

FULLY FORESEEABLE: The reverberating effects of war on water and health in Gaza



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Cover photo: Water Tower destroyed in Khuza'a, Khan Younis, Gaza 2014. ©

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Contents

Summary.....	4
1. The reverberating effects of war on water and health.....	5
2. The reverberating effects of war on water and health in Gaza.....	10
3. Breaking vicious cycles to protect civilians..	14
4. References	17

Summary

This study assesses the reverberating effects of war-induced damage to water and sewage services on people's health in Gaza since 7 October 2023, and discusses them in terms of International Humanitarian Law (IHL) and norms. It interprets publicly-available data and first-hand observation through basic epidemiologic, engineering and legal frames. To comply with IHL, military decision-makers are obliged to consider the reasonably foreseeable indirect impacts of their attacks when planning and conducting military operations, and to facilitate the restoration of essential public services. By 10 April 2024, direct damage to water and sewage services is found to be one of the factors which have led to the deaths of dozens of new-borns due to dehydration, hundreds of thousands of cases of acute diarrhoea, scabies and acute hepatitis-A. Thousands of deaths have been projected to occur in the coming months if cholera is introduced to Gaza. Other factors which build on each other in vicious cycles include: lack of electricity and fuel, over-crowded living conditions, widespread and severe malnutrition, and insufficient humanitarian assistance to mitigate the effects. The nature of the effects are judged to have been foreseeable before 7 October 2023, were explicitly foreseen shortly thereafter, and have now been quantified, qualified and projected into the coming months. Despite this anticipation and verification of the effects, there is no evidence to suggest they have been considered in the planning of attacks. Full compliance with IHL would see Israel provide in the short-term sufficient quantities of safe drinking water, bulk water for sanitation and hygiene, the material required for disease control programmes and protection of the health and maintenance crews. Israel could reduce the effects over the longer term by fully restoring public health, water and sewage services. Future effects could be avoided by factoring them into planning and execution of ongoing military operations. In the absence of compliance with IHL, the end of war for the survivors will come years after the end of hostilities.

1. The reverberating effects of war on water and health

Only the dead have seen the end of war.

Attributed to Plato and Santayana

Context

Apart from the trauma induced by fear and the loss of loved ones, many survivors of war feel the impact of war quite physically long after the guns fall silent. The guns still rage in Gaza, but the enduring physical impact is already quite clear, and sobering. This study explores and exposes just one facet of that impact: the effects on people's physical health in Gaza resulting from damaged water and sewage services and degraded sanitary conditions since 7 October 2023. It interprets publicly-available data and first-hand observation^a within analytical frames of reverberating effects and International Humanitarian Law (IHL). Examining in particular the conditions which facilitate the spread of water-related disease,^b the reverberating effects are found to be fully foreseeable – and therefore treatable and preventable, meaning civilian harm can and should be reduced.

Water and sewage should never mix

Over a century of epidemiological research has established the intrinsic relationship between physical public health, water, and sewage.¹ The 'faecal-oral' route is amongst the most common of the many routes through which disease can be transmitted: deadly pathogens thrive in sewage and may be ingested when they contaminate water or food sources. The pathogens can then be spread by physical contact between people and by people back to the environment, thereby looping back into the 'faecal-oral' route. Diseases of concern include diarrhoea (e.g. dysentery), enteric fevers (e.g. typhoid), acute jaundice syndrome (e.g. hepatitis A), and other faecal-orally transmitted infections and skin conditions such as scabies and lice.² City developers and engineers the world over are directed by regulations to keep drinking water and

^a The current lack of security in Gaza precludes more detailed field investigation.

^b The authors appreciate that this focus precludes consideration on the legality of the use of force by Israel, full examination of direct impact (i.e. classic damage assessments), the important interdependencies between energy with water and health services, other physical water-related reverberating effects, and the much longer-term consequences on the environment.

untreated sewage away from each other,³ as a result, and most urban areas have been built accordingly.

Water and sewage mix again, however, when war comes to cities. Foundational engineering work by the International Committee of the Red Cross (ICRC) has detailed the impact of urban armed conflicts manifests on water and sewage services through damaged infrastructure work, crews prevented from carrying out routine maintenance or repairs, and fewer spare parts for them to work with, often under the strain of meeting a suddenly higher demand driven by migration to cities.⁴ Particularly when conflicts are protracted, the same violence also often ravages individual mental health, collective social cohesion, nutrition,⁵ livelihoods, and programmes to deal with other communicable as well as non-communicable disease – to name just a few of the dozens of related consequences.

