



EXPLOSIVE WEAPONS WITH WIDE AREA EFFECTS: A DEADLY CHOICE IN POPULATED AREAS



A young man walks through the remains of his neighbourhood on the west bank of the Tigris river in Mosul.

EXPLOSIVE WEAPONS WITH WIDE AREA EFFECTS: A DEADLY CHOICE IN POPULATED AREAS

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FOREWORD

While working to protect and assist people affected by armed conflict around the globe, the International Committee of the Red Cross (ICRC) has, for many decades now, borne witness to the human suffering resulting from the use of explosive weapons with a wide impact area in urban and other populated areas. These are large bombs and missiles, rockets, indirect and often inaccurate fire weapon systems such as artillery and mortars, and multi-barrel rocket launchers. Evidence from our frontline work and the accounts of countless individuals affected confirm that the use of such weapons in populated areas is a major cause of civilian harm in today's armed conflicts.

Heavy explosive weapons put at risk everyone and everything within their wide impact areas, often significantly beyond their target. In environments where military objectives, civilians and civilian objects are commingled, the results are devastating. Scores of civilians are killed or injured, often left with permanent disabilities or grave mental trauma. Cities are left in rubble, with houses, infrastructure, schools, means of livelihood and cultural sites destroyed. Services essential for human survival collapse, leaving entire populations without access to water, sanitation, electricity or health care – causing more death and disease, and triggering displacement. Streets and backyards are littered with unexploded ordnance, which keep on killing long after hostilities have ended. Development gains are undermined.

These direct and reverberating effects are increasingly foreseeable and warring parties have a responsibility to prevent and mitigate them. This is not only a humanitarian imperative, but often also a legal one. The principles and rules of international humanitarian law (IHL) apply to the use of heavy explosive weapons in populated areas, and, depending on the circumstances, may well prohibit such use.

The civilian toll of bombing and shelling is unacceptable. There is an urgent need for states and all parties to armed conflict to review and adapt their military policy and practice, and to avoid the use of explosive weapons with a wide impact area in populated areas. These weapons should not be used in populated areas unless sufficient mitigation measures can be taken to limit their wide area effects and the consequent risk of civilian harm. First and foremost, this requires a change in mindset: acknowledging the high risk posed by heavy explosive weapons to civilians, and the difficulty of using them in populated areas in compliance with IHL; elevating the protection of civilians into a strategic priority that should permeate all stages of military decision-making; taking a number of preventive and mitigation measures at all levels – strategic, operational and tactical – to avoid, where possible, conducting hostilities in populated areas, to ensure alternatives to the use of explosive weapons with a wide impact area, and to identify and implement good practices on the use of such weapons to limit their effects; training and equipping armed forces accordingly, so that they can fight in populated areas in a manner that respects IHL and minimizes risks to civilians.

This report provides a range of good practice recommendations to political authorities and armed forces on a number of such preventive and mitigation measures. While some militaries have in place restrictions and limitations on the use of heavy explosive weapons in populated areas, additional measures in this respect are urgently needed. Efforts are currently under way to develop internationally agreed standards in this respect; and it is my hope that this report will contribute to fostering the necessary change of behaviour among parties to armed conflicts. Faithful implementation of the report's recommendations would significantly strengthen protection for civilians and facilitate respect for IHL in environments where achieving such protection and respect is a particularly challenging task.



Peter Maurer
ICRC President

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This report is the result of research, field documentation and dialogue with a number of states, non-state armed groups, and international and non-governmental organizations conducted by the ICRC over the course of a number of years.

The main author of this report was Eirini Giorgou, Legal Adviser, with significant contributions from Kathleen Lawand, then Head of the Arms Unit, and Laurent Gisel, Head of the Arms and Conduct of Hostilities Unit.

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Cordula Droege

Chief Legal Officer and Head of the Legal Division, ICRC

EXECUTIVE SUMMARY

As the world urbanizes, so do conflicts. In recent times, conflicts have, increasingly, been taking place in cities and other areas characterized by concentrations of civilians and civilian objects. This trend is likely to continue. These conflicts are fought using weapons designed to deliver large explosive force from afar and over large areas. Many, if not all, of these heavy explosive weapons are ill-adapted for use in urban and other population centres. When employed in populated areas, where targets are often intermingled with civilians or civilian objects, such weapons are likely to have indiscriminate effects, with devastating consequences for civilian populations.

The use of explosive weapons with a wide impact area in populated areas is one of the main causes of civilian harm in today's armed conflicts. This report by the International Committee of the Red Cross (ICRC) analyses the main issues that the use of such weapons raises, with the aim of inducing a change in policies and practices by parties to armed conflicts, towards better protecting the civilian population against the dangers posed by such use.

The report provides a broad evidence-based assessment of the devastating consequences of the use of these weapons; a technical overview of weapons of concern; an analysis of the implications of the use of these weapons under international humanitarian law (IHL); and a synopsis of relevant policies and practices adopted by parties to armed conflicts. It concludes with detailed 'good practice' recommendations for political authorities and armed forces on measures to be taken in terms of doctrine and policies, as well as training, planning and conduct, to strengthen protection for civilians against the use of heavy explosive weapons in populated areas.

THE USE OF HEAVY EXPLOSIVE WEAPONS HAS DEVASTATING CONSEQUENCES FOR THE CIVILIAN POPULATION

The ICRC has witnessed this pattern of harm in recent and ongoing armed conflicts in over fifteen contexts, including Afghanistan, Gaza, Iraq, Libya, the Philippines, Somalia, Sri Lanka and Yemen. When explosive weapons with a wide impact area are used in populated areas, the overwhelming majority of the casualties are civilians. Bombing and shelling wound and kill large numbers of people, and permanently disable many others, especially in areas where health care is inadequate or inaccessible; they also cause serious long-term psychological trauma among innumerable others, particularly children. Cities – including civilian housing, critical civilian infrastructure, schools, and places of worship – are reduced to rubble.

These devastating consequences are long-lasting. When critical infrastructure is hit, services indispensable to the survival of the population – water, sanitation, electrical power, health care – are disrupted and may even collapse. Lack of essential services seriously endangers the lives and well-being of civilians, and may lead to outbreaks of disease and even epidemics. These 'reverberating' effects can spread far in time and space and can affect a much larger part of the civilian population than those in the impact zone of the attack: women and children are particularly vulnerable, and in specific ways.

The damage and destruction caused by heavy explosive weapons triggers displacement, forcing survivors to flee and expose themselves to an array of new risks, prevents the return of displaced populations and can have a significant impact on the natural environment; all this is com-



People in Gaza pick their way among the ruins of buildings destroyed by bombing.

pounded by the presence of unexploded ordnance (UXO) that keep on killing long after hostilities have ended. Ultimately, the use of heavy explosive weapons in cities and other populated areas significantly undermines achievement of the Sustainable Development Goals (SDGs).

WEAPONS DESIGNED TO HAVE A WIDE IMPACT AREA

This grave pattern of civilian harm is largely caused by the wide impact area of the weapons used, the direct effects of which are likely to occur significantly beyond the target. These wide area effects are principally the result of a weapon's technical characteristics, which determine its accuracy, precision and blast-and-fragmentation radius. Munitions that have a large explosive yield (e.g. large bombs or missiles), weapons that lack accuracy and/or precision (e.g. traditional artillery and mortars), and weapons that fire multiple munitions simultaneously over a large area (e.g. multi-barrel rocket launchers (MBRLs)) are sources of serious concern when used in populated areas. The inaccuracy of the weapon's delivery system, or the munition's large destructive radius, combined with the density of the civilian population in or around the target is a recipe for extensive civilian harm.

SIGNIFICANT CHALLENGES TO COMPLIANCE WITH IHL WHEN USING HEAVY EXPLOSIVE WEAPONS IN POPULATED AREAS

There is no general prohibition under IHL against using heavy explosive weapons in populated areas; however, such use must comply with all the rules governing the conduct of hostilities, notably the prohibitions against indiscriminate and disproportionate attacks and the obligation to take all feasible precautions in attack.

Because of their low accuracy and precision, and their large destructive radius relative to the size of most military objectives in populated areas, when used in such environments many heavy explosive weapons are very likely to have indiscriminate effects. This casts doubt on whether such weapons can, in a populated environment, be directed against a specific military objective, and whether their effects can be limited as required by IHL, so as to comply with the prohibition against indiscriminate attacks.

IHL requires parties to armed conflict to consider the direct and indirect effects of an attack – death or injury of civilians or damage to civilian objects, in particular. While the indirect, reverberating effects of heavy explosive weapons' use in populated areas are well documented and foreseeable, it is doubtful whether parties appropriately factor them into their assessment of the lawfulness of such use. The humanitarian and legal imperative to protect the civilian population requires the taking of measures to limit the wide area effects of weapons – or otherwise reduce the risk to civilians – or using alternative weapons or tactics.

The extent of civilian harm caused by the use of heavy explosive weapons in populated areas – and witnessed by the ICRC and others – raises serious questions about how parties to conflict interpret and apply these key rules of IHL that aim to protect civilians. It also demonstrates the difficulty of using heavy explosive weapons in populated areas in compliance with IHL.

MILITARY POLICIES AND PRACTICES TO PROTECT CIVILIANS AGAINST THE EFFECTS OF HEAVY EXPLOSIVE WEAPONS

Military policies generally recognize that limiting weapons' effects as far as possible to the target, notably to protect civilians, is a critical consideration in the choice and use of weapons in populated areas. Comparatively few armed forces worldwide appear to have standing policies and training specifically on urban warfare and on the choice of weapons and tactics suitable for use in populated areas. However, it is increasingly understood that operations in populated areas require a shift in mindset, policies, doctrine, training, equipment, planning and conduct, in order to respond to the complex challenges populated environments pose to armed forces and to reduce risks to civilians.



Children in Taiz, Yemen, continue to go to school despite the dangers, with lessons taking place among the rubble.

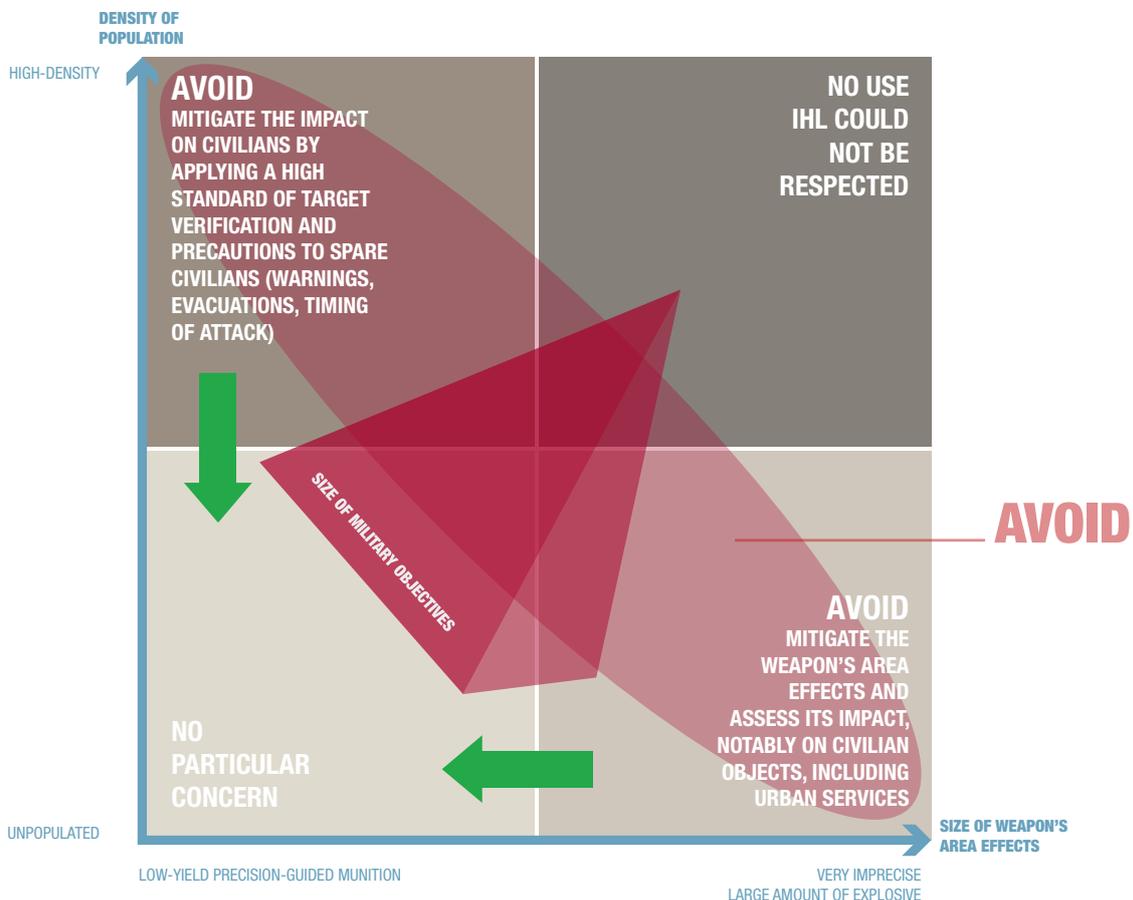
There are a number of examples of specific limitations on the use of certain weapons and methods of warfare in populated areas, including prohibition of the use of certain heavy explosive weapons in particular contexts; guidance on additional weapon-specific measures to be taken, including

considering alternative weapons and tactics; and additional measures and tools to inform the choice of weapons in populated areas and to minimize risks to civilians in urban warfare. Adoption and implementation of such restrictions have been linked to a significant decrease in civilian casualties in some instances.

The findings of this report support the ICRC's call for states and all parties to armed conflict to avoid the use of explosive weapons with a wide impact area in populated areas, owing to the significant likelihood of indiscriminate effects.

THE ICRC IS CALLING FOR THE USE OF HEAVY EXPLOSIVE WEAPONS IN POPULATED AREAS TO BE AVOIDED AS A MATTER OF POLICY

A policy of avoidance means that heavy explosive weapons should not be used in populated areas unless sufficient mitigation measures are taken to limit their wide area effects and the consequent risk of civilian harm. To be effective, such an avoidance policy should entail the adoption of concrete preventive measures and guidance (policies and practices), to be put in place in advance of armed conflicts and military operations, and faithfully implemented, when planning and conducting hostilities in populated areas. Such measures should be shared with partner forces or supported parties and taken into consideration when deciding on the transfer of heavy explosive weapons and when providing support to a party to an armed conflict.





The ICRC delivers an information session about IHL and the ICRC for the Malian armed forces in Bamako.

The extent of civilian suffering and destruction in today's armed conflicts makes it urgently necessary for states and all parties to armed conflicts to reassess and adapt their choice of weapons when conducting hostilities in populated areas. The recommendations put forward in this report aim to assist political authorities and armed forces to give effect to an avoidance policy. These recommendations are grounded in IHL and its aim of protecting civilians from the dangers of hostilities; they are intended as practical guidelines to mitigate the risk to civilians from the use of heavy explosive weapons in populated areas, and to facilitate compliance with IHL when conducting hostilities in such challenging environments as urban and other populated areas.

KEY RECOMMENDATIONS

In view of the significant harm caused to civilians from the use in populated areas of explosive weapons that have a wide impact area, it is recommended that political authorities take the following measures:

1. Ensure that the protection of civilians is explicitly identified as a strategic objective at the highest level, prior to military operations, and is integrated into all military orders.
2. Ensure that doctrine specifically concerning urban warfare is in place, and adopt a policy of avoidance with regard to the use of heavy explosive weapons in populated areas.
3. Ensure that armed forces are equipped with, and trained in the proper use of, weapons and means and methods of warfare that are appropriate for use in urban and other populated areas, including weapons that do not have wide area effects, with a view to minimizing the risk of civilian harm.
4. Make the export of explosive weapons with a wide impact area conditional on recipients putting in place limits on the use of such weapons in populated areas, in accordance with the good practices recommended in this report.
5. When providing support to parties to an armed conflict, take all appropriate measures to ensure that the use of explosive weapons with a wide impact area is avoided in populated areas.
6. Put in place national mechanisms to collect data on incidents involving the use of heavy explosive weapons – including systems to track civilian casualties – and support other entities collecting such data.
7. Make known – in relevant forums, publicly, or within the context of a structured dialogue with the ICRC – good practices, experience and lessons learnt with regard to the choice and use of means and methods of warfare in populated areas, as well as measures adopted with a view to strengthening the protection of civilians and civilian objects against the effects of attacks using heavy explosive weapons.
8. Support the development of essential services that are likely to be more resilient during warfare in populated areas.

With a view to avoiding or at least minimizing civilian harm from the use of explosive weapons with a wide impact area in populated areas, it is recommended that armed forces review their military policies, training curricula and practices in order to incorporate the following good practices:

1. During the planning process at the strategic, operational and tactical levels, do everything possible to keep hostilities in populated areas to a minimum, including by moving them outside populated areas or moving the population outside the site of hostilities.
2. Provide specific training on the conduct of hostilities in urban and other populated areas – including training for all those involved in the planning, decision and execution of attacks – to ensure that the area effects of explosive weapons and the limitations applicable to their use in populated areas are fully known and understood.
3. Do not use explosive weapons with a wide impact area in populated areas unless sufficient mitigation measures have been taken to limit their area effects and the consequent risk of civilian harm. In particular, avoid the use in a populated area of:
 - 3.1 the following weapon systems when unguided, owing to their intrinsic inaccuracy and consequent wide area effects, and irrespective of the size of the target:
 - a. MBRLs
 - b. air-to-ground rockets and air-delivered bombs.
 - 3.2 any explosive weapons whose impact area may be expected to be significantly larger than the target, in particular:
 - a. large-yield munitions, whether guided or unguided, including large-yield bombs and missiles, and large-calibre mortars and other projectiles, when their blast-and-fragmentation radius is significantly larger than the target

The conflict in Marawi, Philippines, devastated huge swathes of the city, leaving people homeless and without essential services.



INTRODUCTION

WAR IN CITIES: OLD WEAPONS IN A CHANGING CONFLICT ENVIRONMENT

Contemporary armed conflicts are increasingly being fought in population centres.¹ This trend is likely to continue with the growing urbanization of the world's population.² It is estimated that some 50 million people worldwide are suffering the effects of urban warfare.³

The urbanization of warfare is compounded by the fact that some belligerents avoid facing their enemy in the open, intermingling instead with the civilian population, and even launching attacks from populated areas. Whether deliberate or unintentional, or an imposition by an adversary, such proximity puts civilians in danger by drawing hostilities into populated areas. Faced with such a situation, recent conflicts show, an adversary will often choose means or methods of combat that do not require it to expose its forces to the risks inherent to military operations in such a complex environment: these means or methods include weapons capable of delivering significant explosive force from afar and over a wide area.

Though the nature of warfare has become more urbanized in recent decades, the means and methods of combat employed by belligerents have so far not undergone a similar evolution. Today, hostilities in urban areas are often conducted with weapons and tactics that were not originally designed, or have otherwise not been adapted, for use in such areas. Large bombs and missiles, and inaccurate indirect-fire weapon systems – such as rockets, artillery, mortars, and MBRLs – have served militaries well in open battlefields and are generally not a cause for concern when used against military objectives in such environments. But when used against military objectives located in populated areas, they typically produce effects that go well beyond their targets, often with devastating consequences for civilians.

¹ ICRC, *International Humanitarian Law and the Challenges of Contemporary Armed Conflicts*, Report prepared for the 31st International Conference of the Red Cross and Red Crescent, Geneva, 2011, (ICRC Challenges Report 2011), pp. 40–42; ICRC, *International Humanitarian Law and the Challenges of Contemporary Armed Conflicts*, Report prepared for the 32nd International Conference of the Red Cross and Red Crescent, Geneva, 2015 (ICRC Challenges Report 2015), pp. 47–53; and ICRC and InterAction, *When War Moves to Cities: Protection of Civilians in Urban Areas*, Outcome Report, May 2017, p. 1. See also V. Bernard, “Editorial: War in Cities: the Spectre of Total War”, *International Review of the Red Cross*, Vol. 98, No. 901, April 2016, pp. 1–11.

² See UN Department of Economic and Social Affairs (UN DESA), Population Division, *The 2018 Revision of World Urbanization Prospects*, United Nations, New York, August 2019 – according to which, 55% of the world's population lives in urban areas, and this proportion is expected to increase to 68% by 2050.

³ ICRC, *Urban Services during Protracted Armed Conflict: A Call for a Better Approach to Assisting Affected People*, ICRC, Geneva, 2015 (ICRC Urban Services Report), p. 7.



Fighting in Harasta, Syria, began in 2012. The area and its people were under siege for more than five years. More than a month of continued air strikes in 2018 forced residents to seek refuge in basements.

As a humanitarian organization working to protect and assist the victims of armed conflict, the ICRC witnesses these consequences at first-hand – which are, typically, not only civilian deaths and injuries and destruction of civilian objects caused by the blast-and-fragmentation effects of the weapon in its impact zone, but also significant indirect (reverberating) effects that extend well beyond the impact zone. These effects, which are exacerbated when hostilities are protracted, often take the form of disruption and degradation of services essential to the survival of civilians, such as health care and water and electricity supply.⁴ Such decline in essential services further threatens the health and lives of civilians, and can lead to disease and more deaths. For those who survive, life in the ruins becomes unbearable, and they may be left with no choice but to flee.

Moreover, the massive destruction inflicted on infrastructure in cities, towns and other populated areas, by the protracted use of heavy explosive weapons, creates a monumental challenge for post-conflict reconstruction and development. Consider Yemen, for instance: four years of armed conflict – with predominant use of heavy explosive weapons – pushed the country back twenty years in its development index.⁵

As the specific vulnerability of civilians in populated areas becomes better known and understood, and with urban warfare being far too frequent and protracted, the humanitarian consequences of the use of explosive weapons with a wide impact area in populated environments are increasingly foreseeable. They must therefore be given close attention by political leaders and policymakers, and taken into account by military commanders⁶ when planning and conducting military operations. The pronounced vulnerability of civilians in populated areas, and the devastation we are all too familiar with in recent urban conflicts, demand a reassessment of the choice of means and methods of warfare – and in particular of weapons – when conducting hostilities in such environments.

⁴ *Ibid.*

⁵ UN Development Programme (UNDP), *Human Development Report 2020: Yemen*: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/YEM.pdf; UNDP, *Human Development Indices and Indicators: 2018 Statistical Update, Yemen*: http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf; and A. Guterres and P. Maurer, “Explosive weapons in cities: Civilian devastation and suffering must stop”, Statement, 18 September 2019: <https://www.icrc.org/en/document/explosive-weapons-cities-civilian-devastation-and-suffering-must-stop>.

⁶ The term ‘commander’ is used throughout this report to refer to those who plan, decide upon and conduct military operations and attacks.



A group of children play football against a backdrop of destroyed houses in Sa'ada, Yemen.

But there are no easy choices for military commanders or their political leaders when wars take place in cities, towns and other population centres. Protecting civilians and civilian objects against the dangers of military operations is typically far more complex in such environments than in rural areas, and the challenges only increase with the density of the population, the degree of integration of civilian infrastructure and interdependency of essential urban services, and the close proximity of civilians and civilian objects to military objectives.

The humanitarian consequences of the use of explosive weapons with a wide impact area in populated areas have been the focus of increasing attention from states, international organizations and non-governmental organizations (NGOs), notably in debates on the protection of civilians and in connection with arms control and disarmament. Increasingly, inferences are being drawn, linking devastating civilian harm with the types of weapon used and the populated environment in which they are used.

The ICRC has been publicly expressing its concern about the use of heavy explosive weapons in populated areas since 2009.⁷ Its concern is based on its observation and documentation of the impact of the use of heavy explosive weapons in populated areas in many armed conflicts fought over the last decade in urban or other populated areas, including in Afghanistan, Colombia, Gaza, Iraq, Lebanon, the Lake Chad region, Libya, Myanmar, Nagorno-Karabakh, the Philippines, Somalia, Sri Lanka, Syria, Ukraine and Yemen. The ICRC has expressed its concern to and raised the issue with the parties to armed conflicts – both states and non-state armed groups – as part of its bilateral and confidential dialogue on the necessity of respecting IHL in the conduct of hostilities.

⁷ J. Kellenberger, “Sixty years of the Geneva Conventions: Learning from the past to better face the future”, Address during the ceremony to celebrate the 60th anniversary of the Geneva Conventions, 12 August 2009: <https://www.icrc.org/en/doc/resources/documents/statement/geneva-conventions-statement-president-120809.htm>



An ICRC staff member playing with children in the Hamam Halaleel camp for people displaced during the hostilities in and around Mosul, Iraq.

Since 2011, based on its observation of the direct and indirect harm to civilians caused by the use of heavy explosive weapons in populated areas, the ICRC has been calling on states and parties to armed conflicts **to avoid using “explosive weapons with a wide impact area in densely populated areas, due to the significant likelihood of indiscriminate effects and despite the absence of an express legal prohibition for specific types of weapons”**.⁸ This call has also been made by the International Red Cross and Red Crescent Movement as a whole.⁹

Likewise, the secretary-general of the United Nations continues to call on states to avoid the use of wide-impact explosive weapons in populated areas¹⁰ and has provided a framework for action in this direction in his *Agenda for Disarmament* launched in 2018.¹¹ A growing number of states and NGOs are calling for robust measures to strengthen protection for civilians against the use of explosive weapons in populated areas, and more generally to strengthen respect for IHL in urban warfare. Initiatives are under way to identify and consolidate necessary policy restrictions on the use of heavy explosive weapons in populated areas through political commitments and/or the development and exchange of good practices, including by means of a political declaration to address the civilian harm caused by the use of these weapons.¹²

8 See, for example, ICRC Challenges Report 2011, cited in footnote 1 above, pp. 40–42; ICRC Challenges Report 2015, cited in footnote 1 above, p. 48; and ICRC, *International Humanitarian Law and the Challenges of Contemporary Armed Conflicts*, Report prepared for the 33rd International Conference of the Red Cross and Red Crescent, Geneva, 2019 (ICRC Challenges Report 2019), p. 13. The scope of the term ‘populated area’ is explained in point 3 of the text box at the end of this introduction. The ICRC no longer refers to ‘densely’ populated areas, as the qualifier ‘densely’ and the distinction between ‘densely populated’ and ‘populated’ areas are undefined and may be deemed arbitrary. (For further discussion of this, see Chapter 5.)

9 See Council of Delegates, “Weapons and International Humanitarian Law”, adopted by Resolution 7 of the 2013 Council of Delegates (CD/13/R7), para. 4, calling on states to “strengthen the protection of civilians from the indiscriminate use and effects of explosive weapons, including through the rigorous application of existing rules of international humanitarian law, and to avoid using explosive weapons with a wide impact area in densely populated areas”.

10 Most recently in UN Security Council, *Report of the Secretary-General on the Protection of Civilians in Armed Conflict*, UN Doc. S/2021/423, 24 May 2021 (UNSG Report 2021), p. 3. The UN Secretary-General has repeated this or similar calls in all of his reports to the UN Security Council on the protection of civilians in armed conflict since 2012.

11 UN Office for Disarmament Affairs, *Securing Our Common Future: An Agenda for Disarmament*, United Nations, New York, May 2018, pp. 34–36.

12 Government of Ireland, Department of Foreign Affairs, “Protecting Civilians in Urban Warfare”, 2021: <https://www.dfa.ie/our-role-policies/international-priorities/peace-and-security/ewipa-consultations/>

For its part, the ICRC has further documented and analysed the consequences for civilians of the use of explosive weapons with a wide impact area in populated areas; their foreseeable effects based on their technical characteristics; the issues raised under IHL; and the restraints already being applied by some armed forces when conducting hostilities in populated areas, including on the use of certain explosive weapons in recognition of their intrinsic inaccuracy or other area effects.



The ICRC provided the people of Benghazi, Libya, with food and essential household items and supported the repair of water infrastructure and health-care facilities.

This report presents the ICRC's observations and conclusions based on this analysis and its ongoing dialogue with armed forces, parties to armed conflict, policymakers and the expert community, including other humanitarian organizations.

- Chapter 1 addresses the **humanitarian impact** of the use of explosive weapons with a wide impact area in populated areas, in particular its direct and indirect effects on civilians.
- Chapter 2 presents the key **technical features**, and consequent foreseeable area effects, of the explosive weapons of concern.
- Chapter 3 analyses the issues raised by the use of explosive weapons with a wide impact area in populated areas under the **rules of IHL** governing the conduct of hostilities.
- Chapter 4 summarizes what is known of existing **military policies and practices** relevant to the use of explosive weapons with a wide impact area in populated areas.
- Chapter 5 concludes with an articulation and unpacking of the ICRC's overarching policy recommendation – the '**avoidance policy**' – followed by a range of '**good practice**' **recommendations** addressed to political authorities, armed forces and non-state armed groups.

The urbanization of warfare makes it all the more urgent to identify concrete and practical measures to reduce the risk to civilians posed by the use of explosive weapons with a wide impact area in populated areas. The ICRC believes that the 'good practice' recommendations in this report can help to guide states and parties to armed conflicts that endeavour in good faith to comply with IHL, and can lead to better protection for civilians in populated areas.

EXPLOSIVE WEAPONS WITH A WIDE IMPACT AREA IN POPULATED AREAS: SCOPE OF THE ISSUE

In the ICRC's view, the use of explosive weapons with a wide impact area should be avoided in populated areas, due to the significant likelihood of indiscriminate effects and despite the absence of an express legal prohibition for specific types of explosive weapons.

1. **'Explosive weapons'** are munitions activated by the detonation of a high explosive substance creating primarily a blast-and-fragmentation effect, and their delivery systems. Weapons designed to injure or damage by means other than explosive force (e.g. incendiary weapons or chemical weapons) are not within the scope of this report.
2. The focus is on **'explosive weapons with a wide impact area'** because they raise particular concerns when used in populated areas. These concerns stem from the significant likelihood that their effects will go well beyond the target: and therefore, when used in populated areas, impact civilians and civilian objects indiscriminately. Explosive weapons of concern can be broken down into three broad categories, all of which are highly likely to impact an area significantly larger than the target:
 - a. weapons that have a wide impact area because of the **large destructive radius of the individual munition used**, i.e. its large blast-and-fragmentation range or effect (such as large bombs or missiles)
 - b. weapons that have a wide impact area because of the **inaccuracy of the delivery system** (such as indirect-fire weapons, including artillery and mortars, particularly when unguided)
 - c. weapons that have a wide impact area because the weapon system is designed to deliver **multiple munitions simultaneously over a wide area** (such as MBRLs).

In this report, the terms 'explosive weapons with wide area effects' and 'heavy explosive weapons'¹³ are used synonymously with 'explosive weapons with a wide impact area'.

3. **'Impact area'** (also referred to as **'area effects'**) is the area over which the explosion may be expected to cause, or risks causing, direct effects (owing to blast, fragmentation and heat).
4. The focus is on the use of explosive weapons with a wide impact area in **'populated areas'**, meaning any **concentration of civilians** or of **civilians and civilian objects**, be it in a city, town or village, or in a non-built-up area, and be it permanent or temporary.¹⁴
5. The term **'urban warfare'** is commonly used in discussions about hostilities in cities and other populated areas. **There is no common understanding of what an 'urban' context is, but the ICRC has suggested that it would encompass the notion of a built-up area containing a complex network of components – including critical infrastructure (such as electricity, water supply, and wastewater installations, as well as health-care facilities) – that enable and support the delivery of essential services on which civilian inhabitants rely**

¹³ The term 'heavy' is not used here to describe the calibre of the munition (according to which weapons are commonly classified as 'light', 'medium' or 'heavy' [calibre]), although the larger the calibre, the wider the area effects of a weapon will normally be.

¹⁴ For more details on the meaning of these terms, see Chapter 3. For further discussion of the scope of 'populated areas' for the purposes of this report, see Chapter 5.

for meeting their basic needs and for their survival.¹⁵ While urban warfare is increasingly being singled out for specific attention by militaries, because of the particularly complex and challenging nature of military operations in built-up urban environments, the risk of indiscriminate effects due to the concentration of civilians and civilian objects also exists in populated areas that are not urban. The notion of **'populated area'** is therefore more appropriate for the purpose of addressing the use and effects of explosive weapons with a wide impact area.

6. To **'avoid the use'** means that explosive weapons with a wide impact area **should not be used** in populated areas, **unless sufficient mitigation measures are taken** to limit the weapons' wide area effects and the consequent risk of civilian harm.
7. This report **does not consider explosive weapons that are already expressly prohibited** by existing IHL treaties, such as anti-personnel mines and cluster munitions, even though the latter in particular would fall within the category of explosive weapons with a wide impact area.¹⁶
8. This report also does not address the serious concerns raised by **direct attacks against civilians and civilian objects**, which are clearly unlawful under IHL. It deals instead with the humanitarian consequences of using explosive weapons with a wide impact area against military objectives (i.e. lawful targets) located in populated areas.
9. **Improvised explosive devices (IEDs)** are included in the scope of the analysis insofar as they fall into one of the three categories of explosive weapons with a wide impact area mentioned in item 2 of this list.
10. This report does not question the **legitimacy of directing attacks against military objectives located in populated areas** *per se*. Rather the concern is with the means and methods chosen to attack lawful targets in populated areas. Such choices should be assessed in light of humanitarian, technical, military, legal and policy considerations, with a view to providing effective protection for civilians and civilian objects.
11. The analysis concerns the use of heavy explosive weapons **in armed conflicts**, whether international or non-international, and whether used by state armed forces or non-state armed groups. The use of such weapons in situations of violence other than armed conflict is beyond the scope of this report. The applicable legal framework is therefore IHL, also referred to as the 'law of armed conflict' or 'the laws of war'.

¹⁵ ICRC Urban Services Report, cited in footnote 3 above, p. 17. As the report explains, there is no agreed definition of what makes a context 'urban', and the distinction between 'rural' and 'urban' is becoming increasingly blurred. An 'urban area' can refer to a broad range of contexts. See, for example, UN-Habitat, *Urban Indicators Guidelines*, UN-Habitat, August 2004 (<https://unhabitat.org/sites/default/files/download-manager-files/Urban%20Indicators.pdf>), according to which the city of Tokyo and a village of 2,000 people in Angola are officially classified as 'urban'. Existing definitions of 'urban' are normally based on population density and/or a geographic area defined by municipal authorities.

¹⁶ Anti-Personnel Mine Ban Convention (1997); Convention on Cluster Munitions (2008); Amended Protocol II to the Convention on Certain Conventional Weapons (1996).

CHAPTER 1

HUMANITARIAN CONSEQUENCES OF THE USE OF EXPLOSIVE WEAPONS WITH A WIDE IMPACT AREA IN POPULATED AREAS

KEY FINDINGS

- The ICRC's first-hand experience and documentation, and data collected by other field-based organizations, confirm that **the use of explosive weapons with a wide impact area in populated areas is a major cause of civilian harm. Women and children** are particularly vulnerable.
- Civilians within the weapon's impact area **are likely to be killed or injured, and civilian property and infrastructure damaged or destroyed.** The blast, fragmentation and heat generated by explosive weapons and their secondary effects typically **cause multiple types of physical injury**, often in combination.
- When heavy explosive weapons are used in populated areas, **health-care** facilities have to manage large numbers of wounded people, arriving at the same time, with multiple and complex traumatic injuries. These challenges are amplified during protracted hostilities, when hospitals and the services they rely on, or ambulances, are damaged and when health personnel are harmed or forced to leave.
- Survivors of explosive weapons in populated areas are often left with **lifelong disabilities**, including due to amputations. Massive explosions and protracted use of heavy explosive weapons are also known to have a significant impact on **psychological and mental health.**
- The use of heavy explosive weapons in populated areas also causes significant **indirect (or reverberating) effects. Critical civilian infrastructure** is damaged or destroyed, and operators are harmed or without safe access to repair, operate or maintain it. This results in **disruption of the delivery of services essential for the survival of civilians**, such as electricity, water and sanitation, and health care. Protracted use of heavy explosive weapons exacerbates these effects and causes the degradation of essential services over time, creating **serious risks for public health**, such as the outbreak and spread of disease and further deaths.
- **These indirect effects affect a much larger part of the population than that in the weapon's impact area, and can extend over time and space.** They are increasingly known and foreseeable, given the prevalence of urban warfare, the availability of public source information and relevant studies, and advances in remote-sensing technology.
- The sustained use of heavy explosive weapons in populated areas is a major driver of **displacement** of civilians, whose reasons for fleeing include, notably, fear for their lives, destruction of their homes, loss of their livelihoods, and degradation of services essential to their survival.

- The use of explosive weapons typically results in contamination by **UXO**, which further threatens the livelihoods, limbs and lives of civilians and hampers the return of displaced people.
- There are concerns about the impact on the **natural environment**, and consequently on public health, of hazardous substances that may be released by the use of heavy explosive weapons in populated areas, either from the components of the munitions themselves or when structures or facilities containing such substances are damaged.
- Reconstruction costs and further **impact on development** can be enormous, especially when the use of heavy explosive weapons in populated areas has been protracted. Destruction of income-generating assets such as shops or livestock, and the death or injury of breadwinners, leads to **loss of livelihoods**. And extensive destruction, heavy loss of lives and livelihoods, and mass displacement can destroy the social fabric of communities.

1.1 INTRODUCTION

The ICRC's point of departure when engaging in dialogue with governments and armed forces on how hostilities are conducted, including on the impact of weapons, is to report on their effects on people's lives and well-being, applying an objective analysis. Working on the frontlines of armed conflicts, the ICRC witnesses and documents the humanitarian consequences of the conduct of hostilities, including those taking place in populated areas. It reminds belligerents of their obligations under IHL, including the requirement to take constant care to spare civilians and civilian objects in the conduct of military operations, and other rules aimed at protecting the civilian population. In addition, the ICRC directly assists, or supports assistance to, persons wounded by weapons of war: this takes the form of first aid, transport to hospital, surgical care and physical rehabilitation for tens of thousands of people in towns, cities and refugee camps that have suffered bombardment, shelling and other use of heavy explosive weapons.¹⁷ The ICRC's weapons analysis is based on consideration of several factors: humanitarian, legal, military and technical.



This father of five and his ten-year-old daughter were wounded when a rocket landed on their house in Zanjili, Iraq. Two of his children were killed.

¹⁷ C. Giannou and M. Baldan, *War Surgery: Working with Limited Resources in Armed Conflict and Other Situations of Violence*, Vol. 1, ICRC, May 2010 (ICRC War Surgery Manual, Vol. 1), pp. 46–47. ICRC surgical hospitals have in the past provided health-impact data on a number of weaponry issues: one study in particular showed that some explosive weapons have a distinct propensity to injure civilians, notably explosive weapons delivered from a distance. See, for example, R. M. Coupland and H. O. Samnegaard, “Effect of type and transfer of conventional weapons on civilian injuries: Retrospective analysis of prospective data from Red Cross hospitals”, *British Medical Journal*, Vol. 319, No. 7207, August 1999, pp. 410–412.

The ICRC also has extensive experience in mitigating health risks, such as communicable diseases, notably for populations affected by armed conflicts taking place in urban areas. The ICRC's emergency response is activated in the affected areas with the aim of maintaining or restoring provision of essential services to the population, for example when they have been disrupted as a consequence of critical civilian infrastructure being damaged by heavy explosive weapons.¹⁸ In this respect, the ICRC also provides longer-term support to local service providers to strengthen the resilience of essential-service systems, in order to mitigate the humanitarian consequences that might follow when essential services are affected by the use of heavy explosive weapons.

The impact of warfare in populated areas can, among other ways, be assessed by framing the issue in public-health terms. The World Health Organization (WHO) defines health as “a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity”.¹⁹ Thus, the human cost of the use of heavy explosive weapons in populated areas encompasses their impact on the health of both individuals and populations.

Following an overview of the pattern of civilian harm observed when heavy explosive weapons are used against military objectives located in populated areas, this chapter highlights the various kinds of impact – both direct and indirect – of their use from a strictly **humanitarian perspective**. While it does not necessarily follow that parties to armed conflicts are required to take into account all these various kinds of impact to comply with IHL,²⁰ the harmful effects of weapons on people are relevant considerations from a humanitarian perspective, regardless of the manner in which IHL considers them and the extent to which it does so.

1.2 A PATTERN OF CIVILIAN HARM

The ICRC's on-the-ground documentation of the impact on civilians of warfare conducted in populated areas, in some fifteen contexts over the last decade, has confirmed that **the use of explosive weapons with wide area effects in populated areas is a major cause of civilian harm**.²¹

Cases collected by the ICRC show a trend of extensive suffering among civilians when military objectives (lawful targets) located in populated areas were attacked with explosive weapons that are inaccurate or that are otherwise prone to wide area effects – such as artillery guns, most mortars, rocket artillery, MBRLs, air-delivered general-purpose bombs, and large IEDs.

Effects have been typically observed well beyond the target: high numbers of civilian deaths and injuries; mental and psychosocial harm; significant damage to and destruction of civilian property and critical infrastructure; disruption of services essential to the survival of the civilian population, including water, electricity, sanitation and health care; contamination by UXO; impact on the natural environment; displacement of the civilian population; and impact on development, among other reverberating impacts. These ‘incidental’ effects are particularly severe when the use of heavy explosive weapons is repeated and protracted over days, weeks and even months. Children and women are especially vulnerable.

These observations are corroborated by data, reports and studies from a variety of international organizations and NGOs. No global statistics, comprehensive and verified, exist; the distinction between heavy and other explosive weapons is not always made; and figures often diverge: even so, these reports – whose main findings are briefly summarized in the following sections –

¹⁸ For example, in Iraq, in 2018, 2.5 million people benefited from improved access to safe drinking water through the rehabilitation of 47 water-supply systems. For an overview of the ICRC's work on essential services, see ICRC Urban Services Report, cited in footnote 3 above.

¹⁹ WHO, *Health Promotion Glossary*, WHO, Geneva, 1998, p. 1.

²⁰ The expected incidental civilian harm that those planning and deciding upon attacks are required to assess under IHL rules is discussed in Chapter 3 below.

²¹ The ICRC documents specific incidents primarily as a basis for dialogue with the relevant parties to the conflict and not for statistical purposes. A few examples are nonetheless provided in the sub-sections below. These figures represent only the data that the ICRC collected and are not the full picture.



A. Yousef/ICRC

Farmers in eastern Aleppo, Syria, sell their produce ahead of Ramadan. Life goes on, but the scars of war remain.

confirm that the pattern of harm resulting from the use of heavy explosive weapons in populated areas consists annually in thousands of civilians killed or injured, and large parts of cities damaged or destroyed in the course of major urban battles; hundreds of thousands of civilians displaced or without access to basic services; and reconstruction costs measured in billions of dollars.

The use of heavy explosive weapons in populated areas can affect people's lives and health in several ways, depending on the density of civilian populations and civilian structures in a given area, that area's topography, the built environment, and the type and number of weapons used. The humanitarian consequences of the use of heavy explosive weapons in populated areas typically observed by the ICRC and other field-based organizations are discussed in more detail in the following sub-sections.

1.3 PHYSICAL EFFECTS OF EXPLOSIVE WEAPONS ON PEOPLE

A major characteristic of explosive weapons with a wide impact area is the number of people that can be affected by their use, in comparison with other weapons such as small arms and certain light weapons. Tens or even over a hundred people can be killed or injured by a single explosion. The extent of damage to people or objects is determined notably by the amount and type of the explosive material, and how it is contained. Obviously, people and objects closest to the centre of the explosion suffer the greatest harm and damage. And the potential for heavy explosive weapons to cause civilian deaths, injury and damage in a given area increases in direct proportion to the density of the population and of civilian objects in that area, and also with the number of such weapons used.

1.3.1 Death and injuries

Between March 2017 and July 2018, urban offensives in four governorates in Iraq and Syria, consisting largely of heavy bombardment and shelling, accounted for an estimated 6,485 civilian deaths. This figure represents eight times more conflict-related civilian deaths than those that occurred in fighting outside urban areas, and 78% of all civilian loss of life caused by fighting in those countries during the period in question.²²

The UN secretary-general's reports to the UN Security Council on the protection of civilians in armed conflict, which are based on extensive documentation by UN agencies and NGOs, consistently highlight the high levels of civilian casualties when explosive weapons, including those with wide area effects, are used in populated areas.²³

In particular, Action on Armed Violence (AoAV), an NGO, surveys reports in daily English language media of explosive-violence incidents from around the world. AoAV's work reveals that during the period from 2011 to 2020, civilians accounted for 91% of those reported killed or injured when explosive weapons were used in populated areas, a pattern that remained constant throughout their monitoring.²⁴ It must be noted that this figure is not limited to explosive weapons with a wide impact area. While AoAV's documentation is not limited to attacks directed against military objectives – which is often difficult to verify – its recent synthesis report concluded that civilians made up 69% of the casualties from attacks that were “explicitly coded as targeting military actors” in populated areas.²⁵

The following facts and figures, taken from various contexts and conflicts, illustrate this grim reality:

- In **Gaza**, the use of heavy explosive weapons during the 2014 military operations reportedly resulted in 1,500 civilians being killed and approximately 11,000 people, mostly civilians, injured.²⁶ During the 2009 military operations, approximately 1,160 civilians were reported killed over the course of the 23-day hostilities, and around 5,000 injured.²⁷
- In **Afghanistan**, the UN Assistance Mission in Afghanistan (UNAMA) documented, in 2020, over 2,000 civilian casualties from indirect fire (including mortars, artillery and rockets), which constituted the primary cause of civilian casualties during ground engagements.²⁸
- In **Iraq**, while the total count of civilians killed and injured as a result of the use of heavy explosive weapons during the military operation to retake Mosul from the Islamic State group is uncertain, and though figures vary significantly between local authorities, coalition sources, UN agencies and NGOs, even the most conservative estimates indicate a high rate of fatality.

²² ICRC, “New research shows urban warfare eight times more deadly for civilians in Syria and Iraq”, News release, 1 October 2018: <https://www.icrc.org/en/document/new-research-shows-urban-warfare-eight-times-more-deadly-civilians-syria-iraq>.

²³ See, most recently, UNSG Report 2021, cited in footnote 10 above.

²⁴ J. Dathan, *A Decade of Explosive Violence Harm*, Action on Armed Violence (AOAV), London, May 2021, (AOAV Synthesis Report). The methodology applied is described in pp. 46–48.

²⁵ *Ibid.*, p. 33.

²⁶ Human Rights Watch, *World Report 2015*, Human Rights Watch, Washington D.C., 2015, (HRW World Report 2015), p. 308.

²⁷ UN Human Rights Council, *Report of the United Nations Fact-Finding Mission on the Gaza Conflict*, UN Doc. A/HRC/12/48, 25 September 2009, paras 30 and 1254; Palestinian Centre for Human Rights (PCHR), *Targeted Civilians: A PCHR Report on the Israeli Military Offensive against the Gaza Strip (27 December 2008–18 January 2009)*, Palestinian Centre for Human Rights, Gaza City, September 2009, p. 10; and K. Smith, *Devastating Impact: Explosive Weapons and Children*, Save the Children, London, 2011, pp. 4–6.

