WRITTEN BY ANNA DE COURCY WHEELER AND EDITED BY RICHARD MOYES

HEALTH AND HARM: PROTECTING CIVILIANS AND PROTECTING HEALTH

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WWW.ARTICLE36.ORG
INFO@ARTICLE36.ORG
@ARTICLE36

Article 36 is a specialist non-profit organisation, focused on reducing harm from weapons.

KEY MESSAGES

- Conflict is a fundamental global health challenge. It is predicated on the idea of inflicting harm to health as a means of achieving a political end. As such, the effects of conflict on public health are multifaceted, interconnected and overwhelmingly negative.
- Protecting civilians is first and foremost, about preventing or minimising death, injury or 'harm' from military action. As such, notions of 'protection' and of 'health' are intrinsically linked.
- The health effects of conflict are wide ranging and have long term implications. As a result of damage and impairment to the social structures upon which public health rests, the full health effects of conflict extend much further than direct deaths and traumatic injuries.
- Compliance with international humanitarian law must be recognised as a necessary minimum baseline in the protection of civilians, and is not sufficient for the full protection and promotion of health and wellbeing during conflict. Patterns of harm that are visible from a public health perspective are not necessarily amenable to legal analysis that tends to focus on specific individual uses and a narrower, near-term and directly causal concept of harms.

KEY RECOMMENDATIONS

- Recognise that stronger protection of civilians is an ongoing challenge and goal that should include attention to the health and wellbeing of people, the environment, and the social structures that support health, sustainable economies and food security.
- Start from a public health perspective when developing initiatives to better protect civilians. Policy discussions should be based on and structured around the pattern of harm identified – including the full excess mortality and morbidity caused by conflict – with reference to existing social and economic structures as well the means and methods of warfare. Such an approach could support more effective, productive and holistic initiatives to protect civilians than a narrower focus on legal compliance alone.
- Constantly strengthen the gathering of data on harms from conflict, and on the determinants of harm. Policy initiatives should be based on analysing solid and sufficient data about the full range of harms caused by conflict and specific weapons technologies, including the long-term and downstream effects of violence on public health.

INTRODUCTION - HEALTH, PROTECTION AND WEAPONS

Armed conflict has historically been undertaken with an emphasis on impairing health of adversaries in order to compel political compliance. Conflict is largely predicated on an acceptance of harming health as a means to an end, yet a prevailing tradition of political philosophy holds that there should be limits to such a practice. The concept of 'protecting civilians' in conflict is bound up with the idea of such limits. Protecting civilians tends to be, first and foremost, about preventing or minimising death, injury or 'harm' from military action. As such, notions of 'protection' and of 'health' are fundamentally linked.

The philosophical belief that there are limits to what is acceptable in conflict, and that civilians should be protected, finds one form of expression in international humanitarian law (IHL). Key limits in IHL are broadly structured around:

- **not killing or injuring people 'in the wrong way' – this relates to 'superfluous injury and unnecessary suffering' protections afforded primarily to combatants; and**
- **not killing or injuring 'the wrong people' – this relates to the concept of civilians, the notion that civilians are protected and that civilian death and injury should be avoided or at least minimised.**

However, whilst civilians are supposed to be protected, the law also recognises that some civilian death and injury can occur: so long as it is not intended for its own sake, and is considered 'proportionate' to the objective being sought. Furthermore, the form and extent of civilian harm that is considered relevant under the law is also limited, with a focus on death and injury that directly and mechanically follow from the actions of combatants in individual cases.

The most obvious health effects we associate with conflict are the direct, traumatic injuries and deaths from gunfire and explosive force. Yet the actual health effects of conflict extend much more widely, as a result of damage and impairment to the social structures upon which public health rests. People experience 'health' as a product of the social and economic environment in which they are living. Damage to physical structures and to the systems of human action and interaction, from the ability of a doctor to see patients to the effective functioning of a local or national economy, serve to erode the mechanisms by which public health is maintained.

As the effects of conflict reverberate through society, people experience a worsening of their conditions of life - a worsening that, over time, takes its toll on health. This wider health impact is seen in patterns of 'excess mortality', where the impact of conflict presents increased death from various forms of disease, and in numbers often significantly greater than deaths from direct violence. The causal relationship of these harms to the specific actions of combatants become diffuse and opaque. Yet it is possible to recognise that certain social structures can serve to transmit or magnify harms, usually because they are structures which, in normal circumstances are relied upon to maintain health in society. Systems and infrastructure, such as water and sanitation, healthcare provision and education facilities, can all serve to transmit the effects of individual instances of violence out to a wider population and to transform and diversify how the effects of violence are experienced. Preventing or minimising the transmission of harms through these social structures has the potential to limit and localise the effects of violence, and so should be an important focus for thinking about protecting civilians.

> *"The additional burden of death and disability caused by the lingering effects of civil war is nearly double the immediate and direct effects. The primary reason is that internal armed conflicts increase exposure to disease, adversely affect access to the supply of medical care, and destroys health infrastructure."* [1]
>
> Stockholm International Peace Research Institute (SIPRI), 2015

THE ROLE OF WEAPONS IN MEDIATING HEALTH EFFECTS

Weapons are from their origins tools for the erosion of human health. Some are ostensibly for eroding the material capacity of an adversary, their boats, or tanks or buildings. Others might be argued to be primarily communicative or symbolic. However, killing and injuring people continues to be central to the role and design of weapons as a category: weapons are a form of negative health technology.

Weapons mediate between the 'intent' of combatants and the actual effects that are caused, and that accumulate as patterns over time. This establishes important tensions. To what extent are the negative health effects that are created through weapons, and that can extend well beyond the immediate circumstances of use, intended by the weapon users? Are certain weapons associated with patterns of problematic effects over time? And to what extent do we normalise harms associated with certain weapons because the use of that technology has now become normalised in society?

Different weapon technologies have different characteristics with different implications for how they mediate between intention and effects. Critical differences between types of weapons relate to three key interrelated factors:

- **The nature of mechanical, chemical or other such forces exerted by the weapon.** This influences how people are directly affected by a weapon, the nature of injuries and the likelihood of death, as well as the extent to which a weapon can cause severe damage to buildings or structures. These are the technical characteristics of how force is applied.

Gulstan, her family, friends and neighbours fled Ras al Ain in Syria in Autumn 2019 when Turkish airstrikes began. They first fled to Hasakah within Syria where they slept on the street and in schools for over two weeks, before crossing the border into Iraq. They are now living in a refugee camp in northern Iraq and continue to suffer the health impacts of their experience including mental trauma and difficulties with access to healthcare, as well as the loss of control and dignity they feel as refugees.
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- **The location and spatial area over which these forces are exerted**. This has a bearing on the extent that a weapon's effects occur in the intended location, as well as how many people, objects or structures might be subject to those effects. In a given context, this influences the extent to which harm is experienced by the intended people. It also influences whether damage or destruction is actually inflicted on buildings, infrastructure or systems that should be really be protected. These are technical characteristics that bear on where, and sometimes when, force is applied.
- **The extent that a potential for further harm can persist over time**. Many weapon types will present some continuing potential for harm. This might result from explosive components failing to detonate as intended and remaining 'live', or from toxic properties of materials released from a weapon remaining in the environment. These are technical characteristics that produce residual capacity for further harm.

For a particular 'type' of weapon, the sharing of certain characteristics within this framework will tend to produce patterns of effect, which will become more visible over time and in the aggregate. Such patterns are visible from a broad public health perspective, but they are not necessarily considered amenable for consideration in a typical legal analysis (under IHL) which tends to focus on individual uses, and a narrower, near term concept of harms.