The effects of war reverberate long after the dust has settled

Bombed-out hospitals and dams and fallen water towers are very visible forms of the direct impact of war. The longer-term and less visible indirect consequences of armed conflict are often referred to as ‘reverberating’ effects. Like ripples from a rock thrown into a smooth lake, the reverberating effects of armed conflict affect everything in their path to varying degrees. A policy-oriented field of study involving epidemiologists, engineers, social scientists, lawyers, surgeons, modellers and other professions is documenting the effects quite well. The reverberations of attacks in urban areas are now known to extend well beyond the blast zone, and long after the dust has settled.^{6-7,8,9,10} In fact, studies of water-related damage in Bosnia and Herzegovina,¹¹ Colombia,¹² Iraq,^{13,14,15} Libya,¹⁶ Syria,^{17,18} Palestine,¹⁹ Ukraine,^{20,21} and Yemen^{22-23,24} have revealed trends and patterns that researchers and practitioners can draw upon to assess, prepare for, recover from, or avoid the reverberating effects.

For urban public services, the overall impact of reverberating effects on any service can be understood as the accumulated influence of direct and indirect impacts on the hardware, consumables, and people that make up the service and other services it connects with.^{5,25} To exemplify from drinking water and sewage service, the shrapnel of an explosive can pierce the pumps of a water treatment plant, thereby interrupting the water supply to a hospital, making it more difficult to maintain sterile conditions in operating theatres and toilets alike, leading to a higher

incidence of post-surgery infections and an environment favourable for the spread of communicable disease. Similarly, the conduct of hostilities can lead to the release of biological and microbiological waste into watercourses and create an environment that enables the development of drug-resistant pathogens, which can, in turn, affect entire communities for decades.^{26,27}

Vicious cycles amplify the reverberating effects

The severity of the impact is known to vary significantly with the 'baseline resilience' of the service or the quality of the infrastructure and associated services before it is damaged.²⁸ Resilient and well-maintained services can bounce back from a single attack, while services that have undergone multiple years, rounds, and types of damage and neglect are considerably more vulnerable to the same amount of damage. The effect of a single attack on a large electrical power station is likely to be felt further afield and for much longer in current Donetsk or Aleppo, for example, than in Geneva. A related reason for this is that restoring a service through emergency repairs is possible where repair crews have both the access and the spare parts they require to carry out their work, two elements which are not always present in war.

Like the intersecting ripples from four or five rocks disturbing the smooth surface of a lake, the effects can build on each other, and accumulate to the extent that recovery or a return to pre-damage conditions near impossible.⁵ The cumulative impact is fed by vicious cycles. A particularly deadly cycle is the loop induced by malnutrition which leads to weakened immune systems: unsafe water and sanitation can lead to diarrheal disease, which can lead to malnutrition, which in turn makes individuals more susceptible to waterborne and other infectious diseases.²⁹ This is doubly the case when people's immunity is weakened, which is often seen when people are displaced to temporary shelters where the crowding further enables greater person-to-person transmission. The effects are greater still when the sudden burden placed on health services is itself decimated or suffering from limited access to essential life-saving commodities. Under these conditions, cholera, typhoid, and scabies resident in the population or introduced from outside can tear through urban neighbourhoods.³⁰⁻³¹ Little wonder, then, that children under 5 years of age living in conflict are 20 times more likely to die from diarrhoea linked to unsafe water and sanitation conditions than to direct violence in conflict.³²

Foreseeability makes compliance with IHL more feasible

The science and trends are by now so well-established that the reverberating effects of damage to water services in protracted urban armed conflicts are, to a degree, predictable. The more that reverberating effects can be anticipated, the more they can be prepared for (through, e.g. disaster risk reduction programmes)³³⁻³⁴ and responded to (through relief efforts aimed at providing better health care or safer water).³⁵

