REFERENCE FRAMEWORK:

MENU OF INDICATORS TO MEASURE THE REVERBERATING EFFECTS ON CIVILIANS FROM THE USE OF EXPLOSIVE WEAPONS IN POPULATED AREAS

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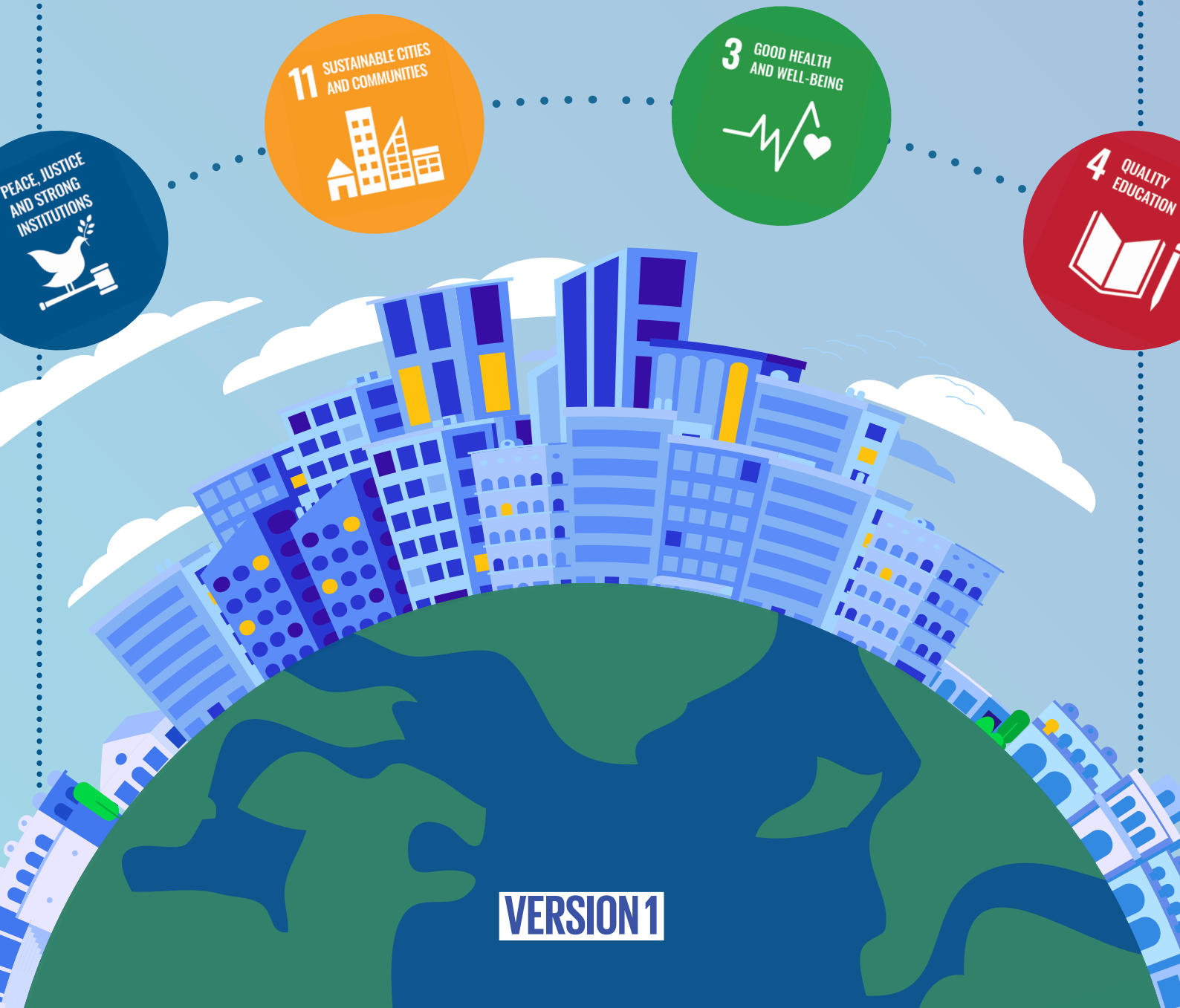

VERSION 1

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UNIDIR welcomes and encourages all feedback on improving the present menu of indicators and building on it for future iterations. This is a UNIDIR Tool, designed to contribute to ongoing efforts to protect civilians in conflict and attain the Sustainable Development Goals.

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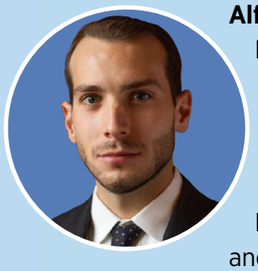

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INTRODUCTION

The impacts of explosive weapons use in populated areas are much wider and longer lasting than the shock waves of the explosive blast. The use of explosive weapons in populated areas sets in motion a series of complex knock-on effects that spread out over time and space in urban ecosystems, with negative consequences for civilian well-being and the environment in which people live. These "reverberating effects" manifest across a wide range of interlinked sectors, including transportation networks, electricity, waste and water management, public health, education, food security, housing and shelter, displacement, culture and identity, economic opportunity, environmental standards, and gender equality.[1] These reverberating effects can cause indirect -yet causally linked- deaths from the use of explosive weapons, and are often underestimated. **The purpose of this document is to offer indicators to document knock-on effects and potentially inform and influence the policy and practice of parties to conflict.** The indicators outlined in this document aim to shed light on the generalized pattern of harm from the use of explosive weapons in populated areas (EWIPA). By using a standardized set of indicators, the data generated can be leveraged to build a comparable evidence base reflecting the consequences to civilian well-being of the use of EWIPA and to inform high-level decision-making on policy and practice.