The technical characteristics of different weapon types are combined, in practice, with the choices that weapon users make about how and where to use a weapon, in what context and in what quantities. Negative health effects of conflict have at their root human decisions and the choices of political actors, but weapons enable certain decisions and certain choices. They serve to expand the potential for harm, and can do so beyond the intent or realisation of those that employ them. It is for this reason that controlling weapon technologies, through prohibitions, regulations and obligations on certain 'types' (that share certain characteristics), has provided an important framework for directly constraining behaviour and choices in conflict.

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The health effects of conflict are wide ranging and have long term implications. They go well beyond the choices of individual soldiers as to who to shoot in a particular instance - and present patterns of effect that become visible over time and on the macro scale. The sections below sketch important patterns of health effect, from the individual to the societal levels. Recognising and orientating to those wider patterns is fundamental to more fully protecting civilians. They present a starting point from which to consider how civilian protection can be strengthened; a starting point for identifying how harms are transmitted and transformed through societal structures, and for identifying whether certain weapon types, in certain patterns of use, are liable to causing extensive harms. From such analysis, opportunities for protecting civilians can be developed.

VIOLENCE AND HEALTH

INDIVIDUAL HEALTH EFFECTS OF VIOLENCE

Conflict causes loss of life, physical injury and widespread mental distress. These individual health effects are among the most immediate and direct impacts of violence, and consequently have received the most attention in state-led discussions on protecting civilians.

× Physical health – traumatic injury

Direct deaths and injuries are the most immediate, visible and noted health effects of conflict[2]. A high-velocity projectile, such as a bullet, is designed to cause death or serious, often lasting, injury, by transmitting kinetic energy to the body. The projectile's path and placement are key factors in the likelihood of causing death or significant injury, though this is also influenced by the type of bullet, its shape, velocity and mass. A bullet, like other forms of penetrating injury, crushes structures along its track, causes shearing, compression and tearing or stretching of bodily tissue and results in soft tissue collapse. A person's head and torso are the most vulnerable, with death or other incapacitation resulting from central nervous system damage, massive organ destruction or haemorrhage.[3] Where limbs are hit, nerves, tendons and blood vessels are endangered, and significant tissue damage can occur. Gunshot wounds are especially vulnerable to anaerobic infection such as gangrene and tetanus if not adequately treated. High-velocity bullets can pull foreign material such as clothing fibre and dirt deep into a wound, complicating cleaning and healing.[4]

Explosive weapons also cause damage to the human body by transmitting kinetic energy, though unlike bullets their impact often covers a wider area due to their powerful blast and fragmentation effects. Because they function by the detonation of high explosive material, explosive weapons create a distinct set of physical effects – a 'blast wave' of pressure which radiates out from the detonation at high speed; 'fragmentation' or material that is projected outwards from the point of detonation, such as shrapnel from the munition itself or debris from the surrounding area; and heat created by the detonation of explosives. Medical authorities point to these three effects when describing the ability of explosive weapons to inflict "multi-system life-threatening injuries on many persons simultaneously".[5]

Civilians next to the detonation of a large explosive weapon are almost inevitably killed immediately as the blast wave causes traumatic amputation of limbs, fatal blood loss, and vapourisation. The blast wave can cause deadly brain injuries or a systemic air embolism, the most common fatal primary blast injury among those who initially survive the explosion.[6] Other internal organs, particularly gas and fluid-filled structures such as the ear and abdomen, are also vulnerable to blast damage that can result in death or permanent injury. A blast wave can also cause crush injuries, including complex fractures and spinal or brain damage, by propelling people into other object or by destroying or destabilising buildings which in turn crush people when they collapse.

Weapon fragments (or 'shrapnel') and other material are projected into the bodies of those in the vicinity, particularly in urban or built-up areas where damage to buildings and other objects and can create additional flying debris. These fragments can cause traumatic amputations, puncture wounds and lacerations. Heat from an explosion can cause severe burns to those at close range, burns that are very difficult to treat, particularly in conflict settings. Explosive weapons can also set fire to fuel sources or toxic chemicals that lie within the impact zone, again raising the risk of burns but also of releasing toxic gasses and choking smoke into the air which can in turn cause additional harms.

These diverse mechanisms of wounding – extending over the area – can cause multiple deaths or leave numerous victims with a lifelong disability.[7] The impact of blast, fragmentation and burn wounds can be especially acute in children, who are physically more vulnerable and for whom treatment can prove more difficult.[8] Exposure to explosive weapons use can also be particularly traumatic to children at a critical time in their psychological development, with long-term effects on their mental health.

× Mental health and psychosocial wellbeing

Conflict is, by its nature, severely distressing to most of those who live through it. There is broad agreement that exposure to the extreme stress of conflict and violence is a risk factor for social and mental health[9], and that emergencies can severely disrupt the social structures and care of those with pre-existing as well as new disorders. According to the World Health Organisation (WHO) "the prevalence of common mental disorders such as depression and anxiety is expected to more than double in a humanitarian crisis."[10] The mental condition of many who experience conflict-related distress will improve over time without clinical intervention, but for some the mental health problems induced by an emergency are more lasting. A recent WHO review of 129 studies in 39 countries suggested at least one in five people who have experienced war or other conflict in the previous 10 years are living with some form of mental disorder, with one in eleven living with a moderate or severe mental disorder.[11] As well as lasting physical effects, violence and conflict can inflict long-term psychological harm on the children and adults who live through it.

Each individual will experience a conflict differently and will have different capacities and resources to cope with the distress conflict causes. In this way, mental health status can also intersect and interact with other vulnerabilities: depression and anxiety are more prevalent among older people, for example, and women are more likely to suffer from depression during and post-conflict than men.[12] Mental disorders, and the ability to access treatment, can also closely correlate with socioeconomic status. Children, as we have noted, are also caught up in a mental health crisis, with long-term impacts for their individual health as well as for broader society.[13]

Social supports that are essential to protecting and supporting mental health are often eroded or destroyed by conflict: the disruption of social networks and families, destruction of livelihoods, and loss of community structures and traditional support mechanisms can have a severely deleterious effect on the mental health of people affected by violence. As can the breakdown of key social services such as health, water and sanitation, housing and education. During conflict, pre-existing problems can be exacerbated, whilst conflict creates new burdens of disease through grief, anxiety and depression, and PTSD.

At the individual level, mental or psychosocial problems can result in people feeling confused or overwhelmed, constantly fearful and anxious, or numb and detached. They can often impair someone's ability to function and therefore their ability to survive through a conflict, and to recover afterwards – as the WHO notes, "access to care isn't just about improving mental health, it can be a matter of survival".[14] People may be rendered unable to care for themselves or dependants such as children or elderly relatives. For some, mental health problems manifest in physical symptoms such as headaches and chest, abdominal or other pain, insomnia, changes to menstrual periods, or fainting.[15] Conflict-related distress can also lead to increased substance abuse.[16]

Despite the wide variety of psychological and psychosocial symptoms documented in conflict-affected populations[17], mental health services risk being under-prioritised in health responses to conflict. Though the danger conflict poses to mental health is often instinctively understood, and though mental health is increasingly recognised as a core public health concern, the difficulties of research in conflict zones, low awareness about mental health disorders, and stigma continue to make both assessing and treating mental health conditions challenging.