The more that reverberating effects can be foreseen, furthermore, the more they can be avoided from the outset, when the Rules of War are followed. Known more formally as the Laws of Armed Conflict (LOAC) or International Humanitarian Law (IHL), the rules guide the conduct of hostilities not least of all to reduce the impact of hostilities on civilians. IHL does this in part by regulating specific attacks or military operations intended to achieve specific military objectives, by providing a specific prohibition on ‘attacking, destroying, removing or rendering useless objects indispensable to the survival of the civilian population’ (Article 54(2) of the 1977 Additional Protocol I) such as public drinking water reservoirs³⁶ and offering special protection to health infrastructure (Article 12 of the Additional Protocol I, Article 18 of the Fourth Geneva Convention, and ICRC, Customary IHL Rule 28). IHL also obliges those planning attacks to factor in the reasonably foreseeable incidental damages that the attack may incur when planning their precautions to reduce the damage, and to gauge the proportion of the damage against the military advantage it would provide.^{37,14} That is, IHL obliges military planners to weigh the incidental damage that “may be expected”³⁸ from an attack against “the concrete and direct military advantage anticipated” by the attack (Article 51 (5) (b) and Article 57 (2) (a) (iii) of Additional Protocol I; and ICRC, Customary IHL Rule 14 (proportionality) and Rule 18 (precautions)). In laypersons’ terms, if warring parties know which non-military effects of their attacks are likely, they must seek to reduce these by factoring them into their battle plans.

The rules of IHL do not explicitly address accumulated harm to civilians and/or damage to civilian objects that can unfold over time. Yet analysis has pointed out that their foreseeability increases as a conflict protracts, because military planners have more time to collect the intelligence required to understand the services and to identify the at least the critical infrastructure.³⁹ In this and other ways, incorporating the reverberating effects into military planning procedures could thus serve to both narrow the legal loophole and to reduce harm to civilians.⁴⁰⁻⁴¹⁻⁴²

It's not only about IHL

Such efforts would complement other legal and political efforts to protect civilians, including military training manuals,^{46,43} UN Security Council resolutions 2417 and 2573 on the protection of civilians and essential civilian services, guidelines and principles which interpret how IHL and international law may protect water⁴¹ or the natural environment,^{44,45,46} the political declaration to outlaw the use of explosive weapons in populated areas (EIWPA),^{47,48} and initiatives to prevent the weaponization of water.⁴⁹

In sum, a better understanding of the reverberating effects of armed conflict can feed a growing body of binding norms, serve compliance with IHL, support reactive and preventative relief programming, and spare civilians from the ravages of war. The extent to which this theory influences or matches reality is clearly currently called into question in Gaza, where Israeli direct or indirect damages to water and sewage systems have induced a host of vicious cycles and conditions which mean the suffering is likely to endure long after the guns have fallen silent.

2. The reverberating effects of war on water and health in Gaza

Vulnerable water and sewage services

Only six months after 7 October 2023,^c more than 1,100 people in Israel and 33,000 people have been killed in Gaza,⁵⁰ with 7,000 additional people reported missing or under the rubble of collapsed buildings, and over 75,000 people injured.⁵⁴

The people and urban services of Gaza have endured several rounds of armed conflict, including in 2002, 2008, 2012, 2014 (see cover photo), and 2021. Each has had incremental and cumulative detrimental effects on water and sewage services.⁵¹⁻⁵²⁻⁵³ Even prior to 7 October 2023, most of the water pumped from the aquifer in Gaza was unsafe to drink because of very high levels of nitrates, chlorides, and salinity.⁵⁶⁻⁵⁴ The desalinated water that most people relied upon for drinking was (by design) devoid of essential minerals and (by negligence) regularly contaminated with microbes.⁵⁵⁻⁵⁶ The resilience of the water and sewage services in Gaza prior to the attacks in 2021 was evaluated to be 'low', and in-league with contemporary Basra (Iraq) and many urban centres in Yemen.³² Indeed, water and sewage services in Gaza were known to be vulnerable to their reliance on power supplies, and hampered by restrictions on the development and importation of goods following Israeli 'de-development' policy from 1967 to 1993,⁵⁷ an Israeli blockade and impediments to development of the sector from 1995 to 2006,⁵⁸ 32 and a more restrictive blockade following the election of Hamas in 2006 until autumn 2023.⁵⁹

The current state of the water and sewage services is beyond any characterisation of resilience. The crews of the Coastal Municipal Water Authority (CMWU) and several municipalities continue to risk and give their lives to provide water and electricity (as in Khan Younis on 26 December 2023).⁶⁰ Their well-laid emergency preparedness plans⁶¹ endured for a few weeks after 7 October. However, with the extent of urban destruction by the end of 2023 greater than Dresden during World War II,⁶² the priorities of the water and sewage maintenance and repair crews quickly turned to 'fire-fighting': delivering precious fuel to keep a few priority wells running, installing temporary water reservoirs at communal shelters, negotiating a temporary pipeline from Egypt, and fixing leaking pipes.⁶³⁻⁶⁴

^c The analysis of this study holds until 10 April 2024.