This document also echoes the Joint Appeal by the United Nations Secretary-General and the President of the International Committee of the Red Cross on the Use of Explosive Weapons in Cities in calling for an end to the devastation and civilian suffering and in highlighting that,

> *"The massive destruction caused by armed conflicts in cities can set development indexes back by years and even decades... This is a major setback to the achievement of many of the Sustainable Development Goals. Progress gained over decades can be quickly reversed as once lively and prospering population centres turn into ghost towns."*[2]

This document outlines indicators that, if made available, collected, contextualized, disaggregated and used in comparison to a control scenario or baseline data from before the use of explosive weapons could shed light on the reverberating effects that the use of EWIPA has on civilian casualties and injuries, sustainable cities and communities, health, and education. These areas are drawn from a select number of Sustainable Development Goals (SDGs) and represent SDG 16, SDG 11, SDG 3 and SDG 4, respectively. These select SDGs and the ensuing indicators should be understood as a starting point to document the causal pathways through which the use of explosive weapons unleashes reverberating effects and hinders development. The choice was based on accessibility of information and prominence of causal pathways. This choice is not necessarily an indication that the chosen SDG areas are the most important, or the only, causal pathways.

1 Adverse environmental impacts can include the risk to people from debris, hazardous materials (e.g. asbestos, industrial chemicals, fuels, PCBs [polychlorinated biphenyls]) and waste. This includes debris from the destruction of buildings in which building materials are pulverized, as well as chemical spills and ground contamination arising from damage to industrial facilities, and pollution from the damage of wastewater sanitation or the collapse of other waste management infrastructure.

2 United Nations, Note to Correspondents: 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 September 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.

Additional SDG areas, such as eradicating poverty, food security, gender equality, clean water and sanitation, energy, and economic growth (SDGs 1, 2, 5, 6, 7 and 8, respectively) – among other areas – must also be considered moving forward and in future iterations of this research framework. The proposed menu of indicators that follows (Chapter 3) is divided into four independent "Tools", one for each of the SDGs observed in this framework.

1.1 MAPPING AND PREVENTING THE INDIRECT EFFECTS OF EXPLOSIVE WEAPONS

Since 2011, at least 260,000 civilians have been killed or injured by explosive weapons, and 357,000 people have been harmed by such weapons in total.[3] It is, however, widely recognized that this figure is an underestimate and fails to capture the true extent of the damage to civilians. This is not least because the effects of explosive weapons extend far beyond the direct loss of life by sparking a wide range of ripple effects across time and space, identified as "reverberating effects". For example, when housing is destroyed, displacement follows. When health infrastructure is affected, mortality and morbidity increase. When schools close, children's opportunities may be reduced over their lifetime, accentuating gender disparities and hindering the wider socioeconomic development of individuals and the community. In addition, damage to water or power supplies – the collapse of solid waste management facilities or running water, for example – has knock-on effects on human health and the environment, which creates a reinforcing loop. It is also well documented that the use of explosive weapons has serious physical and mental health consequences for survivors, which can also affect future generations. These effects do not happen in isolation – they compound and spur vicious cycles.

The use of EWIPA has foreseeable consequences for urban ecosystems, and the reverberating effects of such weapons can further impede the attainment of the SDGs. This is due in large part to the complex interdependence of critical services and infrastructure in populated areas. The International Committee of the Red Cross (ICRC) has led the efforts to record and highlight how the impact of explosive weapons disrupts urban services and reverberates across space and time.[4] Evidence on the pattern of harm from explosive weapons is a crucial building block to advance efforts to protect civilians. However, work in these practical areas is hampered by the lack of systematic and comparable data on the severity and variable impact of damage and destruction of key facilities and infrastructure. There is a growing body of evidence demonstrating that the use of explosive weapons has a particularly devasting impact on civilian welfare, in particular in the provision of health care and education. For example, over 70% of all damage to hospitals in 2018 reported by the Safeguarding Health in Conflict Coalition (SHCC) was attributed to explosive weapons use.[5] To explore this growing body of evidence, two global coalitions concerned with monitoring attacks on health and education, respectively, have provided disaggregated data for this report. These data could allow users to monitor changing impacts on health and education and thus better integrate arms control mechanisms into the protection of civilians and civilian structures. For example, a causal understanding of the foreseeable reverberating effects of explosive weapons ought to be included at all stages of the planning and conduct of operations by all parties to conflict. That is, a clear pattern of harm delineation is essential to understanding where the risks and uncertainties lie in the "civilian protection life cycle".[6] Limitation of civilian harm is not related only to the choice of weapon, though that is a critical component; it is the cumulative effect of numerous risks and decisions made from the early stages of mandating and planning military operations, all the way to the execution, assessment and response phases. Therefore, a clear understanding of reverberating effects and the associated pattern of harm from the use of explosive weapons is critical to protecting civilians and civilian structures.