²⁸ UN Assistance Mission in Afghanistan (UNAMA) and UN Office of the High Commissioner for Human Rights (OHCHR), *Afghanistan: Protection of Civilians in Armed Conflict – Annual Report 2020*, UNAMA, Kabul, February 2021, p. 73.

- In **Iraq** again, in 2016, the ICRC documented 42 incidents involving the use of heavy explosive weapons in Fallujah, 37 of which were described as indirect fire consisting mainly of mortars and rockets. These 42 incidents left at least 115 civilians dead and 150 injured.²⁹
- In **Yemen**, in July 2015, a single attack by mortar shelling in Aden resulted in 107 civilians being killed and another 198 wounded, according to UN estimates.³⁰
- In **Somalia**, in October 2017, a truck bomb weighing between 600 and 800 kg was detonated in central Mogadishu, triggering the explosion of a nearby fuel tanker and killing at least 500 people and wounding 300.³¹
- In **Libya**, in 2018, 47 civilians were killed and 54 injured during the month of May alone; the UN Support Mission in Libya (UNSMIL), which documented these figures, attributed most of the casualties to shelling.³²

The following sub-section outlines the types of injury caused by the use of heavy explosive weapons in populated areas, and the challenges faced by health-care providers in treating victims.

1.3.2 Types of injury

In today's armed conflicts more injuries are caused by explosive weapons than by bullets and landmines.

– Dr Marco Baldan, Senior Surgeon, ICRC, October 2019

Explosive weapons injure and damage principally through **blast**, **fragmentation** and **heat**.³³ Most war wounds treated today are caused by fragments from some sort of explosive device.³⁴

The detonation of a high-energy explosive generates two distinct blast effects: a **blast wave**, which is a high pressure 'shock wave' travelling at supersonic speed and causing rapid and large changes in atmospheric pressure, immediately followed by a mass movement of air as the explosive gases expand, often referred to as '**blast wind**'. Both blast waves and blast winds cause injuries, but by different mechanisms.³⁵

As the **blast wave** passes through an unprotected person, it affects all parts of the body, especially those normally containing air, such as the lungs, intestines and ears. These can be lacerated

29 See, for example, S. George, *et al.*, "Mosul is a graveyard: Final IS battle kills 9,000 civilians", Associated Press (AP), 21 December 2017: <https://apnews.com/article/middle-east-only-on-ap-islamic-state-group-bbea7094fb954838a2fdc11278d65460>. AP estimates that between 9,000 and 11,000 civilians were killed, based on information from Amnesty International, Iraq Body Count and the UN.

30 UN Human Rights Council, *Situation of Human Rights in Yemen: Report of the UN High Commissioner for Human Rights*, UN Doc. A/HRC/33/38, 4 August 2016, para. 19.

31 A. Gulled, "Final death toll in Somalia's worst attack is 512 people", AP, 2 December 2017: <https://apnews.com/article/160cb4be68434264ae1c9df9e20addab>.

32 UN Support Mission in Libya (UNSMIL), "Human Rights Report on Civilian Casualties – May 2018", 1 June 2018: <https://unsmil.unmissions.org/human-rights-report-civilian-casualties-may-2018>.

33 For a description of the principal damage mechanisms of explosive weapons, see Chapter 2.

34 C. Giannou, M. Baldan and Å. Molde, *War Surgery: Working with Limited Resources in Armed Conflict and Other Situations of Violence*, Vol. 2, ICRC, Geneva, March 2013 (ICRC War Surgery Manual, Vol. 2), Section 19.3, p. 29.

35 ICRC War Surgery Manual, Vol. 1, cited in footnote 17 above, Section 3.1.4, p. 58; ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section A.3, pp. 20–21. Other authoritative texts contain more detailed explanations of the pathogenesis and pathophysiology of blast injury. See, for example, E. Kirkman *et al.*, "Blast injury", in A. J. Brooks *et al.* (eds), *Ryan's Ballistic Trauma: A Practical Guide*, 3rd ed., Springer-Verlag, London, 2011, pp. 87–123.

or perforated by the blast wave, depending on the individual's proximity to the blast, and even without evidence of external injury. Lung injuries ('blast lung') carry the highest morbidity and mortality.³⁶

The **blast wind** can make buildings collapse and throw people against objects or objects against people, causing blunt, crush or penetrating wounds.³⁷

The blast produces and propels **fragments** both from the casing and components of the explosive munition (primary fragmentation) and from various objects in the environment, such as stones, bricks, metal and glass shards, and bone fragments (secondary fragmentation). Fragments propelled by an explosion cause penetrating injury, and as with all projectiles, the extent of the injury that may be caused by a single such fragment is determined by the mass and the velocity of that fragment.³⁸



A boy in Kandahar, Afghanistan, receives hospital treatment for mortar wounds.

When interviewed within the context of the armed conflict that broke out in eastern Ukraine in 2014, a morgue doctor noted that 99% of the civilian casualties received by the morgue during the hostilities had died of fragmentation injuries caused by explosive weapons.³⁹

³⁶ 'Blast lung' (rupture of the lung alveoli and their capillaries) is particularly dangerous because pulmonary damage can develop as a result of lung contusion up to 48 hours later. It is the most lethal injury among survivors. See ICRC War Surgery Manual, Vol. 1, cited in footnote 17 above, Section 3.1.4, p. 58; ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.7, pp. 36–39.

³⁷ ICRC War Surgery Manual, Vol. 1, cited in footnote 17 above, Section 3.1.4, p. 58; ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.4.3, p. 34.

³⁸ ICRC, *Wound Ballistics: An introduction for health, legal, forensic, military and law enforcement professionals* (film with additional information), ICRC, Geneva, June 2008, Chapters 1 and 12; Geneva International Centre for Humanitarian Demining (GICHD), *Explosive Weapons Effects: Final Report*, GICHD, Geneva, February 2017, (GICHD Explosive Weapons Effects Report), pp. 59–60; ICRC War Surgery Manual, Vol. 1, cited in footnote 17 above, Section 3.1.4, p. 58; and ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.4.2, p. 34.

³⁹ S. Goose and O. Solvang, "Deadly Cargo: Explosive Weapons in Populated Areas", in HRW World Report 2015, cited in footnote 26 above, p. 28.



Ibrahim from Lebanon received treatment for severe burns to his legs when a nearby gas station was hit by a shell and exploded.

Burns may be caused by the fireball of the explosion itself or by fires ignited by the explosion (secondary fires).⁴⁰ All degrees of burn severity are possible. Mortality from major burn injury in any context is high and death may occur days or weeks later through organ failure and infection. Morbidity and mortality are also increased by the toxic fumes produced by the fires and inhaled by the victims.

Besides the conventional types of injury mentioned above, studies have also described the risk of **biological contamination**, including from viruses such as Hepatitis B and C and HIV found in the blood, other body fluids and tissue fragments (particularly bone fragments) of persons wounded by an explosion, which are disseminated by the explosion and act as an infectious source.⁴¹

⁴⁰ ICRC War Surgery Manual, Vol. 2, cited in footnote 34, above, Section 19.3.1, p. 31 and Section 19.11, p. 40.

⁴¹ Centers for Disease Control and Prevention (CDC), "Recommendations for postexposure interventions to prevent Infection with Hepatitis B Virus, Hepatitis C virus, or Human Immunodeficiency Virus, and tetanus in persons wounded during bombings and similar mass-casualty events — United States, 2008", *Morbidity and Mortality Weekly Report*, Vol. 57, No. RR-6, 1 August 2008, pp. 2–7; I. Braverman, D. Wexler and M. Oren, "A novel mode of infection with Hepatitis B: Penetrating bone fragments due to the explosion of a suicide bomber", *The Israel Medical Association Journal*, Vol. 4, No. 7, July 2002, pp. 528–529.

When an explosive device is detonated, the number of casualties and the distribution of different kinds of injury are determined by a number of factors, such as: the power of the explosion (the larger the bomb, the greater its destructive effects); the distance of people from the blast point and their degree of personal protection; and the environmental conditions (topography of the terrain, open or confined space, presence of buildings, presence of objects containing flammable or toxic material, etc.) that will determine how the blast wave spreads and what its primary and secondary effects will be. When people are injured by heavy explosive weapons in populated areas, typically all of the injury mechanisms mentioned above – blast wave, blast wind, fragmentation and heat – come into play, and most patients will have been affected by some combination of these.⁴²

Fatalities are highest among persons within the radius of the blast wave, which is generally smaller than the fragmentation radius. Indeed, within the blast radius, the density of primary and secondary fragments is so great that lethal injuries are caused by both the blast wave and fragments.⁴³ Survivors typically have more severe injuries than people who were outside this radius, and there will be a higher incidence among them of blast-wave injuries (or pressure-related injuries), including a predominance of ‘blast lung’ and of burns affecting a large body surface area.⁴⁴

Thus, explosions in enclosed or confined spaces – which are commonly found in built-up areas (e.g. a small market or square, a narrow street surrounded by tall buildings, or inside buildings or vehicles) – are particularly devastating, with mortality reaching 50% or higher.⁴⁵ This is because, in an enclosed space, blast waves are reflected off surfaces or channeled and thus intensified, therefore causing significantly more damage to the human body, including through increased secondary fragmentation.⁴⁶



People in Mogadishu, Somalia, prepare to move the unidentified bodies of those killed in an explosion.

⁴² ICRC War Surgery Manual, Vol. 1, cited in footnote 17 above, Section 3.1.4, p. 58; ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.3.1, pp. 29–31 and Section 19.5, p. 34.

⁴³ ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.2, p. 28 and Section 19.3, p. 29.

⁴⁴ D. Leibovici *et al.*, “Blast injuries: Bus versus open-air bombings – A comparative study of injuries in survivors of open-air versus confined-space explosions”, *The Journal of Trauma: Injury, Infection and Critical Care*, Vol. 41, No. 6, December 1996, pp. 1030–1035.

⁴⁵ ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.3.1, p. 31.

⁴⁶ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 91–92. Depending on the circumstances, obstacles such as buildings can form a relatively safe area immediately behind them by creating ‘turbulence’ when the blast wave passes over them, which is why sometimes people close to the explosion survive with relatively minor injuries, while those further away suffer more serious injuries or are killed. See also ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section A.4, p. 21.

The blast wave can cause traumatic brain injury, with long-term and debilitating effects. Clinical studies show that significant numbers of combatants exposed to blast events had traumatic brain injuries, ranging from mild to severe; based on these studies, it is reasonable to assume that the number of civilians affected by such injuries, during armed conflicts where heavy explosive weapons are used in populated areas, could also be high. As symptoms are in large part similar to those of post-traumatic stress disorder (PTSD, discussed further below), most patients may not be correctly diagnosed.⁴⁷

Multiple crush and blunt trauma injuries are also typical consequences of the use of heavy explosive weapons in populated areas, the result of people being inside buildings that collapse. Generally, there are very few survivors among those crushed by the rubble and trapped under it. The time taken to find and extract these people delays their treatment and increases the probability of eventual death or limb amputation. It can also produce ‘crush syndrome’, which was first described as a result of urban bombardment during World War II.⁴⁸



Seven-year-old Mustan suffered injuries to his legs and chest during shelling in Kandahar, Afghanistan.

⁴⁷ ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.4.1, pp. 33–34 and Section 19.5.2, p. 35; I. Cernak and L. J. Noble-Haeusslein, “Traumatic brain injury: An overview of pathobiology with emphasis on military populations”, *Journal of Cerebral Blood Flow and Metabolism*, Vol. 30, No. 2, 2010, pp. 255–266; J. Hamilton, “Pentagon shelves blast gauges meant to detect battlefield brain injuries”, NPR, 20 December 2016: <https://www.npr.org/sections/health-shots/2016/12/20/506146595/pentagon-shelves-blast-gauges-meant-to-detect-battlefield-brain-injuries> (indicating that mild brain injury seems to have been “the signature wound of the wars in Iraq and Afghanistan, affecting more than 200,000 [US] troops”); C. Alexander, “Blast force: The invisible war on the brain”, *National Geographic*, 2015: <https://www.nationalgeographic.com/healing-soldiers/blast-force.html> (on how explosive blast waves break neural connections in the brain); CDC, *Blast Injuries: Traumatic Brain Injuries*, U.S. Department of Health and Human Services, June 2009; and P. Scharre and L. Fish, “NDAA press note: TBI and DoD Study on blast pressure exposure”, Center for a New American Security, 12 December 2017: <https://www.cnas.org/press/press-note/cnas-press-note-tbi-and-dod-study-on-blast-pressure-exposure>.

⁴⁸ E. G. L. Bywaters and D. Beall, “Crush injuries with impairment of renal function”, *British Medical Journal*, Vol. 1, No. 4185, March 1941, pp. 427–432. ‘Crush syndrome’ is a reperfusion injury that causes kidney failure after the release of the crushing pressure. The mechanism is believed to be the release into the bloodstream of breakdown products of muscle that has been deprived of oxygen by the crush. See also ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section B.9, p. 90.

Hospitalized survivors display a prevalence of multiple fragment wounds, mostly involving the limbs and often leading to long-term disability.⁴⁹ Significant medical complications can arise from secondary fragmentation, especially when many small fragments are embedded in the body, including the eyes, which are particularly vulnerable to injuries from small particles of shattered glass or metal.⁵⁰

There was a loud explosion and a blast. The electricity went off. I felt pressure. The windows burst. Random things hit my face and body. Some things that were flying around were burning. Then I lost my sight. I remember that rubble fell on me. When I woke up, my ears were hurting, then I felt my whole body was hurting. I lost my right eye. Fragments have caused flesh wounds all over my face and body. My aunt who was in the kitchen with me died immediately. The other members of the family who were sleeping at the back of the house were wounded by the rubble of the house that fell on them. Two of them, my nine-year-old cousins, sustained multiple fractures.

– Anonymous civilian from Rural Damascus, Syria, September 2014

1.3.3 Health care implications

The difficulty in managing trauma patients who have suffered explosive force is not only the variety and complexity of injuries outlined above, but also the large numbers of people arriving at the same time. In many contexts, health-care personnel will have had no pre-conflict experience of managing either patients with these types of wound or such large numbers of wounded people.⁵¹ Health care needs increase dramatically in times of armed conflict and, because of war-related constraints, this occurs precisely at the moment when it is most difficult to address them.⁵² Simply put, on days when many people arrive in the admission area, some patients may die directly because the hospital's capacities have been overstretched.

It should be kept in mind that this account leaves out the mental impact on those providing health care, whether it be first aid or surgical care in hospital; this impact – for instance, the stress endured by these personnel – is even greater when they have to deal with influxes of patients suffering from multiple injuries caused by the explosion and covering the whole spectrum of trauma.⁵³

Burn injuries present a particular challenge for health care. Serious burns require longer hospitalization than other injuries, more operations, more blood for transfusion, skin grafting and specialized care.⁵⁴ Such extensive hospital resources are absent in many contexts, and generally lacking in situations where armed conflict has degraded health-care capabilities.

⁴⁹ Up to 85% of hospitalized survivors have musculoskeletal injuries. See ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.1, p. 27, and Section 19.3, pp. 29–31; Handicap International, *Causes and Types of Injuries Encountered by Handicap International while Working with Internally Displaced Persons in Syria: A Focus on the Impact of Explosive Weapons*, January 2014.

⁵⁰ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 60.

⁵¹ ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.2, pp. 27–28.

⁵² R. M. Coupland, “Epidemiological approach to surgical management of the casualties of war”, *British Medical Journal*, Vol. 308, No. 6945, June 1994, pp. 1693–1697.

⁵³ ICRC, *Health Care in Danger: The Responsibilities of Health-care Personnel Working in Armed Conflict and Other Emergencies*, ICRC, Geneva, August 2012 (<http://healthcareindanger.org/resource-centre/>), pp. 25–34; ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.2, pp. 27–28, Section 19.2, pp. 27–28, Section 19.2, pp. 27–28.

⁵⁴ D. Church *et al.*, “Burn wound infections”, *Clinical Microbiological Review*, Vol. 19, No. 2, April 2006, pp. 403–434.



ICRC doctors treat the wounded at Mosul General Hospital, Iraq, in 2017.

In addition, many of those in need of urgent medical care never arrive, or arrive too late, at a hospital or other medical facility, because ambulances have been destroyed, are unable to access the wounded in time, or otherwise unavailable; this often results in deaths or amputations that could have been prevented.

The security of health care itself is endangered by the use of heavy explosive weapons in populated areas. An ICRC study found that the number of people killed or injured per event of armed violence affecting health-care personnel or facilities is greater when explosive weapons are used, when compared to other weapons.⁵⁵ Between February 2012 and April 2015, the ICRC recorded some 80 incidents of violence against health care, where the use of heavy explosive weapons in populated areas caused incidental damage to health-care personnel or facilities: ground artillery accounted for 35% of this damage, IEDs 20%, air-delivered bombs 15%, and other unidentified explosive weapons 30%.

When not killed or injured, whether intentionally or incidentally, many health-care professionals flee conflict areas, including to escape from bombing and shelling. AoAV research found that “while damage to health infrastructure [is] often repaired within a matter of years, the loss of health personnel can persist for decades”.⁵⁶

⁵⁵ ICRC, *Health Care in Danger: A sixteen-country study*, ICRC, Geneva, July 2011, p. 12.

⁵⁶ J. Dathan, *Blast Injury: The Reverberating Health Consequences from the Use of Explosive Weapons*, AOAV, London, July 2020, (AOAV Blast Injury), p. 19.

1.3.4 Long-term and lifelong disabilities

Heavy explosive weapons have a long-term, and in many cases lifelong, impact on the life and health of the people injured by them. For example, a person who suffers a limb amputation because of injury from such a weapon will, in addition to first aid and multiple surgery, need lifelong care and physical rehabilitation – fitting and regular replacement of prosthesis, physiotherapy, etc. – in addition to mental health and psychosocial support (described in the next section).

During his or her rehabilitation, the person is generally not capable of contributing to the economic security of the household for a period of several months or more. And long-term disability is a particularly important concern in low-income countries with few resources for services such as physical rehabilitation and socio-economic reintegration.⁵⁷



Pictured here at the ICRC's physical rehabilitation centre in Kabul, Afghanistan, Mahmaddullah was caught in a bomb blast at the age of 14 and suffered a spinal cord injury that paralysed both legs.

Long-term disabilities and their implications, including for rehabilitation, are particularly marked in children, notably because their bodies are still growing. This lengthens and complicates their rehabilitation in comparison with adults, for example, because prosthetic limbs have to be regularly changed as the child grows.⁵⁸

⁵⁷ ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section B.3.2, p. 79.

⁵⁸ K. Smith, cited in footnote 27 above, p. 5; M. Kirolos *et al.*, *The War on Children: Time to End Grave Violations against Children in Conflict*, Save the Children, London, 2018, p. 34.



Four-year-old Omar was injured during the shelling of Eastern Ghouta in Syria. He was severely wounded in the head, chest and stomach. Damage to his spinal cord means he can no longer walk.

1.4 MENTAL HEALTH AND PSYCHOSOCIAL EFFECTS

“My sons are totally devastated. My elder son is no longer going to school owing to psychological issues. My husband used to work but because of the war, he is jobless. Now he is suffering from mental issues [and] he hits his sons.”

– Om Ali, displaced from Taiz, Yemen, 2016

1.4.1 Psychological distress from the explosive event and its aftermath

An explosion is a sudden, loud, extremely violent and dangerous event. That proximity to explosions has a psychological or mental health impact may seem obvious – even intuitive. But it is not always easy to isolate the impact of heavy explosive weapons from the multitude of stressors that affect people in situations of armed conflict, as exposure to explosive force is only one of many potentially traumatic events that could affect the mental health and well-being of individuals.⁵⁹ Nonetheless, there is substantial evidence of the psychological harm that follows explosive events.

⁵⁹ V. Papageorgiou *et al.*, “War trauma and psychopathology in Bosnian refugee children”, *European Child and Adolescent Psychiatry*, Vol. 9, No. 2, June 2000, pp. 84–90; A. K. S. Al Obaidi and S. F. Atallah, “Iraqi refugees in Egypt: An exploration of their mental health and psychosocial status”, *Intervention*, Vol. 7, No. 2, 2009, pp. 145–151.

Studies have documented that people who have been exposed to explosions, including heavy explosive weapons in the context of armed conflicts, experience psychological distress following the event. Symptoms include adjustment disorders, anxiety, depression, acute stress reactions, substance abuse and/or other psychosomatic health complaints. In some people, these symptoms appear days after the event, and in others, up to 24 months later.⁶⁰ They can be particularly acute in children.

During armed conflicts, many different heavy explosive weapons may be used for hours, days or even weeks at a time. During such heavy bombing and shelling, the threat of explosions can itself become an ongoing stressor for individuals, creating a heightened risk of severe and long-lasting mental and psychological distress.⁶¹ Certain military uses of artillery, such as ‘harassing’ fire or heavy ‘saturating’ fire, are designed in part to generate psychological distress in enemy combatants.⁶² When used against enemy combatants in populated areas, these means and methods of warfare can be expected to have similar effects on the civilian population.

The search for survivors in the rubble – involving protracted digging – and the uncertainty about whether those trapped can be rescued alive also exact a serious emotional toll on survivors, relatives and first responders. Collecting body parts, discovering disfigured remains and identifying mangled bodies is extremely distressing for relatives. In some instances, it may not be possible to recover or identify the dead, which creates an additional source of pain for the families.⁶³

Children suffer particularly from mental trauma as a result of bombing and shelling, and other forms of explosive violence. For example, a study of families living in the Gaza Strip found that children who had lost their homes owing to bombardment suffered severe-to-very-severe PTSD in comparison to a control group who had not experienced bombardment.⁶⁴ Children who lost loved ones in an explosion are gravely affected psychologically. Mental trauma can have a significant impact on children’s cognitive development and accompany them into adulthood. Recovery is uncertain, especially where conflict is protracted and mental health care unavailable.⁶⁵

⁶⁰ D. M. Lemonick, “Bombings and blast injuries: A primer for physicians”, *American Journal of Clinical Medicine*, Vol. 8, No. 3, 2011, pp. 134–140; F. M. Freh, M. C. Chung and R. Dallos, “In the shadow of terror: Posttraumatic stress and psychiatric co-morbidity following bombing in Iraq: The role of shattered world assumptions and altered self-capacities”, *Journal of Psychiatric Research*, Vol. 47, No. 2, February 2013, pp. 215–225; D. J. Somasundaram, “Post-traumatic responses to aerial bombing”, *Social Science and Medicine*, Vol. 42, No. 11, June 1996, pp. 1465–1471; M. Lahad and D. Leykin, “Ongoing exposure versus intense periodic exposure to military conflict and terror attacks in Israel”, *Journal of Traumatic Stress*, Vol. 23, No. 6, December 2010, pp. 691–698; C. S. North *et al.*, “Psychiatric disorders among survivors of the Oklahoma City bombing”, *Journal of the American Medical Association*, Vol. 282, No. 8, August 1999, pp. 755–762; and J. J. Miguel-Tobal *et al.*, “PTSD and depression after the Madrid March 11 train bombings”, *Journal of Traumatic Stress*, Vol. 19, No. 1, February 2006, pp. 69–80. In relation to accidental explosions in peacetime, see, for example, S. Rivière *et al.*, “Psychosocial risk factors for depressive symptoms after the AZF chemical factory explosion in Toulouse, France”, *European Journal of Public Health*, Vol. 20, No. 6, December 2010, pp. 625–630.

⁶¹ Article 36, *The Impact of Explosive Violence on Mental Health and Psycho-social Well-being*, Briefing Paper, Article 36, London, September 2013.

⁶² O. S. Dullum *et al.*, *Indirect Fire: A Technical Analysis of the Employment, Accuracy, and Effects of Indirect-fire Artillery Weapons*, Armament Research Services (ARES), Perth, January 2017 (ARES Indirect-Fire Report), pp. 81–82; J.B.A. Bailey, *Field Artillery and Firepower*, Military Press, Oxford, 2003, p. 322, footnote 207: “the most potent characteristic of [saturation fire] is the shock and psychological effect created by sheer weight of explosive”.

⁶³ ICRC, *Accompanying the Families of Missing Persons: A Practical Handbook*, ICRC, Geneva, March 2013, pp. 40–48.

⁶⁴ A. A. Mousa Thabet, Y. Abed and P. Vostanis, “Emotional problems in Palestinian children living in a war zone: A cross-sectional study”, *The Lancet*, Vol. 359, No. 9320, 25 May 2002.

⁶⁵ V. Hubbard, “The impact of explosive violence on children’s psychological health”, AOVAV, 12 January 2021: <https://aoav.org.uk/2021/the-impact-of-explosive-violence-on-childrens-psychological-health/>.



The Palestine Red Crescent Society provides psychosocial support to Gazan children. They are encouraged to express their feelings through art to help them cope with fear and anxiety.

“Our neighbourhood has been subjected to bombings countless times; sometimes the attacks lasted for days. The sound of the explosions and the trembling of the earth was terrifying. We never knew if we would be the next ones to lose our home. My five-year-old daughter was particularly affected, and she has lost her speech. This is when we decided to leave Syria. We are in Lebanon for over a year now and still she does not talk. The slightest sound makes her wince.”

– Refugee from Zabadani, Rural Damascus, Syria, 2014

1.4.2 Mental health and psychosocial sequelae concurrent with physical injuries

As described above, explosions cause unique patterns of injury seldom seen outside combat situations, resulting in a constellation of temporary and permanent physical impairments for victims. These physical injuries may also be accompanied by mental health and psychological symptoms. Studies have shown that a significant number of people who are physically injured in bombings also develop the mental and psychological conditions mentioned above.⁶⁶ Psychological sequelae are greatest for eye, facial, genital, head and burn injuries,⁶⁷ and for injuries to the extremities, treatment of which often includes traumatic amputation of limbs.⁶⁸ Treatment of severe and complex injuries can also be a source of emotional suffering, as medical procedures may be prolonged, repeated and painful.

⁶⁶ For example, depression, anxiety, panic disorder, PTSD, somatization disorder, and substance abuse. See P. Verger *et al.*, “The psychological impact of terrorism: An epidemiologic study of posttraumatic stress disorder and associated factors in victims of the 1995–1996 bombings in France”, *American Journal of Psychiatry*, Vol. 161, No. 8, August 2004, pp. 1384–1389.

⁶⁷ F. Charatan, “Psychiatric effects of terrorist attacks are underestimated”, *British Medical Journal*, Vol. 324, No. 7345, May 2002, pp. 1058–1059.

⁶⁸ Loss of health and autonomy, and bodily disfigurement, put the person affected at risk of a host of psychological problems, including PTSD, anxiety and depression.



At the ICRC's trauma centre in Tripoli, Lebanon, a psychologist discusses mental health with patients who suffered severe injuries.

As mentioned above, blast injuries can also cause brain damage and have neurological consequences. These effects are commonly underreported. AoAV concluded, after researching deaths and injuries of civilians from explosive weapons, that despite its seriousness and prevalence, reported casualties “rarely include invisible injuries, such as traumatic brain injury”.⁶⁹ While it can be difficult to distinguish the symptoms of neurological damage from the psychological effects of exposure to an explosion,⁷⁰ the two are often interlinked: many people with brain injuries from explosions, such as soldiers, have been found to be more likely to develop PTSD, depression, and other psychological conditions.⁷¹

⁶⁹ AOAV Blast Injury, cited in footnote 56 above, p. 6.

⁷⁰ N. M. Elsayed and J. L. Atkins (eds), *Explosion and Blast-Related Injuries: Effects of Explosion and Blast from Military Operations and Acts of Terrorism*, Elsevier Academic Press, Burlington, June 2008, p. xiv.

⁷¹ J. J. Vasterling and S. Dikmen, “Mild traumatic brain injury and posttraumatic stress disorder: Clinical and conceptual complexities”, *Journal of the International Neuropsychological Society*, Vol. 18, No. 3, May 2012, pp. 390–393.

1.5 DESTRUCTION OF CIVILIAN OBJECTS AND IMPACT ON ESSENTIAL SERVICES

1.5.1 Destruction of buildings, in particular civilian population's homes

The use of heavy explosive weapons in urban or other populated areas also causes large-scale damage to buildings, mostly homes. The following facts and figures demonstrate the sheer destructive power of these weapons:

- In **Iraq**, United Nations Satellite Centre (UNOSAT) statistics for Mosul at the end of the military operation in August 2017 indicate a total of 19,888 affected structures within the city, 4,773 of which were destroyed and 8,233 severely damaged. Around 7,620 of the affected structures were situated within the Old City.⁷² According to a different source, destruction estimates for housing assets in the city of Mosul are as high as 65%.⁷³
- In **Syria**, the destruction has been extensively documented. For instance, a report by REACH, the United Nations Institute for Training and Research (UNITAR) and UNOSAT, that analysed satellite-detected damage at different periods of the conflict, identified over 100,000 buildings – in five towns or regions – as damaged, of which almost 30,000 had been destroyed and close to 40,000 severely damaged.⁷⁴
- In **Gaza**, approximately 22,000 homes were reportedly rendered uninhabitable as a result of the 2014 military operation.⁷⁵
- In eastern **Ukraine**, along the line of contact, from the beginning of the conflict in February 2014 until mid-August 2019, the ICRC documented over 1,500 incidents in which heavy explosive weapons were used in populated areas, leaving approximately 4,000 civilian objects (mainly homes) damaged or destroyed.



The destructive power of weapons means that people lose everything: their homes, belongings, livelihoods and possibly their loved ones.

⁷² UNITAR – UNOSAT, “Damage assessment of Mosul, Ninawa Governorate, Iraq”, 27 November 2017.

⁷³ World Bank Group, *Iraq Reconstruction and Investment, Part 2: Damage and Needs Assessment of Affected Governorates*, Washington D.C., January 2018, p. 17

⁷⁴ REACH and UNITAR – UNOSAT, *Syrian Cities Damage Atlas*, REACH, Geneva, March 2019, p. 3.

⁷⁵ HRW World Report 2015, cited in footnote 26 above, p. 308.

While there is no estimate available of the number of affected buildings that would have become military objectives at the time of the attack, the consequences for civilians are in any case devastating, in terms of loss of homes and property, and eventually, displacement (see 1.6 below).

1.5.2 Impact on essential civilian services

Homes are not the only civilian objects damaged or destroyed by bombing and shelling. Infrastructure necessary for the delivery of essential services is often intentionally or incidentally affected, too. A significant proportion of the civilian suffering caused by the use of heavy explosive weapons stems from the **disruption and deterioration of the essential services** on which civilians living in populated areas depend for their survival, such as electricity, water, sanitation, solid-waste disposal and health care. The ICRC has documented⁷⁶ and continues to witness the devastating impact on essential services, during armed conflicts, of the use of heavy explosive weapons.

Most commonly, the use of explosive weapons with a wide impact area will have an effect on the infrastructure necessary to render such services. Cities, towns, villages and other built-up populated areas typically contain a complex web of fragile, centralized and interconnected service infrastructure located underground (e.g. water and wastewater pipelines), at ground level (e.g. electrical substations and health-care facilities), and above ground (e.g. overhead power lines, elevated water reservoirs), all of which are not hardened against attack and as such vulnerable to damage from the use of heavy explosive weapons.⁷⁷ While infrastructure located on or above the ground is affected by the blast-and-fragmentation effects of explosive weapons, underground infrastructure, though invisible, is vulnerable to specific explosive-weapon effects such as cratering.⁷⁸



When infrastructure is bombed, the effect on the population and economy is devastating. People in the Gaza Strip face chronic power shortages, which threaten their physical and mental health and their livelihoods.

⁷⁶ The contents of this section are based on M. Zeitoun and M. Talhami, “The impact of explosive weapons on urban services: Direct and reverberating effects across space and time”, *International Review of the Red Cross*, Vol. 98, No. 901, April 2017, pp. 53–70, and on the ICRC Urban Services Report, cited in footnote 3 above.

⁷⁷ Critical infrastructure extends to the periphery of populated areas, as is often but not always the case for power plants, water-treatment plants and wastewater-treatment plants.

⁷⁸ For an explanation of ‘cratering’ effects, see K. Cross *et al.*, *Explosive Weapons in Populated Areas: Technical Considerations Relevant to their Use and Effects*, Special Report, ARES, Perth, May 2016, (ARES Technical Considerations Report), p. 17, as well as Chapter 2.

The impact on service infrastructure can be direct – meaning the impact caused immediately by the physical effects of the explosion – and indirect or ‘reverberating’ – meaning the second- or higher-order effects triggered by the direct impact. The interdependency and interconnectedness of essential services increases the probability that disruption of one service will have a domino effect on the provision of others. For example, damage to a power station will cause power shortages that will likely disrupt the functioning of hospitals or of water-purification stations, which may in turn lead to the death of patients and the spread of disease. Other services that rely on this particular power station for electricity – such as hospitals, schools, telecommunications, transportation systems, banking and financial services, and emergency services – could also be affected.

Thus, when **critical civilian infrastructure**⁷⁹ – such as power plants, electrical substations and transformers, water- and wastewater-treatment plants, pumping stations, and hospitals and other health-care facilities – located within the area impacted by explosive force is damaged or destroyed, the provision of essential services is disrupted well beyond the impact area – even when an explosive weapon has been used only once.⁸⁰ This generates a range of reverberating effects on civilian lives, health and livelihoods that can extend over time and space, and often trigger displacement.



Staff from the ICRC and the Syrian Arab Red Crescent assess the living conditions of people returning to Aleppo.

⁷⁹ The term ‘critical infrastructure’ is used here to refer to infrastructure within a service system that enables the functioning of that service.

⁸⁰ A weapon’s ‘impact area’ or ‘impact zone’ refers to the area physically affected or at risk of being affected by the explosion. It corresponds to the blast-and-fragmentation radius of the explosive munition(s) delivered by the weapon system, sometimes referred to by the technical term ‘lethal area’ (see Chapter 2).



Residents in Donetsk, Ukraine, live in basements to escape shelling but have no water or electricity.

In 2019, it was estimated that 15.5 million people in **Syria** were in need of water, sanitation and hygiene services, partly because of heavy infrastructural damage sustained during the armed conflict,⁸¹ including from the use of heavy explosive weapons. It was estimated that 80% of the damage in the city of Hama was to its electricity networks and power plants, impacting the provision of essential services.⁸² Another example comes from Palmyra which, in 2017, sustained substantial damage to critical civilian infrastructure following daily aerial bombardment, forcing the city to rely entirely on generators for electricity; civilians had no access to public water networks and all medical facilities were severely damaged.⁸³

In eastern **Ukraine** essential services are highly centralized, with linkages between water, electricity and heating systems. In 2014, as a result of the use of unguided rockets, artillery and other heavy explosive weapons in Lugansk/Luhansk by both parties to the conflict, tens of thousands of people were reportedly left without running water and electricity for weeks.⁸⁴ Moreover, 3.5 million people in the area rely on the Voda Donbassa water system, which twice crosses the line of contact between parties to the armed conflict; it is estimated that conflict-related incidents such as shelling have affected water infrastructure near the line of contact approximately every four days since 2016, with a total of 380 attacks on water documented since 2017.⁸⁵

Hundreds of thousands of people were reportedly left without sufficient water or electricity in **Gaza**, as a result of the use of heavy explosive weapons during the military campaign of 2014.⁸⁶ And in **Afghanistan**, documentary records kept by ICRC delegates indicate that, in July 2017, around 100,000 households in Kunduz had to do without electricity for one week after an electricity transmission tower was hit by an air strike.

⁸¹ UNICEF, *Water Under Fire Vol. 3: Attacks on Water and Sanitation Services in Armed Conflict and the Impacts on Children*, UNICEF, New York, May 2021 (UNICEF Water Under Fire), p.2.

⁸² REACH and UNITAR – UNOSAT, cited in footnote 74 above, p. 37.

⁸³ *Ibid.*, p. 61.

⁸⁴ S. Goose and O. Solvang, cited in footnote 39 above, p. 30.

⁸⁵ UNICEF Water Under Fire, cited in footnote 81 above, p. 18.

⁸⁶ HRW World Report 2015, cited in footnote 26 above, p. 308.

The extent of civilian harm caused by damage to infrastructure depends on its order in the hierarchy of the service-supply system. For example, if an element of upstream water-supply infrastructure located in a city, such as a water treatment plant, is damaged to the extent that it ceases to function, that can deprive hundreds of thousands, even millions, of people of water, whereas damage to a downstream water-supply distribution line typically affects a more localized area and consequently a smaller number of people.⁸⁷

The complexity and interconnectedness of essential-service systems means that disruption of any individual component can have a widespread cascading effect across all of them. Yemen is just one example of where civilian infrastructure has not been spared from the destruction of the conflict and consequently this has exacted a heavy toll on the health of the civilian population... I remember when an electrical substation was hit and destroyed, resulting in the immediate shutdown of all the connected water-supply installations. Upwards of 400,000 people and the local hospital were instantly cut off from the supply of safe water from the public distribution network. In such situations, responding quickly is of paramount importance, but in many cases, service providers have to work to restore services in areas of a city that are still under heavy bombardment. Time is not on their side.

– Massimo Russo, ICRC Water and Habitat Coordinator, Yemen, April 2015

As indicated above, the effective functioning of essential services requires more than just infrastructure; it also depends on **people** (e.g. operators and maintenance staff, hospital personnel) and a steady supply of **consumables** (e.g. fuel, chlorine, medicine), both also at risk from the use of heavy explosive weapons in populated areas. For example, if bombing or shelling incidentally destroys a warehouse containing spare parts or consumables needed to keep a water-treatment plant functioning, or kills or injures the plant's operators or maintenance staff, the plant, even though in itself intact, is unlikely to be able to function properly, with consequent disruption in the supply of drinking water and reverberating effects on public health.

The following case is characteristic. Hodeidah port, the largest in Yemen, which received 70 to 80% of all of Yemen's commercial imports, was heavily damaged in 2015 by air strikes. This reportedly led to a rise in food insecurity and a substantial decrease in the import of fuel needed to run Yemen's water systems and health facilities and to transport goods. A study noted a 28% rise in food prices in Yemen between August and September 2015, the period in which the port's capacity was significantly diminished.⁸⁸

Damage to infrastructure typically has a longer-term effect, which varies according not only to the extent of the damage and the order of the infrastructure in the hierarchy of the supply system

⁸⁷ 'Upstream' refers to the production end of a service (e.g. where water is produced and treated; where energy is generated; and where wastewater is treated), and 'downstream' to the distribution end (e.g. where water and energy are supplied to a consumer and wastewater is collected).

⁸⁸ A. Bottomley and L. Salavert, *Death Sentence to Civilians: The Long-Term Impact of Explosive Weapons in Populated Areas in Yemen*, Humanity and Inclusion (HI), May 2020, (HI, Death Sentence to Civilians), pp. 11–12.

(as discussed above), but also to the availability of spare parts, materials and equipment needed to repair the damaged infrastructure. It also depends on whether technicians and maintenance staff can safely access the damaged infrastructure to make an assessment, carry out repairs or otherwise deliver the consumables necessary for its functioning: they will be impeded from doing so if hostilities are ongoing in the area around that piece of infrastructure or if the area is contaminated by explosive remnants of war (ERW).⁸⁹



A school in Sana'a, Yemen, after an air strike. An estimated 2 million children in Yemen are no longer in school.

In **protracted hostilities**, the direct and indirect effects on essential urban services described above accumulate with the multiple and repeated use of heavy explosive weapons, and make the recovery of essential-service systems particularly difficult and time-consuming. This leads to the incremental degradation of the service infrastructure system and to a vicious cycle of service decline, generating yet more suffering for the civilian population.⁹⁰ For example, the impact on the provision of water, of an attack that damages part of the electricity grid powering a water-pumping station, becomes increasingly severe when an earlier attack has already damaged the existing generators, and another one has damaged a key supply route and prevented the transportation of fuel necessary to operate the generators. The ensuing – prolonged – disruption of the **water supply** can force the population affected to take risks previously unnecessary to obtain water from alternative, unregulated sources, such as shallow groundwater from wells, which tend to be more susceptible to contamination in urban areas. This can lead to the spread of water-borne diseases and even cause an epidemic, creating a public health crisis and causing yet more suffering and death.

Degradation of vital services, and its knock-on effects on public health, can also provoke the displacement of those affected, to other neighbourhoods or even to other cities or towns. A massive influx of displaced persons can in turn place a significant burden on service providers and ultimately the host community, which may already be enduring limited access to scarce resources and an intermittent supply of water. With demand for this vital commodity far surpassing supply, the informal sector usually steps in to truck water that is unregulated both in terms of quality and price, often leading to significant increases in the cost of water.

⁸⁹ See section 1.4 below.

⁹⁰ E. de Pinho Oliveira, “The ICRC’s approach to urban services during protracted armed conflict: Q&A with Evaristo de Pinho Oliveira”, *International Review of the Red Cross*, Vol. 98, No. 901, April 2017, pp. 201–213.

Infrastructure is often exposed and susceptible to physical destruction, with dire consequences for the population if an adequate response is not forthcoming in short order. From first-hand experience, I can say that when such incidents occur, the response is often extraordinarily challenging since there is rarely a readily available back-up and hence the scale of the operation quickly overwhelms all involved. Ultimately, it is the civilian population who are left with the difficult choice to either leave their homes and city or remain and try to cope, with potentially serious risks for public health.

– David Kaelin, ICRC Water and Habitat Coordinator, Syria, November 2013 – December 2016

As indicated earlier in this chapter, one of the essential services that is particularly affected by the use of heavy explosive weapons in populated areas is **health care**. Most health-care facilities and most patients in need of treatment are located in populated areas. As with all essential services, when located within the weapon’s impact area, health-care facilities are vulnerable to being incidentally damaged or destroyed, and medical personnel are at risk of death or injury.



D. Ghahramanyan/ICRC

This maternity department in Nagorno-Karabakh was severely damaged after shelling.

According to a study, the destruction of Hayden Hospital in Sa’ada, Yemen, by air strikes, in 2015, left 200,000 people with no access to lifesaving medical care.⁹¹

⁹¹ HI, Death Sentence to Civilians, cited in footnote 88 above, p. 14.



When Ibn Sina Hospital in Sirte, Libya, came under fire, many of its buildings were destroyed, including the main operating theatre. Patients had to be moved into the corridors.

But beyond these direct effects, often the functioning of hospitals or other health-care centres is disrupted by water or power shortages or an inability to evacuate wastewater and solid waste, while the wounded or sick can be prevented from safely accessing health-care facilities by ongoing hostilities or the presence of explosive remnants of war (ERW). The use of heavy explosive weapons may also endanger and hinder the movement of first responders, obstructing their access to the wounded and depriving those seriously injured of lifesaving interventions. In short, it can be extremely difficult, if not impossible, to deliver safe and effective health care when explosive weapons with a wide impact area are used in populated areas, especially when such use is protracted.

To sum up, the initial impact of the use of heavy explosive weapons in populated areas **can trigger reverberating effects in space and time that affect a much larger part of the population than that in the weapon's impact area**. Many of these reverberating effects are now known and reasonably foreseeable, given the increasing prevalence of urban warfare, the many assessments and studies concerning its humanitarian consequences – in particular those caused by the use of heavy explosive weapons – and the advances in remote-sensing technology. In practice, steps will have to be taken proactively to anticipate the impact on essential services of the use of explosive weapons with a wide impact area in a given populated area, such as gathering information from both public and expert sources, using geospatial and systems mapping capabilities to develop a fuller understanding of the infrastructural layout and the interdependencies that exist between services, and relying on engineers specialized in essential urban services.

1.5.3 Impact on cultural heritage⁹²

Cities and other populated areas are rich in cultural monuments and other objects or sites of cultural significance. From Iraq to Yemen, and from Syria to Lebanon, cultural heritage has suffered the effects of bombing and shelling and the use of other heavy explosive weapons. While much of the destruction has been the result of attacks that deliberately targeted cultural sites and monuments for religious, ideological, political or other reasons, a country's cultural heritage is often incidentally impacted – whether directly or indirectly – by attacks using heavy explosive weapons in populated areas.

The effects on cultural sites and monuments, of using heavy explosive weapons, are well documented. AoAV reported that, by March 2016, all six of the UNESCO World Heritage sites in Syria had been severely damaged or destroyed⁹³ by fighting that largely employed heavy explosive weapons. In total, over 14,400 mosques throughout Syria have reportedly been destroyed since 2016.⁹⁴ In Yemen, the historic old city of Sa'ada was hit by air strikes that damaged several centuries-old mosques and the Marib Dam, considered a wonder of the ancient world.⁹⁵



Many cultural heritage sites in Yemen have been damaged. This landmark building in the UNESCO World Heritage Site in Sana'a has been completely destroyed.

⁹² 'Cultural heritage' is a broad concept and encompasses both the tangible (movable, immovable and underwater) and the intangible. See UNESCO Glossary: http://www.unesco.org/culture/en/natlaws/db/database_glossary_e_2009.pdf.

⁹³ J. Dathan, "The reverberating social and cultural effects of explosive weapon use in Syria", AOAV, 6 February 2019: <https://aoav.org.uk/2019/social-and-cultural-effects-syria/>.

⁹⁴ *Ibid.*

⁹⁵ I. Craig, "The Agony of Saada", *The Intercept*, 16 November 2015: <https://theintercept.com/2015/11/16/u-s-and-saudi-bombs-target-yemens-ancient-heritage/>.



The Great Umayyad Mosque in Aleppo is one of Syria's oldest mosques. It suffered extensive damage during fighting and its 11th century minaret was reduced to rubble.

The damage to cultural sites and monuments is a direct effect of the use of heavy explosive weapons. In turn, it can have significant indirect (reverberating) effects on the civilian population and on societies as a whole. For example, losing cultural property can affect local economies, as some structures or sites can be a source of direct revenue for the civilian population, and even contribute to the wider economy.⁹⁶

Unlike damage to other civilian objects, repairing damaged cultural sites, and consequently cultural heritage, is often impossible. In the long run, the loss of their cultural heritage can destroy a people's connection to their values and beliefs and can significantly hamper the memory and identity of entire communities and generations to come.⁹⁷

1.6 DISPLACEMENT

At first, we stayed in our home. We didn't want to leave. But as the fighting intensified, we couldn't stand it anymore. We were scared our home would be hit by the shelling, so we left. Leaving our house was a last-minute decision. We weren't ready and didn't bring anything with us. My brothers and I were supposed to be taking our exams. But now our lives are in limbo. We don't know when things will be normal again.

– Hamdi, 24, resident of Tripoli, Libya, April 2019

⁹⁶ C. Wille and A. Malaret Baldo, *Menu of Indicators to Measure the Reverberating Effects on Civilians from the Use of Explosive Weapons in Populated Areas*, UNIDIR, Geneva, 2020, p. 30.

⁹⁷ See C. Wille, *The Implications of the Reverberating Effects of Explosive Weapons Use in Populated Areas for Implementing the Sustainable Development Goals*, UNIDIR, Geneva, 2016, p. 15.