Direct impact

Initial damage assessments estimate that about 57% of water infrastructure and assets had been destroyed or damaged by the end of January 2024, including 162 wells.⁶⁵ In Gaza City alone, 40 wells and 9 sewage pumping stations have been damaged, along with over 42km of water and 30km of sewage pipelines.⁶⁶ CMWU headquarters have since been completely destroyed.⁶³ Open-source data combined with eyewitness testimony, satellite images and photographs demonstrate physical damage to major water reservoirs in Tel al Za'atar⁶⁷ and Rafah,⁶⁸ a water treatment plant in Khan Younis,⁶⁹ and infrastructure throughout the territory. As early on as 22 November 2023, over 40% of the water facilities in Gaza had been damaged, with 37% functionally destroyed.⁷⁰ Currently only 17% of groundwater wells and one pipeline from Israel are even partly operational, there is no access to clean water in northern Gaza, and no sewage treatment plants are operational because of Israeli denial of entry of fuel.⁵⁴ The estimated cost of damages to water and sewage services in Gaza (to end January 2024) is over USD 500 million.⁶⁸

Those who live in homes have such little running water that they cannot bathe as regularly as they must to avoid skin infections, particularly important for those with wounds. Many people have no more than one to two litres of safe water to drink every day⁷¹ to use for drinking, cooking, and cleaning, well below what they are used to^{59,72} and the Sphere humanitarian standards in emergency response of 15 litres per day.⁷³ Out of necessity, people defecate in buckets they are obliged to empty nearby.⁶⁶ The untreated sewage stands in the crowded streets or percolates into the aquifer that the few operational groundwater wells draw from.⁷⁴ The situation for the 1.7 million displaced individuals in the middle and south of Gaza (75% of the population) in UN makeshift shelters and camps is considerably worse, where it is not uncommon to have one toilet available for a median of 340 people,⁷⁵ and one shower for over 500 people.⁶⁶

In northern Gaza, at least 23 children have been reported to have died from malnutrition and dehydration as of mid-March 2024⁷⁶ An unknown number of people have no choice but to drink the unsafe water, which is likely to be contaminated with microbes if they are unable to boil or treat it (which is likely, because fuel and chlorine treatment tablets are scarce). The option is to drink the salty water from agricultural wells. Meanwhile, chlorine, and other commodities that would make the water safe to drink and restore the sanitary conditions effort remain on the 'rejected' list of items Israel allows aid agencies to bring into Gaza,⁷⁷ and deliveries even of bottled water continue to be denied by Israeli authorities, especially to northern Gaza.⁵⁴

Reverberating effects and vicious cycles

Moreover, Gaza's healthcare system has collapsed.⁷⁸ Every hospital in Gaza has been damaged, many of them heavily; 25 are no longer functioning, meaning that 10 hospitals (themselves only partially functioning)⁵⁴ are constantly inundated and obliged to triage only for those about to perish from their wounds.⁶⁶ The demand is overwhelming to the point that many patients die at the hospital or health centre before they are treated.^{66,54,79} As with water services, the estimated cost of damages to the health sector in Gaza (to end January 2024) is over half a billion US dollars.⁶⁸ Many of the crews who would normally respond simply cannot. Israeli strikes have killed more than 200 aid workers, 480 health workers, 48 civil defence staff, and several water and sewage personnel.^{54,66}

These are textbook conditions for the outbreak and transmission of water and sanitation-related diseases. The alarm about the spread of infectious diseases in Gaza was sounded early on by the World Health Organization,⁸⁰ United Nations Children Fund (UNICEF),⁸¹ Médecins sans Frontières,⁸² Medical Aid for Palestinians,⁸³ Juzoor,⁸⁴ the Palestinian Health and WASH clusters,⁸⁵ UN-OCHA,⁵⁴ and many more. The concerns have proven well-founded. As of end March 2024, there have been more than 315,000 cases of acute watery diarrhoea reported, 81,000 cases of scabies, 46,000 cases of skin rashes and 19,000 cases of jaundice (presumed to be Hepatitis A).⁸⁶

The cases are expected to spiral, because of lack of clean water to treat patients, and crowded living conditions from people being forced to evacuate from their homes to shelters and camps.⁸⁷ Modellers from the London School of Hygiene and Tropical Medicine and Johns Hopkins University lay out a stark few coming months: more than 58,000 more people are projected to die from injuries and disease by August 2024 if the violence continues at February 2024 rates, and more than 74,000 if it escalates.⁸⁸ If epidemic-prone diseases such as cholera are introduced, the conservative number of 'excess deaths' is projected to rise to over 85,000.^d