Faisal

In early 2018 the war came to Afrin – my wife and I left to stay with her family in a nearby town as my wife was pregnant and we were worried about what the stress would do to the baby. Soon afterwards my father called to say we could return home as the airstrikes, mortars and bombings had lessened in our part of the city. My cousin and I were in Afrin when airstrikes started again – we ran for safety, but as we ran rockets landed next to us every two metres. Whilst we were running my cousin lost his shoes but he was so scared that he only noticed when we managed to reach a house that we could hide in. There was an airstrike on that house. I don't remember it, but I found out when I woke up in hospital. They told me that the house had gone and two other people had died. I sustained a serious head injury – doctors say there is still blood on my brain and I still have shrapnel in my body.

I take medicine now for my head injury, but it has bad side effects. Once, I beat my wife and child and, when my wife asked why, I couldn't remember anything about it. The clinic here has given me a referral for a neurologist and I desperately need an operation as soon as possible. I am still waiting.

Faisal (pseudonym) is from Afrin in Syria. He fled his hometown with his pregnant wife after being injured in an airstrike and then kidnapped and tortured by an ISIS-affiliated militant group. They initially headed north to Ras-al-Ain, but stayed only one month, choosing to cross the border into Iraq after Faisal was nearly hit by a mortar. He now lives in a refugee camp in northern Iraq with his wife and baby daughter.

Ali

When I was rescued from the rubble where I had been trapped for 5 days after a building was hit by an airstrike, I was brought to Erbil where I spent a month in hospital. They did surgery on my arm, and when both my legs started swelling they did surgery on them too. I had 64 surgeries in two and a half months. I had many surgeries that were wrong or went badly, and I almost lost my legs. A piece of metal that had pierced my right arm was taken out, but then the doctor finished his contract and left the hospital, and the next one who came didn't have the right surgery specialism, and did the wrong follow up. I was transferred to a different hospital and the doctors there were so shocked at the way my arm had been treated and suggested another surgery. After so many surgeries anaesthetics did not work on me – I was screaming in pain through the surgery but told them to continue anyway. My arm is still broken now – I have had all these operations and seen no benefit, they have even made it worse. I am still taking painkillers all the time, and my ears are constantly ringing.

Ali Zanoun is one of two known survivors of an international coalition airstrike in Mosul that killed over 100 people. It was the deadliest strike by the international miltary coalition supporting the government of Iraq in the months-long battle for the city between the government of Iraq and 'Islamic State' (ISIS). Ali spent 5 days trapped in the rubble surrounded by the bodies of over 20 family members.

IMPACT ON HEALTHCARE SERVICES

Whilst individuals experience direct physical harms from violence, and mental health harms from proximity to violence, conflict simultaneously erodes societal capacity to address these and other health needs. Whether from healthcare being deliberately targeted[18] or being damaged inadvertently, healthcare services typically come under severe strain from eroded capacity coupled with elevated demand. In mass-casualty incidents in conflict, usually caused by a combination of population density and the area effects of explosive weapons, health facilities can swiftly become overwhelmed. The number of casualties and the range of injury types rapidly outstrip the availability of human and material medical resources – as medical staff are forced to prioritise, injured patients may be denied treatment. People with otherwise survivable injuries can die as staff do not have the time or supplies to treat them. Injuries which could have been treated through complex or time-consuming measures are instead subject to quicker more aggressive interventions such as amputation, with lifelong consequences.[19] For example, even small wounds can easily become infected in an environment where healthcare capacity is overwhelmed or degraded to the point where wounds are difficult to treat.[20] The resulting clinical mismanagement of wounds can have long-lasting implications for affected people, leading to multiple drug resistant (MDR) bacterial infections, multiple surgeries and higher incidence of amputation.[21] Medical personnel responding to blast incidents may not have been adequately trained for the injuries they face, nor mentally prepared for difficult patient triage decisions, and can be overwhelmed by the severity and scale of wounds they encounter. This has implications for their own mental health as well as for patient care and outcomes.

Available resources can be overloaded for hours and days after a single incident; where conflict is prolonged or attacks are frequent, healthcare systems, including personnel, can become chronically overloaded and overwhelmed. This is in part due to the cumulative effects of conflict and the erosion of healthcare: repeated attacks in a populated area compound the damage done and difficulties in rebuilding. For example, when explosive weapons hit medical facilities or detonate nearby they can cause extensive damage to buildings, infrastructure, equipment and ambulances, as well as threatening the lives of patients and staff on the premises.[22] Small arms fire may not cause the extensive structural damage a large explosion can, but it can nevertheless be devastating to the normal operations of a hospital by killing medical workers and damaging specialised equipment and ambulances. Over time, as facilities are damaged or destroyed, medical supplies can become patchy or be cut-off. If one hospital or health facility is rendered out of service by violence it creates a greater patient burden for other nearby healthcare providers and contributes to their overloading.

The increasing urbanisation of warfare renders medical facilities located in towns and cities, close to the populations they serve, particularly vulnerable to the effects of shelling and other forms of warfare. Due to the complex and multifaceted nature of the services they provide, hospitals and other medical facilities tend to rely heavily on interconnected infrastructure for their day-to-day functioning. At the most basic level, access to clean water and basic sanitation is essential to maintaining a hygienic environment within a hospital, where infectious diseases can otherwise easily spread. Electricity is needed for the safe storage of blood and numerous drugs, as well as for light, heat, and the operation of hospital equipment. Communication between hospitals, medical centres and ambulances can be critical to ensuring swift and properly specialised care for incoming patients, as well as for the transfer of essential supplies.

The functioning of this basic infrastructure – water and sewerage systems, electricity grids, internet and telephone lines and roads – can be profoundly degraded by conflict, with severe knock-on 'reverberating effects' for the functioning of healthcare infrastructure. Even where violence does not directly damage a healthcare facility, conflict and weapons can still undermine its effective functioning by destroying, damaging or degrading the infrastructure upon which it relies, by disrupting medical and other supplies and by disrupting transport routes by which staff and patients travel.

Taken together, these effects – direct damage to hospitals, damage to the infrastructure upon which healthcare relies, damage to supply chains and transport routes – severely erode the capacity of a healthcare system to respond to traumatic injuries caused directly by violence. They can also affect the prioritisation of capacities within a country's healthcare system as it warps to accommodate higher levels of violence and traumatic injury. In practice, this means doctors being drawn away from other specialties such as obstetrics or neurosurgery into trauma or other directly-conflict related practices, diminishing capacity in other areas of medicine. This further compounds the loss of skills within a healthcare system that can occurs if medical staff working in conflict are forced to flee, whether internally or abroad.[23]

BOX A: Destruction of a hospital: Al-Shifa complex, Mosul

The Al-Shifa compex in West Mosul, adjacent to the Old City, was a large, modern campus containing four main hospitals, a teaching hospital and specialist clinics, and was considered the most advanced medical facility in Iraq. During 2016-2017, ISIS used these hospital facilities as a headquarters.

The Al-Shifa complex suffered a high level of destruction in the offensive to re-take Mosul, rendering it totally non-operational. This damage came primarily from the heavy use of explosive weapons including airstrikes, artillery and rockets by forces allied with the Iraqi government, as well as the use of improvised explosive weapons by ISIS. Large amounts of rubble and building debris were generated throughout the whole complex and its grounds. All its buildings sustained battle damage, and several sustained structural damage. The teaching hospital and blood bank were assessed to have suffered 100% damage from the conflict; the oncology hospital 90% damage; the Ibn Sina general hospital 80% damage; and the al Batool maternity and gynaecology hospital 65% damage. Following the end of the battle for Mosul, some further damage was caused to the oncology hospital during the controlled destruction of two large IEDs. Additionally, some victim operated IEDs left by ISIS caused further civilian casualties and destruction on the site.