Displacement of the civilian population is a typical consequence of the use of heavy explosive weapons in urban and other populated areas, especially when such use is prolonged. The ICRC⁹⁸ and other organizations⁹⁹ have documented this nexus. Indeed, when cities are bombed and shelled, civilians are often compelled to flee, out of fear for their lives, above all.

- UNHCR estimates that around 30,000 civilians fled Aleppo, in **Syria**, as a result of heavy fighting involving air strikes and shelling between November and early December 2016 alone.¹⁰⁰
- In **Iraq**, between 16 and 17 June 2016 alone, more than 12,000 families reportedly fled Fallujah, and took refuge in camps for internally displaced persons (IDPs), because of the fighting, which was largely conducted by means of heavy explosive weapons.¹⁰¹
- The International Organization for Migration (IOM) estimates that in **Yemen**, as a result primarily of air strikes between March 2015 and October 2017, over 270,000 civilians were displaced from Sana'a city alone.¹⁰²
- In **Libya**, between April and July 2019, ICRC documented the displacement of over 120,000 civilians mainly as a result of the continuous use of heavy explosive weapons (in particular large air-delivered bombs, MBRLs and mortars) in residential areas of Tripoli.
- The use of explosive weapons during the 2014 military campaign in **Gaza** reportedly resulted in the displacement of 108,000 civilians.¹⁰³

In interviews of displaced persons carried out by the ICRC in a range of contexts, “civilians dwelt extensively on how it felt to be under aerial bombardment and shelling. They spoke of the chaos and confusion during the attacks, helicopters whirring and fighter planes roaring overhead; they described their terror as rocket shells and mortars exploded, debris flying everywhere. Fire seemed to come from every side. People ran in all directions, the older children helping their mothers gather the younger ones. Many people died inside their homes, which were completely destroyed.”¹⁰⁴

People flee not just to escape the hostilities, but also to find shelter and means of survival. The destruction of homes and the damage to critical infrastructure caused by the use of heavy explosive weapons – and the knock-on disruption and degradation of services essential to civilian survival (see section 1.5 above) – are major drivers of displacement.¹⁰⁵

⁹⁸ ICRC, *Displacement in Times of Armed Conflict. How International Humanitarian Law Protects in War and Why It Matters*, ICRC, Geneva, April 2019, (ICRC Displacement Report), pp. 30–31.

⁹⁹ Article 36, “Bombing in towns and cities: A major driver of displacement worldwide”, reproduced in International Network on Explosive Weapons (INEW), 16 May 2016: <https://www.inew.org/ewipa-displacement/>; Handicap International, *Qasef: Escaping the Bombing – The Use of Explosive Weapons in Populated Areas and Forced Displacement: Perspective from Syrian Refugees*, Handicap International, September 2016.

¹⁰⁰ UNHCR, “Growing shelter pressure in Aleppo for the thousands fleeing”, 2 December 2016: <https://www.unhcr.org/news/briefing/2016/12/58413f364/growing-shelter-pressure-aleppo-thousands-fleeing.html>

¹⁰¹ Iraqi Red Crescent Society, “Displacement of more than 12,000 families since the start of operations at Fallujah so far, and the Iraqi Red Crescent sends relief teams from three governorates to Ameriyat Al-Fallujah to aid the displaced”, 17 June 2016: <https://reliefweb.int/report/iraqi/displacement-more-12000-families-start-operations-fallujah-so-far-and-iraqi-red-crescent>.

¹⁰² IOM, “UN Migration Agency: Military Attack on Yemen’s Al Hudaydah Port, City Will Endanger Lives, Humanitarian Response”, 5 December 2017: <https://www.iom.int/news/un-migration-agency-military-attack-yemens-al-hudaydah-port-city-will-endanger-lives>.

¹⁰³ HRW World Report 2015, cited in footnote 26 above, p. 308.

¹⁰⁴ ICRC Displacement Report, cited in footnote 98 above, p. 30.

¹⁰⁵ T. de Saint Maurice, “A humanitarian perspective”, *Collegium*, No. 46, Autumn 2016 (*Urban Warfare, Proceedings of the 16th Bruges Colloquium, 15–16 October 2015*), College of Europe/ICRC, p. 153. See also INEW, “Bombing in towns and cities: A major driver of displacement worldwide”, 16 May 2016: <http://www.inew.org/ewipa-displacement/>.



Fighting in Hodeidah, Yemen, forced Afia and her husband to seek refuge in a schoolyard. They are preparing a meal while their granddaughter sleeps on cardboard.

Multiple patterns of displacement have been documented in contexts where the use of heavy explosive weapons in populated areas is protracted.¹⁰⁶ People may move to another part of the same populated area, or to another city, or to rural areas, or to IDP camps.¹⁰⁷ They may even flee across borders. Often, civilians are repeatedly displaced, as they are forced to move from one location or community to another, *inter alia*, owing to shifting front lines or tensions within the host community.¹⁰⁸

In protracted conflict, displacement is also commonly protracted.¹⁰⁹ Even after hostilities end or the conflict itself is over, a large proportion of displaced persons are unable or unwilling to return to their places of residence, where lack of essential services and UXO contamination make life very difficult, if not impossible.

In the Philippines, for example, 65,000 civilians displaced by conflict in Marawi have reportedly been unable to return to their homes more than a year after the end of hostilities because of the extent of the damage in the city and the presence of UXO.¹¹⁰

¹⁰⁶ UN Office for the Coordination of Humanitarian Affairs (OCHA), “Ending protracted internal displacement”, Case Studies, 2017: <https://www.unocha.org/ending-protracted-internal-displacement/case-studies>.

¹⁰⁷ ICRC, *Displaced in Cities: Experiencing and Responding to Urban Displacement Outside Camps*, ICRC, Geneva, July 2018, (ICRC Urban Displacement Report), p. 22.

¹⁰⁸ HI, *Forced Displacement and the Use of Explosive weapons in Populated Areas: Perspectives of Syrian Women Refugees in Lebanon*, HI, October 2017, pp. 11–15; ICRC Challenges Report 2019, cited in footnote 8 above, p. 22.

¹⁰⁹ ICRC Challenges Report 2019, cited in footnote 8 above, p. 38.

¹¹⁰ Internal Displacement Monitoring Centre, *Global Report on Internal Displacement 2019*, Internal Displacement Monitoring Centre, Geneva, May 2019, p. 28.



Makeshift evacuation camps, like this one in Lanao del Sur in the Philippines, are often ill-equipped to accommodate a sudden influx of people. Camps often lack basic facilities like water and toilets.

Civilians attempting to flee bombing and shelling are not always successful. They face many different threats or obstacles, such as: being caught in crossfire or being targeted by parties to the conflict who do not want them to leave the populated area. Civilian convoys are vulnerable to dangers associated with hostilities, harsh environmental conditions, and lack of life-sustaining items (food, water, medicine). While usually providing shelter from the bombs, IDP camps and host communities are not always the safe refuges that civilians in flight are seeking. Overcrowded camps, lack of proper health care, insanitary living conditions, stigmatization and discrimination: these are only some of the serious risks to the lives, health and well-being of IDPs. Women and children, who are at risk also of sexual and gender-based violence, are particularly vulnerable.¹¹¹



Badbaado camp in Mogadishu, Somalia, became home to nearly 30,000 people displaced by drought and fighting.

¹¹¹ ICRC Urban Displacement Report, cited in footnote 107 above, p. 24.

Displacement, especially when prolonged, has crippling effects on individuals and on the society as a whole. Entire generations lose access to education and sources of livelihood, thus compromising their future and that of their family members. Families are separated – sometimes forever – with members left behind or detained by authorities.¹¹² Ultimately, displacement tears apart the societal tissue and can do lasting damage to socio-economic development.



This woman in Kilinochchi, Sri Lanka, lost her arm trying to protect her son during shelling. While being treated in hospital, she lost contact with her husband; she holds the last photo taken of him with their son.

1.7 CONTAMINATION BY UNEXPLODED ORDNANCE

The use of explosive weapons in populated areas, as in any terrain, typically results in UXO¹¹³ being left behind, because a certain number of munitions will not explode as intended.¹¹⁴ For instance, a third of all the *populated* communities in Syria are still contaminated by explosive ordnance.¹¹⁵



The warhead of an unexploded guided bomb in a street in Homs, Syria.

¹¹² ICRC, *The Need to Know: Restoring Links Between Dispersed Family Members*, ICRC, Geneva, 2011, p. 2; ICRC, *Internally Displaced Persons and International Humanitarian Law*, Factsheet, 14 December 2017: “The ICRC’s assistance to internally displaced persons can also include ... putting families back in contact”; ICRC, “Central Tracing Agency: Half a century of restoring family links”, Interview, April 2010: <https://www.icrc.org/en/doc/resources/documents/interview/centra-tracing-agency-interview-070410.htm>.

¹¹³ UXO is defined in Article 2(2) of the 2003 Protocol V to the 1980 Convention on Certain Conventional Weapons as “explosive ordnance that has been primed, fused, armed, or otherwise prepared for use and used in an armed conflict. It might have been fired, dropped, launched or projected and should have exploded but failed to do so.”

¹¹⁴ See Chapter 2 for the different types of fuze that determine at which point a munition is intended to explode.

¹¹⁵ OCHA, *Humanitarian Needs Overview: Syrian Arab Republic*, OCHA, March 2021, p. 10.



An unexploded artillery shell in the kitchen of a house in Libya.

Explosive munitions of every kind have a failure rate that can vary greatly, depending on diverse factors such as their age, conditions of preservation and use, the quality of design and production, the type of material or soil at the point of impact, atmospheric conditions, and the competence of the user.

The presence of UXO exacerbates civilian suffering during active hostilities: it can impede access to health-care facilities, block escape routes, hinder the delivery of lifesaving humanitarian assistance, and prevent the proper operation and maintenance of essential services. UXO may also amplify the destruction caused by heavy explosive weapons, when they are detonated by the blast or fragmentation effect of such weapons, triggering secondary explosions. UXO continue to present a lethal hazard for civilians, notably children, long after active hostilities have ended. Their presence can prevent the return of displaced persons to their places of residence, and significantly delay reconstruction efforts and impede socio-economic development.

Data show that UXO – mortars, bombs, rockets and artillery shells – have accounted for a significant proportion of all civilian casualties from mines and ERW, and are the leading cause of child casualties among casualties of mines and ERW.¹¹⁶

The difficulty of clearing UXO – like their impact in humanitarian terms – is much greater in urban areas than elsewhere. Locating UXO in the midst of rubble and picking them out from among a wide array of everyday objects, many of which are made of similar material (e.g. metal), is an onerous, dangerous, and often extremely time-consuming task. This is made worse in contexts where mines or booby-traps may also be present. An additional challenge is the presence of human remains: clearance operations must ensure that such remains are handled and recovered in a dignified and appropriate manner and in a way that will facilitate their identification, which can further slow down the pace of clearance.¹¹⁷ These challenges account for the prolonged humanitarian impact of UXO in populated areas. It should be kept in mind that their presence is largely the result of the use of heavy explosive weapons in those areas.

¹¹⁶ See International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC), *1999-2013: Casualty Trends*, June 2014, p. 9. This indicates that ERW other than cluster munitions – and including remnants of mortars, bombs, rockets and artillery shells – were the leading cause of child casualties and the second-leading cause of adult casualties between 2004 and 2013. With some variations, this trend continued into 2016 and 2017. See ICBL-CMC, *Landmine Monitor 2017*, December 2017, pp. 55–57; and ICBL-CMC, *Landmine Monitor 2018*, November 2018, pp. 52–54.

¹¹⁷ ICRC, *Weapon Contamination in Urban Settings: An ICRC Response*, ICRC, Geneva, July 2019.

1.8 IMPACT ON CHILDREN AND WOMEN

The impact of heavy explosive weapons varies with the age and gender of their victims. The risks to children and women are of a particular kind. According to ICRC data, children and women account for a large proportion of incidental civilian casualties when heavy explosive weapons are used in populated areas. Despite the difficulties in obtaining disaggregated data based on the age and gender of the victims, several organizations and experts have been able to report on the impact of the use of heavy explosive weapons on children and women specifically.¹¹⁸

For example, research on the effects of the use of heavy explosive weapons in Afghanistan, Gaza, Iraq and Syria has confirmed that children make up a substantial proportion of civilian casualties.¹¹⁹

During the 2009 military operation in Gaza, children reportedly accounted for a third of all civilian casualties; of the 353 children who lost their lives, 82% were killed by heavy explosive weapons.

The psychological effect on children, of the bombing and shelling, has also been documented (see also 1.4.1 above).¹²⁰

A 2013 study found that between 2011 and August 2013, 11,420 children had been reported killed in Syria: explosive weapons were, by a considerable margin, the leading cause of death, killing at least 71% of the children.¹²¹

Research on conflict fatalities in Syria between 2011 and 2016 demonstrated that children were seven times more likely to die from blast injuries than adults involved in the fighting.¹²² Children are more susceptible to abdominal blast injury than adults,¹²³ and they are more vulnerable to complex damage to organs and tissues because their bodies are smaller and more delicate:¹²⁴ as a result, they also require special medical care adapted to their needs.¹²⁵ In addition, the rehabilitation of injured children is more complex because their bodies are still growing; it should also

¹¹⁸ Handicap International, *Syria, A Mutilated Future: A Focus on the Persons Injured by Explosive Weapons*, Factsheet, May 2016; R. Moyes, “Impact of explosive weapons by gender and age – Iraq 2003–2011”, Research Paper, AOAV, London, June 2012; and R. Acheson and B. Fihn (eds), *Women and Explosive Weapons*, Women’s International League for Peace and Freedom (WILPF), Geneva/New York, March 2014 (WILPF, *Women and Explosive Weapons*), pp. 11–18: <https://www.peacewomen.org/assets/file/wew.pdf>. While not limited to heavy explosive weapons in populated areas, the UN secretary-general’s annual report on children in armed conflict documents the heavy price children pay when such weapons are used. See UN Security Council, *Report of the Secretary-General on Children and Armed Conflict*, UN Doc. S/2020/525, 9 June 2021.

¹¹⁹ K. Smith, cited in footnote 27 above, pp. 3–5; A. McDonald, *Invisible Wounds: The Impact of Six Years of War on the Mental Health of Syria’s Children*, Save the Children, London, March 2017, pp. 1–2.

¹²⁰ K. Smith, cited in footnote 27 above, pp. 4–6; and V. Hubbard in AOAV, cited in footnote 65 above.

¹²¹ H. Dardagan and H. Salama, *Stolen Futures: The Hidden Toll of Child Casualties in Syria*, Oxford Research Group, London, November 2013, p. 7.

¹²² V. Hubbard, “The impact of explosive weapons on children’s physical health”, AOAV, 18 January 2021: <https://aoav.org.uk/2021/the-impact-of-explosive-weapons-on-childrens-physical-health/>.

¹²³ In children, “[n]ot only is the abdominal wall smaller and thinner, offering less protection, but the liver and spleen are proportionately larger organs and more vulnerable to blast and trauma”. See ICRC War Surgery Manual, Vol. 2, cited in footnote 34 above, Section 19.9, p. 39.

¹²⁴ K. Smith, cited in footnote 27 above, p. 5; and Lt. J. F. S. Millwood Hargrave, *The Impact of Blast Injury on Children: A Literature Review*, Centre for Blast Injury Studies, Imperial College London, September 2017.

¹²⁵ A. Bull *et al.*, “Paediatric blast injury: Challenges and priorities”, *The Lancet Child & Adolescent Health*, Vol. 2, No. 5, March 2018, pp. 310–311; and P. Reavley, “Bombs & blast waves: Why children in conflict need special care”, ICRC Humanitarian Law and Policy Blog, 13 September 2018: <https://blogs.icrc.org/law-and-policy/2018/09/13/bombs-blast-waves-why-children-conflict-need-special-care/>.

be kept in mind that they are at greater risk of suffering from long-term psychological trauma.¹²⁶ These long-term health problems also affect children's education.¹²⁷



Hayat receives support at the ICRC's rehabilitation centre. She struggles to understand what has happened to her foot. The air strike that destroyed the family home in Sana'a, Yemen, also killed her sister.

Children also suffer when the provision of health care is disrupted by the use of heavy explosive weapons. For example, in **Somalia**, the use of mortars and other explosive weapons reportedly forced the closure of a paediatric hospital and three health clinics in North Mogadishu in 2009: these facilities had previously been conducting 2,500 outpatient consultations per week and treating more than 400 malnourished children.¹²⁸

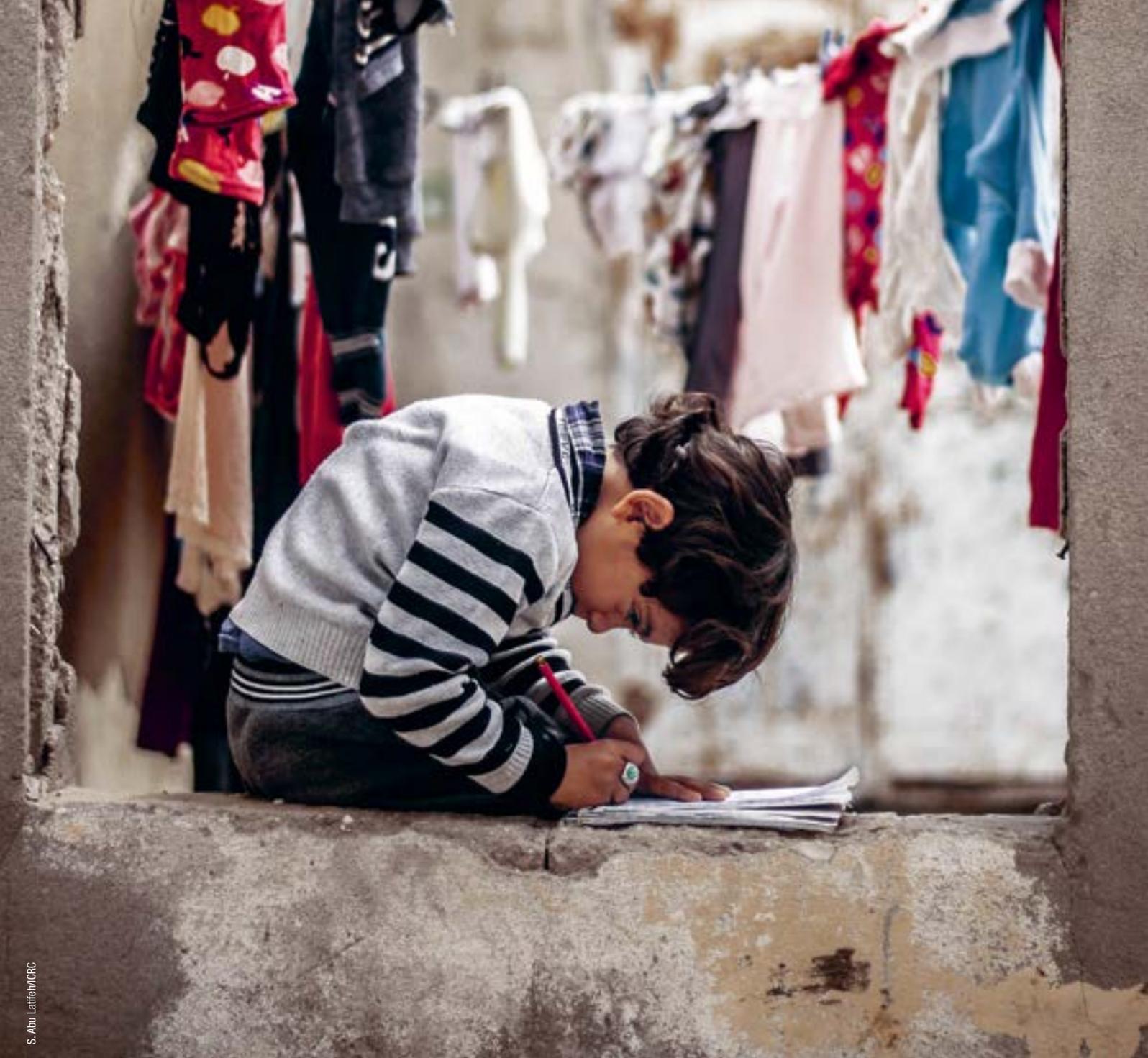
Children's education suffers further setbacks when schools are damaged or destroyed, or when teachers are killed or injured by the use of heavy explosive weapons. Moreover, data show that children, far more than adults, are susceptible to the dangers of ERW, including those that are a by-product of the use of heavy explosive weapons.¹²⁹

¹²⁶ Save the Children, *A Living Nightmare: Gaza One Year On*, Save the Children, London, 2015, pp. 3–4.

¹²⁷ V. Hubbard, "The impact of explosive weapons on children's education", AOAV, 10 March 2021: <https://aoav.org.uk/2021/the-impact-of-explosive-weapons-on-childrens-education/>.

¹²⁸ K. Smith, cited in footnote 27 above, p. 6.

¹²⁹ See, for example, ICBL-CMC, *Landmine and Cluster Munition Monitor*, "The impact of mines/ERW on children", November 2019: <http://www.the-monitor.org/media/3073853/Children-Info-11-19.pdf>.



A child in Gaza finds a place for homework on the balcony of the family's makeshift home.

A report on the consequences for women, of the use of heavy explosive weapons in populated areas,¹³⁰ has highlighted the following: blast waves may cause miscarriages; injured women may have more difficulties in accessing health care or rehabilitation because of social inequalities;¹³¹ injured women are more vulnerable to stigmatization and marginalization; pregnant women and new mothers are more vulnerable to diseases caused by lack of access to safe drinking water, when water or electricity infrastructure is damaged or destroyed;¹³² women who become heads of households, or who are displaced, are more at risk of violence, including sexual violence or exploitation; and attacks in residential areas and markets can disproportionately affect women if patterns of mobility place women and girls in their homes or in markets, as they often do.¹³³

¹³⁰ WILPF, *Women and Explosive Weapons*, cited in footnote 118 above; C. Wille, cited in footnote 97 above, p.17.

¹³¹ AOAV Blast Injury, cited in footnote 56 above, p. 20: “access to treatment for injuries from explosive weapons is likely to be gendered ... It was found that women are frequently less able to access treatment due to cultural and religious inhibitory factors, ones often exacerbated by conflict.”

¹³² M. Butcher, *The Gendered Impact of Explosive Weapons Use in Populated Areas in Yemen*, Oxfam International, Oxford, November 2019, p. 8.

¹³³ WILPF, *Women and Explosive Weapons*, cited in footnote 118 above, p. 16.



With a child in one arm and a heavy jerrycan on her head, this woman in Yemen has to walk 2 kilometres to the nearest water point several times a week.

In addition, a 2019 study on **Yemen** showed that the use of explosive weapons in populated areas directly contributed to difficulties in accessing food: in 2017, some 1.1 million pregnant or lactating women in Yemen were suffering from malnutrition, with serious consequences in the form of child disease and infant mortality.¹³⁴

There have been calls to develop robust mechanisms to track and record civilian casualties and civilian harm – including, at minimum, data disaggregated by age and gender – or to strengthen existing mechanisms.¹³⁵

1.9 IMPACT ON THE NATURAL ENVIRONMENT

Population centres are surrounded by the natural environment and largely depend on it. There is increasing concern about the potential impact on the natural environment, immediate and long-term, of toxic substances and other pollutants that may be released by the use of heavy explosive weapons in populated areas. This can have serious repercussions for public health.

The components of explosive weapons, such as the metals making up the munition casing and the explosive substance contained in the casing, may leave toxic remnants in areas populated by civilians.¹³⁶ These toxic substances can seep into the soil, subsoil and watercourses and continue spreading away from the populated area, poisoning flora and fauna. This can – especially when explosive weapons are used in large quantities – have a significant impact on entire ecosystems, which may take years, if not decades, to remedy.¹³⁷ Such environmental pollution can also have a significant impact on agriculture and, consequently, on civilians' livelihoods and food security.

¹³⁴ M. Butcher, cited in footnote 132 above, p. 9.

¹³⁵ See, for example, S. Adamczyk, *Twenty Years of Protection of Civilians at the UN Security Council*, Policy Brief 74, Humanitarian Policy Group, London, May 2019, p.8; and Lt. J.F.S. Millwood Hargrave, cited in footnote 124 above, p. 19.

¹³⁶ ICRC, *Guidelines on the Protection of the Natural Environment in Situations of Armed Conflict*, ICRC, Geneva, September 2020 (ICRC Guidelines on the Protection of the Natural Environment), p. 100.

¹³⁷ J. Dathan, *The Broken Land: The Environmental Consequences of Explosive Weapons Use*, AOA, London, July 2020, pp. 20–25.

Moreover, facilities containing pollutants such as toxic chemicals, biological agents and radiological substances are often located on the outskirts or in the vicinity of major urban centres. There is a risk of the pollutants being released when these facilities are incidentally damaged by heavy explosive weapons used against targets located in the adjacent urban areas – with similar effects on the natural environment and on civilian health.¹³⁸ Damage to facilities containing hazardous materials (e.g. toxic industrial chemicals) could also generate significant secondary explosions or large fires over a wide area and spread contaminants downwind: some military doctrines on urban warfare require that this risk be assessed.¹³⁹ Finally, some conflict-specific studies have found that much of the rubble resulting from the use of heavy explosive weapons in populated areas was contaminated with asbestos and other hazardous substances.¹⁴⁰

The toxic substances released pose a grave threat to public health, when they enter the human body via air or water or through consumption of products grown on contaminated soil.¹⁴¹ Existing reports acknowledge the need for further research and data, but they also indicate that the release of hazardous substances as a consequence of the use of heavy explosive weapons in populated areas, or their presence in the rubble such use creates, constitutes a direct risk to public and personal health.¹⁴²

1.10 IMPACT ON DEVELOPMENT

The impact of the use of heavy explosive weapons in cities, towns and other populated areas – often extensive, reverberating and long-term – poses a significant challenge to post-conflict reconstruction and undermines development gains and goals.

The damage or destruction of critical infrastructure, and the ensuing disruption of essential services such as water, sanitation and health care (discussed in section 1.5 above), has a major impact on living conditions, and on the prospects for recovery of essential services (because, in addition to the destruction of infrastructure, technical staff and expertise are lost). When schools, cultural monuments and places of worship are reduced to rubble, the social fabric and

¹³⁸ ICRC Guidelines on the Protection of the Natural Environment, cited in footnote 136 above, pp. 50–55; UN Security Council, *Report of the Secretary-General on the Protection of Civilians in Armed Conflict*, UN Doc. S/2019/373, 7 May 2019, p. 12, para. 50; OHCHR, “Chemical disaster fear in Eastern Ukraine prompts UN expert to raise alarm”, 10 March 2017: <https://www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=21344&LangID=E>; United Nations Environment Programme (UNEP), *Lebanon: Post-Conflict Environmental Assessment*, UNEP, Nairobi, January 2007; Toxic Remnants of War (TRW) Project, *Pollution Politics: Power, Accountability and Toxic Remnants of War*, TRW Project, Manchester, 2014, p. 31.

¹³⁹ See, for example, United States, Department of the Army and Marine Corps, *Urban Operations*, ATP No. 3-06/MCTP No. 12-10B, December 2017 (US DOA/MC, Urban Operations), pp. 1–4, paras 1–16, pp. 1–12, paras 1-46 and 1-47, and pp. 3–22, paras 3–97; and France, *Manuel d’Emploi des Forces Terrestres en Zone Urbaine*, 22 July 2005, p. 9, para. II.3.4 and p. 26, para. IV.3.4.b.

¹⁴⁰ W. Zwijnenburg and K. te Pas, *Amidst the Debris: A Desktop Study on the Environmental and Public Health Impact of Syria’s Conflict*, PAX, Utrecht, October 2015; and UNEP, *Environmental Assessment of the Gaza Strip Following the Escalation of Hostilities in December 2008–January 2009*, UNEP, Nairobi, 2009: https://postconflict.unep.ch/publications/UNEP_Gaza_EA.pdf.

¹⁴¹ UNEP, *Technical Note: Environmental Issues in Areas Retaken from ISIL, Mosul, Iraq, Rapid Scoping Mission, July–August 2017*, UNEP, Nairobi, 2017, pp. 15–18. On the long-term health impact of dust and rubble, see, for example, J. Walters, “9/11 health crisis: Death toll from illness nears number killed on day of attacks”, *The Guardian*, 11 September 2016: <https://www.theguardian.com/us-news/2016/sep/11/9-11-illnesses-death-toll>. On breathing problems from dust, smoke or toxic fumes as quaternary mechanisms of blast injury, see, for example, Centers for Disease Control and Prevention (CDC), *Explosions and Blast Injuries: A Primer for Clinicians*, March 2003: <https://www.cdc.gov/masstrauma/preparedness/primer.pdf>, Table 1. On secondary hazards from the detonation of IEDs, including fire with possibly toxic smoke, see, for example, National Academies and the Department of Homeland Security, “IED Attack”, Factsheet: https://www.dhs.gov/xlibrary/assets/prep_ied_fact_sheet.pdf, p. 2. On the release of toxic gases from explosives containing ammonium nitrate, see T. Edgington, “Beirut explosion: What is ammonium nitrate and how dangerous is it?”, *BBC News*, 5 August 2020: <https://www.bbc.com/news/explainers-53664064>.

¹⁴² R. Boor and W. Zwijnenburg, “Exploring environmental harm from explosive weapons in populated areas”, 28 May 2020: https://blogs.paxvoorrrede.nl/2020/05/28/exploring-environmental-harm-from-explosive-weapons-in-populated-areas/?mc_phishing_protection_id=28048-c58n6dfosov9gg7ksv50

collective well-being are seriously affected.¹⁴³ When revenue- and income-generating assets such as shops or livestock are destroyed or cease to function, the financial/economic impact on individuals as well as entire countries can be massive. When agricultural production is hampered by UXO contamination, that leads to further loss of livelihoods, as does the death or permanent disability of household breadwinners. Mass displacement puts considerable strain on host communities. These effects typically exacerbate the suffering of already vulnerable populations and risk perpetuating a vicious cycle of violence and insecurity.



The town of Mouadamieh in Syria suffered years of fighting, which forced thousands to flee. Those who return face total devastation and need long-term support to rebuild their lives and livelihoods.

The United Nations Institute for Disarmament Research (UNIDIR) has examined the specific ways in which the use of heavy explosive weapons affects the implementation of the SDGs, in particular SDG 2 on ending hunger, SDG 6 on ensuring water and sanitation, SDG 3 on improving health, SDG 11 on making cities safer, more resilient and sustainable, and SDG 5 on empowering women and girls. UNIDIR's research has found that “[i]n terms of humanitarian and development consequences, the most important difference between small arms and explosive weapons is the extent to which explosive weapons damage and destroy infrastructure and thereby affect a wide range of essential services”, and concluded that explosive weapons’ “destructive and far-reaching impacts on infrastructure and service delivery ... threaten to undermine the achievement of the SDGs”.¹⁴⁴

¹⁴³ W. Pullan, “The vulnerability of modern cities’ infrastructure to urban warfare”, 43rd Sanremo Round Table: “New Dimensions and Challenges of Urban Warfare” (Online), 16 September 2020: <https://www.icrc.org/en/Sanremo-43rd-round-table-urban-warfare>.

¹⁴⁴ C. Wille, cited in footnote 97 above, p. 20; and C. Wille and J. Borrie, *Understanding the Reverberating Effects of Explosive Weapons: A Way Forward*, UNIDIR, Geneva, 2016.



A widow with five of her seven children at a camp for displaced people in Baghdad, Iraq. The family lost everything during bombing.

Besides the consequences for infrastructure and service-delivery capacity, there are the effects on people's education, health and livelihoods, and these have a deep and disruptive impact on countries' human capital, which is critical to recovery and growth and takes decades to build.¹⁴⁵

In protracted conflicts, this compounded impact of the use of heavy explosive weapons in populated areas makes synergies between humanitarian action, development and peacebuilding efforts difficult, but all the more necessary.¹⁴⁶

¹⁴⁵ K. Forichon, *Considering Human Capital in a Multi-dimensional Analysis of Fragility*, OECD Working Papers No. 80, OECD Publishing, Paris, September 2020.

¹⁴⁶ On the "triple nexus" between humanitarian action, development and peace, see F. Schmitz Guinote, "Q&A: The ICRC and the 'humanitarian – development – peace nexus' discussion", *International Review of the Red Cross*, Vol. 101, No. 912, November 2019.

CHAPTER 2

TECHNICAL CHARACTERISTICS OF EXPLOSIVE WEAPONS ACCOUNTING FOR THEIR WIDE IMPACT AREA¹⁴⁷

KEY FINDINGS

- The size of an explosive weapon's impact area is determined by three main factors: the weapon's **technical features (design)**, the **manner in which it is used**, and the **environment** surrounding the target. The first two are those over which the user has the greatest control.
- Explosive weapons may produce wide area effects because **(a)** each munition's **large blast- and- fragmentation radius** may create effects well beyond the target; **(b)** the **intrinsic inaccuracy or lack of precision** of the weapon system puts a wide area at risk; or **(c)** the weapons are designed to **deliver multiple munitions simultaneously over a wide area**. When these technical characteristics are combined in the same weapon system, area effects are increased.
- **These effects are often amplified in built-up areas**, where blast is partially absorbed, reflected and channeled in and around structures, and where structures and other objects struck by the explosive weapon generate significant secondary fragmentation, causing a greater number of casualties than would occur in an open area.
- **Most traditional indirect-fire explosive weapons are designed and/or employed as area weapons**, i.e. weapons that, owing to their technical characteristics, will have effects over, or put at risk of effects, an 'area' as opposed to a 'point target'. **Area weapons are not suitable for use against point targets located in populated areas.**
- **Trained weapon users can reduce (or increase), to some extent, the area effects of explosive weapons by manipulating technical variables** such as the type and size of the warhead (munition), the type of fuze, the delivery system, and the angle of fire. However, even with the best training and even after making such manipulations and choices, some explosive weapons, by design and/or because of the range at which they are fired, will foreseeably have a wide impact area.
- **Wide area effects are of serious concern in populated areas: the proximity, or even the intermingling, of military objectives and civilians and civilian objects significantly increases the risk of such effects causing incidental civilian harm:**
 - Most **indirect-fire weapon systems** – such as MBRLs, artillery guns, and most mortars – are designed to have area effects. Their use in populated areas creates a significant risk of civilian harm because of their intrinsic imprecision and low accuracy when using unguided

¹⁴⁷ This chapter is based on two technical reports commissioned by the ICRC from Armament Research Services: the ARES Technical Considerations Report, cited in footnote 78 above, and the ARES Indirect-Fire Report, cited in footnote 62 above. The chapter also draws from the GICHD Explosive Weapons Effects Report, cited in footnote 38 above, and from ICRC, *Explosive Weapons in Populated Areas: Humanitarian, Legal, Technical and Military Aspects*, Expert Meeting, ICRC, Geneva, February 2015 (ICRC Expert Meeting on EWIPA Report 2015).

- munitions, and the area effects caused when multiple rockets or projectiles are delivered in rapid succession, or because of the large destructive radius of individual munitions.
- The use of **unguided air-delivered bombs, rockets and other munitions** in populated areas is also of serious concern, in view of their lack of accuracy and the large destructive radius of most air-delivered munitions.
 - Lastly, the use of **munitions with heavy explosive payload**, even when precision-guided, raises serious concerns, given the likelihood that their effects will go significantly beyond the target, even if the target is accurately hit.
 - **The foreseeable wide impact area of heavy explosive weapons raises serious questions about whether it is appropriate to use them in populated areas, especially against point targets.**
 - The development of **new types of bomb, such as the so-called “low collateral damage” weapons**, indicates a growing concern among militaries to avoid the wide impact of certain explosive weapons when used in populated areas. The development of **precision-guided munitions (PGMs)** and of kits that enhance the accuracy of unguided munitions, which increase the probability of hitting the target and reduce area effects, provides more appropriate tools to achieve military aims in populated areas. Some of this new technology is, however, costly and might not be within the reach of all armed forces or armed groups.

2.1 INTRODUCTION

Explosive weapons are designed to deliver a munition with a high explosive payload – a ‘bomb’, ‘rocket’, ‘missile’ or other projectile – to a target.¹⁴⁸ The wide area effects of explosive weapons are largely the product of their design (or technical characteristics): the manner, the context, and the circumstances of their use are also factors.¹⁴⁹ This chapter examines the **technical characteristics of certain types of explosive weapon accounting for their wide area effects when used in populated areas.**

As explained in the introduction to this report, explosive weapons may have a wide impact area when used in populated areas because of (1) the large blast-and-fragmentation range of the individual munition used; (2) the inaccuracy of the delivery system; and/or (3) the delivery of multiple munitions over a wide area.¹⁵⁰ The categories of explosive weapons include large or unguided air-delivered bombs, missiles and rockets; and unguided indirect-fire weapons such as artillery and mortars and MBRLs. Some weapon systems fall within more than one of these categories, and others combine more than one of these technical characteristics: this combination amplifies their area effects.¹⁵¹ Explosive weapons with a wide impact area also include IEDs insofar as they fall within one or more of these categories.¹⁵²

Greater awareness of the technical features and design-dependent effects of these weapons is necessary to develop a fuller understanding of the humanitarian consequences of their use in populated areas.

¹⁴⁸ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 20.

¹⁴⁹ *Ibid.*; ARES Technical Considerations Report, cited in footnote 78 above, p. 48.

¹⁵⁰ ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, pp. 5, 9.

¹⁵¹ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 105, para. 2.1.

¹⁵² IEDs encompass a broad range of improvised weapon systems. They can be ‘victim-activated’, command-operated or timer-operated. IEDs triggered by the presence, proximity or contact of a person function as anti-personnel landmines, and as such (and as explained in the introduction to this report) are excluded from the scope of discussion; they are also prohibited under the 1997 Anti-Personnel Mine Ban Convention.



M. Azayreh/CRC

A man looks on at the devastation caused by a blast in Gaza City.

2.2 THE DAMAGE MECHANISMS OF EXPLOSIVE WEAPONS

As shown in Chapter 1, there are three ways an explosive weapon can cause injury and damage: through **blast, fragmentation, and heat** (thermal energy). The transfer of energy from these three mechanisms can cause death or injury to persons and can damage or destroy structures and other objects within the weapon's impact area. It can also produce secondary fragmentation, firebrands,¹⁵³ penetration, ground shock and cratering.¹⁵⁴

Blast is the overpressure caused by the detonation of a high explosive substance; it is often the primary damage mechanism of large explosive munitions. As described in Chapter 1, when a high-explosive charge detonates, it produces a blast wave that consists of a shock wave travelling at supersonic speed and blast winds that follow the shock wave. As the shock wave passes through unprotected persons, it affects all parts of the body, especially those normally containing air (like the lungs). In addition, the blast winds can cause total body disintegration in the immediate vicinity of the explosion, and traumatic amputations and evisceration further away; they can also throw people against objects.¹⁵⁵ Blast is usually the mechanism that causes the most significant damage to structures: as the energy of the wave travels, it damages the material that it comes into contact with.¹⁵⁶ The blast wave and blast winds can make buildings collapse and fatally compromise the structural integrity of buildings, creating a persistent hazard in urban environments.¹⁵⁷

¹⁵³ 'Firebrands' (or 'embers') are projections from an explosive detonation that are either burning or very hot, and that may transfer thermal energy to their surroundings; ARES Technical Considerations Report, cited in footnote 78 above, p. 17.

¹⁵⁴ See the ARES Technical Considerations Report, cited in footnote 78 above, pp. 13, 16, 17 and 49 for approximations of crater size by weight of general-purpose air-delivered bombs with an impact fuze; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 42–43.

¹⁵⁵ The physical effects of explosive weapons on people are described in more detail in Chapter 1.

¹⁵⁶ ARES Technical Considerations Report, cited in footnote 78 above, pp. 14–15; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 77–78; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 42.

¹⁵⁷ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 43.

The direct effects of the shock wave are generally short in range and duration, although this varies with explosive composition and weight, and with munition design. The surrounding environment may contain or amplify these effects. In the presence of natural or man-made obstacles, as in built-up areas, the blast wave typically cannot move freely outwards from the point of detonation; it is partially absorbed, reflected and channelled in and around structures (e.g. through streets and alleys, or in buildings). When explosive munitions detonate within enclosed spaces such as buildings or vehicles, or in semi-enclosed spaces such as streets, squares or markets surrounded by high buildings, reflection caused by the blast wave, and primary and secondary fragmentation, intensifies the weapon's effects, causing significantly more casualties than would occur in open areas.¹⁵⁸ In other cases, physical obstacles (e.g. buildings – depending on their design and strength, and the construction materials used) may contain the effects of the explosion and provide protection to persons behind them.

In addition to blast, the detonation of an explosive munition typically has primary and secondary **fragmentation** effects. Primary fragmentation results from the munition casing (body) breaking up on detonation. The fragments can be pre-formed – steel balls or cubes, for instance, or uniform metal fragments from a munition casing or 'sleeve' specifically designed to create fragments ('pre-fragmentation') – or non-uniform, that is, naturally occurring parts of the fragmented weapon casing ('natural fragmentation'). The fragments initially travel at high speed away from the point of detonation, causing damage to people, structures and objects, typically at a much greater distance than the blast effects. Secondary fragmentation consists of objects or fragments of objects in the environment projected as a result of an explosion, such as pieces of masonry and window glass from buildings, and parts of vehicles, as well as teeth and bone fragments from humans or animals. Secondary fragments are generally larger than primary fragments and typically do not travel as far or as fast. Secondary fragmentation is particularly common in built-up environments, including urban areas, and can be a major cause of injury and death.¹⁵⁹



This hospital in Donetsk, Ukraine, lost its water and power supply, as well as its windows.

¹⁵⁸ *Ibid.*, pp. 47, 57, and 91–92.

¹⁵⁹ ARES Technical Considerations Report, cited in footnote 78 above, pp. 15–17, 21–22; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 79–81; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 42 and 49. For example, analysis of the 1996 bombing of the Khobar Towers in Saudi Arabia showed that 95% of the survivors suffered injuries from fragmentation; of these, 88% were injured by glass; see GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 51–52. A number of other cases also suggest that secondary fragmentation contributes significantly to the death and injury of civilians: see Case Studies 3, 4 and 5 of Annex B, and Case Study 19 of Annex A, GICHD Explosive Weapons Effects Report.

The **blast-and-fragmentation range** (or radius) of an explosive munition depends on its size (i.e. the weight of its explosive payload) and the composition of the explosive substance, and on whether the munition has been pre-fragmented. There are several ways of calculating and quantifying the expected blast-and-fragmentation range of a munition.¹⁶⁰

One of these is the **'lethal area'**. While there is no universally accepted definition of the term, it is understood here to mean "the area that is completely affected by the warhead".¹⁶¹ This concept is a useful indicator of a weapon's potential area effects. For example, the lethal area of mortars with an impact fuze ranges from 150 m² for 60 mm mortars to 650 m² for 120 mm mortars; the estimated lethal area for a 122 mm artillery projectile is 500 m² and for a 155 mm artillery projectile, 800 m².¹⁶² These estimates are based on testing in open areas; blast-and-fragmentation ranges will vary with the context in which the munition is used, as explained in the next section.

Another concept used to describe the effects of explosive weapons is **'safety distance'**, i.e. the minimum distance from the munition's point of impact at which the risk to friendly troops is considered to be low.¹⁶³ For example, the minimum safety distance from the point of impact of a 120 mm mortar, for training purposes, is 600 m; at 100 m, one out of ten unprotected military personnel (i.e. personnel wearing a helmet, but not protected behind a solid structure) would be affected to the point of being temporarily unable to continue fighting.¹⁶⁴ These figures can serve as a conservative estimate of the munitions' blast-and-fragmentation effects on civilians, as civilians normally lack the training and equipment of military personnel, and will likely include people who are particularly vulnerable, such as children, the elderly, or disabled persons.

Of the three damage mechanisms that take effect when explosive weapons are detonated, **heat** is generally of less significance than blast and fragmentation. However, flammable materials typically found in populated areas, such as fuel stored in motor vehicles and gas canisters, may be ignited by the heat generated by the detonation of explosive weapons or by projected firebrands, causing significant secondary explosions and other hazards well beyond the impact area of the weapon's primary effects.¹⁶⁵

¹⁶⁰ Note that there is no standard metric for blast-and-fragmentation effects; therefore, estimates may vary according to the different methodologies. As per industry standards, figures given for area effects generally assume that the munitions are used in an open area, unless otherwise indicated; see ARES Technical Considerations Report, cited in footnote 78 above, p. 13.

¹⁶¹ ARES Technical Considerations Report, cited in footnote 78 above, p. 48; See also GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 50 and 52, 53, 55. There is no universally accepted definition of 'lethal area'. The word 'lethal' can be misleading, as the concept is premised on target incapacitation, which does not necessarily mean death; it might mean, for example, that the target has been rendered incapable of action for a certain amount of time (see also footnotes 163 and 227).

¹⁶² ARES Technical Considerations Report, cited in footnote 78 above, p. 54.

¹⁶³ In the United States military, the 'minimum safety distance' (MSD) is intended for use in training conditions, while the 'risk estimate distance' (RED) is intended for use under combat conditions. At the MSD, the risk to personnel from the munition's point of impact is considered negligible. The RED is expressed in terms of expected "probability of incapacitation" (PI) among unprotected personnel: a PI of 0.1 means that there is a chance of one in one thousand personnel being incapacitated; a PI of 10 refers to a chance of one out of 10 personnel being unable to continue fighting; see indicatively <https://www.globalsecurity.org/military/library/policy/usmc/mcwp/3-23-1/appf.pdf>. See also ARES Technical Considerations Report, cited in footnote 78 above, p.13 – and GICHD Explosive Weapons Effects Report, cited in footnote 38 above, Table 10, p. 84 and Figure 19, p. 85 – for comparative REDs for six common categories of explosive weapons. For the purposes of this report, the generic term 'safety distance' is used to refer to the minimum distance as described above, whether MSD or RED. For an overview of military policies and practices with regard to safety distances, see Chapter 4.

¹⁶⁴ ARES Technical Considerations Report, cited in footnote 78 above, p. 13; United States, Department of the Army, *The Infantry Battalion*, FM No. 3-21.20, December 2006, p. 10-9, paras 10-20. (superseded by ATP 3-21.20, 28 December 2017).

¹⁶⁵ ARES Technical Considerations Report, cited in footnote 78 above, p. 17: "Firebrands may occur when an explosive munition detonates in close proximity to solid flammable materials such as wooden structures or packaging, forests, or ammunition and associated packaging. Firebrands can act in a similar manner to incendiary munitions and ignite fires well beyond the distance at which primary thermal effects pose a threat."

2.3 FACTORS DETERMINING WIDE AREA EFFECTS

The size of an explosive weapon's impact area is determined by three main factors: the weapon's technical features (design), the manner in which it is used, and the environment surrounding the target.