1.2 THE UNIDIR MENU OF INDICATORS

The Tools (or menu of indicators) outlined in this research framework are built on research that divides the effects of explosive weapons use into three levels: primary effects from the blast wave and fragmentation, secondary effects from the interaction of the blast wave and fragmentation with the surrounding environment, and tertiary or reverberating effects as the consequences from the damage and destruction caused by explosive weapons. The Tools presented in this document disaggregate the impact chain of explosive weapons use even further, into first-, second-, and third-level impacts: respectively, (A) damage and destruction, (B) changes in key services caused by the damage and destruction, and (C) changes in civilian well-being as a result of the changes in key services caused by the damage and destruction. In this impact chain disaggregation, first-level impacts are primary or secondary effects, and second- and third-level impacts can be considered reverberating effects. Finally, the Tools are informed by the three essential elements needed for urban services to function, as identified by the ICRC: people, infrastructure and consumables.[7] The interconnectedness between these three elements allows urban environments to function and improve the human condition. However, the disruption of one element has consequences for the entire ecosystem.

Time and location are also critical in reverberating effects research. When linking reverberating effects to damage and destruction, it is crucial to consider the location and the radius of the impacts under study, as well as developments over time, as some impacts may only show or change after a certain period. It is also important to compare observed effects against baseline data – data from before the use of explosive weapons or against an unaffected location – as it may allow for causal inference. In addition, reverberating effects are interlinked and have a compounding effect, leading to additional impacts that should not be discounted. For example, displacement triggered by explosive weapons use in urban areas often spurs a cycle of reverberating effects for the affected population, such as food insecurity and health hazards. Therefore, this research framework urges users to consider the compounding or cumulative nature of reverberating effects when explosive weapons are used in urban ecosystems.

The Tools to measure civilian harm[8] proposed in this document build on work conducted by UNIDIR in 2016 that highlighted the link

3 Action on Armed Violence explosive weapons monitor: https://aoav.org.uk/explosiveviolence. Action on Armed Violence data include casualties from all explosive weapons, including improvised explosive devices, reported in English-speaking media since 2011.

4 For example, see M. Talhami and M. Zeitoun, 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. 1, 2016, https://international-review.icrc.org/sites/default/files/irc_97_901-6.pdf.

5 Working document prepared by Insecurity Insight for the SHCC.

6 UNIDIR, Opportunities to Improve Military Policies and Practices to Reduce Civilian Harm from Explosive Weapons in Urban Conflict, 2019, https://unidir.org/publication/opportunities-improve-military-policies-and-practices-reduce-civilian-harm-explosive.

7 ICRC, Urban Services during Protracted Armed Conflict: A Call for a Better Approach to Assisting Affected People, 2015, https://www.icrc.org/sites/default/files/topic/file_plus_list/4249_urban_services_during_protracted_armed_conflict.pdf.

8 Civilian harm is used in its broadest understanding possible to include direct harm to civilians as a result of a conflict, including the reverberating effects of explosive weapons in a population, such as preventable medical problems that affect all members of a community, regardless of status, during the period of conflict. Other research efforts have used the term community harm . This framework finds both terms acceptable.

between the reverberating effects of EWIPA and challenges in achieving the SDGs[9] and called for the development of such a framework. Since then, several case studies of reverberating effects have been produced that helped deepen understanding. The Tools were developed following a comprehensive literature review in 2019 of current approaches to documenting the reverberating effects.

1.3 OBJECTIVES

Information on how the reverberating effects of the initial blast of EWIPA impact civilians is needed to inform policy and practice in a range of key areas. For example:

- To help identify, anticipate and prevent foreseeable, yet generalized, patterns of harm from the use of EWIPA
- To assist parties to conflict in making the protection of civilians a strategic priority in the planning and conduct of military operations in urban environments, including by using all available evidence and knowledge to inform new doctrines, strategies and tactics[10]
- To gauge the negative impact on the achievement of certain SDGs and facilitate a high-level reflection and analysis of the consequences of explosive weapons use
- To help humanitarian organizations develop programmatic responses to civilian harm from EWIPA and re-evaluate preparedness and response mechanisms in urban ecosystems
- To inform the policies of governments, international organizations and other stakeholders that want to enhance the protection of civilians in armed conflict and ensure compliance with international humanitarian law (IHL)

Numerous studies have underlined the urgent need to address the use of EWIPA, and standardized data on the reverberating effects on civilians and society are needed to systematically document and map the impact chain. But collecting, collating, verifying and analysing such information is often difficult. Furthermore, assessing causal interlinkages is notoriously complex. In addition, damage and destruction from explosive weapons use is not necessarily or consistently monitored or investigated. To complicate matters further, impacts are interlinked and multifaceted, and at times it can be nearly impossible to distinguish in a meaningful way between the consequences of explosive weapons use and those of the wider conflict. Substantially more work will be needed before systematic data on reverberating effects are widely available.

This document seeks to contribute to the development of a standardized evidence base of the effects on civilians from the use of EWIPA. The Tools in this reference document outline initial options to quantify the damage and destruction of infrastructure in urban ecosystems and outline initial thinking on mapping the consequences of the damage and destruction using indicators linked to the SDGs. To measure the damage and destruction of critical infrastructure, organizations would have to either have direct access on the ground to the asset of concern, use remote sensing capabilities, or employ a combination of both. This methodology can inform these approaches by providing a high-level guide.

