols and guidelines available today are not appropriate for those contexts. There is a need to tailor the guidelines to prevent the healthcare teams from making ill-informed IPC decisions that could potentially cause harm to patients and themselves. MSF has been able to develop, over the years, specific strategies for implementing IPC practices in contexts where access to health care is difficult and health systems have collapsed due to humanitarian emergencies. However, the uncontrollable conditions of war provide an opportunity for organizations to create a cultural shift in the mind-set towards IPC at local level. Gaza is a recent example where, through MSF support provided to Al-Awda hospital, simple IPC measures, such as investing in sinks at point of care, have improved hand hygiene at patient bed level. In Al-Khateeb hospital in Baghdad, where MSF has been supporting IPC in the response to the COVID-19 emergency, the provision of extensive training to medical and non-medical staff has increased the IPC compliance in isolation wards, mainly in relation



to hand hygiene, safe handling of needles and sharps, and the proper treatment of reusable medical devices, by more than double between March and April-2020. While this is promising it is still below the minimum target of 80% and hence there is a lot of room for improvement. Implementing IPC practices rely on huge efforts in training, building capabilities, increasing awareness among health staff and patients, and regular monitoring of IPC activities.

Implementing high quality IPC measures in the Middle East's conflict-affected settings has been a neglected priority for many years. With the COVID-19 pandemic, acting quickly and effectively has never been more critical. This is a call for action for local authorities, the private and public health sector, academics, donors and non-health experts such as environmentalists and anthropologists to join efforts to fight healthcare-associated infections through quality IPC, specifically tailored for conflict and highly insecure settings. This relies on a multidisciplinary approach involving all of these stakeholders. IPC measures need to be contextualized and adapted to the realities and harsh conditions created by conflicts. They need to be adaptable and simple enough to allow implementation in difficult and emergency conditions accounting for all the limitations created by conflicts.

Conflict-associated IPC requires building evidence on the topic, which in itself is challenging in these circumstances and will require an adapted research framework, and the strengthening of research capacities of field workers through targeted programs (El Achi et al., 2019). Adapted training packages are needed to allow the build-up of local IPC skills with minimal supervision. Innovative and more affordable equipment suitable to conflict contexts are essential. Some examples might be designing alternatives to cleaning and disinfection of surgical equipment when automated sterilizers are not available or when power cuts do not

support their use; or innovative alternatives for ventilation when patients are operated on in a tent or in a dismantled building where heating, ventilation and air conditioning (HVAC) systems are destroyed. IPC also needs to be moved up-stream in the medical education curriculum so that no health professional is qualified for practice without at least a basic understanding of IPC principles.

COVID-19's rapid spread with severe morbidity and mortality has suddenly vaulted simple IPC measures to the top priority everywhere in the world. The question is, will this heightened awareness last beyond the pandemic or will we go back to having IPC pushed down the priority list after it has passed? With the Eastern Mediterranean region having, as of June-2020, the highest case-fatality rate from COVID-19 infections in healthcare workers with increasing numbers (Bandyopadhyay et al., 2020), it is highly likely that dozens of deaths might have been prevented in Iraq, Egypt or Yemen, had we been more successful in establishing good quality baseline and emergency preparedness IPC before we were hit by this emergency.

We call for IPC to be prioritized; given the needed attention; fed with contextualized evidence to improve targeted responses and support contextual trainings, specifically important in conflict settings where basic resources are lacking; become a core component of the medical curriculum, which is not the case in many conflict settings in the Middle-East; and be allocated the necessary resources. Only then, will we be able to respect our promise to our patients to "do no harm" and prevent avoidable morbidity and mortality in contexts where the weight of pain and suffering is high.

**Authors contributions:**

Roula El Mouallem (RM), Krystal Moussally (KM) and Anita Williams (AW) wrote the original draft of the article. Ghassan Abu-Sittah (GAS), Ernestina Repetto (ER) and KM conceived the idea. GAS overviewed the work. All authors discussed, reviewed, edited the manuscript and agreed with the final content.