The first two factors are those over which the user has the greatest control. By manipulating and adjusting variables such as the type and size of the warhead (munition), the type of fuze, the delivery system, the distance from which the weapon is launched (its range), and the angle of fire, the user can reduce (or increase) the weapon's area effects to a certain extent.¹⁶⁶ However, even with the best training, and even after making such manipulations and choices, some explosive weapons, by design and/or because of the range at which they are fired, will foreseeably have a wide impact area, i.e. effects occurring well beyond the target when used in populated areas.

The **type and weight of warhead** play an important role in the blast or fragmentation effects of a munition.¹⁶⁷ Most explosive weapons employ warheads the primary effect of which is blast (typically in large bombs) or fragmentation, or some combination of these two effects. This means that the warhead is designed to damage the target primarily through one or a combination of these effects, with the fragmentation radius generally exceeding the size of the blast radius.¹⁶⁸ In general terms, the heavier the weight of the warhead's explosive content (i.e. its explosive yield), the larger the size of the munition's blast and fragmentation radius.¹⁶⁹



The GBU-43/B Massive Ordnance Air Blast bomb is known informally as the “Mother of All Bombs”. This GPS-guided bomb is designed to detonate above the ground, creating a blast overpressure that kills anyone in the vicinity.

¹⁶⁶ ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, pp. 5–6, 24–25; ICRC Challenges Report 2015, cited in footnote 1 above, pp. 50–51.

¹⁶⁷ ARES Technical Considerations Report, cited in footnote 78 above, p. 43; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 22.

¹⁶⁸ Standard ‘high explosive (HE)’ warheads rely primarily on blast or a combination of blast and fragmentation effects; ‘high explosive fragmentation (HE-FRAG)’ warheads are designed to produce a large number of fragments, and rely on these as their primary damage mechanism. See ARES Technical Considerations Report, cited in footnote 78 above, pp. 21–22 and 43; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 82–83.

¹⁶⁹ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 35 and 93.

The choice of **fuze** can also affect the impact area of explosive weapons, by reducing or enhancing certain munition effects. There are three common types of fuze. The fuze most often used with explosive munitions is the **impact, or point-detonating, fuze**. It makes the munition detonate on contact with the target, or inside or underneath the target. Another category is the **time fuze**, which detonates the munition at a pre-set time after it has been fired. Finally, the **proximity fuze** detonates the munition at a specific distance from the target.¹⁷⁰

Time and proximity fuzes can be used to detonate the munition in the air at a set distance above the target, to achieve an ‘airburst’ effect. This can significantly enhance the munition’s blast and fragmentation effects, greatly increasing the weapon’s impact area. In some cases, an airburst fuze might increase the area effect of the munition by up to 100% more than a point-detonating fuze.¹⁷¹ Because munitions exploding in the air are generally more harmful to individuals than structures, when used in populated areas, time and proximity fuzes could significantly increase incidental civilian harm, in particular when there is a civilian presence outdoors.¹⁷² But in some cases they might limit damage to civilian objects or harm to civilians: for example, a munition exploding above a building would have effects on rooftop fighting positions, but the risk of structural damage to the building, and harm to the civilians within it, would be less than in other cases.¹⁷³



A proximity fuze is designed to detonate automatically at a specific distance from the target.

On the other hand, an impact delay fuze programmed to detonate after the munition has penetrated through walls or ceilings, and reached the lower levels of a building, can help localize the blast-and- fragmentation effects within the targeted structure, maximizing casualties within, but limiting incidental civilian harm around the target.¹⁷⁴

¹⁷⁰ ARES Technical Considerations Report, cited in footnote 78 above, pp. 38–39; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 84–86; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 66–67.

¹⁷¹ ARES Technical Considerations Report, cited in footnote 78 above, p. 39.

¹⁷² ARES Indirect-Fire Report, cited in footnote 62 above, pp. 84–86; ARES Technical Considerations Report, cited in footnote 78 above, pp. 14, 38–39 and 43; and PAX and Article 36, *Areas of Harm: Understanding Explosive Weapons with Wide Area Effects*, PAX, October 2016 (PAX/Article 36 Areas of Harm Report), pp. 66–67.

¹⁷³ See, for example, United States, Department of the Army, *Combined Arms Operations in Urban Terrain*, ATTP No. 3-06.11 (FM No. 3-06.11), June 2011, (US DOA, *Combined Arms Operations in Urban Terrain*), p. B-31, para. B-145, p. B-33, paras B-159–B-160, and p. B-34, para. B-164, *inter alia*.

¹⁷⁴ ARES Indirect-Fire Report, cited in footnote 62 above, pp. 43 and 85.

If the factors mentioned above are applied to the following examples of munitions tested in open areas, it yields the following results: a 122 mm artillery rocket with 6.4 kg of explosive mass would have a lethal area of 700 m² when fitted with a point detonating fuze, and a lethal area of 850 m² when detonated in the air (the airburst effect); and a 240 mm artillery rocket with 42 kg of explosive mass would have a lethal area of 1,500 m² when fitted with a point detonating fuze, and one of 1,700 m² when detonated in the air.¹⁷⁵

The **angle of fire** can have a significant bearing on the size and shape of the impact area and on accuracy. Generally speaking, the steeper the angle of fall of the munition, the larger the impact area.¹⁷⁶ By adjusting the angle of fire, the spread of damage may be shaped and mitigated. For example, an air-delivered munition striking a ground target from west to east will typically result in greater damage to the eastern side of the target, as the debris will spread in that direction.¹⁷⁷

Another factor determining the wide area effects of explosive weapons is the **delivery system**, i.e. the weapon system used to launch the munitions and deliver it to the target. **Accuracy and precision** are key concepts in this respect. Because of their importance, these concepts are examined separately in the following section.

Weapons using delivery systems that lack accuracy or precision – such as rocket artillery (in particular, MBRLs), artillery guns and mortars – generally employ munitions with a large blast-and-fragmentation radius. **The combination of the blast-and-fragmentation radius of the individual munition and the inaccuracy of the delivery system further increases the weapon's overall area effects.**

The foreseeable wide impact area of heavy explosive weapons, in particular when unguided, raises serious questions about whether it is appropriate to use them in populated areas, especially against point targets – i.e. targets that have a specific location with a single aim point (e.g. a single vehicle or building or other target of relatively small dimensions) – as opposed to 'area targets'. The latter are less common in urban areas: a target of this kind may be an open area within the city, the whole of which has been turned into a military objective, or several adjacent buildings used by the adversary (e.g. military headquarters situated in a city and consisting of several buildings).¹⁷⁸

¹⁷⁵ *Ibid.*, pp. 31–35; and ARES Technical Considerations Report, cited in footnote 78 above, pp. 56–57.

¹⁷⁶ ARES Indirect-Fire Report, cited in footnote 62 above, pp. 18, 43, 70, 74 and 77.

¹⁷⁷ ARES Technical Considerations Report, cited in footnote 78 above, p. 42. Fragmentation patterns are more substantially affected by the angle of attack than blast effects.

¹⁷⁸ ARES Technical Considerations Report, cited in footnote 78 above, p. 40. The NATO Standardization Office, *NATO Glossary of Terms and Definitions*, AAP-06, 2019 (NATO Glossary of Terms), pp. 14 and 99, defines 'point target' as a "target which requires the accurate placement of bombs or fire" and 'area target' as a "target consisting of an area rather than a single point". The United States Department of the Army, *Military Symbols*, FM No. 1-02.2, November 2020, pp. 5–68, defines 'point target' as "a target that is less than or equal to 200 meters in width and length". On the notion of 'area target', see also US DOA, *Combined Arms Operations in Urban Terrain*, cited in footnote 173 above, p. B-30.

2.4 ACCURACY AND PRECISION

Accuracy and precision are factors that can contribute to a weapon's wide area effects. **Accuracy is the ability to strike a specific target**, measured in terms of the distance from the mean point of impact (average impact position of a number of rounds) to the aim point (normally the centre of the target).¹⁷⁹ **Precision refers to the ability to hit a point consistently**, measured by the standard deviation or 'dispersion' of rounds from the mean point of impact.¹⁸⁰ While accuracy and precision are different concepts, the terms are often used interchangeably.

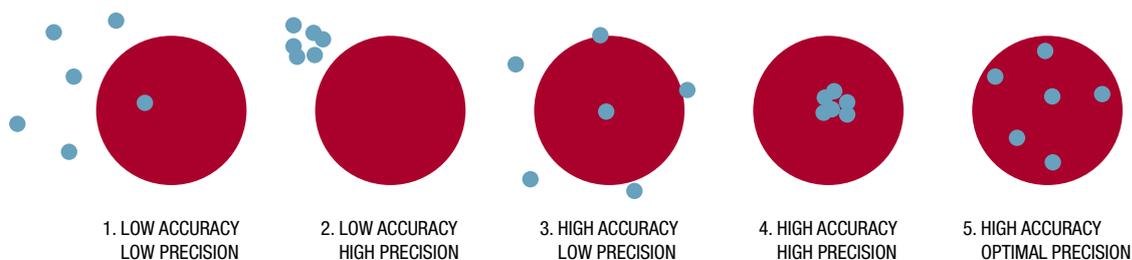


Figure 1. Accuracy and precision as affected by systematic and random errors, where the red circle represents the desired area of effect. Source: ARES Indirect-Fire Report, p. 63.

A common measure of precision is the 'circular error probable' (CEP).¹⁸¹ The CEP is the radius of a circle centered on the mean point of impact within which 50% of the munitions are expected to land. The rest of the munitions might fall in an area extending from the outer border of the CEP to the border of a radius twice the size of the CEP (43.7% of the munitions), or three times bigger (6.1%), or beyond (0.2%). **The larger the CEP, the greater the uncertainty about where the munitions will detonate.**

It is important to emphasize that the CEP estimates only the circular area in which half of the munitions are expected to land.¹⁸² Thus, even if the CEP corresponds to the size of the military objective, civilians and civilian objects in the vicinity of the target would be at high risk because half of the munitions are expected to land outside the target; and the blast-and-fragmentation range of even those munitions landing on the target may go beyond it (especially with regard to those munitions landing near the outer limit of the target).¹⁸³ At any rate, it is clear that **the larger the probability of error for a weapon, the higher the risk of incidental civilian harm**, especially when fired against a target located in a populated area, where military objectives are intermingled with civilians and civilian objects.

¹⁷⁹ ARES Indirect-Fire Report, cited in footnote 62 above, p. 60.

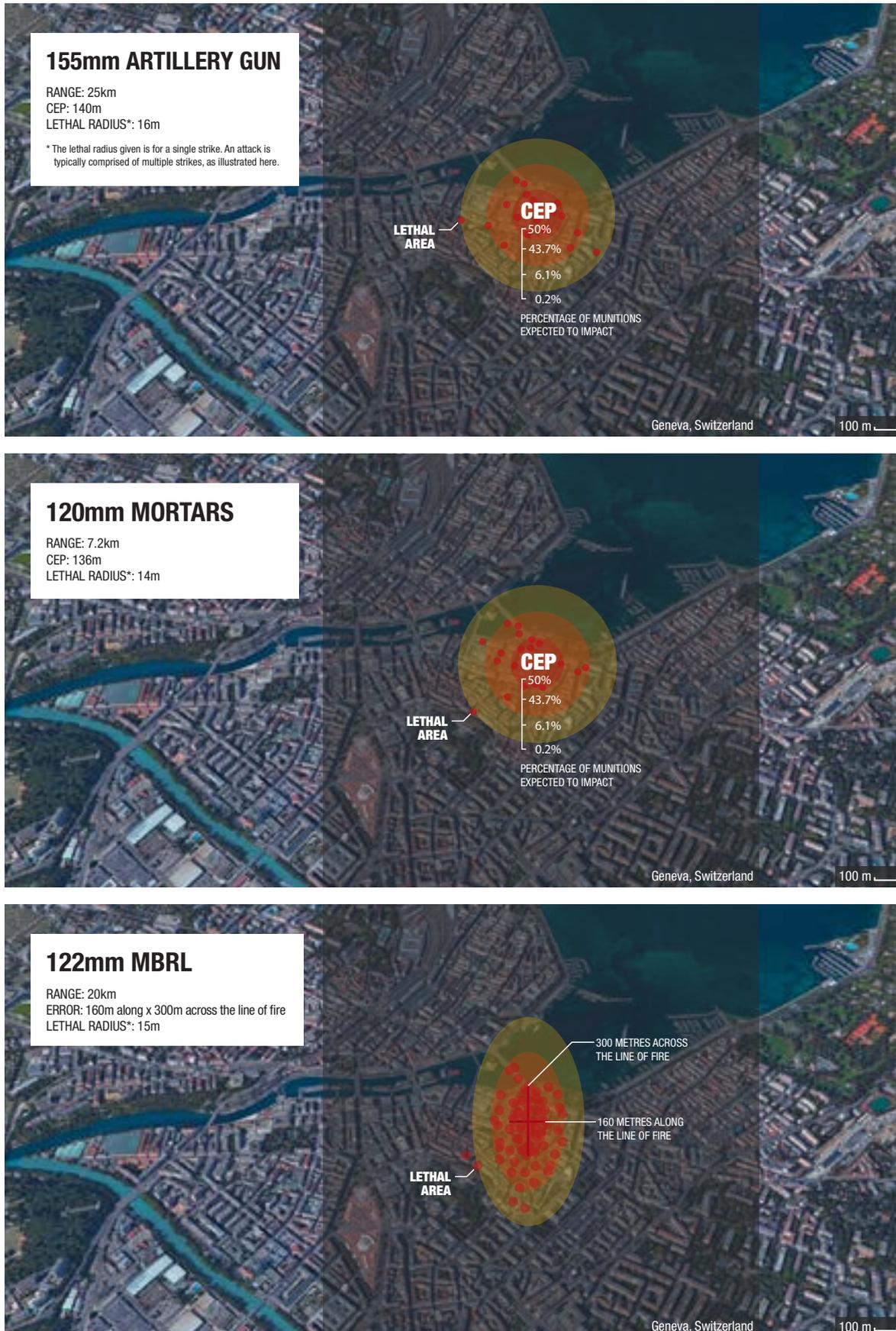
¹⁸⁰ *Ibid.*

¹⁸¹ The CEP is meant to measure the probability that the target will be hit, i.e. the weapon's capability of being directed with a reasonable degree of accuracy at a military target. See, for example, United Kingdom, *Manual of the Law of Armed Conflict*, 2004, p. 69, para. 5.23.3; NATO Glossary of Terms, cited in footnote 178 above, p. 25.

¹⁸² ARES Technical Considerations Report, cited in footnote 78 above, pp. 28–30; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 61–62. These reports emphasize that the circular pattern described by the CEP is rarely achieved, and that while the CEP can be useful to indicate the dispersion of fire (i.e. precision), it "is not useful for describing accuracy".

¹⁸³ ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, p. 25.

Shown below are typical error patterns for various indirect-fire weapons.¹⁸⁴



¹⁸⁴ The illustrations are based on the specifications in the ARES Indirect-Fire Report, cited in footnote 62 above, pp. 61–62, and the ARES Technical Considerations Report, cited in footnote 78 above, p. 28.

Generally, weapons employed for direct fire (where the target is visible and the weapon is aimed directly at it) are more accurate than weapons employed in indirect-fire roles (where the target is not in the line of sight, or where the munition does not follow the line of sight). Moreover, indirect-fire weapons such as traditional artillery, mortars and rocket systems are designed to affect an area, i.e. to have a natural dispersion such that not all munitions strike the same point (see section 2.5.1 below).¹⁸⁵

A weapon's accuracy will influence the extent of its impact area, because the more inaccurate a weapon system is, the wider the area around the target that will be at risk of being struck. In order to compensate for the miss distance and increase the chance of striking the target, an inaccurate delivery system must fire greater quantities of munitions. Thus, indirect-fire weapon systems are often employed in 'salvos': several munitions are launched, or several weapons discharged, simultaneously or in quick succession, to compensate for inaccuracy, thereby generating wide area effects. Another way to compensate for low accuracy is to deliver larger munitions – therefore, with wider blast-and-fragmentation effects – to increase the probability of achieving the desired effects on the target.¹⁸⁶ **The probability of wide area effects and the likelihood of civilian harm increase when munitions with large lethal areas are delivered by inaccurate weapon systems.**¹⁸⁷

Many factors, described as 'errors', affect a weapon system's accuracy and precision. They include errors caused by meteorological conditions (whose influence increases with the range of fire); aiming errors (especially in indirect-fire systems, in which case the errors increase with the range of fire); variations in propellant temperature; mistakes in ballistic calculations; and variations in the projectile's speed and weight, and in the mass of the propellant.¹⁸⁸ The **range** at which a weapon is fired can increase (or reduce) the weapon's wide area effects: the longer the range, the more significant the influence of meteorological and other external factors on the munition's flight, affecting its accuracy. The influence of range on the impact area differs in explosive weapon systems.¹⁸⁹

Accuracy and precision can be improved through **calibration of the weapon's aiming system**, a standard practice among militaries.¹⁹⁰ Especially for indirect-fire weapon systems, successive corrections to a weapon's aim point are often required to ensure that the target will be hit. This generally involves the following process: 'adjustment' rounds are fired towards the target location; their initial and subsequent impact are noted by a forward observer (or by other means); corrections are then made, until there is sufficient certainty that the munitions will land on the target or sufficiently close to it; after this, fire is delivered 'for effect', i.e. in greater intensity. Corrections are made in range increments that vary from 800 to 50 metres. Some militaries refer to such adjustment techniques as 'walking' or 'bracketing' fire.¹⁹¹

Unguided air-delivered bombs, also known as gravity bombs, do not have a measurable CEP. Their accuracy varies greatly, being a product of the aircraft's altitude and speed, the weather, and other factors such as the competence of the pilot.¹⁹²

¹⁸⁵ ARES Indirect-Fire Report, cited in footnote 62 above, pp. 13–14 and 18.

¹⁸⁶ *Ibid.*, p. 13; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 95.

¹⁸⁷ ARES Technical Considerations Report, cited in footnote 78 above, pp. 30–32; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 63–69; and GICHD Explosive Weapon Effects Report, cited in footnote 38 above, p. 28. A distinction is drawn between 'systematic errors', which are consistent from round to round (affecting accuracy), and 'random errors', which are inconsistent from round to round (affecting precision).

¹⁸⁸ ARES Technical Considerations Report, cited in footnote 78 above, p. 48.

¹⁸⁹ ARES Indirect-Fire Report, cited in footnote 62 above, pp. 13, 21, 61–62 and 64–66; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, e.g. pp. 22–23, 29 and 31–32.

¹⁹⁰ ARES Indirect-Fire Report, cited in footnote 62 above, p. 67. There is no universally agreed military definition of 'calibration'. In this report, the term is used to refer to all actions undertaken to improve the accuracy of a firing unit, without actually firing, adjusting, and subsequently recording fire, on an actual enemy target.

¹⁹¹ ARES Indirect-Fire Report, cited in footnote 62 above, pp. 42–45; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 28, 33, 94–95 and 107. On the legal implications of such adjustment methods, see Chapter 3.

¹⁹² ARES Technical Considerations Report, cited in footnote 78 above, p. 31.

The trend in the development of conventional weapon systems has been towards greater accuracy and precision. This trend is driven by the need to increase the effectiveness of munitions for reasons of military utility, while also reducing the risk of incidental civilian harm.¹⁹³

Precision-guided munitions (PGMs) are designed to strike a specific target with the first shot by altering (self-correcting) their trajectory during flight.¹⁹⁴ Modern PGMs achieve a CEP of a few metres,¹⁹⁵ although they are still susceptible to deviations from the target owing to errors such as weather conditions, or interference with the guidance system by enemy countermeasures or other external factors.¹⁹⁶ Retrofitted precision-guidance kits can also reduce the CEP of artillery munitions, albeit not to such an extent as to rival PGMs.¹⁹⁷

Although not all militaries or armed groups have access to such munitions or guidance kits, the decreasing costs of precision technology, and savings potentially gained from lower ammunition consumption and attendant logistic issues, are expected to make this technology increasingly more accessible.¹⁹⁸



A F-16I (Israeli Air Force) with BLU-109 forged steel point tip, and a BLU109 JDAM, 2000lb "bunker buster" penetration bomb.

Precision-guidance is undoubtedly an improvement over inaccuracy,¹⁹⁹ but it does not remove all the dangers that the use of heavy explosive weapons in populated areas creates for civilians and civilian objects. Greater precision and accuracy can help reduce area effects, but that would be obviated by the use of large warheads, i.e. munitions that have a large blast-and-fragmentation

¹⁹³ ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, p. 6.

¹⁹⁴ ARES Indirect-Fire Report, cited in footnote 62 above, p. 86; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 36; and ARES Technical Considerations Report, cited in footnote 78 above, p. 35.

¹⁹⁵ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 36–37.

¹⁹⁶ See an official study by the Australian military published in 2003 and cited in C. Cole, "Are we being misguided about precision strike?", *Drone Wars UK*, 4 December 2015: <https://dronewars.net/2015/12/04/are-we-being-misguided-about-precision-strike/>. The study found that 45.5% of the laser-guided weapons used by US forces in the early days of Operation Desert Storm missed their target owing to poor weather, technical malfunction or pilot error. In the context of recent fighting in Iraq and Syria, an Airwars report found that flawed and outdated intelligence, and the large calibre of munitions used, may also have undermined key benefits of 'smart bomb' technologies. See Airwars, *Death in the City: High Levels of Civilian Harm in Modern Urban Warfare Resulting from Significant Explosive Weapons Use*, Airwars, May 2018, (Airwars Report), p. 5.

¹⁹⁷ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 39.

¹⁹⁸ ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, p. 6.

¹⁹⁹ *Ibid.*, p. 28.

radius (or lethal area).²⁰⁰ Furthermore, the guidance systems for PGMs vary in their accuracy and precision, and PGMs can also be affected by external factors, such as weather and lighting conditions, jamming, cyber attacks or other types of interference, and even the type of construction material in urban environments.²⁰¹

‘Low-collateral-damage’ munitions

The use of so-called ‘low-collateral-damage’ weapons is intended to reduce the harm done to civilians and civilian objects near the intended target.²⁰² This is done in three ways: by reducing the explosive yield; by focusing the blast explosive in a particular direction (akin to a shaped charge), thus reducing the wide area effect of the munition – which is largely responsible for incidental civilian harm; and by manufacturing the bomb casing from a material that results in few metal fragments or shrapnel, such as carbon fibre, or in fragments that have only a limited amount of kinetic energy and so do not fly far from the point of impact.²⁰³

Investment in the development of ‘low-collateral-damage’ munitions has increased in recent years.²⁰⁴ In the GBU-126/B bomb, an example of such investment, the high-explosive content has been reduced from the standard 185 lb to 27 lb – just over 12 kg – and the gap filled with inert material, in order to reduce the bomb’s lethal area to about 10% of that of a bomb with a similar payload.²⁰⁵ Other ordnance have low-collateral-damage equivalents: in some cases, this entails simply reducing the explosive yield by half.



BLU-109 aboard F-15E.

²⁰⁰ Airwars Report, cited in footnote 196 above, pp. 11 and 21. While the report recommends that parties to conflict review the impact of unguided versus guided munitions, with an emphasis on examining the “intensive use of unguided artillery”, it nevertheless stresses that the use of precise munitions in and of itself does not guarantee a low number of civilian casualties or the proportionality of the attack, especially if great numbers of munitions are fired or the munition yields especially large.

²⁰¹ ARES Technical Considerations Report, cited in footnote 78 above, pp. 35–37.

²⁰² PAX/Article 36 Areas of Harm Report, cited in footnote 172 above, p. 33. However, the term ‘low collateral damage’ is not defined.

²⁰³ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, Annex E: Mk 83 Aircraft Bomb, p. 15; and M. V. Schanz, “Focused lethality”, *Air Force Magazine*, 1 December 2008: <https://www.airforcemag.com/article/1208lethality/>.

²⁰⁴ R. Lane and H. Shiotani, *Opportunities to Strengthen Military Policies and Practices to Reduce Civilian Harm from Explosive Weapons*, UNIDIR, Geneva, September 2019 (UNIDIR Food-for-Thought paper), p. 3; and R. Lane, L. Lewis and H. Shiotani, *Opportunities to Improve Military Policies and Practices to Reduce Civilian Harm From Explosive Weapons in Urban Conflict: An Options Paper*, UNIDIR, Geneva, November 2019 (UNIDIR Options Paper), p. 17.

²⁰⁵ Global Security, “GBU-51/B BLU-126/B Low Collateral Damage Bomb (LCDB)”: <https://www.globalsecurity.org/military/systems/munitions/gbu-51.htm>.

While these are undoubtedly positive developments, terms such as ‘low collateral damage’ should be used with caution. Employing a ‘low-collateral-damage’ munition is no guarantee that incidental civilian harm from the attack will indeed be low. Such munitions can still cause significant civilian harm and even prove lethal, e.g. when there is a civilian presence very close to the impact point, or when the limited damage caused is sufficient to disrupt the delivery of an essential service, with potentially long-term domino effects on other services and on the lives and health of a large number of civilians.



An Iranian Qaem-1 Smart Glide Munition.

There have also been examples of the use of free-fall projectiles without explosive content, relying solely on the kinetic effect of the impact rather than a blast wave (such as concrete bombs and bladed anvils).²⁰⁶ This could considerably reduce the incidental civilian harm resulting from an attack.

²⁰⁶ Brigadier-General D. Deptula, United States Air Force, interviewed in “Securing 21st Century Combat Success – The Munitions Effects Revolution”, Maj. Gen. L. Stutzreim & M. Hurley, Mitchell Institute for Aerospace Studies, September 2018: <https://www.afa.org/events/Conference/recordings/scepanel>; S. Lee Myers, “US wields defter weapon against Iraq: Concrete bomb”, *New York Times*, 7 October 1999: <https://www.nytimes.com/1999/10/07/world/us-wields-defter-weapon-against-iraq-concrete-bomb.html>. On a missile-delivered, non-explosive munition developed recently, see J.D. Simkins, “‘Ninja bomb’ is a bladed anvil that shreds terrorists with no risk of collateral damage, Pentagon says”, *Military Times*, 14 May 2019: <https://www.militarytimes.com/off-duty/military-culture/2019/05/14/ninja-bomb-is-a-bladed-anvil-that-shreds-terrorists-with-no-risk-of-collateral-damage-pentagon-says/>



Soko self-propelled 122mm gun-howitzer on display at “Partner 2017” military fair.

2.5 TECHNICAL CHARACTERISTICS OF COMMONLY USED EXPLOSIVE-WEAPON SYSTEMS WITH A WIDE IMPACT AREA²⁰⁷

2.5.1 Indirect Fire

Most traditional **artillery systems** are designed to have area effects. They are generally not designed to destroy individual targets such as a single vehicle (point targets) but to inflict damage across an area.²⁰⁸ They are primarily designed for indirect fire and predominantly make use of unguided munitions.²⁰⁹ An unguided artillery projectile will not reliably strike the exact point at which it is aimed.²¹⁰ When used in populated areas, the intrinsic inaccuracy of these weapon systems puts civilians at risk, a risk that increases with the range of fire and the number of munitions used.

²⁰⁷ The figures provided in this section are examples and as such do not represent all of the weapon systems of the same calibre; the effects of a weapon system will be determined also by the munition used, the way in which the weapon is being fired, and the skills of the crew operating it.

²⁰⁸ UNIDIR Food-for-Thought Paper, cited in footnote 204 above, p. 34: “Errors can be reduced, but artillery is still an area weapon and its suitability must be considered before determining whether to fire into an urbanized environment”. See also footnote 178 above and referenced text for the definitions of ‘point targets’ and ‘area targets’, and the distinction between them.

²⁰⁹ PGMs are increasingly available for artillery-gun, mortar and rocket systems; however, the acquisition and use of PGMs is limited by their high per-munition cost and, frequently, their unsuitability for core artillery roles (namely the need to deliver effects over a wide area). See ARES Indirect-Fire Report, cited in footnote 62 above, pp. 16–17 and 85.

²¹⁰ *Ibid.*, p. 13.

Artillery guns typically operate as a group (or ‘battery’), i.e. with several weapons firing several munitions simultaneously in salvos or barrages to affect an area.²¹¹ They are often used to create covering fire, to allow freedom of manoeuvre for one’s own forces; to restrict the freedom of enemy forces to employ their weapons and take other tactical action, which is, in effect, a form of ‘area denial’; to ‘harass’ enemy forces and lower their morale; and to destroy or suppress enemy artillery, which is known as ‘counter-battery fire’.²¹²

An **artillery gun** is characterized by a heavy barrel, generally several metres long and usually fitted to a self-propelled vehicle or towed trailer. Most artillery guns in use today are manufactured in medium (105 mm, 122 mm and 130 mm) and heavy (152 mm and 155 mm) calibres. As discussed above in relation to accuracy and precision, artillery guns are subject to errors caused by several factors, including meteorological phenomena such as wind. Their accuracy and precision is range-dependent and deteriorates with distance: meteorological factors are the largest source of error when the range of fire exceeds approximately 15 km.²¹³ To compensate for the inherent inaccuracy of artillery systems, fire-adjustment techniques are typically applied: this involves firing several rounds and making corrections after each round, before ‘firing for effect’ at the target.

For example, a 105 mm artillery gun has a CEP of 97 m when fired at a range of 10 km; and at 20 km its CEP is 163 m. A 155 mm artillery gun has a CEP of 140 m when fired at a range of 25 km; and at 30 km its CEP is 275 m.²¹⁴

Mortars are tube-launched indirect-fire systems, typically employing unguided projectiles.²¹⁵ They are widely deployed by military forces, being mostly portable, simple to operate and versatile. In contrast to artillery guns, most mortars are capable of firing only at high-angle trajectories, i.e. above 45 degrees, and at shorter range, making them useful for firing over, into or out of defilade.²¹⁶ They are generally less accurate and precise than artillery guns at comparable distances.²¹⁷ In principle, mortars are fired in salvos at a target with a forward observer to correct the impact location, though often the latter is not done in practice.²¹⁸

²¹¹ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 20, 72 and 95; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 13 and 17. See NATO Glossary of Terms, cited in footnote 178 above, p. 18, according to which, ‘barrage fire’ is fire that is “designed to fill a volume of space or area rather than aimed specifically at a given target”. The GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 113 and 125, defines a ‘barrage’ as “an explosive weapon attack of a minimum of 8 projectiles of the same type impacting one (target) area. For example, 4 guns firing 2 rounds each”, and to a ‘salvo’ as “an explosive weapon attack of between 2 and 9 projectiles of the same type in one (target) area by at least two weapons (one round each)”.

²¹² ARES Indirect-Fire Report, cited in footnote 62 above, p. 17. See also NATO Glossary of Terms, cited in footnote 178 above, pp. 61 and 123. On suppressive, interdiction and harassing fire, see also Chapter 3.

²¹³ ARES Indirect-Fire Report, cited in footnote 62 above, pp. 23 and 74–75; and GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 34.

²¹⁴ ARES Technical Considerations Report, cited in footnote 78 above, p. 54; and ARES Indirect-Fire Report, cited in footnote 62 above, p. 62.

²¹⁵ ARES Technical Considerations Report, cited in footnote 78 above, pp. 55–56. PMGs for mortars remain uncommon in military arsenals.

²¹⁶ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 73–74.

²¹⁷ ARES Indirect-Fire Report, cited in footnote 62 above, p. 74.

²¹⁸ *Ibid.*, p. 30: “[w]hilst, in theory, it would be possible to adjust for accuracy in mortar systems in much the same way as artillery guns, this is often not done in order to preserve some of the essential characteristics of the system: simplicity and speed”.



A 120 mm 2B11 mortar on display.

Mortars can be classified into three broad groups according to calibre: light (60 mm or less), medium (between 61 and 100 mm), and heavy (greater than 100 mm). For the purposes of this report, mortars of concern are those of medium and heavy calibre. Light mortars are no longer in use in many armed forces,²¹⁹ although in recent years a shift appears to have taken place towards their reintroduction.²²⁰

For example, the approximate CEP for a 120 mm mortar is 136 m, with each munition having a lethal area of 650 m². The largest mortars in service are 240 mm in calibre with a lethal area of 1,800 m² for each munition and potentially extensive wide area effects.²²¹

Rocket artillery systems are usually towed or vehicle-mounted and can fire at longer ranges than artillery guns. They can be single- or multi-barrelled. Traditional **MBRLs** are designed to deliver several unguided rockets in quick succession without having to be reloaded, and thus to produce a wide area effect.²²² Unguided artillery rockets are generally less accurate and less precise than other artillery weapon systems, as they are affected to a greater degree by meteorological conditions and subject to more sources of error, such as those caused by the movement of the vehicle-mounted launcher. Each launch causes the vehicle's suspension to compress and rebound, leading to fluctuations in the angle of the launching tubes and thus to greater inaccuracy in the delivery of the rockets.²²³

²¹⁹ *Ibid.*, p. 29; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 74.

²²⁰ J. Tschiderer, "Lightweight handheld mortars: A suitable and effective platform to be organic to rifle platoons", *The Cove*, 13 May 2019: <https://cove.army.gov.au/article/lightweight-handheld-mortars-suitable-and-effective-platform-be-organic-rifle-platoons>; and Rheinmetall, "Two in one: Rheinmetall's new 60 mm mortar for infantry and special forces", 13 August 2019: https://www.rheinmetall-defence.com/en/rheinmetall_defence/public_relations/news/archiv/2019/aktuellesdetailansicht_9_21120.php.

²²¹ ARES Technical Considerations Report, cited in footnote 78 above, p. 56.

²²² *Ibid.*, p. 21; ARES Indirect-Fire Report, cited in footnote 62 above, p. 32; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 32 and 100.

²²³ ARES Technical Considerations Report, cited in footnote 78 above, pp. 32–33; ARES Indirect-Fire Report, cited in footnote 62 above, pp. 72–75; GICHD Explosive Weapons Effects Report, cited in footnote 38 above, p. 32.



Robert Wray

A Russian BM-21 Grad rocket launcher.

The two most prevalent calibres of MBRL are the 107 mm systems with short barrels firing spin-stabilized rockets, and the 122 mm systems with long barrels firing fin-stabilized rockets. The precision of rocket artillery systems is generally not listed in terms of CEP but as the error in metres along and across the line of fire.

Thus, the total 'along x across' error of a 107 mm rocket fired at maximum range (8 km) is 80 m along by 130 m across, and that of a 122 mm rocket fired at 20 km range is 160 m along by 300 m across, resulting in a large elliptical landing area for the rocket.²²⁴

By launching multiple rockets, the MBRL increases the statistical probability of striking the target. It should be kept in mind that every rocket employing a point-detonating fuze will have a lethal area of 450 m² (for 107 mm rockets) or 700 m² (for 122 mm rockets). This results in explosive effects over a much wider area than, for example, traditional gun artillery.

For example, the 122 mm BM-21 Grad-type MBRL, which has been prevalent in conflicts since the early 1960s, can launch up to 40 122 mm rockets in just under 20 seconds, at ranges up to 20 km. At that range, when a full salvo of 40 rockets is fired, the total impact area extends up to 600 x 600 m.²²⁵

²²⁴ ARES Indirect-Fire Report, cited in footnote 62 above, p. 32; and O. S. Dullum, *The Rocket Artillery Reference Book*, Norwegian Defence Research Establishment (FFI), Kjeller, June 2010, p. 49.

²²⁵ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 71, 100 and 104.

2.5.2 Air-delivered munitions

Air-delivered munitions encompass bombs, rockets and missiles. The most commonly used air-delivered munitions are described below.

Most **air-delivered bombs** weigh approximately 250, 500, 1000 or 2000 lb. There are four basic types of air-delivered explosive bomb: penetration, fragmentation, general-purpose (the most common, designed to destroy targets through a combination of blast and fragmentation), and high-capacity (among the largest aerial bombs, designed to destroy targets primarily through blast).²²⁶

The Mk 82, a general-purpose aircraft bomb containing 89 kg of high explosive, is an example of a bomb of the 500-lb (227 kg) class. It creates a powerful blast and can destroy reinforced concrete structures within 16 metres of the point of detonation, when using an impact fuze. This 500-lb aircraft bomb will temporarily incapacitate one out of ten personnel at 250 m from the point of impact.²²⁷

Most Mk 82 aircraft bombs in contemporary conflicts are guided weapons capable of achieving high precision, but when their large blast- and-fragmentation radius extends beyond the perimeter of the target, it puts civilians and civilian objects surrounding the target at risk of harm. Unguided air-delivered bombs (so-called 'dumb bombs') will put a much wider area at risk because of their inaccuracy.



A B-2 Spirit dropping Mk 82 bombs into the Pacific Ocean in a 1994 training exercise.

²²⁶ ARES Technical Considerations Report, cited in footnote 78 above, p. 49.

²²⁷ GICHD Explosive Weapons Effects Report, cited in footnote 38 above, pp. 76, 84 and 93. The distance of 250 m is RED (risk estimate distance) 10; RED is explained in footnote 163 above.

A rocket is a munition that uses rocket propulsion. **Air-to-surface rockets** are, typically, unguided direct-fire weapons fired from aircraft and usually of 57 mm, 70 mm or 80 mm in calibre. They are typically fired in salvos to compensate for their inaccuracy and imprecision, resulting in area effects. They are sometimes ‘ripple-fired’: typically ten or more rockets are fired within seconds for maximum area coverage. Air-to-surface rockets are usually equipped with high-explosive armour-piercing or high-explosive fragmentation warheads. Some military experts (former pilots) regard unguided air-to-surface rockets as area-effect weapons incapable of accurately engaging a point target.²²⁸

2.5.3 Improvised explosive devices

There exists no internationally agreed definition of the term ‘improvised explosive device’ (IED). Understanding of its scope varies among states and international organizations,²²⁹ but generally speaking, the term is used to cover many different types of weapon that are not industrially manufactured:²³⁰ roadside bombs and body-borne or vehicle-borne IEDs used in suicide attacks; shoulder-fired recoilless rocket launchers; anti-personnel or anti-vehicle mines; improvised mortars and rockets; and so-called ‘barrel bombs’.²³¹

Like industrially manufactured explosive weapons, IEDs may have wide area effects because of a large explosive payload, their lack of accuracy, the firing of multiple munitions simultaneously, or a combination of all these factors. Their improvised nature often degrades their accuracy even further and/or makes their impact area harder to predict, as it increases the likelihood of malfunctioning.²³²

IEDs are not necessarily always fully improvised. Often, traditionally manufactured munitions are tampered with or modified. For example, air-to-surface rockets are sometimes modified into **makeshift surface-to-surface rocket artillery**, even though they are designed to be air-delivered from purpose-built and mounted rocket pods. Such improvised rockets are particularly inaccurate and imprecise.²³³

Other improvised air-delivered munitions have also been observed: for instance, ‘**barrel bombs**’, which can be as large as a 50-gallon oil drum filled with 300 kg of almost any type of explosive compound available. The combination of unknown explosive fill, inconsistent manufacturing and unreliable sighting and delivery systems means that the destructive radius for any of the main damage mechanisms (blast and fragmentation) is highly unpredictable. Consequently, such munitions pose a significant risk of civilian harm.²³⁴

The use of improvised artillery, including improvised rockets (often referred to as **improvised rocket-assisted munitions**, or IRAMs) and **improvised mortars**, is widespread in recent armed conflicts taking place in populated areas. These weapons are, by their nature, very inaccurate and deliver significant amounts of explosive into the target area, either individually or in salvo. If they also employ improvised fuzing, there is likely to be a high incidence of failure to detonate

²²⁸ ARES Technical Considerations Report, cited in footnote 78 above, pp. 52–53.

²²⁹ See Amended Protocol II to the CCW (1996), Art. 2(5); International Mine Action Standards (IMAS), *Glossary of Mine Action Terms, Definitions and Abbreviations*, 2nd ed., United Nations Mine Action Service (UNMAS), New York, 2019, p. 24, para. 3.138.

²³⁰ ICRC, “Views and recommendations on improvised explosive devices falling within the scope of the Anti-Personnel Mine Ban Convention”, working paper submitted by the ICRC to the Fourth Review Conference of the States Parties to the Anti-Personnel Mine Ban Convention, Oslo, 25–29 November 2019, p. 5.

²³¹ See, for example, UN General Assembly, *Report of the UN Secretary-General on Countering the Threat Posed by Improvised Explosive Devices*, UN Doc. A/73/156, 12 July 2018, paras 8, 16–17, taken note of by the UN General Assembly, in Resolution 73/67, UN Doc. A/RES/73/67, 13 December 2018, adopted without a vote. See also Twentieth Annual Conference of the States Parties to Amended Protocol II to the CCW (1996), *Report on Improvised Explosive Devices*, UN Doc. CCW/AP.II/CONF.20/2, 30 October 2018, paras 10–13.

²³² See, for example, ARES Indirect-Fire Report, cited in footnote 62 above, pp. 35 ff.

²³³ *Ibid.*, p. 35.

²³⁴ ARES Technical Considerations Report, cited in footnote 78 above, p. 53.



Improvised explosive device.

as designed, creating a persistent risk of unexploded ordnance and increasing the duration of the explosive hazard in the targeted area.²³⁵ Generally, the use of low-quality materials and crude manufacturing processes means that improvised rocket artillery is largely inaccurate and its range and direction of fire can be quite random.²³⁶

Other types of IED that have been extensively documented are body-borne or vehicle-borne IEDs and so-called roadside bombs. When used against a military objective (usually one or more individuals or vehicles), these devices may be quite accurate; nevertheless, their wide area effects, owing to their heavy explosive payload and consequent large destructive radius, are very likely to go well beyond the target, posing a high risk of indiscriminate effects.

²³⁵ *Ibid.*, p. 57.

²³⁶ ARES Indirect-Fire Report, cited in footnote 62 above, p. 35.

CHAPTER 3

INTERNATIONAL HUMANITARIAN LAW AND THE USE OF EXPLOSIVE WEAPONS WITH A WIDE IMPACT AREA IN POPULATED AREAS

KEY FINDINGS

- There is no prohibition against attacking military objectives located in populated areas using explosive weapons with a wide impact area, but the difficulty lies in carrying out such an attack while also respecting the prohibitions against indiscriminate and disproportionate attacks and taking all feasible precautions to avoid or at least minimize incidental civilian harm. **This is difficult, given the high risk that such weapons will have effects well beyond the targeted military objective**, a risk borne out by the humanitarian consequences observed when these weapons are used in populated areas (outlined in Chapter 1) and their foreseeable design-dependent area effects (explained in Chapter 2).
- The extensive civilian harm from the use of heavy explosive weapons in populated areas witnessed in recent and ongoing armed conflicts gives rise to serious questions about how conflict parties interpret and apply the IHL rules governing the conduct of hostilities, each of which strikes a careful balance between military necessity and humanitarian considerations. **Any challenge to the interpretation of these rules must be resolved in accordance with the object and purpose of the IHL principles and rules governing the conduct of hostilities, namely to protect civilians and civilian objects.**²³⁷
- **The greater the density of the populated area, and the wider the impact area of the explosive weapon used compared to the size of the targeted military objective, the higher the likelihood of an indiscriminate or disproportionate attack.**
- **The inaccuracy of certain types of explosive-weapon system** – such as the many unguided artillery, mortar and multiple-rocket launcher systems in use today, as well as unguided air-delivered bombs and rockets – **makes it difficult to direct these weapons against a specific military objective as required by the principle of distinction and the prohibition against indiscriminate attacks.** When used against targets located in populated areas, there is generally a high risk that they will strike civilians and civilian objects as well as the military objectives, without distinction.
- While increasing the accuracy of delivery systems helps to reduce the weapons' wide area effects in populated areas, **the use of munitions that have a large destructive radius**

²³⁷ See ICRC Challenges Report 2015, cited in footnote 1 above, p. 51. Article 51(1) of Protocol I of 8 June 1977 additional to the Geneva Conventions (Additional Protocol I) establishes the overarching principle that “[t]he civilian population and individual civilians shall enjoy general protection against dangers arising from military operations”.

relative to the size of the military objective (such as big bombs and missiles or large-calibre projectiles when used against small-size targets) **also risks running afoul of IHL – in particular the prohibitions against indiscriminate and disproportionate attacks – even when precision-guided.**

- In assessing the expected incidental civilian harm when applying the rules of proportionality and precautions in attack, **both the direct and indirect (or reverberating) effects must be taken into account, insofar as they are reasonably foreseeable in the circumstances.** As urban warfare becomes more prevalent, the experience of armed forces in urban operations will increase, and general knowledge about the interdependence of essential services will continue to grow; consequently, the reverberating effects of the use of heavy explosive weapons in populated areas will also become more reasonably foreseeable.
- **The pattern of civilian harm observed in warfare in populated areas (Chapter 1) and the doctrines and processes in place (Chapter 4) raise doubts as to whether armed forces sufficiently factor in such reverberating effects in their planning and decision-making processes.** Attacks assessed as proportionate might in fact be considered disproportionate if all reasonably foreseeable reverberating effects had been taken into account.
- Respecting the IHL prohibitions against indiscriminate and disproportionate attacks, though necessary, is not enough; the obligation to take all feasible precautions in the choice of means and methods of attack requires that practical measures must be taken as well to avoid or at least minimize civilian harm. **Precautionary measures include limiting the wide area effects of explosive weapons, or choosing means and methods of warfare other than explosive weapons with a wide impact area.** This is legally required if it would prevent or at least minimize incidental civilian harm, and is feasible.
- **Even in situations where troops are under enemy fire (often referred to as ‘self-defence’), the use of force is circumscribed by the prohibitions against indiscriminate and disproportionate attacks, and by all other IHL rules governing the conduct of hostilities.** While the protection of own or friendly forces from imminent danger is a relevant military consideration for precautions and proportionality, it must always be balanced against humanitarian considerations, such as the extent of incidental civilian harm expected to result from the use of heavy explosive weapons. At any rate, force protection can never justify the use of indiscriminate fire as a measure to avoid exposure of own or friendly forces.
- The fact that one party to a conflict puts civilians and civilian objects at risk by intermingling with the civilian population, or even violates IHL, does not relieve the other party of its obligations under IHL. In particular, it does not justify resorting to means or methods of warfare, including the use of heavy explosive weapons, when such use would be unlawful.
- To assist in clarifying how these IHL rules on the conduct of hostilities apply to the use of explosive weapons with a wide impact area in populated areas, it is important that states share information on how they interpret and implement these provisions in practice.

3.1 INTRODUCTION

It is a long-standing principle of IHL that the right of the parties to an armed conflict to choose means and methods of warfare is not unlimited.²³⁸ While only very few explosive weapons with a wide impact area are specifically regulated by IHL,²³⁹ the use of all such weapons, like any other means of warfare, must in all circumstances comply with IHL, notably its principles and rules that aim to protect civilians and civilian objects from the effects of hostilities.

First and foremost, the **principle of distinction** requires parties to an armed conflict at all times to distinguish between civilians and combatants and between civilian objects and military objectives,

²³⁸ See Additional Protocol I, Article 35(1); and Hague Regulations (1899) and (1907), Article 22.