WIDER HEALTH EFFECTS OF VIOLENCE

Beyond causing traumatic injuries and eroding the ability of healthcare to respond to these injuries, violence also corrodes the social systems that maintain health more broadly. This renders people more vulnerable to disease in general whilst also limiting capacity to address illness and ill health. By damaging essential health-supporting infrastructure – electricity, transport, communications and sanitation in particular – the knock-on or 'reverberating' effects of violence can be extensive. This is particularly true in urban settings where infrastructure is densely interconnected.[24]

Where water and sanitation systems are destroyed or impaired by violence – by, for example, an explosive weapons strike that hits a water treatment plant or that damages water or waste pipes – maintaining the sanitary conditions that guard against infectious diseases becomes difficult if not impossible for the surrounding population. Just one broken pipe can affect the water supply to 100,000 people. In Mosul, during fighting in 2016-17, the extensive use of heavy bombs, including so-called 'bunker busters', resulted in underground water and sewerage pipes being affected by blast waves even at a considerable distance from a strike.[25]

Hygiene and sanitation problems are compounded when conflict displaces populations, causing overcrowding (which encourages disease transmission) and amplifying the difficulties affected populations face in accessing healthcare. Where violence obstructs transport, the delivery of vital sanitary supplies such as soap as well as medicines and medical equipment is also disrupted, exacerbating the risk of infectious disease spread as well as complicating the treatment of existing conditions. Conflict can also compound existing socio-economic barriers to accessing healthcare, and erect new ones, through deepening poverty and inequality, including gender-based disparities.

× Infectious diseases,

A lack of access to essential services increases the vulnerability of a population to infectious diseases including typhoid, cholera, dysentery, tuberculosis, pneumonia, Ebola and an array of neglected tropical diseases.[26] Where violence creates situations of mass displacement, inadequate access to clean water and sanitation, poor nutrition and overcrowding, then infectious diseases thrive. A significant spike in infectious or communicable diseases has been observed in conjunction with most conflicts, recent and historical.[27]

Upper respiratory tract infections[28] and waterborne diseases in particular flourish in the conditions created by conflict: Yemen is currently suffering the world's largest cholera outbreak after some 5 years of conflict (see Box B). Wars have also contributed to the re-emergence of polio, a viral disease that, like cholera, occurs under conditions of poor hygiene and which, since the introduction of effective vaccines in the 1950s and '60s, has been on the edge of eradication. In Syria, for example, a polio outbreak in 2013 marked the first in a decade. Where violence causes displacement outbreaks can prove more difficult to contain as flows of displaced people introduce infectious disease to other regions or countries.

BOX B: Cholera in Yemen

The world's largest cholera outbreak, which began in earnest in 2016 and has continued to the present day, has tracked Yemen's ongoing conflict, "amplified by war-related destruction of municipal water and sewerage systems"[29], and has contributed to the UN's assessment that Yemen is the world's worst humanitarian crisis.[30] Six years of war has decimated the already-weak health system, with widespread bombing causing extreme levels of damage and destruction, including to health, water and sanitation infrastructure. The mass displacement of the population and subsequent overcrowding in camps and other areas viewed as safe, and the destruction of water and sanitation infrastructure by bombing[31] – as well as air and naval blockades of rebel-held areas which has led to medical, food and fuel shortages – has created conditions where a waterborne bacterial disease like cholera can flourish.[32] By the end of 2019, A reported 3,750 people had died from cholera since 2017, with a reported 2,188,503 total cases.[33]

Key preventive health measures – notably the ability to conduct widespread immunisation –are severely compromised by conflict, with implications for the immediate and longer-term health of a population.[34] The loss of healthcare facilities and trained healthcare staff can undermine immunisation programmes aimed at preventing infectious diseases from gaining a foothold, whilst at the same time hampering the early detection and control of emerging disease outbreaks. Most vaccines also rely on constant cold storage, yet cold chain management becomes extremely difficult where power supply is rendered uneven and travel times unpredictable due to violence.[35] Where conflict produces large numbers of casualties the resources of already-stretched healthcare systems are often diverted towards immediate treatment and casualty management and away from preventive care.[36] Endemic diseases can similarly find new or stronger footholds in situations of conflict where promising community interventions – such as the distribution of bed nets in the case of malaria – can be swiftly undone.

× Longer term health and non-communicable disease

Conflict not only creates new burdens of disease but erodes healthcare provisions for existing and ongoing healthcare needs and concerns, complicating and constraining the delivery of health services. This is evident in the case of preventive care such as widespread immunisation, but also in the context of chronic and non-communicable diseases. Interruptions in medications and in continuity of care have proven life-threatening – the World Health Organisation has noted that "people suffering from noncommunicable diseases are now one of the biggest at-risk groups during emergencies, with many dying of complications that are easily controlled in normal circumstances".[37]

The toll such diseases during armed conflict is often overlooked: in Syria, for example, almost 46% of population deaths are due to noncommunicable diseases such as cardiac diseases, diabetes, cancer or respiratory diseases such as asthma – higher than the number of deaths caused as a direct result of trauma injuries.[38] As violence affects the supply of medicines[39] as well as the availability and ability of specialists to treat patients, the management of chronic non-infectious diseases suffers. This includes reproductive and

Amena

Before the Turkish airstrikes began, I was pregnant with twins. When we fled, the stress made me miscarry. After I lost my twins I continued bleeding and had so much pain in my back. When we arrived at the camp I went to see the women's doctor here and begged for a thorough exam, but all they had were basic painkillers. I have continued to have pain in the weeks we've been here and sometimes feel like I can't breathe, but I no longer go to the clinic as there is nothing they can do. Our husbands also have old injuries that need more treatment, but there is no help for them.

Amena and her family and neighbours fled Ras al Ain in Syria in Autumn 2019 when Turkish airstrikes began. They first fled to Hasakah within Syria where they slept on the street and in schools for over two weeks, before crossing the border into Iraq. They are now living in a refugee camp in northern Iraq

gender-specific healthcare, adding an additional layer of difficulty for women seeking to access specialised care.[40] Chronic diseases by their nature require the provision of continuous, usually lifelong care, and their management often relies on particular specialised medicines, equipment and/or staff. This continuity of care and medicine is threatened by the reverberating effects of violence which disrupt medical practice[41], the transport of supplies (the effects of which can be particularly acute in rural areas), and the storage of medicines.[42]

IMPACT ON THE UNDERPINNING STRUCTURES OF HEALTH

Public health is dependent upon broad underpinning foundations: a safe environment; adequate and nutritious food; and the financial wherewithal to access basic needs. Conflict and its attendant violence tend to deepen existing social inequalities – and thereby health inequalities – whilst also undermining food security and degrading the natural environment. Together, these factors can have long term, often overlooked, consequences for the immediate and future health and development of a population.