**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Funding Source:**

This paper did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Ethical approval:**

No approval from ethical committee needed

## Reference List

- Abuzerr S, Nasser S, Yunesian M, Yassin S, Hadi M, Mahvi AH, et al. Microbiological Quality of Drinking Water and Prevalence of Waterborne Diseases in the Gaza Strip, Palestine: A Narrative Review. *GEP* 2019;07:122–38. <https://doi.org/10.4236/gep.2019.74008>.
- Allegranzi B, Kilpatrick C, Storr J, Kelley E, Park BJ, Donaldson L. Global infection prevention and control priorities 2018–22: a call for action. *The Lancet Global Health* 2017;5:e1178–80. [https://doi.org/10.1016/S2214-109X\(17\)30427-8](https://doi.org/10.1016/S2214-109X(17)30427-8).
- Bandyopadhyay S, Baticulon RE, Kadhum M, Alser M, Ojuka DK, Badereddin Y, et al. Infection and mortality of healthcare workers worldwide from COVID-19: a systematic review. *BMJ Glob Health* 2020;5:e003097. <https://doi.org/10.1136/bmjgh-2020-003097>.
- Bazzi W, Abou Fayad AG, Nasser A, Haraoui L-P, Dewachi O, Abou-Sitta G, et al. Heavy Metal Toxicity in Armed Conflicts Potentiates AMR in *A. baumannii* by Selecting for Antibiotic and Heavy Metal Co-resistance Mechanisms. *Front Microbiol* 2020;11:68. <https://doi.org/10.3389/fmicb.2020.00068>.

- El Achi N, Papamichail A, Rizk A, Lindsay H, Menassa M, Abdul-Khalek RA, et al. A conceptual framework for capacity strengthening of health research in conflict: the case of the Middle East and North Africa region. *Global Health* 2019;15:81. <https://doi.org/10.1186/s12992-019-0525-3>.
- Fily F, Ronat J-B, Malou N, Kanapathipillai R, Seguin C, Hussein N, et al. Post-traumatic osteomyelitis in Middle East war-wounded civilians: resistance to first-line antibiotics in selected bacteria over the decade 2006–2016. *BMC Infect Dis* 2019;19:103. <https://doi.org/10.1186/s12879-019-3741-9>.
- Israel Ministry of Defense. Restricted Import List Gaza Strip - 2013. 2013.
- Kilinc Balci FS. Isolation gowns in health care settings: Laboratory studies, regulations and standards, and potential barriers of gown selection and use. *American Journal of Infection Control* 2016;44:104–11. <https://doi.org/10.1016/j.ajic.2015.07.042>.
- Médecins Sans Frontières. MSF supports Iraqi hospitals responding to coronavirus COVID-19. Médecins Sans Frontières (MSF) International 2020. <https://www.msf.org/msf-supports-iraqi-hospitals-responding-covid-19-pandemic> (accessed August 13, 2021).
- Médecins Sans Frontières. MSF hospital partially destroyed in Mocha attack. 2019.
- Médecins Sans Frontières. Inside the “MUST”: The mobile unit surgical trailer. MsfOrgUk 2017. <https://msf.org.uk/article/inside-must-mobile-unit-surgical-trailer> (accessed August 13, 2021).
- Moriscot A, Miyabara EH, Langeani B, Belli A, Egginton S, Bowen TS. Firearms-related skeletal muscle trauma: pathophysiology and novel approaches for regeneration. *Npj Regen Med* 2021;6:17. <https://doi.org/10.1038/s41536-021-00127-1>.
- Tsurkov, Jukhadar. Ravaged by war, Syria's health care system is utterly unprepared for a pandemic. 2020.
- United Nations Office for the Coordination of Humanitarian Affairs, World Health Organization. Syrian Arabic Republic: COVID-19 Humanitarian Update No. 05. 2020.