²³⁹ See, in particular, the Convention on Cluster Munitions (2008). Specific weapons already regulated by IHL are, however, beyond the scope of this report.

and to direct their attacks only against combatants and military objectives, never against civilians and civilian objects.²⁴⁰

Even when the parties to a conflict direct their attacks against lawful targets (combatants and military objectives), IHL limits their choice of weapons and tactics (means and methods of warfare) by prohibiting indiscriminate and disproportionate attacks and by requiring them to take all feasible precautions to avoid or at least minimize incidental civilian harm.

Compliance with these key rules becomes particularly difficult in environments where military objectives are located within or in close proximity to a concentration of civilians. **There is indeed a clear link between the concentration of civilians and civilian objects and the concerns raised by the wide area effects of the weapons used** (described in Chapter 2). When combined, these two factors – weapons’ wide area effects and a concentration of civilians – give rise to a significant likelihood of indiscriminate effects, i.e. of striking military objectives and civilians and civilian objects without distinction, and an increased risk of causing excessive incidental civilian harm.²⁴¹



Children in the streets of Mosul, Iraq, play among the rubble and debris.

As indicated in the introduction, for the purposes of this report, the term ‘**populated areas**’ refers to areas where there is a concentration of civilians or of civilians and civilian objects. It is used synonymously with the term ‘concentration of civilians’, found in amended Protocol II and Protocol III of the Convention on Certain Conventional Weapons (CCW), which Protocol III defines as “any concentration of civilians, be it permanent or temporary, such as inhabited parts of cities, or inhabited towns or villages, or as in camps or columns of refugees or evacuees, or groups of nomads”.²⁴²

²⁴⁰ Additional Protocol I, Article 48; and J.-M. Henckaerts and L. Doswald-Beck (eds), *Customary International Humanitarian Law, Volume I: Rules*, ICRC/Cambridge University Press, 2005: <https://ihl-databases.icrc.org/customary-ihl/eng/docs/home>, (ICRC Study on Customary International Humanitarian Law (2005)), Rules 1 and 7. Unless otherwise specified, all IHL principles and rules referred to in this report are rules of customary IHL applicable in both international and non-international armed conflicts.

²⁴¹ This concern was expressed as early as 1973, in a report of the UN secretary-general, which noted that while combat in populated areas is “unlikely to leave the local population unscathed” irrespective of the weapons used, “when area weapons ... are employed, the consequences become magnified”. See UN General Assembly, *Report of the Secretary-General on Napalm and Other Incendiary Weapons and all Aspects of their Possible Use*, UN Doc. A/8803/Rev. 1, 1973, para. 152.

²⁴² Protocol III to the CCW (1980), Article 1(2). The Protocol prohibits the use of air-delivered incendiary weapons to attack military objectives located within a ‘concentration of civilians’ (Article 2(2)). The preparatory work that led to the adoption of the Protocol indicates that the distinctive feature of a ‘concentration of civilians’ is considered to be the density of civilians; see *Official Records of the Diplomatic Conference of Geneva of 1974–1977*, Vol. XVI, p. 564; Amended Protocol II to the CCW (1996), Articles 3(9) and 7(3).



An ICRC employee speaks to members of the National Liberation Army in Colombia about the principles of IHL.

In this report the term ‘populated areas’ has been preferred to ‘densely populated areas’.²⁴³ The term ‘densely’ [populated areas] appears in the IHL rule requiring the taking of precautions against the effects of attacks (so-called ‘passive precautions’).²⁴⁴ However, the rule does not define this term, nor is it defined elsewhere under international law. It seems clear that **the denser the populated area, the more significant the risk of indiscriminate effects** from attacks using explosive weapons with wide area effects, even when such attacks are directed at specific military objectives. However, any populated area, or any concentration of civilians as defined in Protocol III to the CCW, raises the humanitarian and legal concerns highlighted in this report with regard to the likelihood of causing civilian harm, and the extent of such harm, when using explosive weapons with a wide impact area.

Though the scope of this report and its recommendations is limited to ‘populated areas’, civilian objects in areas in which few or no civilians are present remain protected under IHL. Whether isolated or grouped in ‘concentrations’, civilian objects are protected by the principles and rules of distinction, proportionality and precautions in attack, even if civilians have vacated the object, or evacuated the area, in question. This includes the obligation to take constant care to spare civilians and *civilian objects* in the conduct of military operations and the prohibition against area bombardment.²⁴⁵ In other words, civilian buildings and infrastructure – namely every building and element of infrastructure that is not a military objective – in a city, town, or village that has been evacuated retain their protection against area bombardment.²⁴⁶

This chapter summarizes the issues and concerns raised under IHL by the use of explosive weapons with a wide impact area in populated areas, in particular with regard to the prohibitions against indiscriminate and disproportionate attacks, and the obligation to take all feasible precautions in attack.

²⁴³ The ICRC referred to ‘densely populated areas’ in early writings on the issue. See, for example, ICRC Challenges Report 2011, cited in footnote 1 above, p. 40.

²⁴⁴ Article 58(b) of Additional Protocol I requires parties to armed conflicts, “to the maximum extent feasible”, to “avoid locating military objectives within or near densely populated areas”. See also ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 23.

²⁴⁵ Article 51(5)(a) of Additional Protocol I prohibits as indiscriminate, “an attack by bombardment by any methods or means which treats as a single military objective a number of clearly separated and distinct military objectives located in a city, town, village or other area containing a similar concentration of civilians or civilian objects”. See also ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 13.

²⁴⁶ Civilian objects may become military objectives by location, purpose or use, provided they meet the criteria of Article 52(2) of Additional Protocol I, which defines military objectives as “those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage”. See also ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 8.

3.2 THE PROHIBITION AGAINST INDISCRIMINATE ATTACKS

Indiscriminate attacks are prohibited. Indiscriminate attacks are those:

- (a) which are not directed at a specific military objective;
 - (b) which employ a method or means of combat which cannot be directed at a specific military objective; or
 - (c) which employ a method or means of combat the effects of which cannot be limited as required by international humanitarian law;
- and consequently, in each such case, are of a nature to strike military objectives and civilians or civilian objects without distinction.

(ICRC, *Customary International Humanitarian Law*, Vol. 1, Rules 11 and 12; Additional Protocol I, Article 51(4))

The prohibition against indiscriminate attacks defines three types of attack, each of which is of a nature to strike military objectives and civilians and civilian objects without distinction. First, **attacks that are not directed at a specific military objective** (sub-paragraph (a) in the text box above): this refers to the manner in which a weapon is used rather than the characteristics of the weapon itself. Second, **attacks that use a method or means of combat that cannot be directed at a specific military objective** (sub-paragraph (b)): this includes the use of weapons that are not sufficiently accurate to strike a specific target, in all or in certain circumstances. Third, **attacks that employ a method or means of combat the effects of which cannot be limited as required by IHL** (sub-paragraph (c)): this typically refers to weapons the effects of which cannot be controlled in either time or space as required in order to comply with IHL. In addition, IHL prohibits two specific types of indiscriminate attack: **area bombardment and disproportionate attacks** (see sections 3.3 and 3.4 below, respectively).

A distinction should be made between the prohibition against indiscriminate attacks and the **prohibition against weapons that are by nature indiscriminate**. The latter are weapons that are of a nature to strike military objectives and civilians and civilian objects without distinction because they cannot be directed at a specific military objective, or because their effects cannot be limited as required by IHL, in *any* of the normal or expected circumstances of their use. The use of such inherently indiscriminate weapons is prohibited under customary IHL, independently from the prohibition against indiscriminate attacks.²⁴⁷ Legal experts and state practice generally do not support the view that explosive weapons with a wide impact area are indiscriminate *by nature*.²⁴⁸

Conversely, the prohibition against indiscriminate attacks encompasses attacks that employ a method or means of combat that, **in the circumstances of the attack**, cannot be directed at a specific military objective or the effects of which cannot be limited as required by IHL. In fact, means or methods of warfare that can be used perfectly lawfully in some situations could, in other circumstances, violate the prohibition against indiscriminate attacks.²⁴⁹ Populated areas constitute an

²⁴⁷ ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 71; Henckaerts/Doswald-Beck, commentary on Rule 71, p. 244.

²⁴⁸ L. Gisel, "The use of explosive weapons in densely populated areas and the prohibition of indiscriminate attacks", in E. Greppi (ed.), *Conduct of Hostilities: The Practice, the Law and the Future*, Franco Angeli, Milan, 2015, pp. 103 ff.; M. Brehm, "International humanitarian law and the protection of civilians from the effects of explosive weapons", in C. Harvey, J. Summers and N.D. White (eds), *Contemporary Challenges to the Laws of War: Essays in Honour of Professor Peter Rowe*, Cambridge University Press, 2014, p. 251.

²⁴⁹ Y. Sandoz, C. Swinarski and B. Zimmermann (eds), *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949*, ICRC, Geneva/Martinus Nijhoff, Leiden, 1987 (ICRC Commentary on the Additional Protocols), pp. 622–623, para. 1962; ICRC, *Weapons that May Cause Unnecessary Suffering or Have Indiscriminate Effects: Report on the Work of Experts*, ICRC, Geneva, 1973, (ICRC Expert Report 1973), p. 14, para. 27: "The prohibition of indiscriminate warfare relates more often to methods of warfare and methods of using weapons than to specific weapons *per se*. All weapons are capable of being used indiscriminately."



environment that may render indiscriminate certain methods or means of combat that can be lawfully employed in other circumstances, in open battlefields, for instance.²⁵⁰ **This is typically the case of explosive weapons with a wide impact area, the use of which may be indiscriminate – and therefore unlawful – in certain circumstances, notably in populated areas, precisely because of their wide impact area.**²⁵¹

The following sub-sections address a number of significant issues – in connection with the prohibition against indiscriminate attacks – raised by the use and effects of explosive weapons with a wide impact area in populated areas.

3.2.1 Means and methods of combat that cannot be directed at a specific military objective

As provided in sub-paragraph (b) of the definition of indiscriminate attacks (see text box above), indiscriminate attacks include those that use means of warfare “which cannot be directed at a specific military objective”, and consequently are of a nature to strike military objectives and civilians and civilian objects without distinction. An inaccurate delivery system is often one of the main characteristics of weapons that are difficult to direct at a specific military objective in populated areas.²⁵²

Accuracy and precision are relevant to determine whether a weapon can be directed (or aimed) at a specific military objective.²⁵³ As explained in Chapter 2, the larger the probability of error associated with a weapon, the higher the risk of incidental civilian harm.²⁵⁴ Certain unguided tactical ballistic missiles and certain types of rocket artillery are among the weapons deemed inaccurate; their use – in some or in all circumstances – has been designated by some states as contravening the prohibition against indiscriminate attacks.²⁵⁵ IHL does not provide specific criteria that would define whether a weapon system is sufficiently accurate or precise to comply with the rule prohibiting indiscriminate attacks in given circumstances, and states are not forthcoming in specifying what they would consider as a standard of accuracy required by this rule.

Case law, too, does not provide a clear standard of accuracy that could be relied upon to determine whether a weapon’s use complies with the prohibition against indiscriminate attacks. The International Criminal Tribunal for the former Yugoslavia (ICTY) addressed this issue, but its findings

²⁵⁰ ICRC Challenges Report 2011, cited in footnote 1 above, pp. 41–42; ICRC Challenges Report 2015, cited in footnote 1 above, p. 51. This is stated with unambiguous clarity in United Kingdom, *Manual of the Law of Armed Conflict*, 2004, p. 69, para. 5.23.3: “[I]f the military objective consists of scattered enemy tank formations in an unpopulated desert, it would be permissible to use weapons having a wider area effect than would be possible if the target were a single communications site in the middle of a heavily populated area.”

²⁵¹ See, for example, ICRC Expert Report 1973, cited in footnote 249 above, which states that “area weapons have an obvious and uncontrollable tendency towards indiscriminateness” (para. 150); that the “area of effectiveness ... is obviously a dominant factor in determining the discriminateness” (para. 57); and that “[t]he closer the proximity between combatants and noncombatants, the smaller must be the area of effectiveness of the weapon in order for discriminate use of it to become possible” (para. 57); see also UN Human Rights Council, *Report of the Detailed Findings of the Independent Commission of Inquiry Established Pursuant to Human Rights Council Resolution S-21/1*, UN Doc. A/HRC/29/CRP.4, 24 June 2015, para. 415: “[t]he use of weapons with wide-area effects by the IDF in the densely populated, built up areas of Gaza, and the significant likelihood of lethal indiscriminate effects resulting from such weapons, are highly likely to constitute a violation of the prohibition of indiscriminate attacks.”

²⁵² See Chapter 2.

²⁵³ See ICRC Expert Report 1973, cited in footnote 249 above, p. 17, para. 35, referring to German Federal Minister of Defence, *Troop Leadership, Army Regulation (HDv) No. 100/1*, October 1962, Annex III, para. 607; and German Federal Minister of Defence, *Law of Armed Conflict – Guidelines for Teaching (Part 7): General Legal Provisions relating to the Conduct of Hostilities and War on Land*, Joint Service Regulation (ZDv) No. 15/10, March 1961, para. 90.

²⁵⁴ See Chapter 2, section 2.4: “Accuracy and precision”.

²⁵⁵ See state practice relating to Rule 71 in Henckaerts/Doswald-Beck, commentary on Rule 17, pp. 249–250 and in J-M. Henckaerts and L. Doswald-Beck (eds), *Customary International Humanitarian Law, Volume II: Practice*, ICRC/Cambridge University Press, 2005: <https://ihl-databases.icrc.org/customary-ihl/eng/docs/home>, p. 1566.

on the question of weapon accuracy have been inconclusive.²⁵⁶ In the *Martić* case, the ICTY held that a weapon with a dispersion error between 800 and 1,000 metres was indiscriminate when used in densely populated areas and should thus not be used in such environments. It did not, however, draw any conclusions regarding a general standard for weapon accuracy.²⁵⁷ The Appeal Chamber noted that even a pattern of 180 metres x 165 metres would hardly make the finding of the Trial Chamber that the M-87 Orkan was incapable of hitting specific targets unreasonable.²⁵⁸ In *Gotovina*, the Appeal Chamber rejected a '200 metre standard' established by the Trial Chamber that had held impact points located more than 200 metres from a legitimate target as indicative of an indiscriminate artillery attack.²⁵⁹ The Appeal Chamber considered that the Trial Chamber had not sufficiently justified why it drew the line at 200 metres as an acceptable margin of error; it did not, however, elaborate upon what it considered the correct standard to be.²⁶⁰

Commissions of inquiry, established in the context of certain conflicts to investigate possible IHL violations, have similarly failed to delineate relevant standards of accuracy. For example, the International Fact-Finding Mission on the 2008 conflict in Georgia considered that the use of Grad MLRS rockets as an area weapon amounted to indiscriminate attacks by the Georgian forces "owing to the characteristics of the weaponry and its use in populated areas".²⁶¹ In the context of the 2014 Gaza conflict, the UN Independent Commission of Inquiry found that the rockets available to armed groups in Gaza were unguided and inaccurate and that strikes involving these weapons amounted to indiscriminate attacks. Notably, in reaching this conclusion, the Commission relied on estimates that indicated that some of the rockets in question could land as far as three kilometres from any intended target, and up to six kilometres for the longer-range rockets,²⁶² but without offering further insights on the question of a standard of weapon accuracy.

At any rate, **standards of accuracy expected under this rule may evolve and become more exacting with the development of new technologies, such as advances in precision weaponry.**²⁶³

Indicators of accuracy such as the CEP can help inform assessments of whether a weapon can be directed at a specific military objective in the context of an attack. However, the CEP only describes a statistical probability of hitting the target. Put simply, it measures the radius of a circle around the projected mean point of impact, within which only half of all the munitions delivered by the weapon system are expected to land, with the other half expected to fall within an area at least twice the size of the CEP.²⁶⁴ Therefore, in a populated area, where military objectives and civilians or civilian objects are intermingled, even a CEP of the size of the military objective would mean

²⁵⁶ See M. Brehm, *Unacceptable Risk: Use of Explosive Weapons in Populated Areas through the Lens of Three Cases before the ICTY*, PAX, Utrecht, November 2014, pp. 79 and 81, summarizing divergent views on the issue of a metric standard of accuracy as found in ICTY case law.

²⁵⁷ ICTY, *Martić* Trial Judgment, 2007, paras 462–463.

²⁵⁸ ICTY, *Martić*, Appeal Judgment, 2008, para. 250.

²⁵⁹ ICTY, *Gotovina* Trial Judgment, 2011, paras 1892–1945.

²⁶⁰ ICTY, *Gotovina* Appeal Judgment, 2012, para. 64.

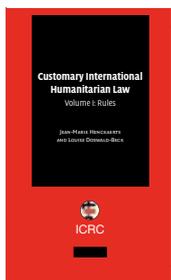
²⁶¹ Independent International Fact-Finding Mission on the Conflict in Georgia, *Report*, Vol. II, September 2009, p. 340.

²⁶² UN Human Rights Council, *Report of the Detailed Findings of the Independent Commission of Inquiry Established Pursuant to Human Rights Council Resolution S-21/1*, UN Doc. A/HRC/29/CRP.4, 24 June 2015, para. 97.

²⁶³ ICRC Challenges Report 2015, cited in footnote 1 above, p. 52; M. N. Schmitt and L. Vihul (eds), *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations*, 2nd ed., Cambridge University Press, 2017, (Tallinn Manual 2.0), p. 456, para. 3; Program on Humanitarian Policy and Conflict Research at Harvard University (HPCR), *Commentary to the HPCR Manual on International Law Applicable to Air and Missile Warfare*, Cambridge University Press, 2013 (HPCR Commentary), p. 60, para. 3; C. Markham and M. N. Schmitt, "Precision air warfare and the law of armed conflict", *International Law Studies*, U.S. Naval War College, Vol. 89, No. 669, 2013, p. 682.

²⁶⁴ As explained in Chapter 2, the CEP estimates the accuracy of a weapon system in statistical terms by measuring a radius within which 50% of all munitions delivered by the weapon system are expected to deviate from the mean point of impact, with the remaining half expected to land in an area extending from the boundary of the CEP up to three times its size. See also M. Zehfuss, "Targeting: Precision and the Production of Ethics", *European Journal of International Relations*, Vol. 17, No. 3, September 2011, pp. 543–556.

that the munitions might be as likely to hit civilians or civilian objects as the target, which would raise concerns under the prohibition against indiscriminate attacks.



In light of their inaccuracy, described in more detail in Chapter 2, **there are inherent difficulties in directing attacks using indirect-fire weapon systems such as artillery and mortars, in particular those employing unguided munitions, against a specific military objective.** The inaccuracy of such weapon systems is also indicated by the fire adjustment methods applied by armed forces when using artillery, for instance (see sub-section 3.2.4 below). Thus, the use of such indirect fire in populated areas entails a high risk of striking military objectives and civilians and civilian objects without distinction. This risk of indiscriminate effects may be lessened in cases where the area over which the weapon is expected to have effects is approximately the same size as, and can thus be largely limited to, the targeted military objective.

3.2.2 Means and methods of combat the effects of which cannot be limited as required by IHL

As provided in sub-paragraph (c) of the definition of indiscriminate attacks (see text box above), IHL prohibits attacks that use a means or method of combat “the effects of which cannot be limited as required by IHL”.

“As required by IHL” refers notably to the prohibition against disproportionate attacks (see section 3.4 below) and the use of weapons the effects of which cannot be limited so as to avoid causing widespread, long-term and severe damage to the natural environment or “the release of dangerous forces and consequent severe losses among the civilian population”.²⁶⁵ This third type of indiscriminate attack also covers the employment of means and methods the effects of which cannot be controlled in time and space, such as biological agents, or water or fire (depending on how they are used).²⁶⁶ This concern leads, among other things, to the imposition of prohibitions and restrictions on the use of incendiary weapons against military objectives located within a concentration of civilians.²⁶⁷ It has been noted that “the weapons primarily concerned are those whose effects are spread over a wide area”.²⁶⁸

The ICRC Commentary illustrates this category of indiscriminate attacks with examples of attacks carried out by means that may be expected to cause “extensive” civilian harm, whether because the means escape the control of the user or because of the sheer power of the weapon used. It provides as an example of the latter a ten-tonne bomb used to destroy a single building. In such a case, “it is inevitable that the effects will be very extensive and will annihilate or damage neighbouring buildings”.²⁶⁹

²⁶⁵ M. Bothe, K. J. Partsch and W. A. Solf, *New Rules for Victims of Armed Conflicts*, Martinus Nijhoff Publishers, The Hague, 1982, p. 347, para 2.5.2.3; S. Oeter, “Methods of combat”, in D. Fleck (ed.), *The Handbook of International Humanitarian Law*, 4th ed., Oxford University Press, 2021, p. 206. On the natural environment, see also ICRC Guidelines on the Protection of the Natural Environment, cited in footnote 136 above, p. 51, para. 111.

²⁶⁶ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 623, paras 1963–1966; Henckaerts/Doswald-Beck, commentary on Rule 12, p. 43; M. N. Schmitt, “War, technology and the law of armed conflict”, in A. M. Helm (ed.), *The Law of War in the 21st Century: Weaponry and the Use of Force*, International Law Studies, Vol. 82, 2006, p. 140.

²⁶⁷ Protocol III to the CCW (1980), Article 2(2) and (3). See also ICRC, *Draft Rules for the Limitation of the Dangers Incurred by the Civilian Population in Time of War*, ICRC, Geneva, 1956, Article 14; and W. Hays Parks, “Le protocole sur les armes incendiaires”, *International Review of the Red Cross*, No. 786, December 1990.

²⁶⁸ S. Oeter, cited in footnote 265 above, p. 206.

²⁶⁹ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 623, para. 1963.



US Air Force

The German city of Wesel lies in ruins after bombing by the Allied powers during the Second World War.

It is indeed difficult to reconcile causing extensive civilian harm with the object and purpose of the IHL rules on the conduct of hostilities, namely to protect civilians and civilian objects, or with several of its specific obligations, in particular that “[t]he civilian population and individual civilians shall enjoy general protection against dangers arising from military operations”.²⁷⁰ And attacks that may be expected to cause extensive civilian harm are indeed the paradigmatic example of attacks of a nature to strike military objectives and civilians or civilian objects without distinction, which is the common characteristic of all types of indiscriminate attack. In this regard, **the use in populated areas of large-calibre or high-payload munitions, which have a large destructive radius even when precision-guided, raises serious concerns under this prohibition when the military objective is significantly smaller than the weapons’ destructive radius, because in such situations the weapons’ effects can be foreseen to be extensive both in terms of impact area and the magnitude of civilian harm likely to be caused.**



An attack expected to cause extensive civilian harm may also violate other IHL rules, such as the prohibition against disproportionate attacks (see section 3.4 below) or the principle of precautions in attack (see section 3.5 below).

²⁷⁰ Additional Protocol I, Article 51(1). See also Articles 48 and 51 more generally, and Article 57(1) of Additional Protocol I.

3.2.3 Use of indirect fire for suppression, harassment, and interdiction under the prohibition against indiscriminate attacks

At times, explosive weapons with wide area effects – most commonly, artillery or other indirect-fire weapon systems – are used for ‘**suppressive**’, ‘**harassing**’ or ‘**interdictory**’ fire, so named for the effects on the enemy that they aim to achieve. The primary purpose of these methods of fire is not to inflict damage on enemy targets, but to prevent the enemy from taking certain actions or, in the case of harassing fire, to inflict psychological stress.²⁷¹

‘Suppressive fire’ (or ‘suppression fire’) can be defined as “fire that degrades the performance of a target below the level needed to fulfil its mission”.²⁷² The purpose of suppressive fire is to prevent an enemy from using their weapons, to inhibit their movement, and/or to allow friendly forces to manoeuvre by serving as covering fire. Suppressive fire implies a continuous flow of fire of low to moderate intensity; it may in effect act as a form of area denial, i.e. to prevent the enemy from accessing, occupying or passing through an area.²⁷³

‘Harassing fire’ is defined as fire “delivered on enemy locations for the purpose of disturbing enemy forces’ rest, curtailing their movement, or lowering their morale”.²⁷⁴ It can involve fire at random or intermittent intervals over a prolonged period of time.

‘Interdictory fire’ (or ‘interdiction fire’) is defined as “fire placed on an area or point to prevent the enemy from using the area or point”.²⁷⁵ More generally, ‘interdiction’ is defined as “an action to divert, disrupt, delay or destroy the enemy’s military surface capability before it can be used effectively against friendly forces or to achieve enemy objectives”.²⁷⁶

The question arises whether the use of such methods in populated areas complies with the prohibition against indiscriminate attacks.²⁷⁷ To comply with this prohibition, suppressive, harassing or interdictory fire in populated areas must be directed at a specific military objective, and must use means capable of being directed at a specific military objective. But in practice it is not always clear that this is the case. **Even if the user intends to direct such fire at a specific military objective, given the inaccuracy of the means typically used for these purposes** – notably indirect-fire weapon systems such as artillery and mortars, in particular when using unguided munitions – **there are serious questions as to whether they can be directed at a specific military objective located in a populated area, as required by the prohibition against indiscriminate attacks** (see sub-section 3.2.1).²⁷⁸

3.2.4 Adjustment techniques for indirect fire under the prohibition against indiscriminate attacks

When using unguided indirect-fire weapon systems such as artillery and mortars, armed forces typically apply **fire-adjustment techniques** to compensate for the fact that they are unlikely – because of the weapon’s inaccuracy – to strike the target with the first round of fire. Some armed forces refer to these methods as ‘walking’ fire against a target or ‘bracketing’ a target. Such techniques consist in firing successive rounds (of either explosive or non-explosive munitions)

²⁷¹ United States, Department of Defense, *Dictionary of Military and Associated Terms*, JP No. 1–02, April 2010, p. 207; NATO Glossary of Terms, cited in footnote 178 above, p. 61.

²⁷² NATO Glossary of Terms, cited in footnote 178 above, p. 123.

²⁷³ ARES Indirect-Fire Report, cited in footnote 62 above, p. 46.

²⁷⁴ United States, *Law of War Manual*, 2016, p. 205, para. 5.4.6.3; NATO Glossary of Terms, cited in footnote 178 above, p. 61.

²⁷⁵ NATO Glossary of Terms, cited in footnote 178 above, p. 69.

²⁷⁶ United States Joint Chiefs of Staff, *Joint Interdiction*, JP No. 3–03, September 2016, p. vii.

²⁷⁷ M. Bothe, K. J. Partsch and W. A. Solf, cited in footnote 265 above, p. 348, para 2.5.3.3.

²⁷⁸ Philippine military doctrine has gone beyond this, by expressly providing that the use of aerial, naval, artillery or mortar fires for interdiction and harassment, especially when the fire missions are unobserved and near populated areas and when civilian casualties or material damage will likely result, is strictly prohibited. See Philippines Department of National Defense and Department of the Interior and Local Government, *Implementing Guidelines for Presidential Memorandum Order No. 393*, DND–DILG Joint Circular No. 2–91, 1991, para. 2(c).

progressively closer to the target; recording the impact of each round using forward observers or other means; then, correcting the aiming point of the next round; and repeating the process until the impact is on or within satisfactory distance of the target, at which point fire is delivered ‘for effect’ at the target (firing in salvos).²⁷⁹

While it is indeed important that fire ‘for effect’ be on-target, the use – in populated areas – of weapon systems that require such methods of adjusting fire poses a significant risk of civilian harm, as **it is likely that the ‘adjustment’ rounds will be off-target and strike civilians and civilian objects. The employment of such methods in populated areas**, especially when explosive munitions are used in the adjustment rounds, therefore **raises questions under the prohibition against indiscriminate attacks**, in particular the prohibition against the use of means and methods of warfare that cannot be directed at a specific military objective.²⁸⁰

3.3 THE PROHIBITION AGAINST AREA BOMBARDMENT

It is prohibited to launch an attack by bombardment by any method or means which treats as a single military objective a number of clearly separated and distinct military objectives located in a city, town, village or other area containing a similar concentration of civilians or civilian objects.

(ICRC, *Customary International Humanitarian Law*, Vol. 1, Rule 13; Additional Protocol I, Article 51(5)(a))

Under the rule prohibiting area bombardment, when a number of clearly separated and distinct military objectives are located in a concentration of civilians or civilian objects, these military objectives “may only be attacked separately”.²⁸¹ In particular, it has been noted that “many heavy explosive weapons, such as artillery and multi-barrel rocket launchers”, would “fall foul of the prohibition of area bombardment when used against multiple, clearly separate and distinct military objectives located in a concentration of civilians”, because these weapon systems are designed primarily to deliver fire over a wide area.²⁸²

What is meant by “clearly separated and distinct” leaves some degree of latitude to those mounting an attack.²⁸³ During the Diplomatic Conference that led up to the adoption of the 1977 Additional Protocols, some states asserted that this required a distance at least sufficiently large to permit the individual military objectives to be attacked separately.²⁸⁴ Proposals to expressly include this idea in the article under negotiation were not adopted, but it is generally agreed that the assessment of whether military objectives are clearly separated and distinct is, at least to some extent, informed by the means available.²⁸⁵ In the ICRC’s view, however, the concepts of ‘clearly separated’ and ‘distinct’ should not be understood as purely subjective or dependent on the circumstances. This rule must be interpreted in good faith, and it would undermine the protective purpose of the prohibition against area bombardment if objects that are clearly separated and distinct to a reasonable third party could be considered not to be so simply because of the attacker’s intent to employ explosive weapons with wide area effects.²⁸⁶

²⁷⁹ ARES Indirect-Fire Report, cited in footnote 62 above, pp. 42–46.

²⁸⁰ ICRC Challenges Report 2019, cited in footnote 8 above, p. 21.

²⁸¹ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, pp. 624–625, para. 1973; ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 13.

²⁸² Meeting of the High Contracting Parties to the CCW, “Mitigating the civilian harm from the use of explosive weapons in populated areas”, Working paper submitted by Germany, UN Doc. CCW/MSP/2018/WP.1, 14 November 2018, para. 24.

²⁸³ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 624, para. 1972.

²⁸⁴ Henckaerts/Doswald-Beck, commentary on Rule 13, p. 45; M. Bothe, K. J. Partsch and W. A. Solf, cited in footnote 265 above, p. 350. See also A. P. V. Rogers, *Law on a the Battlefield*, 3rd ed., Manchester University Press, 2012, pp. 29–30.

²⁸⁵ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 625, para. 1975; H. Blix, “Area bombardment: Rules and reasons”, *British Yearbook of International Law*, Vol. 49, No. 1, 1978, p. 66.

²⁸⁶ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 624, para. 1971.



US Air Force

Bombing during the second World War.

It was already understood when this prohibition in Additional Protocol I was being negotiated and adopted that the degree of physical distance required to consider military objectives as clearly separated and distinct would diminish as military targeting capabilities improved.²⁸⁷ **Military objectives that might have been lawfully treated as a single objective and consequently attacked with heavy explosive weapons in the past may well be considered clearly separated and distinct today or in the future in light of new weapon technology.**

Even when the prohibition against area bombardment is not violated, because the military objectives could not be regarded as being clearly separated and distinct under the circumstances, other IHL rules must be respected. For example, even when several military objectives located within a populated area are so close together that it is not possible to attack them separately, an attack against them would be prohibited if it may be expected to cause excessive civilian casualties or damage to civilian objects in violation of the rule of proportionality, for instance, because of the wide area effects of the weapon used.²⁸⁸

²⁸⁷ H. Blix, cited in footnote 285 above, p. 66; ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 625, para. 1975; ICRC Challenges Report 2015, cited in footnote 1 above, p. 52; M. N. Schmitt, “Targeting in operational law”, in T. D. Gill and D. Fleck (eds), *Handbook of the International Law of Military Operations*, 2nd ed., Oxford University Press, 2015, pp. 282–283.

²⁸⁸ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 625, para. 1975.

3.4 THE PROHIBITION AGAINST DISPROPORTIONATE ATTACKS

It is prohibited to launch an attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.

(ICRC, *Customary International Humanitarian Law*, Vol. 1, Rule 14; Additional Protocol I, Article 51(5)(b))

Also known as the ‘principle of proportionality’, this rule is reinforced by certain rules flowing from the principle of precautions in attack, in particular the obligation to do everything feasible to assess whether an attack may be expected to be disproportionate and to cancel or suspend an attack if it becomes apparent that it may be expected to have disproportionate effects.²⁸⁹



The Additional Protocols to the Geneva Conventions being signed in 1977.

As is the case when applying all the other rules governing the conduct of hostilities, **the proportionality assessment** must be carried out before deciding upon an attack. It **requires a commander to take into account all incidental harm to civilians and civilian objects that is foreseeable** based on information reasonably available from all sources in the circumstances.²⁹⁰ **This includes not only civilian death, injury and destruction within the explosive weapon’s impact area, but also indirect or ‘reverberating’ effects, meaning those effects not directly caused by the weapon’s explosive impact, but which are nonetheless a product thereof.** Indeed, there is no requirement that the relevant incidental civilian harm – unlike the military advantage anticipated from the

²⁸⁹ Additional Protocol I, Articles 57(2)(a)(iii) and 57(2)(b); ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rules 14 (proportionality), 18 and 19 (precautions).

²⁹⁰ ICRC Challenges Report 2015, cited in footnote 1 above, pp. 52–53; ICRC Challenges Report 2019, cited in footnote 8 above, pp. 18 and 20; ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, p. 23; L. Gisel (ed.), *The Principle of Proportionality in the Rules Governing the Conduct of Hostilities under International Humanitarian Law*, Expert Meeting, ICRC, Geneva, August 2018 (ICRC Proportionality Report), pp. 43–51; International Law Association Study Group on the Conduct of Hostilities in the 21st Century, “The conduct of hostilities and international humanitarian law: Challenges of 21st century warfare”, *International Law Studies*, U.S. Naval War College, Vol. 93, No. 322, 2017, (ILA Study Group Report), p. 353; E. C. Gillard, *Proportionality in the Conduct of Hostilities: The Incidental Harm Side of the Assessment*, Chatham House, London, December 2018, (Chatham House Report), pp. 18–20, paras 61–69; Tallinn Manual 2.0, cited in footnote 263 above, p. 416, para. 5 and pp. 472–473, paras 6–7; I. Robinson and E. Nohle “Proportionality and precautions in attack: The reverberating effects of using explosive weapons in populated areas”, *International Review of the Red Cross*, Vol. 98, No. 901, April 2016, pp. 107–145.

attack – be “concrete” and “direct”.²⁹¹ Several states expressly include harm due to the foreseeable indirect (or reverberating) effects of attacks, either when describing the relevant standard or through the examples they provide.²⁹²

While there must be a causal link between the attack and the reverberating effects, there are no temporal or geographic requirements other than being reasonably foreseeable for the determination of the effects to be considered.²⁹³ For example, as explained in Chapter 1, the incidental damage caused by heavy explosive weapons to critical civilian infrastructure, such as electrical power plants and supply lines, might disrupt services essential to civilian survival, such as water distribution, health care, power supply and sanitation.²⁹⁴ This is likely to result in significant civilian harm, affecting a large number of persons beyond the weapon’s impact area and for a period of time well beyond the immediate aftermath of the attack.²⁹⁵ Such harm must be taken into account in the proportionality analysis insofar as it is reasonably foreseeable at the time of the attack, though what should be considered reasonably foreseeable in practice is a vexed question.²⁹⁶



Little can be salvaged from the ruins of this power station warehouse in Tawahi, Yemen.

- ²⁹¹ In interpretative declarations upon ratification of Additional Protocol I (accessible [here](#)) or in military manuals, a number of states have interpreted the term ‘military advantage’ as meaning “the advantage anticipated from the attack considered as a whole and not only from isolated or particular parts of the attack”. However, the attack as a whole constitutes a finite operation (an attack) with defined limits and must not be confused with the entire war effort. See ILA Study Group Report, cited in footnote 290 above, pp. 343 and 364, and references therein.
- ²⁹² Third Review Conference of the States Parties to the CCW, *Final Declaration*, UN Doc. CCW/CONF.III/11, 17 November 2006, p. 4, adopted by consensus (CCW Third Review Conference Final Declaration); Ireland, intervention at the CCW Review Conference, Main Committee II – Explosive Remnants of War, 9 November 2006; United Kingdom, *Manual of the Law of Armed Conflict*, 2004, p. 77, para. 5.30.2 and p. 86, para. 5.33.4; United States, *The Commander’s Handbook on the Law of Naval Operations*, 2017, para. 8.11.4. For statements made specifically in the cyber domain, see Denmark, *Military Manual*, 2016, p. 677; France, *International Law Applicable to Operations in Cyberspace*, 2019, p. 16; New Zealand, *Manual of Armed Forces Law*, 2019, Vol. IV, pp. 8–39, para 8.10.22; Norway, *Manual of the Law of Armed Conflict*, 2013, p. 210, para. 9.54.
- ²⁹³ The 1974–1977 Diplomatic Conference rejected attempts to limit incidental loss to those in the immediate vicinity of the military objective, in the context of discussions on the precautions required to apply the principle of proportionality. See M. Bothe, K. J. Partsch and W. A. Solf, cited in footnote 265 above, pp. 406–407, para. 2.6.2; I. Robinson and E. Nohle, cited in footnote 290 above, pp. 128 and 131; ILA Study Group Report, cited in footnote 290 above, pp. 353–354; New Zealand, Statement at the CCW Meeting of Government Experts, June 2003; *Official Records of the Diplomatic Conference of Geneva of 1974–1977*, Vol. XIV, p. 186 (Egypt). However, there are diverging views, according to which long-term risks should be excluded from the proportionality assessment. See C. Greenwood, “Legal issues regarding explosive remnants of war”, working paper submitted to the CCW Group of Governmental Experts, UN Doc. CCW/GGE/I/WP.10, 22 May 2002, para. 23. See also K. Rizer, “Bombing dual-use targets: Legal, ethical and doctrinal perspectives”, *Air and Space Power Journal*, May 2001, p. 8.
- ²⁹⁴ ICRC Urban Services Report, cited in footnote 3 above, pp. 21–32.
- ²⁹⁵ ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, p. 15; and ICRC Urban Services Report, cited in footnote 3 above, pp. 19, 32, 35 and 46.
- ²⁹⁶ See I. Robinson and E. Nohle, cited in footnote 290 above, pp. 117 ff.

Likewise, as acknowledged by CCW states parties, civilian harm caused by unexploded ordnance is a foreseeable effect of the use of explosive weapons that must be considered in the proportionality assessment even though it is delayed.²⁹⁷

Proportionality must be assessed *ex ante*. **What is foreseeable at the moment of attack is to be assessed from the perspective of the ‘reasonable commander’, namely a person trained and experienced in the military art, making use in good faith of information from all sources reasonably available to them in the circumstances.**²⁹⁸

From the practice observed by the ICRC, it remains unclear to what extent, and how, the reverberating effects of an attack are factored into targeting decisions by armed forces. Some armed forces appear to consider at least some reverberating effects, such as the impact on electrical grids²⁹⁹ and chemical, biological and radiological hazards or environmental hazards (fire, flooding, etc.) due to forces expected to be released from the target or another object located within the weapon’s impact area.³⁰⁰ Considering second- and third-order consequences is deemed “sound planning” by some armed forces, and effects beyond collateral damage to the area in the immediate vicinity of the target “should be a major, deliberate consideration in planning, executing, and assessing military actions on any scale”.³⁰¹

Parties to a conflict must do everything feasible to assess whether an attack will comply with the rule of proportionality.³⁰² In the ICRC’s view, this entails **an obligation to do everything feasible to obtain information that will allow for a meaningful assessment of the foreseeable incidental effects, on civilians and civilian objects, of an attack.**³⁰³ Depending on the circumstances, this may include collecting information to map critical infrastructure within the impact area of the explosive weapon to be used, to assess the impact of the eventual damage of such infrastructure on the provision of essential services, and to estimate the civilian harm resulting from such disruption. Assessing the likelihood and magnitude of reverberating effects might require technical expertise (e.g. from engineers or public health specialists).³⁰⁴ In populated areas, where military objectives are intermingled with civilians and civilian objects, it is imperative that the proportionality assessment be conducted with utmost care, given the heightened risk of incidental civilian harm.³⁰⁵

²⁹⁷ CCW Third Review Conference Final Declaration, cited in footnote 292 above, p. 4: “[T]he foreseeable effects of explosive remnants of war are a relevant factor to be considered in applying the international humanitarian law rules on proportionality and precautions in attack.” However, the US Department of Defense, in its 2016 Law of War Manual, considers such harm as “remote” and therefore excluded from the proportionality assessment; see pp. 261–262, para. 5.12.1.3.

²⁹⁸ I. Robinson and E. Nohle, cited in footnote 290 above, p. 121; ICRC Proportionality Report, cited in footnote 290 above, pp. 58–59; P. Benvenuti, “The ICTY prosecutor and the review of the NATO bombing campaign against the Federal Republic of Yugoslavia”, *European Journal of International Law*, Vol. 12, No. 3, 2001, p. 517; and ICTY, *Galić* Trial Judgment, 2003, para. 58.

²⁹⁹ See, for example, United States, Chairman of the Joint Chiefs of Staff, *Target Development Standards*, CJCSI 3370.01B, 6 May 2016, p. D-B-6.

³⁰⁰ United States, Chairman of the Joint Chiefs of Staff Instruction, *No-Strike and the Collateral Damage Estimation Methodology*, CJCSI No. 3160.01A, October 2012 (US CJCS, CDEM), mainly pp. D-A-7, D-A-9 – D-A-12 and D-A-34. The US’s collateral damage estimation methodology has been endorsed for use by NATO; see Chapter 4.

³⁰¹ Australia, Department of Defence, *Targeting*, Operations Series, ADDP No. 3.14, February 2009, p. 1–10, para. 1.21.

³⁰² ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 18.

³⁰³ Henckaerts/Doswald-Beck, commentary on Rule 15, pp. 54–55; ICRC Challenges Report 2015, cited in footnote 1 above, p. 52.

³⁰⁴ United States, Department of the Army, *Field Manual on Intelligence Support to Urban Operations*, FM No. 2-91.4, March 2008, (superseded by TC 2-91.4, 23 December 2015, now rescinded), p. 3-2; Tallinn Manual 2.0, cited in footnote 263 above, p. 477, para. 6; and ICRC Proportionality Report, cited in footnote 290 above, p. 49.

³⁰⁵ Although the rule of proportionality leaves the commander a “fairly broad margin of judgement” or “subjective evaluation”, application of the rule must be guided by the principle of protection for civilians against dangers arising from military operations (codified in Article 51(1) of Additional Protocol I) and the obligation to spare civilians as far as possible (codified in Article 57(1) of Additional Protocol I). See ICRC Commentary on the Additional Protocols, cited in footnote 249 above, pp. 683–684, paras 2208 and 2210; and ICTY, *Galić* Trial Judgment, 2003, para. 58.

What is reasonably foreseeable by a commander in a given case should be informed by past experience and lessons learnt from their country's armed forces. It should also draw on the ever-growing experience gathered from other urban conflicts. This includes data on, and lessons learnt from, the use of heavy explosive weapons in previous urban operations and their devastating consequences for civilian populations.³⁰⁶ It also includes information in the public domain regarding the dependence of essential services on critical civilian infrastructure and their interconnectedness. It is reasonably foreseeable today that incidental damage to critical infrastructure will have reverberating effects on essential services, such as health care and water distribution, that may cause civilian deaths or outbreaks of disease.³⁰⁷ In sum, the precautions that may be deemed feasible, in assessing compliance with the rule of proportionality, expand proportionately with improvement in the information, expertise and tools available to commanders to anticipate the reverberating effects of a planned attack.³⁰⁸

The assessment of the incidental effects of a planned attack using heavy explosive weapons must be informed by consideration of the context of the attack, including the effects of previous attacks.³⁰⁹ An assessment should therefore be made not only of the foreseeable damage, but also of the capacity and time required to repair the damage and recover the service.³¹⁰ Thus, a commander who is, or should be, aware that critical civilian infrastructure (for example, hospitals or electrical or water infrastructure) has already been partially damaged should foresee that any future incidental damage by a new attack using heavy explosive weapons would exacerbate the reverberating effects on civilians. Similarly, in protracted conflicts, the commander should be aware that the quality of essential services will have become degraded because of the inability to ensure proper maintenance of infrastructure, lack of consumables or unavailability of maintenance staff, and that the reverberating effects of damage to critical civilian infrastructure from new attacks would therefore have a more significant impact on the affected population.³¹¹



Wires and poles melted when this electricity provider's warehouse in Gaza was destroyed.

³⁰⁶ ICRC Challenges Report 2015, cited in footnote 1 above, pp. 52–53; ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, p. 5; I. Robinson and E. Nohle, cited in footnote 290 above, pp. 121 ff.; UN Human Rights Council, *Report of the Detailed Findings of the Independent Commission of Inquiry Established Pursuant to Human Rights Council Resolution S-21/1*, UN Doc. A/HRC/29/CRP.4, 24 June 2015, para. 447.

³⁰⁷ See Chapter 1 and ICRC Urban Services Report, cited in footnote 3 above.

³⁰⁸ L. Gisel, “Relevant incidental harm for the proportionality principle”, in *Urban Warfare*, Proceedings of the 16th Bruges Colloquium, 15–16 October 2015, College of Europe/ICRC, *Collegium*, No. 46, Autumn 2016, p. 128.

³⁰⁹ I. Robinson and E. Nohle, cited in footnote 290 above, pp. 124–125. On the relationship between reverberating effects and a pattern of repeated attacks, see ICTY, *Kupreškić Trial Judgment*, 2000, para. 526.

³¹⁰ L. Gisel, cited in footnote 308 above, p. 128; W. H. Boothby, *The Law of Targeting*, Oxford University Press, 2012, p. 414.

³¹¹ ICRC Urban Services Report, cited in footnote 3 above, pp. 21–28.

With respect to the **types of harm relevant to the assessment of incidental civilian harm** – whether direct or indirect – the rule of proportionality (and various rules on precautions; see section 3.5 below) speaks of “loss of civilian life, injury to civilians and damage to civilian objects or a combination thereof”. In the view of the ICRC, “damage to civilian objects” encompasses the consequences for civilians of impairing the civilian use of objects employed simultaneously for military and civilian purposes;³¹² loss of functionality;³¹³ and environmental damage.³¹⁴ This would be the case, for example, when a water-purification station ceases to function because the lines that supply electricity indispensable for its operation are damaged by the use of heavy explosive weapons, or when an attack using such weapons damages the environment either directly or through contamination by unexploded ordnance. Moreover, “injury” is to be construed broadly to include illness and disease, as well as wounds.³¹⁵ Thus, illness or disease triggered by, for example, inadequate or insufficient water provision owing to the disruption of essential services caused by an attack using heavy explosive weapons constitutes civilian harm relevant for the proportionality assessment.