This document also aims to highlight the differential gendered impact of explosive weapons use by encouraging the inclusion of gender-sensitive indicators and the collection of gender-disaggregated data. It is crucial to engage with all ongoing and future data collection efforts to emphasize the importance of data disaggregated by gender and age, where appropriate and relevant, to highlight the differential impact at all levels of explosive weapons use on different demographic groups.[11] This document hopes to contribute to the mainstreaming of gender-disaggregated data by proposing gender-sensitive indicators.

1.4 WHO CAN BENEFIT FROM THIS DOCUMENT?

The proposed indicators are intended for use and testing by all stakeholders interested in documenting the use of explosive weapons and mapping the impact chain, most notably those working on documenting the indirect consequences of conflict. Different communities need the findings from such research in different formats. However, all interested users can benefit from a standardized research framework to generate disaggregated and comparable evidence.

Systematic evidence on how explosive weapons affect civilians is important to support efforts to bring about practical changes in the doctrines and practices of parties to conflict. Similarly, systematic evidence can contribute, by informing practical actions, to the United Nations Secretary-General's Agenda for Disarmament.[12] Nuanced mapping of how particular practices affect people and their livelihoods can show general patterns of civilian harm. This supports the obligation to prevent reverberating effects and ensure compliance with existing international standards and IHL. The evidence base can also shed light on considerations that ought to be included by parties to conflict throughout the civilian protection life cycle of mandating, planning and conducting operations in urban environments.

Improved data can also enable a more evidence-informed and prioritized response from humanitarian actors assisting communities affected by explosive weapons. These actors include humanitarian mine action organizations that carry out risk education, victim assistance and explosive ordnance clearance. A wider range of humanitarian actors, including those who provide immediate response and assistance in emergency situations to civilians affected by conflict and those who support service providers in maintaining essential services, could also benefit from this research framework. Systematic evidence on the reverberating effects of the use of EWIPA can help all these stakeholders adjust projects and improve preparedness for aid delivery, contingency planning and wider response efforts.

Users of this research framework will have different information needs, depending on their policy or programmatic focus. For example, public policymaking requires monitoring of trends over time. Responses from on-the-ground organizations require nuanced geolocations, as well as details on the extent of the immediate damage and the effect on service delivery associated with the failure of a physical asset. For an IHL analysis, it is important to measure specific patterns of harm, as this would make impacts foreseeable and thus introduce and support considerations of civilian harm and reverberating effects under the threshold of "reasonable foreseeability" in all relevant standards of engagement.[13] However, all these users can benefit from the same research framework to generate systematic and standardized evidence that maps causal chains in patterns of harm to civilians from

9 C. Wille, The Implications of the Reverberating Effects of Explosive Weapons Use in Populated Areas for Implementing the Sustainable Development Goals, UNIDIR, 2016, http://www.unidir.org/files/publications/pdfs/ewipa-and-the-sdgs-en-651.pdf.

10 Language drawn from the United Nations Secretary-General s report on the protection of civilians in armed conflict: Security Council, S/2020/366, 2020, para. 35.

11 Sex-disaggregated data are data collected and presented separately for women and men, referring to their biological sex. Gender refers to a socially constructed set of norms, behaviours and roles associated with being a woman or a man in a given society. Gender is non-binary and diverse; it refers to people of all gender identities and expressions. For the purpose of this document, the term gender-disaggregated data has been favoured to encourage data collectors to include and present separately all forms of gender identity.

12 UNODA, Securing Our Common Future: An Agenda for Disarmament, 2018, https://www.un.org/disarmament/wp-content/uploads/2018/06/sg-disarmament-agenda-pubs-page.pdf.

13 For more details on reasonable foreseeability, see E. Nohle and I. Robinson, War in Cities: The 5 Reverberating Effects of Explosive Weapons , Humanitarian Law & Policy, 2 March 2017, https://blogs.icrc.org/law-and-policy/2017/03/02/war-in-cities-the-reverberating-effects-of-explosive-weapons.

the use of EWIPA. Having a common research framework will make it easier to communicate and exchange knowledge with one another, facilitating multidisciplinary dialogue and agreements.

The goal of this document is to offer a research framework for the systematic and standardized collection of indicators that could document the generalized pattern of harm to civilians from the use of explosive weapons, with attention to the reverberating effects. This is done in the hopes that knowledge will be leveraged to protect civilians.

1.4.1 Building bridges with the development community

The Tools suggest using data from development policy areas to measure and analyse the reverberating effects of explosive weapons and their reversal of development processes. Systematic use of data can help shed light on causal links between explosive weapons use in populated areas and how the reverberating effects negatively affect civilian well-being and development processes.

Exploring the impact of the use of explosive weapons through the lens of sustainable development may also help integrate the often-siloed communities of development and arms control. Use of the SDG indicators can demonstrate how damage and destruction from explosive weapons hinders the attainment of sustainable development objectives, beyond the tragic and immediate loss of human life from conflict. At present, the SDG indicators on sustainable cities and communities, health and education do not directly refer to the challenges brought about by conflict or the damage caused by explosive weapons. SDG 16, which focuses on peaceful and inclusive societies, includes an indicator on conflict-related deaths per 100,000 population (SDG 16.1.2) but otherwise focuses on other forms of violence, as well as rule of law related indicators. Regular use of the SDG framework to demonstrate the impact of explosive weapons could shed light on key obstacles to achieving the 2030 Agenda for Sustainable Development.