× Environment

Although protection of the environment is important on its own terms, environmental conditions are also significant for human health and can be adversely affected by violence, in particular the persistence of certain weapons materials and weapon effects during and after a conflict. The physical, chemical and biological environment – particularly safe water and clean air – is a known determinant of human

Fruit stall at Bardarash refugee camp, northern Iraq © Anna de Courcy Wheeler/ Article 36

health. Where violence and conflict, and certain weapons in particular, contribute to the degradation of the environment, the pollution caused can have a significant impact on a population's health and wellbeing, not just in the immediate term but also long after violence has ended or moved on.[43]

Toxic remnants of war (TRW)[44] threaten to erode environmental and thereby human health, and as a result are increasingly under scrutiny.[45] As one example, the use of weapons containing depleted uranium (DU)[46] has been the subject of UN working papers, investigation by criminal prosecutors at the International Criminal Tribunal for the former Yugoslavia (ICTY)[47], and calls for a moratorium from the European Parliament, numerous states, UN agencies and civil society. DU is a radioactive and toxic heavy metal whose use "creates hotspots of persistent contamination that present a hazard to communities long after conflict ends, particularly for pregnant women, as well as children"[48]. It is thought to be capable of damaging DNA (genotoxic) and to cause cancer.[49]

The targeting of or incidental damage to oil infrastructure can have a devastating effect on the environment and human health. Oil infrastructure is often targeted due to its economic importance, but the health and environmental risks are numerous.[50] In the short term, the release of harmful substances into the air[51] has been linked to severe effects on the respiratory system, with symptoms that include coughing, wheezing, respiratory infections, eye and nose irritation and decreased pulmonary function. In the longer term, it is linked with increased rates of asthma among affected populations, as well as increased risk of diseases such as chronic bronchitis or loss of lung function. The substances released can, over time, often spread across a large area and when deposited in soil they can pollute drinking water and agricultural land. Oil spills from wells, refineries and transport hit by, for example, heavy explosives, can similarly pollute soil and water sources, with long-term knock on effects for the health of livestock and people who are thereby exposed to hazardous chemicals.

Beyond the persistence of certain weapons and effects within the environment, the way in which a weapon interacts with the (built) environment can also have a significant and long-term impact on a population's health. With cities increasingly the main battlefield for conflicts, urban combat is having a notable impact on the environment and on human health. This is particularly true when explosive weapons are used, resulting in release of particulate matter from destroyed cement and concrete. This particulate matter can cause extensive environmental contamination, as well as risks to human health through the inhalation of impurities such as asbestos. Where critical infrastructure – water treatment plants, hospitals etc – are hit by heavy explosives, pollutants and chemicals that are immediately hazardous to human health are often released. These can leach into surrounding soil, water or other debris with long term implications for the health of affected communities as well as for attempts to clear rubble and reconstruct.

× Food security, nutrition

Conflict is now the primary cause of food emergencies, with severe short- and long-term impacts on human health. According to the UN's Food and Agriculture Organisation (FAO) "the proportion of undernourished people living in countries in conflict and protracted crisis is almost three times higher than that in other developing countries".[52] Food security – the availability, access to and utilisation of food, and the stability of these three[53] – relies on a chain of interconnected infrastructure and networks that connects food production with those who need sustenance, via importation, processing facilities, markets and shops.

The ways in which warring parties fight, and the weapons they use can have direct and dramatic impacts on this chain. In a recent report, the UN Special Rapporteur on the right to food detailed the way in which conflict can "trigger food insecurity through the loss of assets, the undermining of communities' coping capacities and the breakdown of social support systems... the disruption of agricultural activity, the

Dulfat

All the time we were in Mosul there were airstrikes, bombing, fighting – mortars, artillery, bombs from drones. The women would stay inside at home because we had families – and we had to stay inside, hiding as a family. When the airstrikes started, everyone was frightened – it feels like an earthquake. We all hid in one room, all packed together: we couldn't even stretch our legs out, there wasn't enough space. We all stayed together because of the bombings, four or five families living there. I can't really describe it but it was like the bombs blew up your heads with fear. We existed like bodies without souls, I thought they could hit us at any moment. It was just women and children in that room. The bombing was like a genocide, they were targeting everyone.

When Mosul's Old City was surrounded we couldn't find any affordable food - it cost 80,000 Iraqi dinars (around 67 USD) for a chicken! We were starving for around three to six months. We were cooking anything we could find – we made soup with water and grass, and a little bread. I had to go to the hospital and go on an IV drip – they gave me 5 bottles because I was starving.

Now I'm sick and can't go anywhere – I don't have money for medicine and healthcare, and the journey to the hospital is not possible. I'm old and alone with daughters, and no one is helping – we need everything.

Dulfat (pseudonym) is from a town in the southern province of Mosul. Her husband was killed by Islamic militants in 2009, but when 'Islamic State' (ISIS) seized her village her sons joined them against her wishes. As the fighting drew closer, Dulfat and her daughter fled to Mosul in search of safety. They ended up in Mosul's Old Town, the site of an intense bombing campaign during the battle to retake Mosul from ISIS.

deterioration of food-related economies and the deliberate undermining of access to food and humanitarian assistance by parties to the conflict".[54] For populations who rely directly on the agricultural sector for their food and livelihoods, or for those already facing hardship or vulnerabilities based on gender, age, ethnicity or migration status, the effects of conflict upon food security can be particularly acute.

Where conflict drives people from their homes, destroys food production and markets and ruins livelihoods, the most vulnerable are swiftly priced-out of an ability to sustain themselves, with immediate and long-term implications for their health – particularly the health of children. Even after a conflict has ended, unexploded ordnance can contaminate pastoral and agricultural land, restricting what can be used for cultivation, further constricting food production, or forcing people to risk injury or death.

At its most severe, food insecurity causes not just hunger but starvation and famine – "an extreme crisis of access to adequate food, manifested in widespread malnutrition and loss of life due to starvation and infectious disease".[55] In the short term, malnutrition can leave civilians more vulnerable to infectious diseases, impede the healing of wounds, cause muscle atrophy and fatigue, and contribute to the failure of vital organs including the kidneys and reproductive organs. The longer-term impact of undernutrition or malnutrition is harder to specify, but evidence suggests that severe acute malnutrition in particular is not only life-threatening at the time, but can often have severe adverse consequences for health in later life.[56]

× Impaired development

Alongside the environment and food security, individual economic status and the overall economy of a state have a direct impact on public health. And like the environment and food, the economy and economic development can be devastated by conflict: the consequences of war for a country's development can be profound.

At the aggregate or governmental level, conflict is associated with a sharp drop in 'Gross Domestic Product per capita' (GDPpc). [57] This is particularly the case where weapons destroy industry and utilities, reducing national productivity as well as affecting livelihoods. Conflict

also undermines the ability of a state to maintain or provide basic services and social safety nets, with knock-on effects for the health of people who rely on such services. This is partly due to a reduction of funds, but also as resources and attention shifts from longer-term needs such as healthcare towards more immediate military or defence endeavours. This diversion of (increasingly) limited funds does not only happen during active conflict, but can persist through post-conflict reconstruction where resources that could have been used to further the development of a state are instead diverted to reconstruction and repair efforts.[58] This is particularly true where heavy explosive weapons have been used extensively in populated areas: the damage they cause to infrastructure and the reverberating effects of such damage can be observed years after a conflict has ended.

At the human level, conflict destroys human and physical capacity, it displaces people, it stunts community economic growth and decimates what may already be limited resources. Savings, assets and, most crucially, income are eroded or lost entirely in the violence. This is especially the case in civil conflicts, where lower household incomes may be accompanied by higher expenditure driven by the conflict. In such cases, the inability to earn an income can mean an inability to buy adequate amounts of nutritious food or to purchase essential medicines, with significant immediate and lasting negative health consequences. As is often the case, the most vulnerable groups – the most financially insecure – are usually the most affected by violence and the most likely to be forced to turn to negative coping strategies and be vulnerable to exploitation.

OPPORTUNITIES TO PREVENT HARM

Conflict is a fundamental global health challenge. It is predicated on the idea of inflicting harm to health as a means of achieving a political end. As such, the effects of conflict on public health are multifaceted, interconnected and overwhelmingly negative: it typically increases the burden on a health system at the same time as damaging its infrastructure, and leads to shortages of staff, supplies, medicines and money. It can also erode the foundations of population health – economic development, a safe environment, and access to sufficient and nutritious food. From a public health perspective, conflict – especially that which is protracted, or which involves extensive use of heavy explosive weapons in towns and cities – is usually catastrophic.