As discussed in Chapter 1, the use of explosive weapons with a wide impact area in populated areas can cause significant **mental harm** to civilians.³¹⁶ Although psychological trauma is less easy to understand and anticipate than physical injuries or death, it is broadly accepted today that human health encompasses both physical and mental health. In this regard, while there is no settled international law on taking incidental mental harm into account, a recent military manual³¹⁷ indicates an awareness that the psychological effects of hostilities should be considered, and that it is an area in which the practice of belligerents in the future might be influenced by evolving research and understanding of such consequences.

Poverty, unemployment and economic hardship are usually not considered to constitute relevant incidental civilian harm per se.³¹⁸ Neither is **displacement** as such. However, displacement is relevant to the proportionality assessment. First, disease or deaths among displaced persons constitutes relevant incidental civilian harm – when it is the result of damage to health, and lack of essential items for survival, directly attributable to displacement. In addition, the ICRC and some others hold the view that displacement caused by incidental damage to a civilian object will affect the “value” or “weight” of the object incidentally damaged when assessing whether the incidental

³¹² ICRC Challenges Report 2019, cited in footnote 8 above, p. 19 and references therein.

³¹³ L. Gisel, T. Rodenhäuser and K. Dörmann, “Twenty years on: International humanitarian law and the protection of civilians against the effects of cyber operations during armed conflicts”, *International Review of the Red Cross*, Vol. 102, No. 913, September 2020, pp. 27–29.

³¹⁴ ICRC Guidelines on the Protection of the Natural Environment, cited in footnote 136 above, p. 19; for state positions, see footnote 33 above. See also Henckaerts/Doswald-Beck, practice related to Rule 45, pp. 846–848.

³¹⁵ This finds support in the Tallinn Manual, which considers that “serious illness and severe mental suffering that are tantamount to injury” fall within the scope of incidental civilian harm; see Tallinn Manual 2.0, cited in footnote 263 above, p. 417, para. 8; ICRC Proportionality Report, cited in footnote 290 above, pp. 36–37; Chatham House Report, cited in footnote 290 above, p. 31, paras 107–108.

³¹⁶ See Chapter 1, section 1.4: “Mental health and psychosocial effects”; UN Human Rights Council, *Report of the Independent International Commission of Inquiry on the Syrian Arab Republic*, UN Doc. A/HRC/25/65, 12 February 2014, para. 88; UN Human Rights Council, *Report of the Detailed Findings of the Independent Commission of Inquiry Established Pursuant to Human Rights Council Resolution S-21/1*, UN Doc. A/HRC/29/CRP.4, 24 June 2015, paras 558–564. While this is not unique to explosive weapons, one of the doctrinal uses of explosive weapons such as artillery and mortars is to lower enemy morale. Where combatants and civilians are mixed, the use of these weapons will likely have as an incidental effect an equal if not greater psychological effect on civilians, who are not trained in combat. See also ILA Study Group Report, cited in footnote 290 above, pp. 351–352; Chatham House Report, cited in footnote 290 above, pp. 32–33, paras 109–117.

³¹⁷ Netherlands, *Military Manual*, 2005, p. 54, para. 0476.

³¹⁸ I. Robinson and E. Nohle, cited in footnote 290 above, p. 130; I. Henderson and K. Reese, “Proportionality under international humanitarian law: The “reasonable military commander” standard and reverberating effects”, *Vanderbilt Journal of Transnational Law*, Vol. 51, No. 1, 2018, p. 851; and United States, *Law of War Manual*, 2016, p. 261, para. 5.12.1.3.



A boy reuses water to wash in al-Malika camp for internally displaced people in Yemen.

civilian harm is excessive.³¹⁹ For example, if a civilian dwelling is incidentally destroyed by heavy explosive weapons, the “weight” assigned to that destruction, when assessing whether the incidental civilian harm may be excessive under the rule of proportionality, includes the displacement that such destruction may cause.

In sum, based on the extensive civilian harm, direct and indirect, witnessed in recent armed conflicts, there are serious questions as to whether militaries sufficiently factor all relevant effects of an attack, including its reverberating effects, into the proportionality assessment. Military doctrine and practice are neither entirely clear nor consistent in this respect, as will be discussed in Chapter 4. What is clear is that **using explosive weapons with a wide impact area against military objectives in populated areas carries a substantial risk of causing significant direct and indirect civilian harm, and of falling foul of the rule of proportionality.**

³¹⁹ ICRC Challenges Report 2019, cited in footnote 8 above, p. 19; L. Gisel, cited in footnote 308 above, p. 124; ICRC Proportionality Report, cited in footnote 290 above, pp. 41–43; ICTY, *Final Report to the Prosecutor by the Committee Established to Review the NATO Bombing Campaign Against the Federal Republic of Yugoslavia*, June 2000, para. 18.

3.5 THE OBLIGATION TO TAKE PRECAUTIONS

3.5.1 The obligation to take constant care

In the conduct of military operations, parties to an armed conflict must take constant care to spare the civilian population, civilians and civilian objects.

(ICRC, *Customary International Humanitarian Law*, Vol. 1, Rule 15; Additional Protocol I, Article 57(1))

The general obligation to take constant care supplements the basic rule of distinction. It applies to the entire range of military operations and not only attacks within the meaning of IHL.³²⁰ The term ‘military operations’ encompasses “any movements, manoeuvres and other activities whatsoever carried out by the armed forces with a view to combat” or “related to hostilities”.³²¹ It includes, for example, ground operations in urban areas, establishment of military installations, defensive preparations, quartering of troops, and search operations.

The obligation of constant care is an obligation of conduct, to mitigate risk and prevent harm. It applies constantly in the planning or execution of any military operation.³²² As a general rule, **the higher the risk for the civilian population in any given military operation, the more will be required in terms of care.**³²³ It goes without saying that a stringent standard of care is particularly necessary when conducting operations in urban areas.³²⁴

The requirement to take constant care extends to every aspect of military operational training, planning and mission execution, and is interpreted by some as demanding that soldiers be trained and directed to instinctively endeavour to mitigate civilian risk in all situations.³²⁵

The constant care requirement may shape an operational plan, for instance, by not fighting in densely populated areas or attacking military objectives therein if such attacks are likely to cause heavy civilian casualties.³²⁶ In particular, it may be implemented by ensuring that troops manoeuvring towards or within densely populated areas, or otherwise expected to conduct combat action therein, have the tactics and equipment appropriate for such fighting,³²⁷ including weapons other

³²⁰ M. Bothe, K.J. Partsch and W.A. Solf, cited in footnote 265 above, pp. 325–326, para. 2.2.3 (Article 48), and p. 408, para. 2.8.2 (Article 57); ILA Study Group Report, cited in footnote 290 above, p. 380; HPCR Commentary, cited in footnote 263 above, p. 149; Tallinn Manual 2.0, cited in footnote 263 above, p. 476, para. 2; Col. (ret.) N. Neuman, “A precautionary tale: The theory and practice of precautions in attack”, *Israel Yearbook on Human Rights*, Vol. 48, 2018, p. 28;

³²¹ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 680, para. 2191, p. 617, para. 1936, and p. 600, para. 1875.

³²² Tallinn Manual 2.0, cited in footnote 263 above, p. 477, para. 5.

³²³ ILA Study Group Report, cited in footnote 290 above, p. 381.

³²⁴ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 679, para. 2190: “[T]he precautions prescribed here will be of greatest importance in urban areas because such areas are most densely populated”; and J. Horowitz, “Joint Blog Series: Precautionary measures in urban warfare: A commander’s obligation to obtain information”, ICRC Humanitarian Law and Policy Blog, 10 January 2019: <https://blogs.icrc.org/law-and-policy/2019/01/10/joint-blog-series-precautionary-measures-urban-warfare-commander-s-obligation-obtain-information/>.

³²⁵ This is supported by the ILA Study Group Report, cited in footnote 290 above, p. 381; HPCR Commentary, cited in footnote 263 above, p. 142, para. 2; G. Corn and J.A. Schoettler Jr, “Targeting and civilian risk mitigation: The essential role of precautionary measures”, *Military Law Review*, Vol. 223, No. 4, 2015, pp. 794 and 800.

³²⁶ J. F. Quéguiner, “Precautions Under the law governing the conduct of hostilities”, *International Review of the Red Cross*, Vol. 88, No. 864, December 2006, p. 800; United States Department of Defense, “Final report to Congress on the conduct of the Persian Gulf War, appendix on the role of the law of war”, *International Legal Materials*, Vol. 31, No. 3, May 1992, p. 622. For instance, “avoid[ing] populated areas, where Coalition and Iraqi civilian casualties and damage to civilian objects necessarily would have been high” was “one reason for the maneuver plan adopted for the [1991 Gulf War] ground campaign” and notably for “deciding against an amphibious assault into Kuwait City”.

³²⁷ S. Muhammedally, “Preparedness in urban operations: A commander’s planning checklist to protect civilians”, ICRC Humanitarian Law and Policy Blog, 11 May 2021: <https://blogs.icrc.org/law-and-policy/2021/05/11/preparedness-in-urban-operations/>.

than heavy explosive weapons. It may also require that inquiries into incidents of the use of heavy explosive weapons in populated area causing civilian harm *inter alia* identify good practices and lessons learnt. These assessments could take the form of battle-damage assessments, after-action reviews, or various types of investigation that would help better understand the direct and reverberating effects of the use of such weapons in populated areas. To prevent or mitigate such civilian harm in future attacks and future conflicts, the knowledge gained should trigger or inform the revision of military policies and practices, including restrictions and limitations on the use of heavy explosive weapons in populated areas, and adjustment of tactics, techniques, and procedures.³²⁸



ICRC delivering a training session on international humanitarian law to Iraqi military officers.

Given that there is significant risk of harm to civilians whenever a military is executing an attack, IHL imposes additional obligations specific to those planning or deciding on or carrying out attacks; it also requires parties to protect civilians and civilian objects under their control against the effects of attacks. These obligations will be discussed in greater detail below.

3.5.2 Precautions in attack

- All feasible precautions must be taken to avoid, and in any event to minimize, incidental loss of civilian life, injury to civilians and damage to civilian objects.
- Each party to the conflict must do everything feasible to verify that targets are military objectives.
- Each party to the conflict must take all feasible precautions in the choice of means and methods of warfare with a view to avoiding, and in any event to minimizing, incidental loss of civilian life, injury to civilians and damage to civilian objects.
- Each party to the conflict must do everything feasible to assess whether the attack may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.
- Each party to the conflict must give effective advance warning of attacks which may affect the civilian population, unless circumstances do not permit.

(ICRC, *Customary International Humanitarian Law*, Vol. 1, Rules 15, 16, 17, 18 and 20; See also Additional Protocol I, Article 57(1) and (2))

³²⁸ ICRC Challenges Report 2019, cited in footnote 8 above, p. 18;

When planning or deciding upon an attack, parties to armed conflict have an obligation to take all feasible precautions to avoid, or at least minimize, incidental civilian harm. **The obligation to take precautions is very stringent, as all precautions that are “feasible” must be taken. This is understood to mean all those precautions that “are practicable or practically possible taking into account all circumstances ruling at the time, including humanitarian and military considerations”.**³²⁹ The obligation to take all feasible precautions in the choice of means and methods of warfare is particularly relevant to the use of heavy explosive weapons in populated areas. **This requires an assessment of the foreseeable effects of the available weapon systems** based on their technical features and the planned circumstances of their use, **as well as consideration of alternative weapons and tactics**, if these would avoid or minimize the likelihood or extent of expected incidental civilian harm. Such precautions can include practical measures to minimize their impact area and consequent effects on civilians and civilian objects, such as manipulating the technical features of a chosen weapon – for example, the type and size of warhead, the type of fuze, the delivery system, the distance from which the weapon is launched, or the angle and timing of the attack.³³⁰

Although there is no obligation under IHL to acquire the most precise weapons available on the market, parties to armed conflicts have a duty to ensure that they have the means available to respect IHL rules.³³¹ And when planning attacks, **the obligation to take all feasible precautions in the choice of means and methods of warfare might require them to choose the most precise weapon available, and the smallest possible calibre or explosive yield that achieves the military advantage sought, so as to minimize incidental civilian harm.**³³²

The obligation to take all feasible precautions in attack includes a requirement to give **effective advance warning of attacks** that may affect the civilian population, unless circumstances do not permit. Effective advance warnings – i.e. warnings that enable civilians to adequately protect themselves, such as giving them enough time to evacuate or otherwise seek shelter – can reduce the risk of incidental civilian harm from the use of heavy explosive weapons in populated areas. However, the fact that civilians have received effective advance warnings and that evacuations have been allowed, or even ordered, does not necessarily mean that an area is no longer “populated”. In such cases, experience shows that civilians often remain in the area, and parties therefore cannot presume that the area is necessarily devoid of civilians. **Those who remain in the area do not lose their protected status because they did not heed a warning or evacuate. Moreover, providing advance warnings does not relieve an attacker from taking all other precautionary measures that are feasible.**³³³

³²⁹ Protocol II to the CCW (1980), Article 3(4); Protocol III to the CCW (1980), Article. 1(5); Amended Protocol II to the CCW (1996), Article 3(10); ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 15.

³³⁰ ICRC Challenges Report 2015, cited in footnote 1 above, p. 50; ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, pp. 5, 22 and 25; ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 682, para. 2200, which notes that the “precision and range” of the available weapons “should be taken into account”; J. F. Quéguiner, cited in footnote 326 above, p. 801; W. H. Boothby, cited in footnote 310 above, p. 124; I. Henderson, *The Contemporary Law of Targeting*, Martinus Nijhoff Publishers, Leiden, 2009, p. 171. See also Chapter 2, section 2.3: “Factors determining wide area effects”.

³³¹ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 599, para. 1871.

³³² C. J. Markham and M. N. Schmitt, cited in footnote 263 above, p. 687; Lt S. W. Belt, “Missiles over Kosovo: Emergence *lex lata* of a customary norm requiring the use of precision munitions in urban areas”, *Naval Law Review*, Vol. 47, 2000; ILA Study Group Report, cited in footnote 290 above, p. 384; V. Koutroulis, “All feasible precautions in the choice of means and methods of warfare”, in *Urban Warfare*, Proceedings of the 16th Bruges Colloquium, 15–16 October 2015, College of Europe/ICRC, *Collegium*, No. 46, Autumn 2016, pp. 51–52; HPCR, *Manual on International Law Applicable to Air and Missile Warfare*, HPCR, Cambridge, May 2009, p. 9, para. 8; and HPCR Commentary, cited in footnote 263 above, pp. 83–84, para. 2.

³³³ K. Dörmann, “Obligations of international humanitarian law”, *Military and Strategic Affairs*, Vol. 4, No. 2, September 2012, p. 19.



A. Lohm/ICRC

Civilians leave their neighbourhood in Mosul, Iraq, during the second phase of a military offensive to reclaim the city from armed groups.

The inability to take specific precautions – such as the unavailability of precision-guided munitions, or when circumstances do not permit giving a warning to the civilian population – does not justify use of explosive weapons with a wide impact area in violation of the other IHL rules regulating the conduct of hostilities, in particular the prohibitions against indiscriminate or disproportionate attacks.³³⁴

3.5.3 Precautions against the effects of attacks and the prohibition against the use of human shields

- The parties to the conflict must take all feasible precautions to protect the civilian population and civilian objects under their control against the effects of attacks.
- Each party to the conflict must, to the extent feasible, avoid locating military objectives within or near densely populated areas.
- Each party to the conflict must, to the extent feasible, remove civilian persons and objects under its control from the vicinity of military objectives.
- The use of human shields is prohibited.

(ICRC, *Customary International Humanitarian Law*, Vol. 1,³³⁵ Rules 22, 23, 24 and 97; See also Additional Protocol I, Articles 58 and 51 (7))

Civilians can be protected most effectively when they are not surrounded by fighting. Because urban warfare occurs amid civilians, it is critical that parties fulfil their obligation to take all feasible precautions to protect civilians and civilian objects under their control from the effects of attacks. Precautions against the effects of attacks include removing civilians and civilian objects from the vicinity of military objectives, and not, even in peacetime, situating military objectives (such as a barracks or a store of military equipment or ammunition) within or near densely populated areas, to the extent feasible. During an armed conflict, care must also be taken to avoid, to

³³⁴ Henckaerts/Doswald-Beck, commentary on Rule 20, pp. 64–65.

³³⁵ Under customary IHL, the second and third rules are “arguably” applicable in non-international armed conflicts. See Henckaerts/Doswald-Beck, commentary on Rules 23 and 24, pp. 71 and 74.

the extent feasible, placing troops, military equipment or transports in densely populated areas.³³⁶ Employing strategies and tactics that take combat outside populated areas is another way not to situate military objectives in these areas and to also reduce urban fighting.³³⁷ Building shelters and organizing warnings and evacuations are among the other precautionary measures that can be taken to protect the civilian population against the effects of attacks, including attacks by means of heavy explosive weapons.³³⁸ Finally, populated areas can be protected against the use and effects of heavy explosive weapons by the establishment of protected zones such as demilitarized zones or non-defended localities.³³⁹

While the presence of enemy fighters, bases or equipment in a populated area cannot always be avoided and is not necessarily a violation of IHL, **the use of human shields is absolutely prohibited**. This is understood as a prohibition against using the presence or movements of the civilian population or individual civilians or other protected persons to render certain points or areas or armed forces immune from military operations, in particular to shield military objectives from attack or to shield, favour or impede military operations. This prohibition is most relevant for the party to the conflict that controls the civilian population.³⁴⁰ For instance, it is prohibited to shield military objectives from being attacked with heavy explosive weapons by using the presence of the civilian population to make such an attack by an adversary violate the rule of proportionality.

Respect for these rules is critical to help reduce the risk of civilian harm in populated areas. It might not always be possible to avoid situating military objectives within or near densely populated areas, but doing so significantly reduces the risk to civilians, including the risk posed by the use of heavy explosive weapons when military objectives are situated in such areas.



The Dominican, Guatemalan, Honduran, Nicaraguan and Salvadoran armed forces take part in a workshop on the rules governing military operations.

³³⁶ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, p. 694, paras 2251–2252.

³³⁷ ICRC Challenges Report 2019, cited in footnote 8 above, p 19.

³³⁸ ICRC Commentary on the Additional Protocols, cited in footnote 249 above, pp. 694–695, para. 2257.

³³⁹ ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rules 36 and 37.

³⁴⁰ *Ibid.*, Rule 97; Additional Protocol I, Article 51(7).



Members of the ICRC's ordnance disposal team and the Libyan Red Crescent count unexploded ordnance they have collected in Sirte, Libya.

3.5.4 Explosive remnants of war

Not all heavy explosive weapons or munitions detonate upon impact or as otherwise intended. ERW, and in particular UXO, are responsible for a significant amount of civilian harm, both during and after the end of hostilities. This harm can be either direct, such as death or injury from an ERW explosion, or indirect, such as when UXO prevent access to health-care facilities, agricultural land or roads.³⁴¹ Protocol V to the Convention on Certain Conventional Weapons seeks specifically to prevent and mitigate the serious impact, in humanitarian terms, of ERW; in this regard, it complements the precautionary obligations discussed above.

The UXO obligations contained in Protocol V apply to almost all of the weapons that qualify as 'explosive weapons with a wide impact area' for the purposes of this report.³⁴² In short, Protocol V requires states and non-state armed groups party to armed conflicts, as well as states parties whose territory is affected by ERW, to:

- mark and clear, remove or destroy ERW in territory under their control, as soon as feasible after the cessation of active hostilities (Article 3)
- as far as practicable, record and retain information on the type, number and location of explosive ordnance used or abandoned during the conflict, as well as on the targeted areas, to the maximum extent possible, and make such information available to the party in control of the affected area without delay after the cessation of hostilities (Article 4)³⁴³
- take all feasible precautions in the territory under their control to protect civilians and civilian objects from the risks and effects of ERW, both during and after the end of hostilities, including warnings, risk education, and marking, fencing and monitoring affected areas (Article 5).

³⁴¹ See Chapter 1, section 1.7.

³⁴² Protocol V to the CCW applies to all explosive munitions other than mines, booby traps and 'other devices' (see Article 2). The term 'other devices' includes certain types of IEDs (see Amended Protocol II to the CCW (1996), Article 2(5)), which may also constitute explosive weapons with a wide impact area, as discussed in the Introduction and in Chapter 4.

³⁴³ See also ICRC, *Identifying and Addressing Challenges to Implementation of Article 4 of Protocol V to the CCW*, Expert Meeting, ICRC, Geneva, October 2013, (ICRC Expert Meeting on Protocol V), p. 37, para. 3.

In addition, Protocol V contains a detailed technical annex that identifies a number of preventive and other measures that states are encouraged to take in order to minimize the occurrence of ERW, including in terms of production, storage and transportation of munitions.³⁴⁴ The measures identified in Protocol V and its annex may be seen as best-practice recommendations for states not party to the Protocol.

The IHL rules on precautions outlined in the previous sections apply when Protocol V does not. These require that a party to conflict take all feasible precautions to avoid, and in any event to minimize, incidental civilian harm when it uses heavy explosive weapons that may become ERW.³⁴⁵ Moreover, a party in control of an area containing ERW must take all feasible precautions – such as those provided in Protocol V – to protect civilians from the effects of ERW.³⁴⁶ Compliance with these provisions can significantly reduce the civilian harm from unexploded heavy explosive weapons.



The indigenous guard in Colombia is organized by local people whose goal is to protect civilians from harm. They carry a sacred stick to identify themselves and collect munitions at their own risk.

3.6 COMPLIANCE WITH IHL IN ALL SITUATIONS

Warfare in populated areas, where military objectives are intermingled with or in close proximity to protected persons and objects, represents a significant operational challenge for military commanders. It entails a more demanding analytical process during the planning phase, as well as complex decision-making in real-time situations. When civilians and civilian infrastructure are the main features of the “battlefield”, the responsibility of commanders to avoid or minimize incidental civilian harm is heightened.³⁴⁷

³⁴⁴ Protocol V to the CCW (2003), Article 9 and Technical Annex.

³⁴⁵ See ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 15.

³⁴⁶ *Ibid.*, Rule 22.

³⁴⁷ ICRC Challenges Report 2015, cited in footnote 1 above, p. 53; see also United States, Chairman of the Joint Chiefs of Staff, *Joint Urban Operations*, JP No. 3-06, November 2013 (US CJCS, Joint Urban Operations), p. IV-17: “[T]he presence of significant infrastructure and protected sites increases the requirements for accurate identification and targeting, precise delivery of fires, and concern for collateral damage.”

The inherent vulnerability of civilians in populated areas requires that IHL be scrupulously respected when conducting hostilities in such environments, even when the enemy is not respecting IHL or when friendly forces are defending themselves against an attack.

3.6.1 No condition of reciprocity

The use of heavy explosive weapons in populated areas is sometimes defended by reference to the behaviour of the adversary – in particular in asymmetric conflicts, where armed groups tend to commingle with the civilian population or launch attacks from populated areas, or might even resort to unlawful practices such as the use of human shields.

While the conduct and tactics of the adversary are relevant factors that can influence the feasibility of precautions, compliance with IHL is not subject to reciprocity. **The fact that one party to a conflict puts civilians and civilian objects at risk by intermingling with the civilian population, or even violates IHL, does not relieve the other party of its obligations under IHL.**³⁴⁸ In particular, **it does not justify resorting to means or methods of warfare, including the use of heavy explosive weapons, that would be unlawful in the circumstances.**

3.6.2 The use of heavy explosive weapons in “self-defence”

The ICRC has observed that heavy explosive weapons are used in several contexts to provide support to ground forces that are, or risk being, under enemy fire. This may be more or less anticipated, and thus planned for, depending on the extent to which enemy attack was foreseeable. However, where armed forces must quickly react to incoming fire, and when they are unable to verify its precise location and select the most appropriate weapon, that typically results in the use of inaccurate or other wide impact area explosive weapons, causing significant incidental civilian harm.

In such situations, some states invoke – in dialogue with the ICRC, often referring to their rules of engagement – the notion of ‘self-defence’ to suggest that IHL restrictions on the use of force, including on the choice of weapons, would be less stringent compared to other, ‘pre-planned’ attacks, and to justify the use of weapons that carry a high risk of indiscriminate effects in the circumstances. However, any use of force in armed conflict, regardless of whether it is offensive or defensive, must comply with the parties’ obligations under IHL. **Self-defence can never justify the use of explosive weapons with a wide impact area in populated areas if such use would violate the IHL prohibitions against indiscriminate and disproportionate attacks,** which are absolute and also apply to fire support for troops under enemy fire.

Nonetheless, protecting own or friendly forces from enemy fire is a relevant military consideration that affects the feasibility of precautions in attack. Force protection is also a relevant ‘military advantage’ when assessing the proportionality of an attack, but only insofar as it is ‘concrete and direct’ – which is primarily the case when troops are under enemy fire, i.e. in ‘self-defence’ scenarios. To assess the feasibility – and thus the scope of the obligation – of taking precautions under IHL, force protection and other military considerations must however be balanced against humanitarian considerations, such as the likelihood and magnitude of incidental civilian harm that may be expected to result from the use of heavy explosive weapons.³⁴⁹ In this respect, **the greater the risk of incidental civilian harm anticipated from the attack (including the use of force in defence, in response to enemy fire), the greater the risk to its own forces the attacking party may have to be prepared to accept.**³⁵⁰

³⁴⁸ See ICRC Study on Customary International Humanitarian Law (2005), cited in footnote 240 above, Rule 140; and Additional Protocol I, Article 51(8).

³⁴⁹ I. Henderson, cited in footnote 330 above, p. 204; R. Geiss, “The principle of proportionality: ‘Force protection’ as a military advantage”, *Israel Law Review*, Vol. 45, No. 1, March 2012, pp. 77–79; ILA Study Group Report, cited in footnote 290 above, pp. 366–367.

³⁵⁰ ICRC Challenges Report 2019, cited in footnote 8 above, p. 21; M. N. Schmitt, “Precision attack and international humanitarian law”, *International Review of the Red Cross*, Vol. 87, No. 859, September 2005, p. 462; and N. Neuman, “Applying the rule of proportionality: Force protection and cumulative assessment in international law and morality”, *Yearbook of International Humanitarian Law*, Vol. 7, 2004, pp. 96 and 106–109.

Finally, the obligation to take care to spare civilians and civilian objects must be applied constantly during all military operations; the specific obligation to take precautions in attack is already applicable during the planning phase of an attack (see sub-sections 3.5.1 and 3.5.2 above). Parties to conflict that plan to conduct hostilities in populated areas should typically expect to have to respond to enemy fire launched from such areas. It is thus incumbent upon them to do everything feasible to ensure that the troops tasked with conducting such operations have the means and training – and the rules of engagement and the tactics, techniques, and procedures – to defend against such enemy attacks while minimizing incidental harm to civilians and damage to civilian objects.

Members of a Malian armed group listen to a presentation organized by the ICRC on IHL and humanitarian principles.



CHAPTER 4

MILITARY POLICY AND PRACTICE RELATING TO THE USE OF EXPLOSIVE WEAPONS WITH A WIDE IMPACT AREA IN POPULATED AREAS

KEY FINDINGS

- Military policy generally recognizes that limiting weapons' effects as far as possible to the target, notably to protect civilians, is a critical consideration in the choice and use of weapons in populated areas.
- **Comparatively few armed forces throughout the world appear to have adopted doctrine or a specific policy on training for urban warfare and on the choice of weapons and tactics suitable for use in populated areas.** However, **it is increasingly being acknowledged that operations in populated areas require a shift in mindset, doctrine, training, equipment, planning and conduct,** in order to respond to the complex challenges that populated areas pose to armed forces and reduce risks for civilians.
- **Existing military policy and practice reflect an acknowledgement by many militaries of the humanitarian concerns arising from the use of explosive weapons with a wide impact area in populated areas,** and in particular, acknowledgement of the fact that such use heightens the risk of civilian harm. To address these concerns, some policy and instructions provide commanders with guidance on limiting the area effects of the weapons or munitions used. Relevant elements of policy and practice are mainly mission-specific, although in some states they form part of a more consistent approach towards urban warfare.
- In particular, there are a number of examples of **express limitations on the use of certain weapons and methods of warfare** in populated areas, including prohibitions against the use of heavy explosive weapons; guidance on **additional weapon-specific measures** to be taken; and **other measures and tools to inform the choice of weapons in populated areas and to minimize risks to civilians** in urban warfare.
- In several instances, mortars, artillery, MBRLs and air-delivered bombs using unguided munitions are expressly singled out because of their inaccuracy, and their use against military objectives situated in populated areas is subject to restrictions or to be avoided altogether; precision and/or smaller-calibre munitions are mentioned among the alternatives to consider. Other examples of restrictions include limiting the use of high-explosive artillery or mortars to areas from which civilians have been evacuated or to self-defence scenarios; avoiding the use of indirect fire against moving military objectives; establishing 'no-strike lists' where only the use of light weapons is permitted; and using time-delay instead of proximity fuzes.
- Other weapon-specific measures recommended or mandated by military policies and instructions include: changing the angle or direction of attack; giving advance warning; and considering alternatives – weapons and tactics – to the use of heavy explosive weapons.

- Additional tools for mitigating civilian harm, beyond weapon-specific measures, include: enhanced collection of intelligence about the situation on the battlefield, including the presence of civilians and civilian objects and the pattern of life in and around the target; maintaining safety distances from civilians and civilian objects; the conduct of collateral-damage estimates prior to launching the attack, and of battle-damage assessments and after-action reviews after attacks, to draw lessons for future operations; and the establishment of civilian-casualty tracking cells.
- In order to ensure proper implementation of the measures and restrictions mentioned above, **thorough training in the use and effects of explosive weapons with a wide impact area**, as well as in other weapons and tactics that may be more appropriate for use in populated areas, **is indispensable**.
- It is also critical to **ensure that concerns and lessons identified through battle-damage assessments and after-action reviews are incorporated in instructions and planning for future operations**. A short feedback loop should also be set up within a given military operation, to the extent feasible, so that information on the effects of past operations, including their effects on civilians and civilian objects, is taken into account while planning and deciding upon an attack.
- A number of states and other entities, such as the UN, the North Atlantic Treaty Organization (NATO) and the African Union, have developed **policies on the protection of civilians in armed conflict**. While not specific to the use of heavy explosive weapons in populated areas, such policies often impose measures that can significantly mitigate the risk of civilian harm from the use of these weapons, such as training in best practices that reduce the likelihood of civilian casualties; improving battle-space awareness; identifying and incorporating lessons learnt; and establishing processes for tracking civilian casualties.
- In addition to obligations under IHL and humanitarian considerations **there are a number of strategic reasons for taking measures to minimize civilian harm in populated areas**. Civilian harm may undermine the legitimacy of the military mission, affect local or international support, and eliminate avenues for reconciliation. And extensive damage to civilian objects, including critical civilian infrastructure, increases post-conflict reconstruction costs and hampers military operations at the tactical level.

Some 500 members of the Afghan National Army listen to an information session on IHL during the Afghan National Army Hero camp in Kandahar.



4.1 INTRODUCTION

Military policy and practice generally consider that the choice and use of weapons in populated areas must be made so as to limit effects as far as possible to the target, in order to ensure compliance with IHL and to protect civilians. Beyond this general recognition, in their doctrine³⁵¹ and practice armed forces have responded differently to the heightened risk to civilians posed by the conduct of hostilities in populated areas.

According to the information available to the ICRC to date, **comparatively few armed forces throughout the world appear to have produced doctrine or adopted a specific policy for training in urban warfare, including in the choice of weapons and tactics suitable for use in populated areas.** More examples of urban-warfare doctrine have emerged recently, but they have not always underpinned urban-warfare training or – even less so – the choice of suitable weapons or tactics. Relevant elements of policy and practice are mainly mission-specific, but for some states they form part of a more consistent approach towards urban warfare. In addition, some states and military alliances have developed specific policies for the protection of civilians in armed conflict, which are also of relevance to urban warfare, including in connection with the use of heavy explosive weapons in populated areas.

When looking for military policy and practice relevant to the use of heavy explosive weapons in populated areas, it is important to bear in mind that the expression ‘explosive weapons with a wide impact area’ is not a legal or military term of art, but a concept that factually describes the foreseeable ‘footprint’ of a weapon in a populated area, i.e. the area directly impacted or at risk of being directly impacted by the explosive munitions delivered by the weapon system. In general, military policies do not explicitly refer to the ‘wide area effects’ of weapons. However, the correlation between weapons that have such effects, the populated environment in which they are used, and the risk of harm to civilians and of damage to civilian structures is implicitly or explicitly recognized in military doctrine and procedures related to targeting and to the choice of means and methods of warfare.³⁵² A number of militaries use the concept of a ‘collateral hazard area’:³⁵³ this provides an approximate calculation of the foreseeable area of effect of the weapon, which must be taken into account – to protect civilians – during the planning and execution of attacks, notably with regard to weapon-target matching.

This chapter provides an overview of elements of existing military policy and practice – available to the ICRC – that are relevant to restrictions imposed on the use of explosive weapons with a wide impact area in populated areas. It is based on public-source materials, official statements from state representatives, and information shared by military experts at experts’ meetings. This overview does not purport to be exhaustive; it only reflects military policies and practice that the ICRC was able to identify. While they belong to a limited number of states, it is possible that other states have adopted such policies without making it public or sharing it with the ICRC – though more transparency can only be encouraged in this respect. Where present and available, these elements demonstrate a recognition among a number of armed forces of the fact that **operations in**

³⁵¹ The term ‘doctrine’ is used in this report to refer to all documents and principles that guide the actions of weapon bearers at strategic, operational and tactical levels, independently of the forms they take. It therefore encompasses all directives, policies, procedures, codes of conduct, reference manuals, instructions, and rules of engagement – or their equivalents – that serve to educate, train and guide weapon bearers during their careers, giving them a common vocabulary and shaping the decision-making process, tactics and behaviour in operations; see ICRC, *Handbook on International Rules Governing Military Operations*, ICRC, Geneva, December 2013, pp. 30–31. Militaries may understand the term ‘doctrine’ differently and may adopt broader or narrower definitions of it.

³⁵² Article 36 and Center for Civilians in Conflict (CIVIC), *Report on a Workshop Examining Military Policies and Practices on the Use of Explosive Weapons in Populated Areas*, October 2018, p. 4.

³⁵³ ‘Collateral hazard area’ (CHA) is defined as “[a]n area formed by measuring a CER [collateral effects radius] from either the edge of a target facility outline, the aimpoint for a point target, or the edge of an engagement zone or artillery sheaf for an area target”; see US CJCS, CDEM, cited in footnote 300 above, p. GL-4. CHA provides for an evaluation of the area over which the blast-and-fragmentation effects of weapons will affect civilians and civilian objects, but it does not take into consideration the effects likely to result indirectly from the attack.

populated areas require a shift in mindset, doctrine, training, planning, equipment and conduct, in order to respond to the complex challenges that populated environments pose to armed forces and to reduce risks to civilians.³⁵⁴

The first section reviews express restrictions and limitations on the choice and use of certain explosive weapons as well as other weapon-specific measures to limit their area effects in populated areas and the risk of civilian harm. The second section examines additional tools to inform the choice of weapons in populated areas and to minimize risks to civilians during urban warfare. This includes guidance to limit the wide area effects of the weapons and the reverberating effects of an attack; methodologies to estimate collateral damage; and measures to prevent harm to own and friendly forces and to protect civilians.



Senior military officers meet at the Senior Workshop on International Rules governing Military Operations (SWIRMO), jointly organized by the ICRC and the Swiss army.

4.2 EXPRESS LIMITATIONS AND OTHER WEAPON-SPECIFIC MEASURES ON THE USE OF CERTAIN EXPLOSIVE WEAPONS IN POPULATED AREAS

Some military policy and practice recognizes that there are challenges in employing weapons that are inaccurate or otherwise have wide area effects in populated areas, and that these challenges can be offset by taking measures to reduce the area effects of the weapon and by considering alternative weapons and tactics. As noted above, while some militaries have urban warfare-specific doctrine that provides guidance on the use of means and methods of warfare in populated areas, most armed forces do not have standing limitations on the use of explosive weapons in populated areas. Rather, they use mission-specific rules of engagement (RoE) to identify which weapons may be used, and how, in specific operations, missions or other instances. Other instruments such as 'strategic directives' and 'standard operating procedures' may also stipulate more general restrictions on the use of force, including on types of fire. Additionally, commanders sometimes issue instructions or guidance on weapons' use for specific missions.³⁵⁵

³⁵⁴ Lt-Col. J. Bodnar and S. Collins, "NATO joint military operations in an urban environment: A capstone concept", *The Three Swords Magazine*, No. 34, April 2019, p. 95: "To be successful, entirely new ways of operating are required; in other words, the concept calls for a mindset change."

³⁵⁵ RoE are the orders governing the type and amount of force that may be employed during military operations. They may apply to all (standing RoE) or some operations (RoE for counter-insurgency, stabilization, offensive or defensive operations), or adapted to the needs of a specific mission. Military 'standard operating procedures' (SOPs) are a written set of instructions detailing the procedures for carrying out a task. 'Strategic directives' are the directions issued at national level to a commander and the forces under their command regarding the nature or conduct of operations (e.g. direction to minimize collateral damage). 'Tactical guidance' is the advice given to military forces to steer the conduct of operations at the tactical level.



Senior officers in Myanmar take part in a workshop on the practical application of IHL organized by the ICRC.

This section contains examples of military policy and practice known to the ICRC that indicate **express limitations on the use of specific explosive weapons or related methods of warfare in populated areas, as well as other measures to limit their wide area effects and the risk of civilian harm.**³⁵⁶ Such limitations do not necessarily mean that the state applying them considers that they are legally required.³⁵⁷

What follows is an anonymized list of **measures identified in existing military policy and practice** known to the ICRC and drawn from doctrine and other policies, official statements, and contributions to experts' meetings. The measures listed are taken from the policies and practice of 14 states and two multinational entities, some of which have recent experience of urban warfare.³⁵⁸

³⁵⁶ OCHA, *Reducing the Humanitarian Impact of the Use of Explosive Weapons in Populated Areas: Compilation of Military Policy and Practice*, OCHA Policy and Study Series, October 2017 (OCHA Compilation); and Meeting of the States Parties to the CCW, "Mitigating the civilian harm from the use of explosive weapons in populated areas", Working paper submitted by Germany, UN Doc. CCW/MSP/2018/WP.1, 14 November 2018.

³⁵⁷ The policies and practices in this chapter do not necessarily reflect obligations that states regard themselves as having under international law. Some policies expressly provide that the limitations go beyond the state's obligations under IHL; see, for example, State of Israel, *The 2014 Gaza Conflict: Factual and Legal Aspects*, May 2015, p. 192, para. 354; G. S. Corn and G. P. Corn, "The law of operational targeting: Viewing the LOAC through an operational Lens", *Texas International Law Journal*, Vol. 47, No. 2, 2012, p. 357, footnote 101, and p. 369 emphasizing that "controls on the use of artillery in populated areas" are not "indications of per se prohibitions against such use".

³⁵⁸ The terminology used below reflects that used by states and multinational entities in their oral and written examples of policy and practice, and does not necessarily coincide with the ICRC's use or understanding of specific terms.

A. Restrictions and limitations

1. On categories of weapons or munitions

- The use of MBRL is prohibited in populated areas.
- The use of artillery in populated areas is generally prohibited; it is permitted only on an exceptional basis in certain exigent circumstances (primarily self-defence).
- The use of artillery in populated areas is permitted only when proven beyond all reasonable doubt that such areas are “mainly populated by enemy combatants”.
- The use of mortars is allowed only in areas evacuated of civilians.
- Certain classes of munitions may not be used in some operations (e.g. in populated areas) because of their calibre and attendant capability to cause widespread damage.
- The use of mortars in urban areas is limited to situations where there is imminent risk to the lives of friendly forces.
- Special (higher-level) authorization is required to use ‘heavy’ weapons in populated areas.

2. On modes of fire

- Unobserved indirect fire in populated areas is prohibited.
- The use of indirect fire against moving targets (including in populated areas) should be avoided.

3. On the manner of use or combination of certain weapons and modes of fire

- The use of indirect fire for counter-battery purposes and for bombardment is allowed only in areas evacuated of civilians.
- The use of 107-millimetre rocket artillery (a type of MBRL) in populated areas is allowed only in unitary rounds; salvos are prohibited.
- The use of artillery in populated areas is permitted only in direct-fire mode.

B. Mitigation measures

1. Relating to the choice of weapon or munition or the manipulation of technical characteristics

- Delayed-action (time-delay) fuzes (for munitions to detonate deep inside targets and limit damage to adjacent structures) should be used when operating in populated areas.
- Proximity fuzes and variable time fuzes are excluded in built-up areas, because the nature of urban areas may cause such fuzes to function prematurely.
- Point delivery/precision-guided munitions (PGMs) should be used when operating in populated areas.
- Smaller bombs (500 lbs, 250 lbs) should be used when operating in the vicinity of populated areas.
- The use of ‘non-lethal’ or ‘low-collateral-damage weapons’ should be given preference when operating in populated areas.

2. On the manner of use

- The impact of indirect fire and adjustment of fire should be under constant observation; a broad array of forward observers should be deployed.
- Fire should be adjusted (by firing adjustment rounds and making corrections based on the impact of such rounds) from the side devoid of civilian presence.
- ‘Minimum safety distances’ – a minimum distance between a target and a populated area or civilian object, as well as between a target and sensitive facilities (ranging from 100 to 400 metres) – should be established for the protection of civilians and/or civilian objects.

The sub-section below sets out several publicly available examples of policies and practices – adopted by multinational entities, states and non-state armed groups – precluding or otherwise limiting the use of certain explosive weapons in populated areas, because of their inaccuracy or other area effects and of the consequent high risk they pose to civilians, and imposing a number of weapon-specific mitigation measures. These examples indicate that a number of states and other actors have acknowledged the specific challenges related to urban warfare and to the use of heavy explosive weapons in populated areas in particular, and have adopted doctrines and policies to

mitigate them. However, these examples should not be understood as implying that in each case enough was done in practice to protect civilians from the effects of heavy explosive weapons. In other words, such policies are not necessarily sufficient or always translated into practice in the conduct of military operations, as demonstrated by recent and ongoing armed conflicts.

4.2.1 AMISOM

In 2011, faced with high levels of civilian harm in populated areas such as the city of Mogadishu, the African Union Mission in Somalia (AMISOM) placed significant restrictions on the use of indirect-fire weapons through a policy that was incorporated in its RoE. The significant decrease in civilian casualties since 2012 has been linked to this policy.³⁵⁹

While most details of the policy are confidential, some of its elements have been made public and are summarized below. The policy is structured around three main pillars: ‘avoid’, ‘attribute’ and ‘amend’. The ‘avoid’ pillar means that:

[W]here possible, AMISOM will avoid the use of indirect fire, which can cause CIVCAS [civilian casualties], unless the purpose of observed indirect fire is to achieve a military objective for extreme self-defence measures. Indirect fire will only be used to protect the civilian population where a clear military objective is identified and where the military advantage gained is overwhelmingly superior to the potential risk of harm to the civil population.³⁶⁰



Members of AMISOM and the Somali National Army completed a joint operation to re-establish control over the town of Afgoye and its residents, including 400,000 internally displaced people.

³⁵⁹ M. Brehm, cited in footnote 248 above, p. 259; N. Grubeck, *Civilian Harm in Somalia: Creating an Appropriate Response*, CIVIC, Washington D.C., November 2011, p. 20.

³⁶⁰ OCHA Compilation, cited in footnote 356 above, p. 25.

The policy also recognized that “direct-fire weapons, such as long-range, large-calibre rifles can provide a rapid and accurate response, with less potential for civilian casualties than indirect fire”.³⁶¹ **It contains various measures aimed at limiting instances of indirect fire,³⁶² including the following:**

- **Avoid indirect fire against military objectives situated in the midst of public gatherings.** Public gatherings that do not represent a threat to AMISOM operations are to be treated as temporary ‘no-fire zones’.
- **Restrict the use of the 107-millimetre MRBL.** This weapon may be used to disperse groups of enemy fighters en route to a forming-up position **only when single rounds can be fired and the effects recorded before subsequent rounds are fired. Under no circumstances are 107-millimetre MRBL to be fired in salvos.**
- Formalize a stricter chain of command for the use of mortar and artillery fire.
- Provide predeployment and refresher training in IHL, including such issues as choosing not to use a particular weapon, exercising a high degree of restraint and restricting counter-battery fire and unobserved fire.
- Use of unmanned aerial vehicles (UAVs) to conduct pattern-of-life assessments.
- Use of Collateral Damage Estimates and after-action reports.
- Creation of a CIVCAS tracking cell and incident assessment team to investigate any instance of civilian casualties.³⁶³

4.2.2 NATO/ISAF

NATO has long recognized the need to identify and develop capabilities necessary for operations in urban areas.³⁶⁴ In December 2015, in the context of the NATO Urbanization Project, the Headquarters Allied Command Transformation noted that, to meet the challenges of operating in an urban environment, “urban tactics, techniques, and procedures (TTPs) should become mandatory for all arms during collective training”.³⁶⁵ **For NATO, owing to the complexity and challenges they present, urban operations warrant their “own set of conceptual operationalization, specific doctrine and training, and adapted weapons and equipment”.**³⁶⁶ NATO has developed a ‘Capstone Concept’ on ‘Joint Military Operations in an Urban Environment’, to pave the way for the development of future capabilities and a future NATO Urban Doctrine.³⁶⁷

Some of the clearest policy limitations regarding the use of specific weapons are evident in NATO’s campaign in Afghanistan, where commanders of the NATO-led International Security Assistance Force (ISAF) introduced a number of ‘tactical directives’ to limit the use of certain weapons in or near concentrations of civilians, among other measures.³⁶⁸ Of most relevance to the use of heavy explosive weapons in populated areas is a 2009 tactical directive **limiting the use**

³⁶¹ *Ibid.*

³⁶² P. D. Williams, “The African Union Mission in Somalia and civilian protection challenges”, *Stability: International Journal of Security & Development*, Vol. 2, No. 2, August 2013, p. 12.

³⁶³ The Civilian Casualty Tracking, Analysis, and Response Cell (CCTARC) was established under the authority of the African Union Peace and Security Council and is owned and controlled exclusively by AMISOM; see M. B. Keenan, “Population-centric security force assistance: Creating a mindset of civilian protection”, Remarks at AFRICOM’s Sixth Academic Symposium, 24 June 2014: <https://civiliansinconflict.org/press-releases/remarks-africom-academic-symposium/>.

³⁶⁴ See NATO, Research and Technology Organization, *Urban Operations in the Year 2020*, No. RTO-TR-071, RTO/NATO, Neuilly-sur-Seine, April 2003.

³⁶⁵ Wg Cdr G. Pendleton, “New concepts: Joint urban operations and the NATO Urbanisation Project”, *The Three Swords Magazine*, No. 29, December 2015, p. 55: http://www.jwc.nato.int/images/stories/_news_items_/2015/urbanisation_dec2015.pdf.