PROMOTE PEACEFUL AND INCLUSIVE SOCIETIES FOR SUSTAINABLE DEVELOPMENT, PROVIDE ACCESS TO JUSTICE FOR ALL AND BUILD EFFECTIVE, ACCOUNTABLE AND INCLUSIVE INSTITUTIONS AT ALL LEVELS

MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES

ENSURE INCLUSIVE AND EQUITABLE QUALITY EDUCATION AND PROMOTE LIFELONG LEARNING OPPORTUNITIES FOR ALL

1.5 HOW IS THIS DOCUMENT STRUCTURED?

The Tools that follow (Chapter 3) suggest ways of linking infrastructure damage and destruction and disruptions of service provision to indicators of human well-being. The proposed Tools use the SDG framework to outline a uniquely adapted menu of indicators that covers, in the first part (section 3.1), indicators to measure civilian casualties from explosive weapons and, in the second part (section 3.2), indicators to map the impact chain of explosive weapons use on civilian well-being, organized following the chain of destruction: (A) indicators on damage and destruction, (B) indicators on the changes in key services caused by the damage and destruction, and (C) indicators on the changes in civilian well-being as a result of the changes in key services caused by the damage and destruction.

The Tools are framed around the 2030 Agenda for Sustainable Development, in particular conflict casualties from SDG 16 on peace, justice and strong institutions; SDG 11 on sustainable cities and communities; SDG 3 on health; and SDG 4 on education. Where possible, the Tools propose the direct use of SDG indicators. Where necessary, the SDG indicators are adapted, as specified in the technical section, to fit the requirements of explosive weapons-related research. Where no SDG indicators are available or where it is unlikely that the data for the official SDG indicators are going to be publicly available at the subnational level, alternative research approaches to documenting or measuring the reverberating effects are discussed.

Please note that the indicators under the different SDG Frameworks have been retrieved verbatim or near verbatim from their respective custodian agencies or responsible institutions, as outlined in the publicly available SDG Indicators Metadata Repository, published by the Statistics Division of the United Nations Department of Economic and Social Affairs. When it was not possible to fully retrieve the technical guidance verbatim, slight modifications have been made, usually for consistency with the rest of the document or clarity, but in keeping with the original meaning or spirit of the indicator.

2. METHODOLOGICAL CONSIDERATIONS IN DOCUMENTING AND MEASURING THE REVERBERATING EFFECTS OF EXPLOSIVE WEAPONS USE

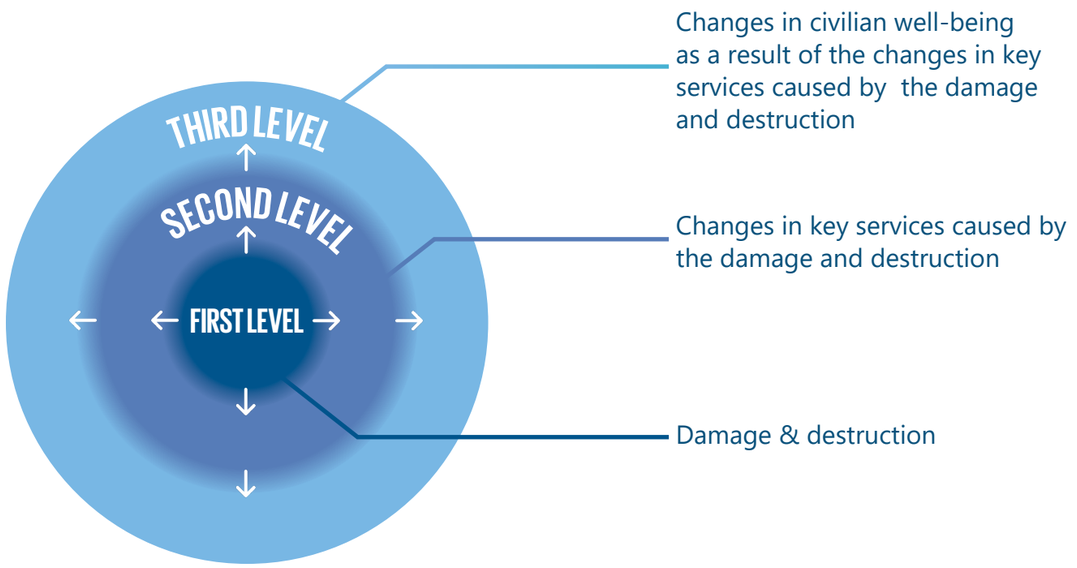
2.1 EFFECTS OF EXPLOSIVE WEAPONS USE IN POPULATED AREAS