^d Projecting the number of war-related deaths while hostilities rage is not an exact science, as it obliges numerous assumptions which are difficult to verify and validate. But when the assumptions and parameters are made transparent so that others can replicate the work, as here, the models are an important complement to the foresight of medical and technical crews who have spent years accumulating the knowledge. The authors of the current piece built a similar mathematical model to project future diarrhoea cases using a pathogen-specific agent-based susceptible-exposed-infected-recovered compartmental model. The model was run using five causative agents (Shigella spp., enterotoxigenic Escherichia coli, enterotoxigenic Escherichia coli, Entamoeba histolytica, and norovirus) and pathogen-specific parameters under different scenarios, including post-evacuation population densities, various treatment availability levels, and levels of transmissibility. The authors chose to not report the results because the publicly available data required to inform and parametrize the chosen model was deemed insufficient to accurately reflect the reality observed in Gaza.

This situation is worsened considerably by a great lack of food. Already, 95% of the population face high acute food insecurity, the highest rates ever recorded globally,⁷⁵ and widespread famine is imminent.^{89,90,91,92} The increased nutritional vulnerability of children, pregnant and breastfeeding women and the elderly is of particular concern.⁶⁸ The death of new-borns from dehydration is due at least in part to their mothers lacking enough sustenance to feed them. In Gaza, the classic deadly loop of epidemiology (unsafe water and sanitation → increased diarrheal disease → increased malnutrition → increased susceptibility to waterborne diseases) is complete, and the cycle are made more vicious by the lack of ability to redress it.

Beyond the quantifiable effects of insufficient water and sanitation through increasing disease cases and deaths, the impact of the violence reverberates onto individual dignity. Women and girls disproportionately feel the impact of insufficient water and hygiene, generally.⁹³ Currently in Gaza, 91% of women cannot meet their personal and menstrual hygiene needs.⁹² Very few people in Gaza have been able to retain the levels of hygiene, privacy, and pride that they had, expect, and deserve.

Longer-term effects

Even if the violence were to stop tomorrow, however, the reverberations of war on water and health services is expected to claim thousands more. The Israeli flooding of Hamas tunnels with seawater has likely made the underlying parts of the freshwater aquifer so salty that it will be impossible to irrigate with,⁹⁴ and take decades to remediate. The volume of hypertension and kidney disease which results may be difficult to quantify but is entirely predictable. The lack of safe water raises concerns over antimicrobial resistance (AMR), especially given the over 75,000 injuries that may require antibiotics. Pathogens that reside in sewage can often become more lethal and resistant to frontline drugs and antibiotics with time,^{31,95} and have been shown to multiply even in the water used by hospitals and health centres in Gaza.⁹⁶ With increased exposure to sewage, and without sufficient safe water to de-contaminate wounds, the number of people who remain infected or succumb to their wounds can only – and very predictably – increase. AMR can affect the healthcare system for years, especially in the absence of resources to implement effective infection control procedures.

3. Breaking vicious cycles to protect civilians

The vicious cycles must be broken

The reverberating effects of war-induced damage to water and sewage services on people's health in Gaza since 7 October 2023 manifest most directly in the infants dying of malnutrition, the hundreds of thousands of people suffering from water-related disease, and the thousands more projected to perish from it. The magnitude of the effects is amplified by a number of factors, including: i) the breakdown of the health system due to attacks on health services; ii) the denial of delivery of electricity and fuel; iii) the very poor sanitary conditions, due mainly to crowding of people forced into ever-smaller areas, little household/washing water, and prevalence of untreated sewage; iv) the severe and widespread malnutrition; and v) the denial of basic humanitarian assistance to reduce the effects. The factors build on each other in cycles which create the conditions for ever-more suffering, and which must be broken.

The virtue of breaking the vicious cycles is perfectly evident by considering counterfactual scenarios. Were food abundant in Gaza, mothers would be able to feed their babies, and people's immunity would increase so they would be able to fight the pathogens. Were people able to return to their homes, there would be less overcrowding, and the transmission rates of infectious disease would be much lower. Were fuel allowed in, the sewage plants could resume functioning, bringing the transmission rates down further. Were water, sewage and health services made resilient, diseases could be treated, skin infections washed, and preventative programmes initiated.