One of the key challenges to improving civilian protection is ensuring that these wider patterns of harm are acknowledged and taken into account in the consideration and development of policies aimed at shaping behaviour. At present, much of the state-led discussion around the protection of health in conflict focusses narrowly on adherence to International Humanitarian Law (IHL) including its prohibitions on attacks on health care facilities and workers. Such discussions tend to limit consideration of harms to shorter-term direct physical effects.

The danger of this narrow focus is that the effects of conflict – including the health effects – as well as the broader imperative to protect civilians are then viewed, analysed and responded to through a lens that is deeply ambivalent about implying that any additional constraint could or should be placed on freedom of military action. Such a focus on legal compliance can also neglect the role of weapon technologies in situations where parties seek to comply with legal requirements but the outcome for civilians is still harmful, as well as impacts from the interaction between weapons technologies and the contexts in which they are used that may be difficult to fully foresee in specific instances. Patterns of harm that are visible from a public health perspective are not necessarily amenable for legal analysis that tends to focus on specific individual uses and a narrower, near-term and directly causal concept of harms. For these reasons compliance with the law must be recognised as a necessary minimum baseline in the protection of civilians, and is not sufficient for the full protection and promotion of health and wellbeing.

Beyond narrow framings, the full protection of civilians could instead be taken to imply:

Constantly working to reduce harm

Recognising stronger protection of civilians as an ongoing and evolving challenge and goal rather than a static and finite set of obligations. Protecting civilians should include conflict prevention and sustainable development, characterised by the highest standards of public health, evidence and transparency in analysis for policymaking, accountability in governance, and environmental protection.

Taking a public health approach to developing strategies to reduce harm

Starting from a public health perspective can encourage a better understanding of the full nature and scale of harms that conflict inflicts on a population's health and wellbeing, and thus illuminate more successful entry points for policy responses. For effective interventions to protect civilians, policy discussions should be based on and structured around the pattern of harm identified, with reference to the existing social and economic structures (such as health, education, water and sanitation) from which harms can propagate as well the means and methods of warfare (the technology used plus its context)[59].

Starting with widest view of civilian harm from conflict

A public health approach opens the door to recognition of the full excess mortality and morbidity that results from conflict, even where that excess cannot be attributed through a direct causal link to specific conflict actions or incidents. By not excluding certain harms from the onset, or discounting them because causality is not clear despite their correlation to conflict, an alternate language and categorisation can be developed to both reflect the full range and extent of harms documented, including those longer-term and more complex social harms. This in turn can aid in the identification of entry points for the future recognition, prevention and remediation of those harms.

Identifying and recognising the fundamental importance of patterns of harm that are produced over time - rather than only being concerned with individual cases

Taking the public health perspective as a starting point encourages an understanding of the overall pattern of effects rather than certain health effects being viewed in isolation, where they can be more easily dismissed as 'incidental' or one-off harms. This allows policy-makers to recognise and seek to prevent or remedy the full extent of harms caused, including those that are more distant or obscured.

Work to strengthen the gathering of data on harms from conflict, and on the determinants of harm.

All three of the bullet points above require attention to building the data from which we analyse conflict. Public health approaches are based on data, and a full assessment of harm requires broad data across all aspects of public health. Identifying patterns of harm requires disaggregated data within which relationships and correlations can be identified over time – including on how different groups experience different vulnerabilities and how different impacts correlate with particular means or methods.

Recognising that IHL provides a baseline of obligations for combatants towards civilian protection, but that it should not limit efforts to promote stronger protection through policy initiatives

IHL applies in all circumstances of armed conflict and sets out legally binding rules that all actors must meet. Too often the law is used as an excuse for refusing to formalise policies that could afford greater protection. There is substantial space for policies and practices to be developed and adopted to strengthen protection of civilians beyond IHL obligations. These have included military tactical directives or rules of engagement within specific conflicts, in as well as overarching international policy documents such as the Safe Schools Declaration. It is universally recognised that such policies adopted in or in response to conflict cannot fall below legal obligations.

Recognising that full protection of civilians relies upon norms and standards that value civilians

The downgrading of what is considered acceptable in health, education or other social areas that frequently accompanies conflict should be resisted and repaired as much and as soon as possible. Societal norms and standards that uphold human dignity as well as expectations regarding the functioning of social services can enable us to both build stronger and more demanding expectations, as well as serve as a means to better protection by setting standards for actors in conflict.

That work for the full protection of civilians should be a collaborative endeavour

All states and international actors should consider minimising the effects of conflict on civilians to be a moral obligation to which we can all commit. The interests of specific groups may pull in different directions, particularly where there persists a tendency to frame military interests as necessarily in opposition to civilian interests. Recognising our shared common goal should, however, enable us to work towards that goal constructively, collaboratively, transparently and in good faith.

ENDNOTES

1 Scott Gates et al (2015) "The consequences of internal armed conflict for development", WritePeace Blog, Stockholm International Peace Research Institute (SIPRI), 30 March 2015.

2 In his 2019 Protection of Civilians Report to the UN Security Council, UN Secretary-General Antonio Gúterres noted that "civilians continue to account for the vast majority of casualties, and are targeted and victims of indiscriminate attacks and other violations and harm by parties to conflict." United Nations, Security Council, Protection of Civilians in Armed Conflict – Report of the Secretary General, S/2019/373.

3 Nicholas Maiden (2009), "Ballistics reviews: mechanisms of bullet wound trauma", Forensic Sci Med Pathol. 20095(3), pp. 204-9.

4 Kyle Petersen et al (2007), "Trauma-related infections in battlefield casualties from Iraq", Annals of Surgery, 245(5), pp. 803-811.

5 Center for Disease Control and Prevention (2003), "Explosions and Blast Injuries: A primer for clinicians"

6 Ibid.

7 For more detail on the types of injuries caused by explosive weapons see: Article 36 (2018), "Explosive Weapons: Protecting civilians from the use of explosive weapons in populated areas"; Humanity and Inclusion (2019), "The Waiting List: Addressing the immediate and long-term needs of victims of explosive weapons in Syria"; Save the Children (2019) "Blast Injuries: The impact of explosive weapons on children in conflict".

8 Save the Children (2015), "Nowhere safe for Yemen's children: The deadly impact of explosive weapons in Yemen".

9 Mark Van Ommeren et al (2005), "Mental and social health during and after acute emergencies: emerging consensus?", Bull WHO, 83(1), pp.71-74.

10 World Health Organisation (2019) "Mental health in Emergencies", WHO Fact Sheet.

11 Mental disorders focussed on were: depression, anxiety disorder, post-traumatic stress disorder, bipolar disorder and schizophrenia. Several health states within a particular disease that are relative to different levels of functional impairment (i.e. none, mild, moderate or severe) were considered. "According to WHO's review, the estimated prevalence of mental disorders among conflict- affected populations at any specific point in time (point prevalence) is 13% for mild forms of depression, anxiety, and post-traumatic stress disorder and 4% for moderate forms of these disorders. The estimated point prevalence for severe disorders (i.e. schizophrenia, bipolar disorder, severe depression, severe anxiety, and severe post-traumatic stress disorder) is 5%. It is estimated that one in 11 people (9%) living in a setting that has been exposed to conflict in the previous 10 years will have a moderate or severe mental disorder." In non-conflict situations, 1-3 percent of the population is thought to have some form of psychiatric disorder. See ibid.