³⁶⁶ Lt-Col. J. Bodnar and S. Collins, cited in footnote 354 above, p. 94; NATO defines ‘doctrine’ as follows: “Fundamental principles by which the military forces guide their actions in support of objectives. It is authoritative but requires judgement in application”, in NATO Glossary of Terms, cited in footnote 178 above. Some of the instruments referenced in the following may not qualify as ‘doctrine’ in this strict sense of the term.

³⁶⁷ Lt-Col. J. Bodnar and S. Collins, cited in footnote 354 above, pp. 93–94.

³⁶⁸ The directives were framed as part of the effort to win hearts and minds and were also binding on US forces in Afghanistan.

of “air-to-ground munitions and indirect fires against residential compounds.”³⁶⁹ The effect of the directive was to oblige commanders to consider alternative means and methods of combat, such as small-arms fire instead of air-to-ground or indirect fire, or even withdrawing when military personnel’s lives were not at risk.³⁷⁰ Implementation of the directive resulted in a significant reduction in civilian casualties.³⁷¹

Subsequent ISAF commanders issued revised tactical directives in 2010 and 2011 with a continued focus on protecting civilians. The August 2010 tactical directive required, among others, the commander to determine, prior to the use of fires, that there were no civilians present; if it was not possible to assess the risk of civilian presence, fires were prohibited, except under certain (undisclosed) conditions relating to the risk to ISAF and Afghan forces.³⁷² The November 2011 tactical directive reminded forces that in every location where there was evidence of human habitation, civilians should be presumed to be present until otherwise apparent. Training and investigations were also re-emphasized.³⁷³ The directive was reportedly revised in August 2012 to further restrict the use of indirect fire and air-delivered munitions against civilian dwellings and other structures that may contain civilians, except in cases of self-defence when other options were not available.³⁷⁴



Members of ISAF assist the Afghan National Army in an operation to clear insurgents from the village of Shewan.

³⁶⁹ NATO/ISAF, *Tactical Directive on the Employment of Force* (revised), 6 July 2009: https://www.nato.int/isaf/docu/official_texts/Tactical_Directive_090706.pdf (NATO/ISAF Tactical Directive 2009).

³⁷⁰ G. Gaggioli (ed.), *The Use of Force in Armed Conflicts: Interplay between the Conduct of Hostilities and Law Enforcement Paradigms*, Expert Meeting, ICRC, Geneva, November 2013, p. 86, Appendix 5: Summary of the presentation by Richard Gross.

³⁷¹ *Ibid.*; UNAMA and OHCHR, *Afghanistan Annual Report 2012: Protection of Civilians in Armed Conflict*, UNAMA, Kabul, February 2013, p. 31.

³⁷² NATO/ISAF, “General Petraeus issues updated tactical directive: Emphasizes disciplined use of force”, news release, 4 August 2010: <https://reliefweb.int/report/afghanistan/afghanistan-general-petraeus-issues-updated-tactical-directive-emphasizes>. The news release contains the unclassified sections of this revision.

³⁷³ NATO/ISAF, *Tactical Directive*, 30 November 2011 (no longer accessible online). See also UNAMA and OHCHR, cited in footnote 371 above, p. 23.

³⁷⁴ UNAMA and OHCHR, cited in footnote 371 above, pp. 34 and 38.

More recently, **in March 2021, NATO issued a handbook, *Protection of Civilians*, that explicitly acknowledges that** populated environments pose a challenge to IHL application, one that must be given due consideration when attempting to mitigate civilian harm in military operations. More specifically, the handbook **stipulates that there is a “military need to take into account the negative wide-area effects of explosive weapons in populated and/or urban areas including foreseeable second and third order effects”**.³⁷⁵

4.2.3 Australia

Australian doctrine on operations in urban environments recognizes that “because there will almost certainly be civilians in the area, **the RoE for the operation may preclude using certain weapons, such as HE [high explosive] or automatic fire, in order to limit collateral damage**”.³⁷⁶ It further provides that “**in many urban activities, the use of weapons is restricted. Limits will almost certainly be placed on the use of air support and indirect fire.**”³⁷⁷

4.2.4 France

French doctrine related to collateral damage estimation (see section 4.3.2 below for more details) provides that **for medium or small-sized targets, recourse will be systematically made to munitions equipped with a guidance kit**, in order to avoid impact beyond the target and thus minimize the risk of exposure of civilians and civilian objects to harm.³⁷⁸

4.2.5 Israel

The RoE of the Israel Defense Forces (IDF) contain “**stringent limitations**” and even prohibitions **against the use of certain weapons, including high-explosive artillery, in or near populated areas** in various operations over the past two decades, with a view to minimizing the risk of harm to civilians.³⁷⁹ Notably, in 2010, a State of Israel report recommended that military orders governing “the use of mortars in populated areas and in close proximity to sensitive facilities” be made more stringent and that regulations imposing safety distances from sensitive facilities be highlighted with IDF units at all levels, “specifically with regard to the use of artillery”.³⁸⁰

With respect to the 2014 Gaza conflict, an Israeli government report explained that the context of urban warfare “presents particular challenges, both tactical and humanitarian, due to the limited accuracy of regular HE [high-explosive artillery] shells, on the one hand, and the presence of civilian property and of civilians that may have remained in the area, on the other”.³⁸¹ In that operation, IDF directives “**generally prohibited the firing of HE [artillery] shells into populated areas and required the observance of specified ‘safety margins,’ i.e. set distances from civilians**”³⁸² determined “on the basis of research conducted by technical experts, focusing on the accuracy of each artillery calibre and its dispersal range”.³⁸³ The directives permitted only the firing of HE artillery shells “in close proximity to, or into, populated areas on an exceptional basis, in certain exigent circumstances”,³⁸⁴ and even then, the use of artillery

³⁷⁵ NATO, *Protection of Civilians Allied Command Operations Handbook*, NATO, 11 March 2021 (NATO Protection of Civilians Handbook), p. 29.

³⁷⁶ Australian Army, *Operations in Urban Environments (Developing Doctrine)*, Land Warfare Procedures – General, No. LWP-G 3-9-6, May 2012, p. 1-18, para. 1.25.

³⁷⁷ *Ibid.*, p. 4-2, para. 4.5.

³⁷⁸ Centre interarmées de concepts, de doctrines et d’expérimentations, *Estimation des dommages collatéraux*, PIA-3.9.9_EDC(2014), 2 July 2014 (France, *Estimation des dommages collatéraux*), p. 23, para. 16.

³⁷⁹ See, for example, State of Israel, cited in footnote 357 above, p. xvii, para. 48; and State of Israel, *Gaza Operations Investigations: An Update*, January 2010, pp. 29–30, para. 100 and p. 31, para. 108. During an operation in 1996, Israeli artillery batteries were reportedly prohibited by their RoE from firing on targets within 300 metres of UN establishments without specific permission from higher authority; W.M. Reisman, “The lessons of Qana”, *Yale Journal of International Law*, Vol. 22, No. 2, 1997, p. 385.

³⁸⁰ State of Israel, *Gaza Operations Investigations: Second Update*, July 2010, p. 34, para. 157 and p. 15, para. 66.

³⁸¹ State of Israel, cited in footnote 357 above, p. 191, para. 350.

³⁸² *Ibid.*, p. 192, para. 354. See also paras 355–357.

³⁸³ *Ibid.*, p. 192, footnote 467.

³⁸⁴ *Ibid.*, p. 192, para. 354.

generally “occurred in urban areas that were known to be largely evacuated [of civilians]” following advance warnings.³⁸⁵

Other practices to minimize potential civilian harm from the use of artillery included calibration techniques “designed to optimize the artillery cannons’ accuracy”, such as “firing a few inert shells (away into an area empty of civilians) before engaging in live fire”³⁸⁶, and “the deployment of an extensive forward-observation array”, also to optimize accuracy.³⁸⁷

4.2.6 Philippines

In the Philippines, guidelines, published in 2010, **prohibited the use of aerial, naval, artillery or mortar fires for interdiction and harassment, especially if the fire missions were unobserved and near populated areas and if civilian casualties or material damage to civilian objects were likely consequences.**³⁸⁸ The guidance is still in effect, but subsequent practice indicates that it does not stipulate a binding prohibition but an aspiration that can be set aside if required by operational conditions.

4.2.7 Sri Lanka

During the Lessons Learnt and Reconciliation Commission (LLRC), created in May 2010 following the civil war in Sri Lanka, high-ranking government officials and military officers stated that during the armed conflict there were **policy restrictions in place with regard to the use of certain means and methods of warfare in populated areas – in particular indirect fire, artillery, mortars and air strikes** – and that alternative tactics were employed (such as sending in ground troops with “personal weapons”), despite the increased risk to own forces. According to government officials,³⁸⁹ during the last stage of the conflict security forces “ended the use of heavy calibre guns and combat aircraft and aerial weapons that might cause civilian casualties”.³⁹⁰

4.2.8 United Kingdom

Military doctrine in the **United Kingdom (UK)** has acknowledged that the wide area effects of certain explosive weapons can be problematic when such weapons are used in populated areas. For example, the 2004 *Joint Service Manual of the Law of Armed Conflict* states that “[i]f the military objective consists of scattered enemy tank formations in an unpopulated desert, it would be permissible to use weapons having a wider area of effect than would be possible if the target were a single communications site in the middle of a heavily populated area.”³⁹¹ It also provides guidance on the choice of alternative types of weapon with regard to expected incidental damage,³⁹² and draws attention to the fact that “especially during fighting in towns, the tactics employed can make a great difference to the control of incidental damage. Similarly, when used against targets in an urban or populated environment, artillery may be expected to cause a lot of incidental damage which would need to be considered in relation to the anticipated military advantage. The same military advantage might be just as well achieved by manoeuvre, outflanking or by-passing the objective, rather than direct assault.”³⁹³

³⁸⁵ *Ibid.*, p. 193, para. 357.

³⁸⁶ *Ibid.*, p. 193, para. 358.

³⁸⁷ *Ibid.*, p. 193, para. 359.

³⁸⁸ Philippines, *Implementation Guidelines for Presidential Memorandum Order No. 393*, Joint Circular No. 2-91, 1991, para. 2(c).

³⁸⁹ LLRC Archives, “Transcript of Representation of Sri Lanka Secretary of Defence, G. Rajapaksa”, 17 August 2010. See also LLRC, *Report of the Commission of Inquiry on Lessons Learnt and Reconciliation*, November 2011, pp. 60–61, para. 4.66.

³⁹⁰ Sri Lanka, Ministry of Defence, *Humanitarian Operation: Factual Analysis*, July 2011, p. 59, para. 183 and pp. 63–64, para. 196.

³⁹¹ United Kingdom, *Joint Service Manual of the Law of Armed Conflict*, 2004, para. 5.23.3.

³⁹² *Ibid.*, p. 83, para. 5.32.4 (as amended on 4 July 2011): “A direct fire weapon aimed at the target, such as a rifle or a wire-guided anti-tank missile, is less likely to cause incidental damage than indirect fire weapons such as mortar or artillery rounds unless, of course, they miss the target and hit civilian property instead. Free fall bombs are less likely to hit a narrowly defined target, unless dropped at very low altitude, than precision munitions.”

³⁹³ *Ibid.*, para 5.32.4 (as amended on 4 July 2011).

The 2009 *Army Field Manual*, which contained a chapter on urban operations, included a number of restrictions on and measures in relation to the use of artillery in populated areas, in order to reduce the risk of civilian harm. In particular, the manual recommended using “massed or non-precision artillery ... on the fringes of urban areas”, in order to reduce its “collateral damage effects”,³⁹⁴ i.e. the incidental civilian harm likely to be caused by the weapon’s wide area effects. Further, the manual noted that using artillery in direct-fire mode can contribute to reducing incidental civilian harm, because artillery rounds can be fired using a lower charge compared to, say, tank guns (hence the destructive effects will be more limited).³⁹⁵

4.2.9 United States

The **United States (US)** military has long had doctrine on urban warfare.³⁹⁶ This includes urban-specific field manuals and other publications, sections on urban operations in documents with a broader scope, and specific doctrine on training for urban operations.³⁹⁷ **Restrictions stipulated in US doctrine include designating areas as ‘no-fire areas’ or as ‘restrictive-fire areas’ that “may be limited to small-arms fire and grenades with prohibitions against air strikes, artillery, mortars, and flame weapons”,³⁹⁸ with a view to protecting civilians and critical installations; prohibiting attacks on targets in heavily populated areas; restricting munitions used in attacks;** restricting attacks to certain times of the day; giving warning prior to attacks so that civilians can leave the area; and aborting attacks unless accuracy can be guaranteed.³⁹⁹ Detailed restrictions on the use of specific weapons in urban operations, and prohibitions against them, are set out in tactical directives and RoE developed by commanders for each operation.⁴⁰⁰

US doctrine on urban warfare also singles out specific categories of weapons and munitions for caution, notably because of the high risk of incidental civilian casualties and damage to civilian objects. For example, **basic (unguided) rockets for multiple-launch rocket systems (MLRS, also known as MBRL) are generally “of limited use in urban areas due to their exceptional destructive capabilities and the potential for collateral damage”.**⁴⁰¹ While noting that mortars are used more than any other type of indirect-fire weapon, US doctrine acknowledges that “the natural dispersion of indirect fires will result in many hits on buildings”, and that **particular care must be taken “when planning mortar fires during urban operations to minimize collateral damage”.**⁴⁰² More recent doctrine also acknowledges that the use of mortars in urban areas can damage civilian infrastructure and cause civilian casualties, and identifies two methods to “control the amount of

³⁹⁴ United Kingdom, *Urban Operations*, AFM Vol. 2, Pt. 5, Army Doctrine Publication No. AC 71657, 2009 (on file with the author), p. B-5-26, para. 63. The manual has been superseded by Army Doctrine Note 15/13 ‘Operations in Urban Environment’, which is not publicly available.

³⁹⁵ *Ibid.*, p. B-5-28, para. 64.

³⁹⁶ United States, Department of the Army, *An Infantryman’s Guide to Combat in Built-Up Areas*, FM No. 90-10-1, September 1982 (superseded by several publications, the most updated of which is the US DOA, Combined Arms Operations in Urban Terrain, cited in footnote 173 above). The US defines ‘doctrine’ as “the fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives”. Doctrine consists of a) fundamental principles, b) tactics, techniques, and procedures, and c) terms and symbols. See J. Spencer, “What is Army doctrine?”, Modern War Institute, 21 March 2016: <https://mwi.usma.edu/what-is-army-doctrine/>; United States, Department of the Army, *Operations*, FM No. 3-0, February 2008, pp. D1-D-2 (superseded by FM No. 3-0, October 2017). Some of the instruments referenced in the following may not qualify as ‘doctrine’ in this strict sense of the term.

³⁹⁷ United States, Department of the Army, *Training for Urban Operations*, TC No. 90-1, May 2008.

³⁹⁸ US DOA, Combined Arms Operations in Urban Terrain, cited in footnote 173 above, pp. 13-27-13-28, para. 13-14 and pp. 12-4-12-5, para. 12-2. See also United States, Department of the Navy, Marine Corps, *Military Operations on Urbanized Terrain (MOUT)*, MCRP No. 12-10B.1, April 2018 (US MC, MOUT), p. 6-1, para. 6102.

³⁹⁹ US CJCS, Joint Urban Operations, cited in footnote 347 above; and US DOA/MC, Urban Operations, cited in footnote 139 above, pp. 3-13-3-14, para. 3-55.

⁴⁰⁰ US DOA, Combined Arms Operations in Urban Terrain, cited in footnote 173 above, p. 1-11, para. 1-5 and p. 2-41, para. 2-18; US CJCS, Joint Urban Operations, cited in footnote 347 above, p. IV-44; US MC, MOUT, cited in footnote 398 above, para. 1005.

⁴⁰¹ US DOA/MC, Urban Operations, cited in footnote 139 above, p. 3-14, para. 3-58.

⁴⁰² United States, Department of the Army and Marine Corps, *Tactical Employment of Mortars*, ATP No. 3-21.90/MCTP No. 3-01D, 9 October 2019, p. 4-28, para. 4-174.

collateral damage”: **using heavy mortars with precision ammunition and fire-control systems, and putting in place RoE** that restrict ammunition for mortars, and the conditions under which mortars can be used, in urban operations.⁴⁰³ Furthermore, **in urban operations, “the potential for collateral damage” may prevent the use of artillery.** This risk could, however, be offset by “employing guided munitions”, using mortars “as a high-angle alternative to field artillery fire” or using aircraft to fire “guided precision munitions and weapons with low-explosive yields”.⁴⁰⁴ **US doctrine on urban warfare generally expresses a preference for the use of precision weapons,⁴⁰⁵ but it also acknowledges that “precision does not reduce or mitigate all risk”.⁴⁰⁶ So-called ‘non-lethal’ and ‘low-collateral-damage’ weapons are also identified as alternative means of warfare for use in urban operations (see section 2.4 above).⁴⁰⁷**

Moreover, **US doctrine on urban warfare restricts the use of certain fuzes in urban environments**, in order to limit explosive effects, as far as possible, to the target. As explained in Chapter 2, the choice of fuzing can exacerbate or mitigate civilian harm in populated (particularly urban) environments. For example, US doctrine restricts the use of proximity fuzes (which are programmed to detonate the munition at a certain height after its launch), because in urban areas the varying height of nearby buildings may cause such fuzes to function prematurely and thus increase the risk to civilians and civilian objects. Instead, point-detonating and time-delay fuzes are preferred, because they allow for the effects of the munition to be contained, to the extent possible, on or within the target.⁴⁰⁸

In addition to doctrine that regulates the use of particular weapon systems in certain environments, restrictions on the types of munitions and fuzes are also incorporated in overarching targeting doctrine that deals with the methods for: identifying targets; matching weapons with targets; planning these weapons’ effects on targets; engaging targets; and assessing the impact on the targets and on civilians and civilian objects afterwards.⁴⁰⁹

Weapon-specific measures to minimize risks to civilians were also put in place during US operations in Afghanistan. The 2012 handbook, *Afghanistan Civilian Casualty Prevention*, recognizes that the majority of civilian casualties from indirect fire “occur because rounds fail to strike their intended target”.⁴¹⁰ The handbook stipulates a number of best practices and tactics, techniques and procedures **to avoid or reduce incidental civilian harm when using indirect fire**, in particular in populated areas, including the following: **using precision or low-collateral-damage munitions** where feasible; **avoiding the use of indirect fire** when more accurate weapons (e.g. snipers, air-to-ground fires) are available; **avoiding fire for effect without adjusting fire first, and adjusting fire using single rounds, preferably ‘less lethal’ training rounds** (to reduce the impact if rounds land off target); **increasing the safety zone and monitoring of the area prior to fire registration; ‘walking’ the fire onto the target from the side devoid of civilian presence; and avoiding using**

⁴⁰³ *Ibid.*, p. 4-27, paras 4-167-4-169.

⁴⁰⁴ US DOA/MC, Urban Operations, cited in footnote 139 above, pp. 3-13 – 3-14, para. 3-55.

⁴⁰⁵ US CJCS, Joint Urban Operations, cited in footnote 347 above, p. IV-18: “In order to maximize the effects of fires on the adversary while at the same time minimizing the adverse effects on the city and its inhabitants, fires must be as accurate as technology and planning will allow.” See also US DOA/MC, Urban Operations, cited in footnote 139 above, p. 1-2, para. 1-5: “Operations conducted in urban areas require precise application of firepower to avoid unnecessary civilian casualties, despite the fact that urban terrain and infrastructure makes precision weapons employment more difficult and degrades munitions effectiveness.”

⁴⁰⁶ US CJCS, Joint Urban Operations, cited in footnote 347 above, p. IV-15.

⁴⁰⁷ *Ibid.*, p. IV-17, which provides other examples of ‘non-lethal’ capabilities, such as: obscuration smoke, illumination fire to disrupt enemy activity or support friendly forces, and employment of some information-related capabilities, such as electronic attack and offensive cyberspace operations. ‘Low-collateral-damage weapons’ are not defined.

⁴⁰⁸ US DOA, Combined Arms Operations in Urban Terrain, cited in footnote 173 above, p. B-21, para. B-95; p. B-31, para. B-145; p. B-33, paras B-159-B-160; p. B-34, para. B-164; and p. B-35, para. B-167, *inter alia*.

⁴⁰⁹ United States, Department of the Army, *Joint Targeting*, JP No. 3-60, January 2013.

⁴¹⁰ United States, Center for Army Lessons Learned, *Afghanistan Civilian Casualty Prevention: Observations, Insights and Lessons*, Handbook No. 12-16, June 2012, p. 24.

indirect fire against moving targets. Further, it recognizes the need to improve training in indirect fires for forces, in order to increase proficiency and avoid mistakes that lead to rounds failing to impact the intended target.⁴¹¹

With regard to air strikes, the handbook notes that civilian casualties in Afghanistan were typically not the result of the inaccuracy of the weapon used. On the contrary, they occurred when the munition hit the target, either because the target was misidentified as a military objective or because the presence of civilians in or around the target was not identified.⁴¹² The handbook outlines a number of measures for minimizing civilian harm, including **using precision munitions, changing the angle and direction of attack, employing a fuze that will cause the minimum collateral damage, and applying the ‘shift cold’ technique**, i.e. “dragging laser-guided bombs off their target into a previously cleared area in case collateral damage concerns were observed after weapons release”. Tactical alternatives (e.g. flying over an area without launching any munitions) are also identified.⁴¹³ Lastly, the handbook implicitly requires **the application of safety distances from civilians and civilian objects when using air-delivered munitions.**⁴¹⁴

4.2.10 Non-state armed groups

The practice of non-state armed groups as regards the use of heavy explosive weapons in populated areas is discernible from recent and ongoing armed conflicts. A well-documented practice of many non-state armed groups is the use of IEDs.⁴¹⁵ **Where IEDs have wide area effects, they constitute heavy explosive weapons for the purposes of this report.** IEDs are commonly employed unlawfully in direct attacks against civilians or civilian objects, but they are also used to strike military objectives.⁴¹⁶ As mentioned in the introduction to this report, **when used in populated areas, IEDs generate the same concerns as other heavy explosive weapons. Their improvised nature often means that they are more likely to be inaccurate and/or malfunction; therefore they pose a higher risk of incidental – often indiscriminate – civilian harm.**



A patient who lost a hand, both legs and his eyesight in the blast from an IED lies in intensive care in Kandahar, Afghanistan.

⁴¹¹ *Ibid.*, p. 25.

⁴¹² *Ibid.*, p. 33.

⁴¹³ United States, Center for Army Lessons Learned, *Afghanistan Civilian Casualty Prevention: Observations, Insights and Lessons*, Handbook No. 12-16, June 2012, p. 30.

⁴¹⁴ *Ibid.*, p. 118.

⁴¹⁵ Use of IEDs by states’ armed forces in recent armed conflicts, where hostilities were conducted in populated areas, has also been documented. UNIDIR, *Addressing Improvised Explosive Devices: Options and Opportunities to Better Utilize UN Processes and Actors*, UNIDIR, Geneva, November 2015, p. 13.

⁴¹⁶ *Ibid.*, p. 14.

Beyond what can be observed from their practices, little is known of non-state armed groups' policies or operational instructions on the choice of means and methods of warfare in populated areas, not least because of the challenges in engaging in and maintaining a dialogue on the conduct of hostilities (or on their policies concerning the use of weapons) with such actors. Nevertheless, where contact and dialogue have been possible, codes of conduct reflecting IHL have sometimes been put in place,⁴¹⁷ some of which were provided to non-state armed groups by the ICRC directly or by other actors.⁴¹⁸



The ICRC holds an information session on IHL for members of Iraq's Popular Mobilization Units.

All six non-state armed groups involved in a survey conducted by Geneva Call stated that protecting the civilian population and preventing collateral damage (incidental civilian harm and damage to civilian objects) **caused by the use of explosive weapons was a priority for them.** One group specifically mentioned endeavouring as far as possible to use explosive weapons only outside populated areas, and to move operations away from populated areas in general. The groups mentioned various precautionary measures taken to reduce incidental civilian harm when using explosive weapons, including avoidance of fighting in densely populated areas and use of non-explosive weapons when the risk of civilian casualties was too high.⁴¹⁹

More recent discussions have similarly shown that some non-state armed groups actively endeavour to minimize civilian harm in the context of hostilities. For example, a representative of one non-state armed group told Geneva Call that the group would try to use 'guerilla methods' and 'small weapons' to minimize civilian harm, while a representative from another group mentioned their group's use of small weapons to reduce civilian casualties. Finally, representatives from various non-state armed groups mentioned the importance they placed on gathering information to conduct a proper assessment of civilian presence around a potential target, in order, then, to determine what weapon should be employed to minimize incidental harm to civilians.⁴²⁰

⁴¹⁷ ICRC, "Engagement with non-state armed groups: Why, how, for what purpose and other salient issues", position paper, ICRC, Geneva, March 2021, p. 9.

⁴¹⁸ ICRC, *Increasing Respect for International Humanitarian Law in Non-International Armed Conflicts*, ICRC, Geneva, February 2008, p. 23.

⁴¹⁹ Geneva Call, *In Their Words: Six Armed Non-State Actors Share their Policies and Practice with Regards to Protecting Civilians from Explosive Weapons*, Geneva Call, Geneva, November 2017.

⁴²⁰ Geneva Call, *Conduct of Hostilities by Armed Non-State Actors*, Garance Series: Issue 3, Geneva Call, Geneva, 2020, pp. 14–15.

4.3 ADDITIONAL TOOLS TO INFORM THE CHOICE OF WEAPONS IN POPULATED AREAS AND TO MINIMIZE RISKS TO CIVILIANS IN URBAN WARFARE

In addition to the express limitations on the use of certain explosive weapons in populated areas and other weapon-specific measures outlined in the previous section, it is relevant to consider additional tools to inform the choice of weapons in populated areas and to minimize risks to civilians in urban warfare.⁴²¹ In particular, existing urban warfare doctrine explicitly recognizes the challenges posed by the wide area effects of certain explosive weapons and the complex nature of the urban environment, before outlining specific measures to minimize civilian casualties when operating in such environments.⁴²² Three examples of measures and tools for mitigating the risk of civilian harm are addressed in more detail below: consideration of the weapons' reverberating effects (4.3.1); methodologies for estimating collateral damage (4.3.2); and safety distances (4.3.3). In addition, militaries may choose to avoid fighting in populated areas altogether, in order to avoid or minimize incidental harm to civilians and civilian objects. An example of this is the Coalition's ground campaign during the 1990–1991 Gulf War, which included manoeuvres to avoid populated areas in Iraq, where civilian casualties and damage to civilian objects “necessarily would have been high” (although air strikes were conducted against targets located in populated areas). For the same reason, apparently, an “amphibious assault into Kuwait City” was rejected as a course of action.⁴²³

4.3.1 Considering reverberating effects

As explained in Chapter 1, heavy explosive weapons may have indirect or reverberating effects. This is a factual concept used to describe those effects that are not directly and immediately caused by the attack, but are nevertheless the product thereof.⁴²⁴ While the notion of reverberating effects is not specific to the use of explosive weapons with a wide impact area in populated areas, it is of particular relevance to these weapons. This is because attacks using heavy explosive weapons in populated areas are very likely to cause civilian casualties and damage to civilian objects within the weapons' impact area, which often cause a cascade of indirect effects that result in further injuries and deaths among civilians. For example, damage to critical infrastructure, such as a electrical substation or transformer, will generally interrupt the provision of electricity. This can have a domino effect on other essential services that depend on electrical power for their functioning, such as water distribution and health care, leading to civilian harm (illnesses, disease, and even death). The reverberating effects of an attack using heavy explosive weapons can thus affect a much larger part of the civilian population than that present in the immediate impact zone.

⁴²¹ This section will not address general policy and practice beyond the choice of means and methods of warfare. However, such policy, including measures such as the establishment of civilian-casualty tracking cells, no-strike policies, positive identification target procedures and effective warnings, can also contribute significantly to mitigation of civilian harm. A number of such good practices are contained in the compilation of good practices published by OCHA. Others have been shared or identified in military-to-military and other discussions among experts, and reproduced in such documents as the UNIDIR Food-for-Thought Paper, cited in footnote 204 above, p. 33.

⁴²² US CJCS, Joint Urban Operations, cited in footnote 347 above, pp. IV-16 – IV-17: “[T]he presence of significant infrastructure and protected sites increases the requirements for accurate identification and targeting, precise delivery of fires, and concern for collateral damage.”

⁴²³ See United States Department of Defense, “Final report to Congress on the conduct of the Persian Gulf War, Appendix on the role of the law of war”, *International Legal Materials*, Vol. 31, No. 3, May 1992, p. 622.

⁴²⁴ M. N. Schmitt, “Wired warfare: Computer network attack and *jus in bello*”, *International Review of the Red Cross*, Vol. 84, No. 846, June 2002, p. 392. On the relevance of the notion of foreseeable reverberating effects to the application of the IHL rule of proportionality in attacks, see Chapter 3. For a description of the reverberating effects of explosive weapons on urban services, see Chapter 1.



The ICRC provides drinking water for residents in Donetsk, Ukraine, who were without water for several days because of damage to water infrastructure.

These effects are increasingly foreseeable, as urban warfare becomes more and more prevalent, and **some states' military doctrine expressly requires consideration of indirect/reverberating effects in planning and targeting decisions.** For example, US doctrine recognizes that “[m]ilitary operations that devastate large amounts of infrastructure may result in more civilian casualties than directly caused by combat itself” and provides that “[c]ommanders must understand that destroying or disrupting any portion of the urban infrastructure can have a cascading effect (either intentional or unintentional) on the other elements of the infrastructure”.⁴²⁵ The notion of reverberating effects is referred to in this doctrine as “second and third order effects”.⁴²⁶ More recent publications reiterate the importance of considering such indirect effects, ‘including the potential reverberating effects of a particular attack’, whether near-, medium- or long-term, or cumulative.⁴²⁷ In addition, French doctrine provides that, for targets whose neutralization may have indirect consequences for the civilian population, such as a power station providing electricity to a hospital, particular efforts must be made to estimate such eventual consequences for civilians, beyond the principles of proportionality and military necessity.⁴²⁸

Reverberating effects have also been acknowledged in relevant NATO doctrine, under the designation ‘second and third order effects’. In a NATO handbook on protection of civilians, issued in March 2021, it is stipulated that one of the *main* processes to be considered when attempting to mitigate civilian harm is the targeting process, which should include “legal and engineering

⁴²⁵ US DOA/MC, Urban Operations, cited in footnote 139 above, p. 1-2, para. 1-6; p. 1-4, para. 1-18; and p. 1-18, para. 1-72. See also United States, Department of the Army, *Urban Operations*, FM No. 3-06, October 2006 (US DOA, Urban Operations), p. 2-6, para. 2-19 and p. 2-19, para. 2-60.

⁴²⁶ United States, Chairman of the Joint Chiefs of Staff, *Target Development Standards*, CJCSI No. 3370.01B, May 2016, p. D-B-6; United States, Department of the Army, *Insurgencies and Countering Insurgencies*, FM No. 3-24/MCWP No. 3-33.5, C1, May 2014, p. 3-2, para. 3-6; p. 7-19, para. 7-91; and p. 9-12, para. 9-46. See also US DOA, Urban Operations, cited in footnote 425 above, pp. 2-17-2-18, para. 2-58; US CJCS, Joint Urban Operations, cited in footnote 347 above, p. III-12.

⁴²⁷ United States Center for Excellence in Disaster Management & Humanitarian Assistance, *Handbook on Best Practices for Civilian Harm Mitigation and Response in U.S. Military Operations*, 1 August 2021 (US Handbook on Best Practices), p. 14.

⁴²⁸ France, *Estimation des dommages collatéraux*, p. 18, para. 125.

considerations **and take into account second and third order effects that can negatively affect the civilian population for a longer time, such as impacts to the natural environment as well as to the civilian services or infrastructure**”.⁴²⁹ The handbook also gives examples of what would constitute secondary and tertiary effects: the former category includes damaged infrastructure affecting transportation routes, electricity, water and telecommunication services, and disruption of financial services, such as access to banking and cash; the latter category would include weakened government and judicial services, traumatized populations, and an increase in criminality.⁴³⁰



The streets of Aden, Yemen, flooded with sewage because of damage to infrastructure.

Various military manuals include the requirement to consider indirect effects, either expressly or through the examples they provide.⁴³¹ French doctrine notably provides that collateral-damage estimation of effects on civilian structures must include consideration of the cultural, economic and environmental aspects of possible damage.⁴³² To assist those who plan and execute attacks in foreseeing reverberating effects, some militaries ensure that engineering experts in power, transportation, etc. are involved in planning and targeting processes by providing insights and advice to inform targeting and weaponeering decisions.⁴³³

4.3.2 Methodologies for estimating collateral damage

In calculating the expected effects of an attack against a military objective situated in a populated area, a number of militaries apply a collateral-damage-estimation methodology (CDEM).⁴³⁴ **The CDEM is a formal process that estimates the effects of the munitions on the target and their incidental effects.** The CDEM can be a crucial aspect of the targeting-approval process and a critical element of efforts to limit civilian casualties.⁴³⁵

⁴²⁹ NATO Protection of Civilians Handbook, cited in footnote 375 above, p. 25.

⁴³⁰ *Ibid.*

⁴³¹ United Kingdom, *Manual of the Law of Armed Conflict*, 2004, p. 86, para. 5.33.4; United States, *The Commander's Handbook on the Law of Naval Operations*, 2017, para. 8.11.4. See also the definition of 'collateral effect' in Australian Defence Force Publication, cited in footnote 301 above, para. 1.21.

⁴³² France, *Estimation des dommages collatéraux*, p. 19, para. 205.

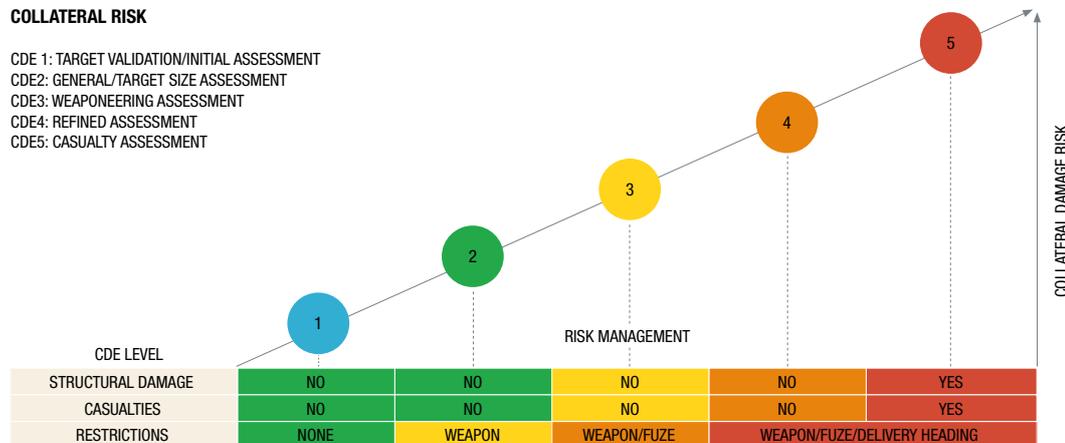
⁴³³ UNIDIR Options Paper, cited in footnote 204 above, pp. 15–16. However, further work by armed forces is required in order to achieve a fuller understanding of 'foreseeable' effects of attacks on civilians.

⁴³⁴ US military doctrine defines the CDEM as a body of joint standards, methods, techniques and processes to conduct collateral-damage analysis and produce collateral-damage estimates; See US CJCS, CDEM, cited in footnote 300 above, p. D–2.

⁴³⁵ Estimation methodologies have evolved over the years. For historical perspective on some of these methodologies, see Chapter 17 on collateral-damage-estimation methodology in M. R. Driels, *Advanced Weaponeering*, Vol. 2, 3rd ed., American Institute of Aeronautics and Astronautics, Reston, 2020, pp. 549–568.

Preventing or mitigating civilian harm in the targeting process is not limited to the CDEM; often, militaries involve other subject-matter experts or capabilities (intelligence, weaponing, lawyers, civil affairs, etc.) in efforts to mitigate risks for civilians. The CDEM is examined in detail in this section as it incorporates important considerations as regards the area effects of explosive weapons and a number of mitigation measures to reduce such effects and the risk of civilian harm, including restricting the use of certain weapons or munitions on a case-by-case basis.

The CDEM used by a number of militaries today is a form of ‘tiering’ methodology. As the methodology moves through the collateral-damage estimation (CDE) levels, the depth of analysis, and the risk of incidental harm that the commander is authorized to accept, increases.⁴³⁶ Accordingly, **the CDEM assists commanders in determining whether they have approval authority to launch an attack against an intended target. It can also support commanders when making proportionality assessments and implementing obligations concerning precautions in attack.** To make projections about the expected incidental civilian harm, **the CDEM takes into account the area effects of the weapon and the likely presence of civilians and civilian objects in and around the target and within the weapon’s impact area.** To do this, it generally relies upon a combination of available empirical data, probability, historical observations and complex modelling for analysis. It takes into account factors such as population density, the structural integrity of buildings, and the proposed time of attack.⁴³⁷ It may be supplemented by current intelligence, such as pattern-of-life data, for a more refined estimate.⁴³⁸ The US CDEM, which has been approved for use during NATO combat operations,⁴³⁹ also includes ‘weaponing’ options, i.e. options allowing militaries to select the appropriate weapon to achieve the desired effect on the target (also referred to as ‘weapon-target matching’) while avoiding or minimizing incidental harm to civilians and damage to civilian objects.



A diagram of the “Risk and Collateral Damage Estimation Methodology” as found in the US Army’s Chairman of the Joint Chiefs of Staff Instruction entitled “No-Strike and the Collateral Damage Estimation Methodology”.

⁴³⁶ *Ibid.*, p. 561. See also European External Action Service (EEAS) and European Union Military Committee (EUMC), *Avoiding and Minimizing Collateral Damage in EU-led Military Operations*, Brussels, 3 February 2016, p. 12.

⁴³⁷ Lt-Col. J. Cherry, Sqn Ldr K. Tinkler and M. N. Schmitt, “Avoiding collateral damage on the battlefield”, *Just Security*, 11 February 2021: <https://www.justsecurity.org/74619/avoiding-collateral-damage-on-the-battlefield/>.

⁴³⁸ US CJCS, CDEM, cited in footnote 300 above, p. D-A-36: “To aid the casualty estimation, commanders may use their discretion, experience, and current intelligence (e.g. pattern of life (POL) data) to determine daytime and nighttime cultural norms.”

⁴³⁹ NATO School, “Collateral damage estimation methodology”, course catalogue: <https://www.natoschool.nato.int/Academics/Resident-Courses/Course-Catalogue/Course-description?ID=95>

In principle, the CDE is required to take place before an attack of any kind, be they ‘pre-planned’ or ‘dynamic’, but it is often carried out in a ‘compressed’ and accelerated manner in the case of the latter.⁴⁴⁰ However, in circumstances of self-defence such as ‘troops-in-contact’, it is unclear whether, and how, militaries carry out the CDE.

While the use of CDEM, in conjunction with other processes, has been proven to minimize civilian casualties, it also has limitations.⁴⁴¹ The accuracy of the CDE analysis will depend on time constraints: the assessment may range from in-depth analysis for pre-selected targets to a more compressed analysis for dynamic or time-sensitive targets. Lack of current intelligence, including civilian pattern-of-life data, can be a key challenge to CDEM.⁴⁴² Where such current intelligence exists and can provide a more refined estimate, that data must be employed in the casualty estimate and will supersede the standard baseline provided by CDEM.⁴⁴³

As a rule, CDEM focuses on the incidental civilian harm (i.e. deaths and injuries among civilians or damage to civilian objects) directly caused by an attack. In addition, CDEM can account for the expected incidental harm to facilities placed on no-strike lists (NSL), which may include critical infrastructure such as water-supply facilities, electricity-generating facilities, waste facilities, commercial fuel service stations, urban gas supply or electrical transmission lines. The potential reverberating effects from damage or destruction undoubtedly play an important role in the decision to place such facilities on NSL in the first place.⁴⁴⁴ That said, it remains unclear to what extent these potential reverberating effects are taken into account by armed forces when making a decision to remove such facilities from NSL, so that they may be subsequently attacked (e.g. critical infrastructure might fulfil both a civilian and military function such that part thereof fulfils the IHL definition of a military objective). While this depends on the targeting-approval process for a given operation, it appears that such indirect effects are not taken into account in a comprehensive or standardized manner.⁴⁴⁵ A recent US publication highlights this gap and identifies it as an area in which good practices are needed.⁴⁴⁶

⁴⁴⁰US CJCS, CDEM, cited in footnote 300 above, p. D-A-36: “Field CDE is typically used in dynamic targeting when there is a time-constrained opportunity to engage a fleeting target ... Field CDE is typically conducted by JTACs [joint terminal attack controllers], FOs [forward observers], or by aircrew. Field CDE is a degraded mode of CDE, and creates the opportunity for increased risk. A Field collateral damage estimate will typically be a verbal call, and should be documented for future review/analysis ... Typically, CDE Level 4 analysis is not authorized for Field CDE.”

⁴⁴¹OCHA Compilation, cited in footnote 356 above, p. 30: “The [CDEM] produces a conservative characterization of the risk of collateral damage for commanders and decision makers. It uses a mix of empirical data, probability, historical observations, and complex modeling for CDE analysis. However, it is inherently limited by the quantity and reliability of collected and analysed weapons effects data, weapon delivery uncertainties, and target information. Furthermore, the [CDEM] cannot always account for the dynamics of the operational environment. Ultimately CDE is an estimative process to help inform a commander’s decision-making”; S. Muhammedally, “Minimizing civilian harm in populated areas: Lessons from examining ISAF and AMISOM policies”, *International Review of the Red Cross*, Vol. 98, No. 1, April 2016, p. 225: “CD[E]M does not account for unknown transient civilian or noncombatant personnel and/or equipment in the vicinity of a target area. This includes cars passing on roads, people walking down the street, or other civilian entities whose presence in the target area cannot be predicted to a reasonable certainty within the capabilities and limitations of intelligence collections means.”

⁴⁴²ICRC Expert Meeting on EWIPA Report 2015, cited in footnote 147 above, p. 29; and S. Muhamedally, cited in footnote 441 above, p. 244.

⁴⁴³Lt-Col. J. Cherry, Sqn Ldr K. Tinkler and M. N. Schmitt, cited in footnote 437 above.

⁴⁴⁴US CJCS, CDEM, cited in footnote 300 above, p. B-4.

⁴⁴⁵For example, CDEM does not take secondary explosions into consideration; see US CJCS, CDEM, cited in footnote 300 above, p. D-6. See also M. Brehm, *Protecting Civilians from the Effects of Explosive Weapons: An Analysis of International Legal and Policy Standards*, UNIDIR, New York/Geneva, 2012, p. 123, footnote 302: “[T]he process does not account for reverberating, longer-term impacts on civilians that may result from the destruction of infrastructure essential for their survival or well-being.” In some military policy, CBRN risks are an exception, i.e. when there is a likelihood of chemical, biological, radiological or nuclear (CBRN) contamination as a result of direct or incidental damage of objects containing dangerous forces.

⁴⁴⁶See US Handbook on Best Practices, cited in footnote 427 above, p. 25.

A further challenge is created by the fact that **the more inaccurate or imprecise the weapon, the harder it will be to carry out a CDE. For certain types of explosive weapons, in particular indirect-fire weapon systems, carrying out a CDE will not guarantee sufficient limitation of their wide area effects and of incidental civilian harm.**⁴⁴⁷ In addition, it is not clear to what extent CDEM take into account specific features of the urban environment, beyond the target (architecture, construction material, etc.), that affect the effects of explosive weapons, in order to reach more accurate estimates of such effects and consequently of civilian harm.⁴⁴⁸ Lastly, the value of the CDE as a tool to reduce the risk of civilian harm will depend on the extent to which post-strike analyses of civilian casualties, and other lessons-learned exercises, are carried out and their results fed back into CDE models.⁴⁴⁹

In fact, **the effectiveness of CDEM in preventing or reducing civilian harm depends to a large extent on whether post-attack evaluations of the actual effects of the weapon used are made and compared against the pre-attack estimate. These evaluations can take the form of battle-damage assessments following an attack and after-action reviews following an operation.**⁴⁵⁰ Such analyses can contribute to mitigating civilian harm, and improve military policy and practice with regard to the conduct of operations in populated areas, provided they examine the direct and indirect effects of the attack on civilians and civilian objects, in addition to the effects on the target.⁴⁵¹ Systematic conduct of these assessments might not always be feasible – for instance, when an operation is carried out in areas controlled by the adversary. When such assessments are carried out, **it is important to maintain a short ‘feedback loop’, so that lessons learnt can be incorporated in future attacks or operations, and reflected in military doctrine and decision-making processes,** as appropriate.

⁴⁴⁷ Article 36 and CIVIC, cited in footnote 352 above, pp. 4–5. See also US CJCS, CDEM, cited in footnote 300 above, p. D-6: “Rocket Assisted Projectiles (RAPs) or enhanced/extended range artillery, mortar, and naval gun munitions are not addressed beyond CDE Level 3 due to the considerable increase in ballistic errors associated with these munitions and the significant increase in risk associated with their use in urban areas”.

⁴⁴⁸ EEAS/EUMC, cited in footnote 436 above, p. 12; and US CJCS, CDEM, cited in footnote 300 above, p. D-A-7.

⁴⁴⁹ NATO, Protection of Civilians Handbook, cited in footnote 375 above, p. 31: “CIVCAS mitigation procedures, with particular relevance to the Collateral Damage Estimate Methodology (CDEM) process ... include data/ evidence gathering, tracking, reporting and monitoring of CIVCAS, as well as actions to monitor, investigate and track civilian casualty and collateral damage claims ... In ISAF, the introduction of the Civilian Casualty Mitigation Team (CCMT) 34 was the leading factor in the reduction of CIVCAS incidents.”

⁴⁵⁰ United States, *Law of War Manual*, 2016 (pp. 252–253, paras 5.11.1.1–5.11.1.3) describes three kinds of assessments of the risk to civilians: general assessments of the risk to civilians and the effectiveness of efforts to reduce that risk, carried out in the planning of a military operation; pre-strike assessments of expected civilian casualties; and after-action assessments and investigations.

⁴⁵¹ United States, Joint Staff, *Methodology for Combat Assessment*, CJCSI No. 3162.02, March 2019, p. D-1: “The JFC has a responsibility to account for any unintentional or incidental injury or damage to civilians, noncombatants, or their property ... Despite the best efforts of the joint force, collateral damage will occur. In accordance with the values of our nation and the Law of Armed Conflict, it is imperative that the joint force completes CDA to identify any deficiencies requiring correction ... CDA compares the collateral damage estimate conducted in Phase 3 of the JTC with the observed, inferred, or reported damage. CDAs may inform and refine CDEs, if analysts anticipated collateral damage. If collateral damage occurs for other reasons, this assessment process is critical for the joint force to determine the cause, or causes, of the collateral damage.”