Compliance with IHL can mitigate the effects

The facts push in the opposite direction, however, obliging questioning of the extent to which International Humanitarian Law has been implemented and mitigates the reverberating effects in Gaza. IHL obliges all involved in military decision-making to make provisions for and facilitate the repair and restoration of the services which can

prevent the transmission of disease.⁹⁷ This means either restoring the damages directly or providing safe access and security for people who run and repair the services – the water crews and health care staff and volunteers who are on the frontline. IHL also stipulates that maintenance of basic living conditions is the responsibility primarily of the force in control of a territory.⁹⁷ Compliance with this aspect of IHL regarding solely water and sewage, then, would see the Israeli state improve the sanitary conditions by eliminating the potential for water and sewage to mix. The most immediate and beneficial actions Israel could take in this regard would be large-scale delivery of chlorine to treat water, restoration of the water transmission lines from Israel (and rebuilding the damaged water reservoirs to receive it), delivery of fuel to run the sewage treatment plants, and provision of the material and equipment to run a full-scale disease-control programme including strengthening any existing early warning and response or similar surveillance networks. Such efforts would have to be followed immediately by rehabilitation of the large-scale sewage treatment plants and drinking water facilities, reconstruction of dozens of public health centres and hospitals, and training of people to replace the hundreds of water and health workers who have been killed. Currently, there is no evidence of these obligations being fulfilled, and this despite the International Court of Justice statement in its January 2024 Order that “The State of Israel shall take immediate and effective measures to enable the provision of urgently needed basic services and humanitarian assistance to address the adverse conditions of life faced by Palestinians in the Gaza Strip”⁹⁸ and similar follow-on statements in its Order of March 2024.⁹⁹

Compliance with IHL can prevent future effects

Preventing further damages to urban services or the disease from occurring would be much more effective – and rise to the urgency and magnitude of the current challenge. To comply with IHL, all involved in military decision-making are obliged to consider the reasonably foreseeable indirect impacts of attacks, at all stages of planning and conduct of military operations, with a view to justifying them in terms of military advantage gained. Whether the concerns about chronic effects on health in Gaza (e.g. kidney disease) can be reasonably attributed to the violence would oblige a considerably longer epidemiological investigation. The causal links between

⁹⁷ This was also recognized in the separate opinion of Judge *ad hoc* Barak in the case regarding the Application of the Convention on the Prevention and Punishment of the Crime of Genocide in the Gaza Strip (South Africa v. Israel) of 26 January 2024, where he noted the Supreme Court of Israel had ordered the Israeli army in the past to repair water pipes during an armed conflict in Gaza (Separate opinion, Judge Barak, para. 10).

damage to water services and water-related disease are much more clear,^f however, particularly in the context of widespread malnutrition and obstructed relief and repair efforts, and the very good prior and increasing level of Israeli knowledge of and control over the services. The nature, if not the magnitude of the reverberating effects of war on water and health services in relation to infectious disease are judged to have been foreseeable before 7 October 2023, were foreseen publicly by several actors shortly thereafter, and future effects have now been quantified and qualified. The foreseeability increases with each day that passes, furthermore, because more data can be collected, and knowledge of the reverberating effects developed. While the military gain of each attack or the sum of the attacks which have damaged the water and sewage services in Gaza have yet to be gauged, there is currently no evidence that their effects have been considered. Indeed, there is a growing body of evidence that the great bulk of effects are disregarded¹⁰⁰ or carried out with unparalleled awareness and information,¹⁰¹ if not intentionally.⁹⁹

The future

Even if the guns were to fall silent tomorrow, the survivors in Gaza will not see the end of war for decades after the water-related diseases have been eradicated, if the unquantified but suspected damage done to the aquifer, agricultural fields and environment is shown to undermine the basic conditions of life of people in Gaza. With the conduct of hostilities in Ukraine and Yemen equally apparent, survivors of future armed conflict in other parts of the world can be expected to suffer similar fates when the rules of war are not respected, and water and health services are not protected from armed conflict, or are weaponized. Further investigation is thus required not only to detail the evidence observed and cited in this study, but to interpret the drivers behind the trends so they may help reverse the extensive damage foreseen, and ultimately lead to peace.

^f Apart from those described in the literature, the authors have seen similar suffering unfold in Syria, Lebanon and Yemen when water and health services have been severely damaged. If precedent and experience alone were not ample sufficient to foresee the evidence of foreseeable consequences of conflict, infectious disease modelling offers a tool which has shown to be one tool which can provide rough evidence - to estimate reverberating epidemiological effects of war and inform plans to mitigate them as outlined under IHL, particularly when full baseline and case-control surveys or clinical trials cannot be conducted.

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