12 Ibid.

13 In 2015, UNICEF UK reported the wide range of often overlooked impacts explosive violence can have on children: "Unremitting anxiety and exposure to violence can undermine children's psychological development, impairing cognitive and sensory growth. It is now largely accepted that exposure to violence can threaten the development of children's brains and lay the foundations for cycles of intergenerational violence." UNICEF UK (2015), "Keeping Children Safe in Emergencies".

14 Mark van Ommerman, "Mental health conditions in conflict situations are much more widespread than we thought", World Health Organisation, 11 June 2019.

15 For example, one mental health practitioner reported that among the Yazidi women he worked with in the region, flashbacks, fainting, nightmares and a loss of hope for the future were common. Article 36 interview, 25 November 2019, Dohuk, Iraq.

16 For example, in post-conflict Somaliland, the vast majority of men chew khat, a narcotic plant. This amphetamine-like drug reportedly has negative impacts on individual users, their families and communities, including loss of economic productivity and a potential increase in gender-based violence. Rachel Thompson and Mukesh Kapila (2018), "Healthcare in conflict settings: Leaving no one behind", World Innovation Summit for Health, 2018, p. 12.

17 See, for example, R. Srinivasa Murthy and Rashmi Lakshminarayana (2006), "Mental health consequences of war: a brief review of research", World Psychiatry, 5(1), pp. 25-30.

18 "In contemporary armed conflicts, parties to the conflict all too frequently launch direct attacks on health-care facilities so as to deprive their enemies of medical services. While the impact of such tactics is easy to identify for the sick and the wounded, the knock-on effect on the whole population, which is consequently unable to access those essential services, is simply dramatic and all too often overlooked as a humanitarian issue." ICRC (2014), "Healthcare in Danger", p. 8.

19 Humanity and Inclusion (2019), "The Waiting List: Addressing the immediate and long-term needs of victims of explosive weapons in Syria", p. 18: "[t]reating resultant trauma injuries requires a referral system, including functioning tertiary-level facilities. In turn, this requires drugs and other medical supplies, as well as water, soap, electricity and food. None of these basic amenities are guaranteed in war zones." See also Thompson and Kapila (2018), "Healthcare in conflict settings: Leaving no one behind", p. 7.

20 "A new and worrying impact is evidence of antimicrobial resistance. Infections in war wounds in the Middle East have been attributed to multidrug-resistant pathogens. Yet few facilities have the capacity to diagnose these cases, and there are reports of delays in treatment and clinical mismanagement of wounds." Thompson and Kapila (2018), "Healthcare in conflict settings: Leaving no one behind", p. 7. See also, Alu Abbara et al (2018), "A summary and appraisal of existing evidence of antimicrobial resistance in the Syrian conflict", International Journal of Infectious Diseases, Vol. 75, pp. 26-33

21 Article 36 interview with Humanity and Inclusion, Erbil, Iraq, 22 November 2019. See also: Médecins Sans Frontières (2016), "Conflict Medicine: A Manifesto"; Rupa Kanapathipillai et al (2019), "Antibiotic resistance in conflict settings: lessons learned in the Middle East", JAC-Antimicrobial Resistance, 1(1) .

22 A study by the International Committee of the Red Cross found that explosive weapons are the leading cause of damage to healthcare facilities in conflicts around the world. ICRC (2011), "Healthcare in Danger: A sixteen country study".

23 This likelihood is enhanced by continued attacks on health workers despite repeated UN Security Council condemnation of such attacks, which are in violation of international humanitarian law. In its sixth annual report, the Safeguarding Health in Conflict Coalition (SHCC) reported an increase in attacks on doctors, nurses, paramedics, midwives, vaccination workers and other health workers in conflict situations including in the bombing and shelling of an MSF-supported hospital in Syria, and airstrikes in Yemen. Safeguarding Health in Conflict Coalition (2019), "Impunity Remains: Attacks on healthcare in 23 countries in conflict".

24 ICRC (2015), "Urban Services during Protracted Armed Conflict: A Call for a Better Approach to Assisting Affected People,", p. 28.

25 Article 36 interview with UNDP in Iraq, 21 Nov 2019.

26 Neglected Tropical Diseases (NTDs) are communicable diseases that prevail in tropical and subtropical countries and affect more than one billion people. They include: Buruli ulcer; Chagas disease; Dengue and Chikungunya; Dracunculiasis (guinea-worm disease); Echinococcosis; Foodborne trematodiases; Human African trypanosomiasis (sleeping sickness); Leishmaniasis; Leprosy (Hansen's disease); Lymphatic filariasis; Mycetoma, chromoblastomycosis and other deep mycoses; Onchocerciasis (river blindness); Rabies; Scabies and other ectoparasites; Schistosomiasis; Soil-transmitted helminthiases; Snakebite envenoming; Taeniasis/Cysticercosis; Trachoma; and Yaws. Populations living in poverty, without adequate sanitation and in close contact with infectious vectors and domestic animals and livestock are those worst affected.

27 See Maire A. Connolly and David L. Heymann (2002), "Deadly Comrade: War and Infectious Diseases", The Lancet, vol. 360; Paul H. Wise and Michele Barry (2017), "Civil War and the Global Threat of Pandemics", Daedalus, vol. 146, no. 4.

28 For example, diphtheria, a life-threatening respiratory disease many doctors viewed as history in an age of widespread vaccination, re-emerged in late 2017 in Bangladesh's Cox's Bazar (a border district that is home to hundreds of thousands of ethnic Rohingya, over half of whom are children, who have fled from Myanmar following a campaign of violence against them) due to a combination of malnutrition, crowded living conditions, lack of access to adequate sanitation and vaccination coverage falling below 80% among the refugee population.

29 Firdausi Qadri et al (2017), "Cholera in Yemen – An old foe rearing its ugly head", New England Journal of Medicine.

30 UNHCHR (2017), "Yemen Factsheet – June 2017".

31 In one particularly noteworthy example, a newly constructed cholera treatment centre run by Médecins sans Frontières was hit by a Saudi-led coalition airstrike, rendering it non-functional: Médecins Sans Frontières, (2018) "Yemen: Airstrike hits MSF cholera treatment centre in Abs".

32 "[L]ess than half the country's health facilities are functioning; health and sanitation workers have gone unpaid for many months; the availability of clean water is minimal; and warring parties are restricting access for aid workers ... A campaign planned to begin in June [2017] was curtailed before it began when the government suspended its request for the vaccine; with 21 of Yemen's 23 governorates affected, it had already become too widespread." Rachel Thompson (2017), "Yemen's health crisis: How the world's largest cholera outbreak unfolded", Chatham House.

33 "Weekly Epidemological Monitor", Vol. 12 Iss. 2, World Health Organisation: Regional Office for the Eastern Mediterranean, 15 December 2019.

34 According to UNICEF, almost two thirds of children who have not been immunised with basic vaccines live in countries affected by conflict: Unicef (2019) "Two-thirds of unimmunized children live in conflict-affected countries". See also Ngo Valery Ngo et al (2019), "Armed conflict, a neglected determinant of childhood vaccination: some children are left behind", Human Vaccines & Immunotherapeutics, vol.16 no 6.