The three patients in this room had to be quickly moved from their beds when al-Thawra Hospital in Taiz, Yemen, was attacked.

4.3.3 Safety distances

As explained in Chapter 2, **'safety distance' is the minimum distance from the point of impact of a munition at which the risk to troops from the weapon's effects is considered low.** Initially, the concept was developed for the protection of own and friendly forces. But some armed forces have indicated that safety distances may also be applied to protect civilians, taking in this respect an approach to avoiding civilian casualties that is similar to the one they take to avoid harming own or friendly troops.⁴⁵² The use of safety distances when employing explosive weapons with a wide impact area (such as indirect-fire weapon systems) indicates a recognition of the extent to which the weapon's area effects present a risk of injury to own troops and to civilians.

However, militaries may adopt a different approach with respect to own/friendly and civilian casualties: they might use safety distances to determine the likelihood and possible degree of harm to own or friendly forces when fire is used against targets in close proximity to these, but might use CDEM when assessing the risk of incidental civilian casualties or damage to civilian objects. For example, French doctrine provides for the CDE to take into account the minimum distance from the aim point at which civilians and civilian objects can be situated without risk of exposure to harm. Such distances are determined on the basis of the munitions' explosive payload and degree of accuracy, and are informed by strategic choices. They are different from risk estimate distances (RED), which are used to determine the acceptable risk of exposure for own or friendly forces.⁴⁵³

4.3.4 Policy on the protection of civilians

A number of states and other entities, such as the UN, NATO and the African Union, have developed policies on the protection of civilians (PoC) in armed conflict.⁴⁵⁴ PoC policies accessible to the ICRC are usually of a general nature and do not specify the implications for the choice and use of explosive weapons in populated areas.

⁴⁵² United States, Department of the Army, *Protection of Civilians*, ATP No. 3-07.6, October 2015, (US DOA, Protection of Civilians), p. 5-4, para. 5-22.

⁴⁵³ France, *Estimation des dommages collatéraux*, p. 23, para. 317 and pp. 19-20, paras 206 and 208.

⁴⁵⁴ NATO, *Policy for the Protection of Civilians*, 9 July 2016: https://www.nato.int/cps/en/natohq/official_texts_133945.htm. See also United Kingdom Foreign and Commonwealth Office, *UK Government Strategy on the Protection of Civilians in Armed Conflict*, 7 December 2011; and US DOA, *Protection of Civilians*, cited in footnote 452 above.

Over the past decade, NATO has worked on developing specific policies and guidelines for the protection of civilians, drawing in particular on lessons learnt from its experience in Afghanistan.⁴⁵⁵ In July 2016, NATO adopted the NATO Policy for the Protection of Civilians. The policy recognizes that “[p]romoting long-term, self-sustained peace, security and stability is best achieved in cooperation with the local authorities, population and civil society” and that “[a]voiding, minimizing and mitigating harm to civilians is an indispensable element of this approach”.⁴⁵⁶ In the same vein, in March 2021, NATO issued its *Protection of Civilians Allied Command Operations Handbook*, which has “the overall aim of building a strong Protection of Civilians mind-set” and which incorporates the 2016 policy mentioned above.⁴⁵⁷ According to the handbook, the first and most central element permeating NATO’s PoC policy is ‘understanding the human environment’ (UHE), which emphasizes a “ ‘population-centric’ view, focusing on the population’s perception in regards to the safety and security of their environment, including what they perceive as threats”.⁴⁵⁸ By emphasizing the UHE, **NATO operations are meant to acquire a population-centric perspective, to complement the traditional military-centric perspective, and thus achieve a more comprehensive approach to the protection of civilians.**

UN peace operations also implement a PoC policy,⁴⁵⁹ which was under review at the time of the drafting of this report. This policy is supplemented by guidelines, particularly these: *Protection of Civilians: Implementing Guidelines for Military Components of United Nations Peacekeeping Missions* (2015)⁴⁶⁰ and *Use of Force by Military Components in United Nations Peacekeeping Operations* (2017).⁴⁶¹ These guidelines contain a series of duties and measures that, albeit not specific to the use of heavy explosive weapons in populated areas, are nevertheless relevant mitigation measures for reducing the risk posed to civilians by the use of such weapons. Indicatively, they require planners to review the capacity (including capabilities) of forces to operate in populated areas⁴⁶² and stress the importance of training.⁴⁶³

PoC policies might further require training personnel not only in complying with legal obligations and policy guidance that address the protection of civilians, but also in implementing best practices that reduce the likelihood of civilian casualties, including through exercises, predeployment training, and simulations of complex operational environments that include civilians.⁴⁶⁴ They may also provide that militaries should develop, acquire and field intelligence, surveillance, and reconnaissance systems that, by enabling fuller battle-space awareness, contribute to the protection of civilians.⁴⁶⁵

In addition, such policies may emphasize the importance of assessments and after-action reports, to create a positive feedback loop and ensure that future engagements minimize incidental civilian casualties.⁴⁶⁶ Lessons learnt from processes such as after-action reviews and battle-damage assessments could lead to restrictions on the choice and use of certain explosive weapons in

⁴⁵⁵ See NATO Protection of Civilians Handbook, cited in footnote 375 above. See also OCHA Compilation, cited in footnote 356 above, pp. 34–36 for various ISAF tactical directives for the mitigation of civilian casualties.

⁴⁵⁶ See NATO Policy for the Protection of Civilians, cited in footnote 454 above, para. 10.

⁴⁵⁷ NATO Protection of Civilians Handbook, cited in footnote 375 above, p. 5.

⁴⁵⁸ *Ibid.*, p. 8.

⁴⁵⁹ United Nations Department of Peacekeeping Operations (DPKO)/Department of Field Support (DFS), *The Protection of Civilians in United Nations Peacekeeping*, Policy, Ref. 2015/07, April 2015.

⁴⁶⁰ DPKO/DFS, *Protection of Civilians: Implementing Guidelines for Military Components of United Nations Peacekeeping Missions*, Ref. 2015/02, February 2015.

⁴⁶¹ DPKO/DFS, *Use of Force by Military Components in United Nations Peacekeeping Operations*, Ref. 2016/24, January 2017.

⁴⁶² DPKO/DFS, cited in footnote 460 above, p. 9.

⁴⁶³ DPKO/DFS, cited in footnote 461 above, p. 18.

⁴⁶⁴ United States, *Policy on Pre- and Post-Strike Measures To Address Civilian Casualties in U.S. Operations Involving the Use of Force*, Executive Order 13732 of 1 July 2016, Federal Register, Vol. 81, No. 130, 7 July 2016, pp. 4485–4486, Sec. 2.

⁴⁶⁵ *Ibid.*

⁴⁶⁶ *Ibid.*

populated areas, to the extent that patterns of civilian harm from the use of these weapons are identified. Lastly, PoC policies may stipulate procedures for civilian-casualty tracking, including investigation of incidents alleged to have caused civilian harm and appropriate responses to such incidents (e.g. compensation for victims' families).⁴⁶⁷ Civilian-casualty tracking can also lead to lessons learnt that should inform future targeting processes and decisions.

For example, Colombian military doctrine recalls the obligation to protect the civilian population. In a context where armed forces are engaged in so-called "counter-guerrilla" operations in the context of an armed conflict, the notion of protection of civilian populations is a key issue. Thus, the doctrine mentions that scalable capabilities provide a range of lethal and non-lethal actions commensurate with the commander's intent, can create the desired effects while reducing collateral damage, and allow the commander to find the right balance between effects and collateral damage so that army units, joint forces, and the civilian population in the operational area are protected.⁴⁶⁸ In operational practice, protected objects and persons are identified and located, which makes it possible to define no-fire zones during the targeting process.



The once lively Aleppo neighbourhood of al-Jadaida has been virtually reduced to rubble by the Syrian war.

4.4 STRATEGIC REASONS FOR MINIMIZING CIVILIAN HARM

In addition to compliance with their obligations under IHL, or humanitarian considerations to protect civilians beyond their legal obligations, **armed forces have a number of strategic reasons for taking measures to minimize civilian harm in populated areas.**

Firstly, **extensive civilian casualties may undermine the legitimacy of the military mission, thereby benefiting the adversary.** Indeed, in "wars among the people, where the real battles are for legitimacy, civilian harm can have significant and strategic impact".⁴⁶⁹ As noted above, before the introduction of its policy in 2011 to restrict the use of indirect fire, commentators noted

⁴⁶⁷ Such as the civilian-casualty tracking cell and incident-assessment team established under AMISOM's indirect-fire policy (see section 4.2.1).

⁴⁶⁸ Colombia, Centro de Doctrina del Ejército, *Manual fundamental de referencia del ejército*, Fuegos, 3-09 (2016), p. 4, paras 4-1 – 4-3.

⁴⁶⁹ C. D. Kolenda *et al.*, *The Strategic Costs of Civilian Harm: Applying Lessons from Afghanistan to Current and Future Conflicts*, Open Society Foundations, June 2016, p. 4. See also United States, Department of the Army, *Counterinsurgency*, FM No. 3-24, December 2006, p. 1-25, para. 1-141; US DOA, *Combined Arms Operations in Urban Terrain*, cited in footnote 173 above, p. xxi; R.D. Sloane, "Puzzles of proportion and the 'reasonable military commander': Reflections on the law, ethics, and geopolitics of proportionality", *Harvard National Security Journal*, Vol. 6, No. 299, June 2015, p. 342.

that failure to protect civilians was undermining AMISOM's strategic and operational success.⁴⁷⁰ Similarly in the case of ISAF, restrictive measures were imposed by means of tactical directives in order to “avoid the trap of winning tactical victories – but suffering strategic defeats – by causing civilian casualties or excessive damage and thus alienating the people”.⁴⁷¹ Further, civilian casualties may lead to a significant decline in political, military or financial support (both local and international) for the party considered responsible, and can become a divisive issue between multinational partners.⁴⁷²

Secondly, **civilian harm might eliminate avenues for reconciliation, and trigger more violence, thereby prolonging the conflict.**⁴⁷³ Thirdly, **extensive damage to civilian objects, including critical civilian infrastructure, greatly increases post-conflict reconstruction costs.**⁴⁷⁴ Fourthly, **extensive destruction also hampers military operations at a tactical level.** For example, United States doctrine on urban warfare recognizes that “[a]n urban area often becomes more of an obstacle to advancing troops and a stronger position for defending troops after being reduced to rubble by weapons fire”.⁴⁷⁵

While no two armed conflicts are ever the same, and every commander's mission is different, the examples of military policy and practice outlined in this chapter confirm three things: first, that warfare cannot be conducted the same way in a populated area as in an open battlefield; second, that the choice of weapon can significantly exacerbate or reduce civilian harm; and third, that it is possible to restrict the use of heavy firepower even in such challenging environments as urban or other populated areas without compromising mission achievement and force protection.



A man in Nagorno-Karabakh surveys the devastation to buildings and homes caused by shelling.

⁴⁷⁰ P. D. Williams, cited in footnote 362 above, pp. 8–10.

⁴⁷¹ NATO/ISAF Tactical Directive 2009, cited in footnote 369 above.

⁴⁷² L.N. Condra *et al.*, “The effect of civilian casualties in Afghanistan and Iraq”, National Bureau of Economic Research Working Paper No. 16152, July 2010, pp. 21–22 and 34; and J.R. Ballard, *Lessons Learned from Operation AL FAJR: The Liberation of Fallujah*, 10th Annual Command and Control Research and Technology Symposium: The Future of C2, 2005, p. 5.

⁴⁷³ US DOA, Protection of civilians, cited in footnote 452 above, p. 1–3, para. 1–7; Open Society Foundations, cited in footnote 469 above, pp. 23–28; and P. D. Williams, cited in footnote 362 above, pp. 8–10.

⁴⁷⁴ Lt-Col. N. Durhin, “Protecting civilians in urban areas: A military perspective on the application of international humanitarian law”, *International Review of the Red Cross*, Vol. 98, No. 901, April 2016, p. 198; M. Knights, “Infrastructure targeting and postwar Iraq”, The Washington Institute, 14 March 2003: <https://www.washingtoninstitute.org/policy-analysis/infrastructure-targeting-and-postwar-iraq>.

⁴⁷⁵ US DOA, Combined Arms Operations in Urban Terrain, cited in footnote 173 above, p. B-1, para. B-5.

A bird's-eye view of the damage in the worst affected area of Marawi in the Philippines.



CHAPTER 5

STRENGTHENING THE PROTECTION OF CIVILIANS BY AVOIDING THE USE OF EXPLOSIVE WEAPONS WITH A WIDE IMPACT AREA IN POPULATED AREAS

The findings of this report indicate that **the most deleterious consequences of urban warfare result from the use of explosive weapons with wide area effects**. The report shows that when such weapons are used in urban and other populated areas, they are very likely to have indiscriminate effects: in other words, there is a high risk of their striking military objectives and civilians or civilian objects without distinction.

This underpins the ICRC's position that **the use of explosive weapons with a wide impact area should be avoided in populated areas, owing to the significant likelihood of indiscriminate effects** and despite the absence of an express legal prohibition against specific types of explosive weapons. Such an avoidance policy means that **explosive weapons with a wide impact area should not be used in populated areas unless sufficient mitigation measures can be taken to reduce such risk**, namely by limiting the weapons' wide area effects and the consequent risk of civilian harm.

The 'avoidance policy' that the ICRC calls on states and parties to armed conflict to adopt is based on the following findings:

- the highly concerning **pattern of significant direct and indirect civilian harm observed when explosive weapons with a wide impact area are used in populated areas**, leading to the devastating humanitarian consequences witnessed in recent urban conflicts, as described in Chapter 1
- **the wide area effects of the types of explosive weapons of concern are design-dependent and foreseeable**, as explained in Chapter 2
- the **legal concerns** raised by the use of explosive weapons with a wide impact area in populated areas, **notably under the IHL prohibitions against indiscriminate and disproportionate attacks**, as analysed in Chapter 3
- **examples of existing military policies and practices restricting the use of certain explosive weapons with wide area effects, or the adoption of measures to reduce such area effects, in populated areas, in order to mitigate risks to civilians**, as presented in Chapter 4; such examples demonstrate that an 'avoidance policy' that incorporates appropriate mitigation measures to reduce civilian harm is not only desirable, but also possible.

The first part of this final chapter unpacks the avoidance policy that the ICRC is calling on states and non-state armed groups to adopt: it summarizes why such an avoidance policy is necessary (sub-section 5.1.1) and explains what it entails in practice (sub-section 5.1.2).

The second part of this final chapter offers a range of good-practice recommendations to political authorities, state armed forces and non-state armed groups, for facilitating the operationalization of the avoidance policy.

As demonstrated by the Oslo Global Conference on Reclaiming the Protection of Civilians under International Humanitarian Law,⁴⁷⁶ the Maputo and Santiago declarations,⁴⁷⁷ and the current diplomatic endeavour towards the adoption of a political declaration,⁴⁷⁸ the international community is, increasingly, coming to see that efforts are urgently needed to reduce the risk of civilian harm from the use of heavy explosive weapons when hostilities are conducted in populated areas. **In the ICRC's view, the recommendations presented at the end of this report can contribute significantly to such efforts, and can facilitate respect for IHL in environments as challenging as urban and other populated areas.**

5.1 AN AVOIDANCE POLICY

5.1.1 Why is an avoidance policy necessary?

The need for an avoidance policy is dictated by the devastating consequences for civilians when explosive weapons with a wide impact area are used in populated areas, which the ICRC has observed in recent and ongoing armed conflicts. As demonstrated in this report, these consequences are not limited to direct civilian death and injury and direct destruction of civilian objects. Equally devastating are the indirect or reverberating effects on the lives and health of civilians, resulting notably from the disruption of services essential to their survival (such as health care and water- and electricity-supply systems) when critical civilian infrastructure enabling such services is damaged or destroyed – effects that are exacerbated in protracted armed conflicts, leading to further displacement, illnesses, and deaths among civilians.

The avoidance policy is further dictated by strong legal concerns. The use in populated areas of explosive weapons with a wide impact area entails a significant likelihood of indiscriminate effects, namely a high risk of striking military objectives and civilians or civilian objects without distinction. These risks increase with population density and with the area effects of the explosive weapons used, and are heightened when heavy explosive weapons are used in cities and other urban areas.

The factors accounting for high risks of civilian harm include:

- **the wide area effects of the weapon**, which – due to its large explosive payload and subsequent destructive radius or its inaccuracy, or the firing of multiple munitions simultaneously over a large area – go significantly beyond the target
- the concentration (density) of civilians and civilian objects, including critical civilian infrastructure; **the higher the density of the civilian population, the higher the risk to civilians as well as the risk of IHL violations** from the use of wide impact area explosive weapons

⁴⁷⁶ Oslo Global Conference on Reclaiming the Protection of Civilians under International Humanitarian Law, May 2013, co-chairs' summary: https://www.regjeringen.no/globalassets/upload/ud/vedlegg/hum/recommendations_final.pdf.

⁴⁷⁷ Maputo Regional Meeting on Protecting Civilians from the Use of Explosive Weapons in Populated Areas, Communique, 28 November 2017: <https://www.inew.org/maputo-regional-conference-on-the-protection-of-civilians-from-the-use-of-explosive-weapons-in-populated-areas/>; Santiago Regional Meeting on Protecting Civilians from the Use of Explosive Weapons in Populated Areas, Communique, December 2018: <https://www.inew.org/wp-content/uploads/2018/12/Santiago-Communique-EWIPA.pdf>.

⁴⁷⁸ Ireland, Department of Foreign Affairs, "Protecting civilians in urban warfare", 2021: <https://www.dfa.ie/our-role-policies/international-priorities/peace-and-security/ewipa-consultations/>; Meeting of the States Parties to the CCW, "Mitigating the civilian harm from the use of explosive weapons in populated areas", working paper submitted by Germany, UN Doc. CCW/MSP/2018/WP.1, 14 November 2018; see also United Nations and ICRC, "Joint appeal by the UN secretary-general and the president of the International Committee of the Red Cross on the use of explosive weapons in Cities", 18 December 2019: <https://www.un.org/sg/en/content/sg/note-correspondents/2019-09-18/note-correspondents-joint-appeal-the-un-secretary-general-and-the-president-of-the-international-committee-of-the-red-cross-the-use-of-explosive-weapons>.

- the level of **complexity and interconnectedness of critical civilian infrastructure and of services essential to the survival of the civilian population**, such that damage to or destruction of one component of this urban system can render that system inoperable and can trigger domino effects on other services that depend on the affected components
- the **unique effects of heavy explosive weapons when used in built-up areas (in contrast to non-built-up areas)**, including the channelling of blast waves, the increased amount of secondary fragmentation, and the increased risk of damaging critical civilian infrastructure
- the particular **challenges the urban environment poses to armed forces** (such as proximity of military objectives to civilians or civilian objects, limited visibility, difficulty of manoeuvring, risk of interference with precision-guidance systems) that will influence the effects of the chosen means and methods of warfare.

This observed pattern of harm suggests an objective difficulty in using heavy explosive weapons in populated areas in conformity with the IHL prohibitions against indiscriminate and disproportionate attacks. This is not to say that every such use will necessarily fall foul of these IHL rules, only that there is a high risk of it.⁴⁷⁹

It is often argued that the devastating humanitarian consequences witnessed when heavy explosive weapons are used in populated areas are due to a lack of compliance with IHL rules. However, as the ICRC has previously stated:

“Although there is no dispute that any use of explosive weapons in populated areas must comply with ... IHL rules, there are divergent views on whether these rules sufficiently regulate the use of such weapons, or whether there is a need to clarify their interpretation or to develop new standards or rules. Based on the effects of explosive weapons in populated areas being witnessed today, there are serious questions regarding how the parties using such weapons are interpreting and applying IHL. Divergent practice of militaries, and contrasting views among experts and in the case law of international criminal tribunals regarding what is or is not legally acceptable, may point to ambiguities in IHL and the need for states to clarify their interpretation of the relevant IHL rules or to develop clearer standards to effectively protect civilians.”⁴⁸⁰

Due to the pattern of civilian harm observed when explosive weapons with a wide impact area are used in populated areas, and the objective difficulty of using such weapons in conformity with key IHL rules regulating the conduct of hostilities, **the ICRC is calling for such use to be avoided as a matter of policy.**

The adoption and implementation of an avoidance policy is necessary to close the gap between the goal of IHL to protect civilians from the danger of hostilities and the devastating consequences observed when heavy explosive weapons are used in populated areas. It would contribute to significantly reducing the risk of civilian harm and the risk of IHL violations when hostilities are conducted in urban and other populated environments.

5.1.2 What does an avoidance policy entail?

It is the ICRC’s position that to better protect civilians and facilitate respect for IHL, **explosive weapons with a wide impact area should not be used in populated areas unless sufficient mitigation measures can be taken to reduce such risk**, namely by limiting their wide area effects and the consequent risk of civilian harm.

The scope of the avoidance policy is defined – and thus limited – by two key elements: the type of weapons of concern, namely explosive weapons with a wide impact area, and the location of their use, namely populated areas.

⁴⁷⁹ See Chapter 3 for a more detailed analysis.

⁴⁸⁰ ICRC Challenges Report 2015, cited in footnote 1 above, p. 51; and ICRC Challenges Report 2019, cited in footnote 8 above, p. 14.

A man stands in front of his house in Ukraine, which was destroyed by shelling. He and his wife are receiving support from the ICRC to rebuild it.



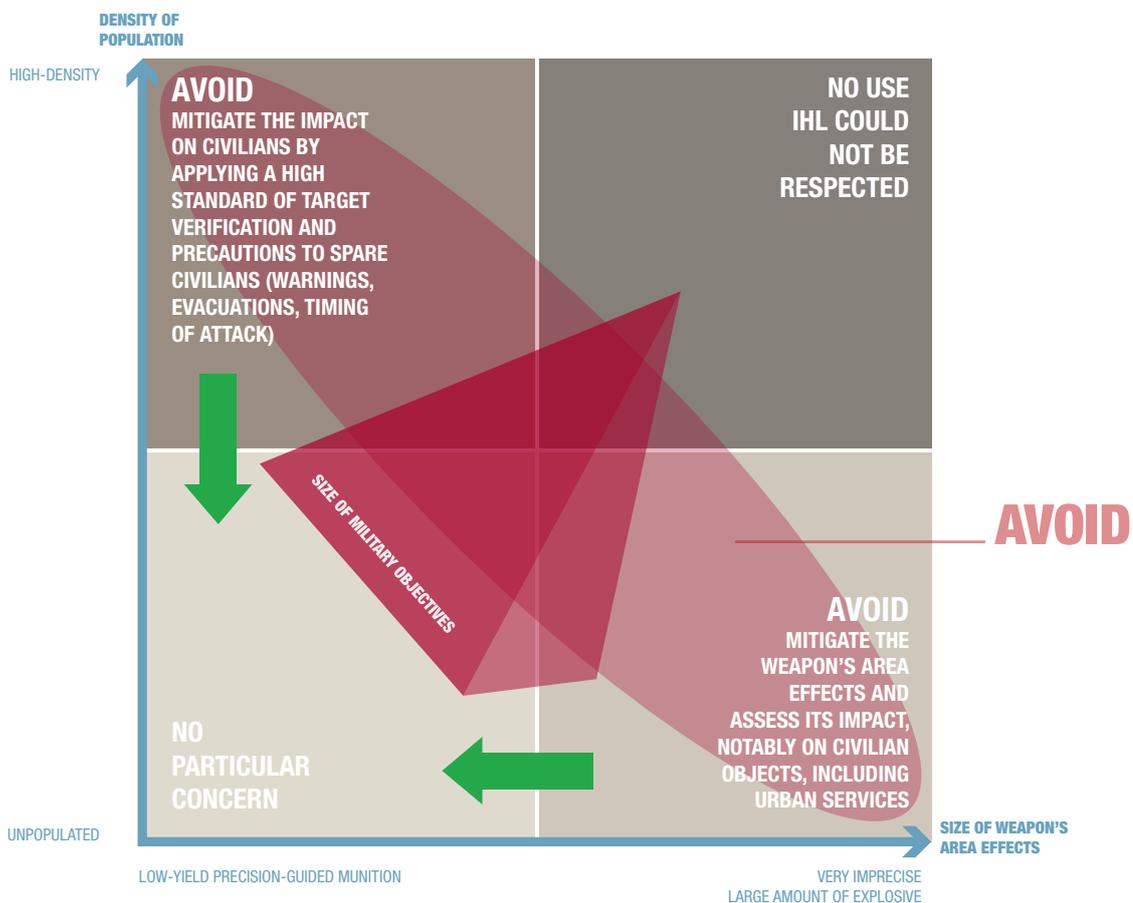
To be effective, an avoidance policy entails implementation of preventive and mitigation measures.

First, the avoidance policy should rely on a wide range of **preventive and other measures and guidance, policies and practices, at every level, to minimize situations where the use of heavy explosive weapons would have to be considered in populated areas** – including, for instance, avoiding the conduct of hostilities in such areas and providing for alternatives (weapons, means and methods) to such use.

Second, if the use of heavy explosive weapons in populated areas has to be considered, **sufficient mitigation measures have to be taken to reduce the risk of civilian harm. This depends on three parameters**, which can vary considerably with the circumstances:

- **the density of civilians in the area**
- **the size of the weapon's impact area (area effects)**
- **the size of the military objective.**

Variations in these three parameters can change the humanitarian and legal assessment of a particular situation.



At one end of the spectrum, **in an area containing a high density of civilians and civilian objects, the use of explosive weapons with a large impact area, especially against relatively small military objectives, seems irreconcilable with IHL rules and the obligation to spare the civilian population from the effects of hostilities.** For instance, an attack using a salvo of 40 unguided artillery rockets from a distance of 20 kilometres with a foreseeable total 'lethal area' of 600 metres x 600 metres, against a small enemy position in a densely populated neighbourhood of a town, would fall foul of the IHL prohibition against indiscriminate attacks.

At the other end of the spectrum, **the use of explosive weapons with a small impact area, against a large military objective situated in a sparsely populated area, would not cause the same degree of concern.** For instance, this would be the case for the use of an air-delivered low-yield precision-guided munition against a large military barracks in a neighbourhood that has been largely emptied of its population.



The Laser Homing Attack Missile or LAHAT produced by Israel Aerospace Industries on display at the 2018 Asian Defence and Security trade show.

In the figure above, the box in the top right represents the clear-cut situation in the first example, where circumstances would not allow respect for IHL; and the box in the bottom left represents the situation in the second example, where the use of explosive weapons would not be likely to cause indiscriminate effects. This assessment is also influenced by the size of the military objective, represented by the triangle: the smaller the specific military objective, the greater the likelihood of indiscriminate effects from the use of heavy explosive weapons.

In the vast majority of cases, though, the operational reality will fall somewhere between these two extreme scenarios: the taking of mitigation measures is most relevant to these other cases.

Mitigation measures aim to shift attackers from a situation where they should not use explosive weapons with a wide impact area to a situation where civilian harm will be sufficiently mitigated. Mitigation measures have to be taken at all levels (strategic, operational and tactical)⁴⁸¹ and must pervade all aspects of the military decision-making process (doctrine, education, training, equipment, and military practice, including the choice and use of means and methods of warfare). Such measures include, notably, targeting and ‘weaponing’⁴⁸² measures to significantly reduce the size of the explosive weapons’ impact area and to limit their effects as far as possible to the target, and/or measures to significantly change the circumstances of the attack such that the area is no longer populated (see green arrows in the figure above).⁴⁸³

⁴⁸¹ See UNIDIR Food-for-Thought Paper, cited in footnote 204 above, p. 5 (footnote omitted): “Avoidance of the use of explosive weapons in urbanized environments requires choices in military strategy and capability to be made available to a deploying force.” See also UNIDIR Options Paper, cited in footnote 204 above, p. 5.

⁴⁸² ‘Weaponing’ refers to the process of selecting the appropriate weapon to achieve the desired effects on the target, while minimizing to the extent possible incidental civilian harm; see Chapter 4, section 4.3.

⁴⁸³ ICRC Challenges Report 2019, cited in footnote 8 above, p. 14.



When the conflict in Nagorno-Karabakh escalated in 2020, civilians bore the brunt of the shelling.

Such mitigation measures would also facilitate respect for the IHL prohibitions against indiscriminate and disproportionate attacks, and for the general obligation to take constant care to spare the civilian population, civilians and civilian objects, notably by taking all feasible precautions in attacks, including in the choice of means and methods of warfare.

When mitigation measures are not feasible, sufficient and/or effective for reducing the weapon's area of impact and the consequent risk of civilian harm to an acceptable level, heavy explosive weapons should not be used.

5.2 RECOMMENDATIONS

The ICRC recommends to states, armed forces and all parties to armed conflicts the following good practices aimed at protecting civilians and civilian objects from dangers associated with the use of heavy explosive weapons in populated areas. **While these recommendations are grounded in IHL and its aim of protecting civilians from the danger of hostilities, they do not purport to express legally binding requirements *per se*, but to operationalize an avoidance policy.** Based on the existing practices mentioned in Chapter 4, **they are practical guidelines to prevent or reduce the harm caused to civilians from the increasingly well-known and foreseeable direct and indirect effects of the use of explosive weapons with a wide impact area in populated areas, and to facilitate compliance with IHL when conducting hostilities in such challenging environments.**

The list is by no means exhaustive, and notably does not include all the IHL rules and principles that parties to conflict have to comply with in all situations, including when using explosive weapons in populated areas.

A) TO POLITICAL AUTHORITIES

In view of the significant harm caused to civilians by the use in populated areas⁴⁸⁴ of explosive weapons with a wide impact area, it is recommended that political authorities take the following measures.

Preventive measures

1. Ensure that **protection of civilians is explicitly identified as a strategic objective** at the highest level prior to military operations and that the armed forces integrate it into all military orders.
2. Ensure that the military authorities develop **specific military doctrine or adapt existing doctrine** to address the humanitarian concerns and the operational challenges posed by the conduct of **hostilities in populated areas, including urban warfare**.
 - 2.1 Mandate **doing everything possible to keep hostilities in populated areas to a minimum, including by moving them outside populated areas or moving the population outside areas of hostilities**, and other measures to prevent or mitigate civilian harm.
 - 2.2 Review, amend, adapt or update existing policies or develop new **policies to mitigate the risk to civilians posed by the use of explosive weapons with a wide impact area in populated areas**.
3. Support the **development of essential services that would be more resilient** during warfare in populated areas, with the aim of mitigating the humanitarian consequences of urban warfare by ensuring that civilians have access at minimum to essential services of a quality necessary to preserve their lives, security, physical and moral integrity, and dignity.

Avoidance policy

4. **Adopt an avoidance policy** to the effect that explosive weapons with a wide impact area should not be used in populated areas unless sufficient mitigation measures are taken to limit their wide area effects and the consequent risk of civilian harm.
5. Ensure that such an avoidance policy, the good practices operationalizing it, and complementary policies on the protection of civilians during armed conflict are **integrated into military doctrine, training, planning and practice**.
6. Ensure that **the urban fabric, the specific vulnerabilities** of the civilian population living in urban areas, **the interconnectedness of critical civilian infrastructure and services** essential to civilian survival, **and the cumulative impact of protracted conflict** on them are understood and **inform military doctrine and decision-making processes**.
7. Ensure that **armed forces personnel are equipped with and trained in the proper use of weapons and means and methods of warfare that are appropriate for use in urban and other populated areas**, including weapons that do not have wide area effects, with a view to minimizing the risk of civilian harm.
8. Ensure that **the wide impact area** of certain explosive weapons **and their foreseeable humanitarian consequences**, and the way in which such consequences are amplified in built-up urban environments, **are given due consideration in the development, acquisition and legal review of these weapons**.
9. **Make the export of explosive weapons with a wide impact area conditional on recipients putting in place limits on the use of such weapons in populated areas**, in accordance with the good practices recommended in this report.
10. **When providing support to partner forces and/or parties to an armed conflict, make the supply of explosive weapons with a wide impact area conditional on recipients limiting the use of such weapons in populated areas** in accordance with the good practices recommended

⁴⁸⁴As explained above, for the purposes of this report and these recommendations, the term ‘populated areas’ refers to any concentration of civilians or of civilians and civilian objects.

in this report, and take all appropriate measures to ensure that this is the case in practice, including the following:⁴⁸⁵

- 10.1 When providing support in the form of explosive weapons with a wide impact area, ensure that training is provided** to recipients so that they:
 - a. know and understand the effects of such weapons in populated areas, including their indirect (reverberating) effects
 - b. implement the good practices recommended in this report.
- 10.2 Ensure that good practices and lessons learnt** in relation to the use of explosive weapons with a wide impact area in populated areas are shared with partner forces and/or supported parties.

Data collection

- 11. Put in place national mechanisms – including civilian-casualty tracking systems – to collect data** on incidents involving the use of explosive weapons with a wide impact area in populated areas, **and support other entities collecting such data**, for the purpose of:
 - 11.1** documenting direct civilian casualties (deaths and injuries), as far as possible disaggregated by age and gender, and damage to civilian objects, including critical civilian infrastructure
 - 11.2** documenting the indirect (reverberating), systemic short- and long-term effects on essential urban services
 - 11.3** increasing understanding, and foreseeability, of the effects of these weapons in populated areas
 - 11.4** ensuring that armed forces incorporate such understanding in military decision-making processes at all levels.

Transparency and exchange of good practices

- 12. Share publicly, in relevant forums, or within the context of a structured dialogue with the ICRC:**
 - 12.1 good practices, experience and lessons learnt regarding the choice and use of means and methods of warfare in populated areas**, including specific restrictions on the use of explosive weapons in populated areas and alternative weapons and tactics
 - 12.2 good practices, experience and lessons learnt regarding other measures adopted with a view to strengthening the protection of civilians and civilian objects against the effects of attacks** using explosive weapons with a wide impact area in populated areas, including:
 - a. decisions by relevant authorities and urban planners to avoid situating military objectives (e.g. military bases) within or near populated areas
 - b. where appropriate, making publicly available information on the situation of critical civilian infrastructure, particularly infrastructure necessary for the provision of water, electricity and health care and for wastewater management.
 - 12.3 how IHL rules are implemented** by the armed forces **when using explosive weapons in populated areas**, in particular the prohibitions against indiscriminate and disproportionate attacks and the obligation to take all feasible precautions in attacks.

⁴⁸⁵ See also ICRC, *Allies, Partners and Proxies: Managing Support Relationships in Armed Conflict to Reduce the Human Cost of War*, ICRC, Geneva, March 2021, especially pp. 97, 104, 130, 131 and 142. This publication provides additional recommendations to governments, armed forces, and multinational and non-state actors on strengthening the protection of civilians within the context of support relationships in armed conflict.

B) TO ARMED FORCES⁴⁸⁶

With a view to avoiding or at least minimizing civilian harm from the use of explosive weapons with a wide impact area in populated areas, it is recommended that armed forces review their military policies, training curricula and practices in order to incorporate the following good practices. The ICRC has provided additional recommendations on urban warfare more generally in this document: *Reducing Civilian Harm in Urban Warfare: A Commander's Handbook*.⁴⁸⁷

Preventive measures

1. Doctrine

- 1.1 **Identify protection of civilians as a strategic objective** at the highest level prior to military operations and incorporate it in all military orders.
- 1.2 **Develop specific military doctrine or adapt existing doctrine** to address the humanitarian concerns and the operational challenges posed by the conduct of **hostilities in urban and other populated areas, including by explicitly limiting the types of weapons and munitions that may be used in such areas.**

2. Training

- 2.1 **Provide training** for all those involved in the planning, decision-making and execution of attacks, including the targeting process, **to ensure that the effects of explosive weapons in populated areas, including their area effects,** and the limitations applicable to their use, **are fully known and understood.**
- 2.2 **Ensure that all those involved in the targeting process,** including forward observers and forward air controllers, **are trained to identify critical civilian infrastructure.**
- 2.3 Provide **specific training on the conduct of hostilities in populated areas, including urban warfare,** as well as predeployment and refresher training to forces that are likely to be engaged in such operations.

3. Planning

- 3.1 During the planning process at the strategic, operational and tactical levels, **do everything possible to keep hostilities in populated areas to a minimum, including by moving them outside populated areas,** for example, by pushing or drawing the adversary outside populated areas where feasible, leaving escape routes for the adversary to flee populated areas, and favouring any other tactic that would take the fight outside populated areas – and if that is not possible, **by moving the population outside the area where hostilities may be expected to take place,** for example, by letting civilians leave a besieged area or organizing temporary evacuation from sites of hostilities.
- 3.2 **Study and develop, and then plan** at the strategic, operational and tactical levels, **alternatives – weapons, munitions and tactics –** to the use of explosive weapons with a wide impact area in populated areas.

4. **Ensure effective maintenance and adequate storage of explosive weapons and munitions,** and do not deploy poorly maintained or stored weapons or munitions in operations in populated areas.

Avoidance policy

5. **Do not use explosive weapons with a wide impact area in populated areas unless sufficient mitigation measures have been taken** to limit their area effects and the consequent risk of civilian harm. In particular, **avoid the use in a populated area** of:

- 5.1 **when unguided,**⁴⁸⁸ the following weapon systems, because of their intrinsic inaccuracy and consequent wide area effects, and irrespective of the size of the target:

- a. **MBRLs**
- b. **air-to-ground rockets and air-delivered bombs.**

⁴⁸⁶The following applies *mutatis mutandis* to non-state armed groups.

⁴⁸⁷ICRC, *Reducing Civilian Harm in Urban Warfare: A Commander's Handbook*, ICRC, Geneva, 2021.

⁴⁸⁸'Precision guidance' is not a uniform concept, and guidance is not a guarantee of high accuracy. 'Guided weapons' may also have an important degree of inaccuracy, depending on the type of guidance systems used; see Chapter 2 for further explanation.

- 5.2 any explosive weapons whose impact area may be expected to be significantly larger than the target**, in particular:
- a. **large-yield munitions, whether guided or unguided**, including large-yield bombs and missiles, and large calibre mortars and other projectiles, when their blast-and-fragmentation radius is significantly larger than the target
 - b. **any explosive weapons designed or employed to have area effects**, when their foreseeable impact area is significantly larger than the target because of their intrinsic inaccuracy or for other reasons, such as **unguided indirect-fire weapon systems**, especially medium- and large-calibre artillery guns and mortars, and other 'area weapons' against 'point targets'.
6. Ensure that the restrictions outlined in recommendations 5 and 7 are reflected in **doctrine**⁴⁸⁹ – including tactical directives, standard operating procedures, and standing and/or mission-specific rules of engagement – **for operations in populated areas (including urban warfare)**.

Mitigation measures

7. **Employ means and methods of warfare, the effects of which can be limited to the military objective**, including by using the most appropriate munition, warhead, fuze and delivery system.
8. **Modernize fire-control systems and the fire-direction centre** of artillery and mortar units, **and use robust calibration techniques and procedures that are safe for civilians**, in order to enhance the accuracy and precision of indirect fire.
9. In the operational planning process, **ensure that critical civilian infrastructure and, to the extent possible, the essential service systems they enable or serve, are identified and mapped and that such findings are communicated to the operational military decision-makers**. To this end, actively seek information on the nature, location, condition and inter-connectedness of critical civilian infrastructure, notably by including the relevant expertise (as per recommendation 10) in the targeting process.
10. In addition to the participation of experts on weapons' effects and legal advisers, **ensure where feasible the participation of engineers with relevant expertise** (i.e. structural and field engineers, including those with expertise in water, wastewater and electrical systems), **as well as urban planners, in the decision-making process for targeting**, to advise on the structural make-up of buildings, the location of critical civilian infrastructure, the inter-connectedness of essential services, and the danger posed by secondary explosions.
11. Take appropriate **measures to reduce the density of civilian presence** in populated areas where attacks may be carried out – including by means of warnings and evacuations – and more generally, take measures **to minimize the exposure of civilian population to the dangers arising from military operations**.
12. Presume civilian presence in buildings and other locations where there is evidence of human habitation, **unless otherwise apparent**. In particular, **do not presume that an area is devoid of civilians**, based solely on the fact that warnings have been issued or evacuations have been ordered or have taken place.

⁴⁸⁹ ICRC, *Handbook on International Rules Governing Military Operations*, cited in footnote 351 above, pp. 30–31: "Doctrine... is understood as being all standard principles that guide the action of arms carriers at strategic, operational and tactical levels, independently of the forms these principles take. It therefore encompasses all directives, policies, procedures, codes of conduct, reference manuals and rules of engagement – or their equivalents – that serve to educate, train and guide arms carriers ... and shap[e] the decision-making process, tactics and behaviour in operations."

Additional measures to reduce the risk of civilian harm

13. **Establish concepts similar to ‘safety distances’** for operations in populated areas, in order to spare civilians and civilian objects (in particular critical infrastructure) from the effects of explosive weapons, and ensure that any such distances are adapted to the size of the impact area of each explosive weapon used and to the specificities of the urban terrain.
14. **Ensure that qualitative data and intelligence are gathered** from all sources reasonably available, in order to verify that the target is lawful and to determine the presence of civilians and civilian objects and their movements in the area containing the target.
 - 14.1 **Include the nature, location and condition of critical civilian infrastructure** and its interconnectedness with essential service systems.
 - 14.2 **Ensure that such information is continuously updated and available to field commanders** before and during the conduct of military operations in populated areas.
15. **Carry out collateral-damage estimates (CDE) or similar assessments:**
 - 15.1 **Ensure that such assessments consider the extent of civilian harm** that may be expected from an attack, **including its reverberating effects**, notably the impact of destroying or damaging critical civilian infrastructure on the services enabled by such infrastructure.
 - 15.2 **Ensure that such assessments incorporate the information and assumptions referred to in recommendations 9, 10, 17 and 18.**
 - 15.3 **Ensure that such assessments are carried out in both deliberate (pre-planned) and, even if in a less sophisticated manner, in dynamic engagements.**
16. Incorporate in military doctrine **best practices for recording, retaining and transmission of information on the use of explosive ordnance**, as recommended by the ICRC in its 2013 report.⁴⁹⁰

Post-attack measures

17. **Create a mechanism to track, assess and investigate all instances of civilian casualties and damage to civilian objects**, to the extent possible, including the correlation between such civilian harm and the means and methods of warfare used, **with a view to drawing lessons learnt** for incorporation in doctrine, training, planning and practice in the future.
18. When undertaking after-action reports, battle-damage assessments or relevant investigations:
 - 18.1 ensure that these processes record **both the direct and the indirect (reverberating) effects** of explosive weapons with a wide impact area on civilians and civilian infrastructure
 - 18.2 ensure that the **lessons learnt**, including with regard to the effects of specific types of weapons in populated areas, **are incorporated as soon as possible in the targeting process, and in doctrine, training, planning and practice in the future.**
19. **Share publicly, in relevant forums or within the context of a structured dialogue with the ICRC**, information on efforts undertaken and measures implemented to reduce the risk to civilians from the use of explosive weapons in populated areas.

⁴⁹⁰ ICRC, *Identifying and Addressing Challenges to Implementation of Article 4 of Protocol V to the CCW*, Expert Meeting, ICRC, Geneva, October 2013, p. 37, para. 3. Recording, retaining and transmitting information on the use or abandonment of explosive ordnance constitutes a legal obligation under Article 4 for states party to Protocol V to the CCW.

The scale of the destruction in Syria has created a complex humanitarian emergency that requires long-term planning and responses.



5.3 CONCLUSION

The humanitarian consequences of the use of heavy explosive weapons in urban and other populated areas, outlined in Chapter 1 of this report, are well documented in recent and ongoing armed conflicts in many parts of the world.

Their devastating direct and indirect effects are largely the result of a deadly combination: the weapons' technical characteristics described in Chapter 2 and consequent wide impact area, which is very likely to extend beyond the targeted military objective, and the density of civilian presence in urban and other populated areas. Consequently, **heavy explosive weapons are inappropriate for use in populated areas**, as such use entails a high risk of affecting civilians and civilian objects indiscriminately or disproportionately. As the legal analysis in Chapter 3 demonstrated, **in many circumstances, attacks using such weapons will be prohibited by IHL.**

Restrictions and limitations on the use of heavy explosive weapons in urban and other populated areas (some of which were outlined in Chapter 4) have been proven to contribute to a reduction in civilian casualties. However, the reality on the ground dictates that much more needs to be done in this direction to **put the protection of civilians back at the centre of considerations** when planning and carrying out operations in populated areas. Far from accepting the death and destruction caused by heavy explosive weapons' use as a tragic but unavoidable by-product of warfare, policymakers and armed forces have a responsibility to **adapt their military policies and practices to the requirements of the law, humanitarian imperatives and the realities of the modern battlefield. A fuller understanding and consideration of the foreseeable direct and indirect effects** of attacks using heavy explosive weapons will ensure that the balance between military necessity and humanitarian considerations – central to the rules governing the conduct of hostilities which are aimed at protecting civilians – is adequately met.

In sum, this report demonstrates that **a political commitment to take action and change the unacceptable status quo is both urgently needed and possible: the use of heavy explosive weapons in populated areas should be avoided**, and such an avoidance policy needs to be incorporated in military doctrine, education and training, and reflected in equipment and military decision-making processes. **As the examples in the previous chapters have shown, mitigation measures can and should be taken** to reduce explosive weapons' area effects and the consequent risk of civilian harm. Ultimately, **alternative weapons and tactics should be made available** to armed forces, enabling them to fight in populated areas in a manner that respects IHL and strengthens the protection of civilians.

It is hoped that this report will contribute to tangible progress in preventing and mitigating civilian harm. **The ICRC calls on all states and parties to armed conflict to adopt and implement the recommendations presented earlier in this chapter.** In the ICRC's view, these and similar measures would facilitate respect for IHL and significantly strengthen the protection of civilians from the effects of hostilities in high-risk environments such as urban and other populated areas. We stand ready to support these efforts and will continue working on ways to effectively address this pressing humanitarian concern, in order to alleviate the suffering of men, women, girls and boys affected by armed conflict.

Children play in the al-Sahel Syrian refugee camp in Akkar, Lebanon.
This area of Lebanon took in more than 60,000 Syrian refugees.



The ICRC helps people around the world affected by armed conflict and other violence, doing everything it can to protect their lives and dignity and to relieve their suffering, often with its Red Cross and Red Crescent partners. The organization also seeks to prevent hardship by promoting and strengthening humanitarian law and championing universal humanitarian principles. As the reference on international humanitarian law, it helps develop this body of law and works for its implementation.

People know they can rely on the ICRC to carry out a range of life-saving activities in conflict zones, including: supplying food, safe drinking water, sanitation and shelter; providing health care; and helping to reduce the danger of landmines and unexploded ordnance. It also reunites family members separated by conflict, and visits people who are detained to ensure they are treated properly. The organization works closely with communities to understand and meet their needs, using its experience and expertise to respond quickly and effectively, without taking sides.

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