Blast effects from the detonation of explosive weapons cause direct damage. The interaction of the blast effect with the environment causes additional destruction. **Primary effects** of explosive weapons are those caused directly by the weapons' components. These effects are caused by the high-pressure blast wave that results from the detonation, and from the fragmentation of the weapons system. Measures of primary effects include blast overpressure, fragmentation, heat and light (also referred to as "flash"). **Secondary effects** of explosive weapons result from the interaction of the blast wave and fragmentation with the surrounding environment. The most significant secondary effects include secondary fragmentation, firebrands, ground shock and cratering, fire, and flying and falling debris. Direct deaths and injuries from explosive weapons are part of the primary or secondary effects. **The reverberating (or tertiary) effects** of explosive weapons are the consequences (or product thereof) from the damage and destruction caused by explosive weapons, including indirect harm to civilians, but excluding direct deaths and injuries.[14] The reverberating effects of explosive weapons spread out in space and time after the initial impact through a complex causal chain of interconnected and interdependent urban structures. These effects are cumulative, and they intersect and interact, spreading into multiple areas of civilian life. The Tools presented in this document disaggregate the impact chain of explosive weapons use further by subdividing it into first-second-and third-level impacts: respectively, (A) damage and destruction, (B) changes in key services caused by the damage and destruction, and (C) changes in civilian well-being as a result of the changes in key services caused by the damage and destruction. **In this impact chain disaggregation, first-level impacts are primary or secondary effects, and second- and third-level impacts are reverberating effects.**[15]

14 C. Wille and J. Borrie, Understanding the Reverberating Effects of Explosive Weapons: A Way Forward, UNIDIR, 2016, p. 5, http://www.unidir.org/files/publications/pdfs/reverberating-effects-research-agenda-en-653.pdf.

15 Primary, secondary, and tertiary effects of explosive weapons shed light on the mechanisms through which explosive weapons cause harm in populated areas, whereas the impact chain, first, second, and third level impacts, capture the sequence of how the harm from explosive weapons in populated areas happens.

FIGURE 1: Impact chain: Impact levels from instances of explosive weapons use[16]



Reverberating effects can be measured in terms of civilian impact but have to be understood within the complex interlinked systems in which societies function and essential services are delivered. While some reverberating effects can be quantified, others are too complex and require complementary qualitative and anecdotal treatment.[17] In addition, reverberating effects are not necessarily a linear development and take place within interconnected, interdependent and dynamic civilian structures and urban services.

2.2 ATTRIBUTION OF CAUSE AND EFFECT

The aim of reverberating effects research is to explain what occurred and how it occurred and to demonstrate the causal pathway to the use of explosive weapons that unleashed the observed impact chain. Yet, it is challenging to causally link information on civilian harm to instances of explosive weapons use. That is, attributions of cause and effect are notoriously difficult. Methodologically rigorous reverberating effects research should include an in-depth description of the causal chain connecting observed outcomes with instances of explosive weapons use. It is crucial to be able to demonstrate that the effects documented are a causal consequence of explosive weapons use, as the sole or exclusive cause, and not of the wider conflict. To do this, for research purposes, the factors of location and time are key, as they will provide some parameters to isolate observed effects and begin to map the causal pathways. Considering the observed effect against baseline service condition or performance data is also key, since within a system there may be redundancies that could allow some nodes to fail without disrupting the delivery of the service or, contrarily, the system may have pre-existent fragilities and shortcomings that were only exacerbated -not caused- by explosive weapons. Similarly, for research purposes, it is also important to document "access" to services, in terms of the number of households, business, or infrastructure served, from before the use of explosive weapons, in order to measure changes in service provision, as opposed to just the number of service plants rendered inoperable. To be clear, comparing post-shock indicators against pre-shock indicators (baseline data) could provide a "difference" that may reflect observed changes attributable to the use of explosive weapons. Should a more exhaustive comparison be desirable, it would be advisable to compare observed effects against a "counterfactual" or "control scenario", allowing for a contrast between an affected setting and one that has largely remained unaffected by the use of explosive weapons (for more on the use of a counterfactual, see annex 5.1).

One approach to mapping causal chains is to subdivide indicators into three categories, depending on how closely they reflect causal pathways, for example (a) demonstrable causality, (b) reasonable association and (c) merits deeper EWIPA-related research.[18] "Demonstrable causality" can be defined as the clear existence of a causal relationship between observed cause and effect and a logical sequence between them – in this case, the observed effect being dependent on the use of explosive weapons as the sole cause. To demonstrate causality, statistical techniques are available that offer researchers the ability to isolate exogenous effects. "Reasonable association" can be defined as the existence of a relationship between the observed cause and effect, but causality is not necessarily clear. Finally, "merits deeper EWIPA-related research" can be defined as the presumption of a relationship between the use of explosive weapons and observed outcomes, but the cause and effect is not necessarily clear and neither is the existence of a relationship with exclusive dependence, meaning that other exogenous factors could be the driving factors. However, the presumption is strong enough that qualitative and anecdotal evidence is worth exploring to shed light on the possibility of a causal chain. Some statistical methodologies that use a counterfactual or control scenario might be useful in isolating observed effects for drawing causal inference (for more, see annex 5.1).[19]

Nonetheless, the increasing availability of information on instances of damage and destruction by explosive weapons offers opportunities to delineate the causal chain of the observed reverberating effects within a defined location and time period and tie in a wider qualitative description of complex interlinkages.