35 In Mosul, for example, the bombing of the nearby electricity grid and the destruction of power lines connecting Mosul to Iraq's national power grid meant that electricity was only intermittently available. Electricity in Mosul was intermittently available to 656 (54.6%) households, with no households having a regular supply. In west Mosul, 389 (86.3%) reported no electricity: Riyadh Lafta et al (2018), "Living in Mosul during the time of ISIS and the military liberation: results from a 40-cluster household survey", Conflict and Health, vol. 12 no. 31. Electricity shortages also mean that lab services cannot continue, and heating or air conditioning that maintains an ambient temperature for seriously ill patients is interrupted: Alice Debarre (2018), "Hard to reach: Providing healthcare in conflict", International Peace Institute, p.4

36 In Yemen, for example, the diphtheria outbreak that began in late 2017 has been traced to "a huge gap in the immunisation coverage in the last three years due to the obviously collapsed health system" (see Fekri Dureab et al (2019), "Diptheria outbreak in Yemen: the impact of conflict on a fragile health system", Conflict and Health, Article no. 19) and in Syria immunisation rates plummeted from over 80 percent in 2010 to just 43 per cent by 2014 as years of conflict took their toll (op. cit. UNICEF (2019)). A study of 16 countries with large conflict-affected populations found that fourteen of the countries were below the global average of 85% coverage for diphtheria, pertussis and tetanus (DPT3) in 2014, and that despite together representing just 12% of the global population, these states were responsible for 67% of global polio cases and 39% of global measles cases between 2010 and 2015: John Grundy and Beberley-Ann Biggs (2019), "The impact of conflict on immunisation coverage in 16 countries", International Journal of Health Policy and Management, vol. 9 no. 8, pp. 211-22.

37 World Health Organisation – Regional Office for the Eastern Mediterranean (2017) "Beyond the bullets and bombs: Saving the lives of chronic disease patients living in conflict settings".

38 Ibid.

39 Where violence affects transport systems – for example, through the erection of road blocks or damage to roads or railways from explosive weapons – the availability of essential medical supplies is rapidly compromised. This can be particularly acute in rural areas where logistics and transport capacity is often lower, even before an outbreak of conflict. Shortages in medicines, medical commodities and basic medical equipment, a lack of continuous supply, oversupply of certain medicines, and the use of lower-quality or outdated drugs challenge the management of longer-term conditions as well as infectious diseases. Shortages can also lead to higher prices, preventing the most vulnerable from being able to access crucial medication and undermining the ability of a government to pay for a population's health needs.

40 For more detail on the effects of conflict on reproductive health, see: Isabelle Arradon (2018), "The hidden face of war", International Crisis Group.

41 For example, the ICRC has estimated that in Yemen some 25 percent of dialysis patients have died each year since the conflict there began. This is attributable to the difficulties patients experience in accessing treatment, including the closure of specialist clinics, broken machines and lack of essential supplies, as well as ongoing insecurity including checkpoints, airstrikes and bombings medical facilities: ICRC (2018) "Hidden cost of war: In Yemen, thousands could die of kidney failure".

42 Insulin, for example, is essential for the management of Type 1 diabetes but requires cold storage, something that can be a challenge in conflict-affected contexts where the tactics of warring parties can render the supply of power unreliable at best. Electricity shortages also mean that lab services cannot continue, and heating or air conditioning that maintains an ambient temperature for seriously ill patients is interrupted. Op. cit. Alice Debarre (2018).

43 Conflict and Environment Observatory (2014), "Pollution Politics: Power, accountability and toxic remnants of war".

44 Toxic or radiological substance resulting from military activities that forms a hazard to humans or ecosystems, for example heavy metals, unexploded ordnance waste, radioactive materials, fuel hyrdocarbons and endocrine disrupting compounds.

45 Conflict and Environment Observatory (2014)

46 The US and UK used depleted uranium in ammunition during the 1991 and 2003 wars in Iraq, firing it at more than 1,100 locations including densely populated areas; it was used by NATO during its 1999 bombing of Yugoslavia; and DU ammunition has since been used in Syria. See: "The United States used depleted uranium in Syria", Foreign Policy, 14 February 2017; "US Pentagon confirms it used depleted uranium in Syria", Middle East Eye, 17 February 2017; "The Pentagon said it wouldn't use depleted uranium rounds against ISIS. Months later, it did – thousands of times", The Washington Post, 16 February 2017.

47 See: ICTY, "Final report to the prosecutor by the committee established to review the NATO bombing campaign against the Federal Republic of Yugoslavia", para. 26.

48 PAX and ICBUW (2016), "Targets of Opportunity".

49 Ibid.

50 In one of the best known example, the intentional destruction of over 600 oil wells in Kuwait during the 1990-1991 caused extensive and lasting pollution; Islamic State (ISIS/ISIL) militants set fire to oil wells in Iraq leaving what was described by researchers as "a toxic trail of destruction which could have severe health consequences for communities" (PAX (2017), "Living under a black sky") and more recently Yemen's Houthi rebels claimed responsibility for drone strikes on an oil-processing facility and an oil field in Saudi Arabia ("Houthi drone strikes disrupt almost half of Saudi oil exports", NPR, 14 September 2019.)

51 These include volatile organic compounds such as benzine, a known carcinogen, polycyclic aromatic hydrocarbons (PHAs), carbon monoxide, sulphur dioxide, and particulate matter.

52 Food and Agriculture Organization of the United Nations (FAO) (2016), "Peace and food security: investing in resilience to sustain rural livelihoods amid conflict", p. 4.

53 The FAO has outlined four main dimensions of food security: Food availability, which addresses the "supply side" of food security and is determined by the level of food production, stock levels and net trade; Economic and physical access to food; Food utilisation determines the nutritional status of an individual, and is commonly understood as the way the body makes the most of various nutrients in the food, determined by good care and feeding practices, food preparation, diversity of the diet and intra-household distribution of food, combined with good biological utilization of food consumed; and stability of the other three dimensions over time. For food security objectives to be realized, all four dimensions must be fulfilled simultaneously. See: FAO (2008), "An introduction to the basic concepts of food insecurity".

54 United Nations General Assembly (2017), Right to Food – Note by the Secretary-General, A/72/188.

55 For food insecurity to meet the definition of famine, certain technical criteria must be met: at least 20 per cent of households in an area face extreme food shortages with a limited ability to cope; acute malnutrition rates exceed 30 per cent; and the death rate exceeds two persons per day per 10,000 persons.

56 For example, stunting – where children are short for their age due to inadequate nutrient intake – has been linked to delayed mental development, reduced intellectual capacity and poor performance in school. In later life, stunting and/or episodes of severe acute malnutrition have been associated with a host of chronic diseases including cardiovascular disease, lung disease and diabetes. See: Natasha Lelijveld (2016), "Chronic disease outcomes after severe acute malnutrition (ChroSAM): a cohort study", The Lancet: Global Health, vol. 4 no. 9; Saskia de Pee and Martin W Bloem, "The role of foods as a source of nutrients in the prevention of stunting", World Food Programme.

57 World Bank, "Fragility, Conflict and Violence". See also: Scott Gates et al (2015), "The consequences of internal armed conflict on development (part 2)", SIPRI – WritePeace blog.

58 C. Wille (2016), "The implications of the Reverberating Effects of Explosive Weapons Use in Populated Areas for Implementing the Sustainable Development Goals", UNIDIR.

59 This is of particular note as the combination of a weapon's specific effects with where it is used, so the interaction between technology and context, can generate particular identifiable patterns of harm. For example, the use of explosive weapons in 'populated areas', as well as causing direct casualties in greater numbers than elsewhere, can also cause 'reverberating' effects for civilians due to the inter-dependence of urban infrastructure. Thus damage to electricity infrastructure, for example, may have knock-on effects for healthcare and water services. This highlights the significance of looking at 'context' as a determinant for how harms may be experienced, exacerbated and transmitted. See Elizabeth Minor (2020), "Protecting civilians as an international policy agenda – A snapshot in 2019", Article 36.

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