16 This figure is only intended to illustrate a theoretical model perspective. It is intended to show a simplified and generalized sequence of impacts. This figure does not intend to suggest that there is a mathematical relationship between point of detonation, distance, and impacts, which is manifestly not the case in urban environments, as pressure waves accelerate when they move through confined spaces of a city and dissipate in more open areas. For example, building structures and construction materials, soil types , among other factors, all influence the overall distance in which effects are realised both above, surface and sub-surface levels.

17 As an example of reverberating effects research with both quantitative and qualitive considerations, see Article 36 briefings on Health and Harm: Protecting Civilians and Protecting Health and Education and Conflict: Protecting Civilians and Protecting Education.

18 These categories are intended solely as food-for-thought or for illustrative purposes. These categories should be understood as an invitation to think about detailed methodological efforts for causal inference. For example, methodologies that risk-adjust for contributing factors can also be useful in measuring causal consequences from the use of explosive weapons, but a more detailed discussion on risk-adjusting methodologies falls outside the scope of this framework.

19 This framework suggests that reverberating effects research discusses impacts in terms of contribution or reasonable association as opposed to attribution , unless the causal chain is clearly proven. When the causal chain has been clearly demonstrated, attribution is the preferred term.

BOX 1: LOCATION AND TIME IN REVERBERATING EFFECTS RESEARCH

Location

For research purposes, reverberating effects are more easily quantified within a specific location and in a radius or in outward rings around the instance of explosive weapons use. However, this does not mean to imply that reverberating effects are limited by physical borders, follow concentric circles, or necessarily follow a linear progression. For example, if a health facility is destroyed, the impacts may be felt not only in the full catchment area the hospital services, but also in overwhelmed medical facilities in other jurisdictions as the flow of patients is redirected. Similarly, the collapse of basic services can lead to population displacement to neighbouring areas, countries or continents. Nonetheless, for quantitative research and mapping purposes, it is important to delimitate the impact radius and outward rings under study. Delimitating a radius of the affected urban ecosystems will set the parameters to quantify observed outcomes.[1] To be able to quantify the differential impact of reverberating effects along spatial dynamics, one possible research approach is to establish several outward rings as parameters to gauge how the reverberating effects spread across a defined geographical space. If done over time, following spatial parameters could also shed light on how these impacts change over time.

Time

Reverberating effects change over time and are dynamic. Specific impacts may be stronger or weaker in the immediate, medium or long-term (and there is no temporal limitation to when these effects truly end). Different reverberating effects occur in the immediate, or the medium- or long-term, aftermath of explosive weapons use. Reverberating effects can also be the result of cumulative damage from explosive weapons. However, for quantitative research purposes, it is important to clearly define and delimitate the time frame under study. Since each context is unique, "long term" can be defined differently in each scenario. **One approach is to establish several parameters or windows of time to gauge how the reverberating effects continue to expand across time periods – for example, at one week after the use of explosive weapons, at the one-month mark, and at the one-year mark and beyond – and doing so systematically for each observed indicator to gain comparable insights.** The research can be designed to capture the temporal dynamics of these effects retroactively (as they happened in the past) or prospectively (as they are unravelling and into the future). It is also important to compare observed effects after the use of explosive weapons with the same indicators in the same area before the use of explosive weapons. Such a comparison will give researchers the basis to argue that observed consequences are, to some extent, due to the use of explosive weapons. Thus, it is important to measure the consequences of explosive weapons at different time periods after their use, but always against a benchmark or baseline of indicators from before the conflict or before the use of explosive weapons.

Note on limiting reverberating effects research in relation to location and time

From a legal perspective, in line with international humanitarian law, there are no spatial or temporal limitations on reverberating effects from the use of explosive weapons that should be considered in relation to obligations for proportionality and precautions. Rather, the threshold is the "reasonable foreseeability" of such effects.

However, for research purposes, especially quantitative studies that aim to measure these effects, it is important to define the radius under consideration and the temporal limitations. Therefore, it may be important to include in the discussion of data limitations that the restrictions of the study do not have legal implications regarding the extent to which indirect or reverberating effects must be taken into account in legal assessments, and are thus only illustrative of the full extent of the damage and destruction.

1 Please note that the radius of the reverberating effects is much wider than the blast effect and do not follow a linear order, and that there are no true physical limits to the reverberating effects.

2.3 SELECTED EXAMPLES OF DATA ON DAMAGE AND DESTRUCTION OF URBAN SERVICES

The ICRC has led the way in aiding our collective understanding of the complex and interconnected nature of urban systems and the devastating knock-on effects to civilians from conflict in urban areas. In particular, the ICRC identification of the three essential elements needed to keep urban services functioning – **people, infrastructure and consumables** – has set the foundation for mapping how disruption to urban structures affects the civilian population.[20] The ICRC has also developed specific knowledge products outlining the impact of explosive weapons on urban services.[21] In addition, the ICRC has paved the way to considering the reverberating effects of explosive weapons use in populated areas as reasonably foreseeable effects that parties to conflict are obliged to take into account.[22]

It is nonetheless challenging for explosive weapons researchers to reference specific damage and destruction of key infrastructure owing to a general shortage of weapons-specific and location-specific disaggregated data. The data collected by the World Health Organization (WHO) through the Surveillance System of Attacks on Healthcare (SSA) are reliable, standardized and systemic. However, the current disaggregation of attack types makes it hard to isolate the impact of explosive weapons. This is because categories such as "violence with heavy weapons" and "violence with individual weapons" both include firearms and explosive weapons. The reason the weapons categories are not as strict as desk researchers would like is because the main reporters into the system are health care workers and health partners, and it is challenging for them to differentiate in a detailed manner between different types of weapons used, let alone under pressing circumstances. In addition, these data do not publicly disaggregate impacted personnel or patients by gender or age. The Researching the Impact of Attacks on Healthcare (RIAH) project prepared a working paper discussing conceptual issues and methodological considerations to evaluating the impact of attacks on healthcare in conflict.[23]

Article 36 has produced research exploring how the impacts of explosive weapons affect civilians and communities across space and time. Recently, Article 36 has released briefings on health and harm,[24] education and conflict,[25] and protecting civilians and harm from weapons (with particular reference to Iraq).[26] These briefings enhance the collective understanding of the impacts that explosive weapons have on civilian well-being and contribute to the goal of conflict prevention and sustainable development. Similarly, Action on Armed Violence has produced research on the long-term harm to civilians from explosive weapons. Action on Armed

20 ICRC, Urban Services during Protracted Armed Conflict: A Call for a Better Approach to Assisting Affected People, 2015, https://www.icrc.org/sites/default/files/topic/file_plus_list/4249_urban_services_during_protracted_armed_conflict.pdf.

21 M. Talhami and M. Zeitoun, 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. 1, 2017, https://international-review.icrc.org/sites/default/files/irc_97_901-6.pdf.

22 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. 1, 2017, https://international-review.icrc.org/sites/default/files/irc_97_901-9.pdf.

23 Blanchet et al., Conceptual issues and methodological approaches to evaluating the wider and longer-term impact of attacks on healthcare in conflict , Researching the Impact of Attacks on Healthcare, 2020, https://riah.manchester.ac.uk/wp-content/uploads/2021/01/Impact-Methods-Working-Paper-min-1.pdf.

24 A. de Courcy Wheeler, Health and Harm: Protecting Civilians and Protecting Health, Article 36, 2020, https://article36.org/wp-content/uploads/2020/08/A36-protecting-health.pdf.

25 A. de Courcy Wheeler and E. Minor, Education and Conflict: Protecting Civilians and Protecting Education, Article 36, 2020, https://article36.org/wp-content/uploads/2020/08/A36-protecting-education.pdf.

26 E. Minor, Protecting Civilians and Harm from Weapons: Illustrations from Iraq, Article 36, 2020, https://article36.org/wp-content/uploads/2020/08/A36-protection-weapons-iraq-1.pdf.

BOX 2: SELECTED ORGANIZATIONS PRODUCING DATA ON DAMAGE AND DESTRUCTION OF HEALTH AND EDUCATION INFRASTRUCTURE BY EXPLOSIVE WEAPONS

These organizations monitor all attacks on health care and education. Damage and destruction by explosive weapons are subsets within larger data sets that could be made available to the explosive weapons research community.

Global Coalition to Protect Education from Attack (GCPEA)

GCPEA is an inter-agency coalition formed in 2010 to address the problem of targeted attacks on education during armed conflict. Their political engagement centres on the Safe Schools Declaration. GCPEA's monitoring includes attacks on schools, universities, teachers and students by explosive weapons. The data on education under attack for the 2020 map are disaggregated by sex and age and present clear evidence of the differential impact of explosive weapons on girls, including incidence of sexual violence. However, the data are not readily available in a disaggregated format by weapons category, and data on explosive weapons vary by country and by year.

Safeguarding Health in Conflict Coalition

The Safeguarding Health in Conflict Coalition is a group of international non-governmental organizations working to protect health workers, services and infrastructure. Their political engagements focus on United Nations Security Council resolution 2286, which addresses attacks on health services in armed conflict. The report Impunity Remains, published in 2019 covering 2018 data, included a breakdown by weapons category. While the weapon-disaggregated data for 2019 exist, they have not been published.

Insecurity Insight

Insecurity Insight is a not-for-profit association that monitors attacks on health and education, as well as aid, in protection settings and disaggregates the data by weapons category. Insecurity Insight engages with aid agencies and other actors to support them in evidence-based policymaking. Data are shared on the HDX platform. The weapons disaggregation information is not yet systematically available to external users but can be made available upon request.

Violence has produced a full report on the reverberating effects of explosive weapons,[27] and several case studies linking the use of explosive weapons to health, economic, environmental, societal and cultural impacts.[28] In addition to the examples outlined above, two non-governmental coalitions, the SHCC and the Global Coalition to Protection Education from Attack (GCPEA), among others, are currently focused on building and expanding an evidence base mapping damage and destruction of health and educational infrastructure from explosive weapons.

Finally, InterAction and Stanford Health Policy have, after conducting a literature review and interdisciplinary workshop, produced a report on addressing the reverberating effects of military operations on civilian life.[29] This report is intended to document gaps and opportunities in understanding and minimizing indirect effects on civilians affected by conflict.

27 J. Dathan, When the Bombs Fall Silent: The Reverberating Effects of Explosive Weapons, Action on Armed Violence, 2018, https://aoav.org.uk/wp-content/uploads/2018/06/Reverberating-effects-v5.pdf.

28 Accessible at https://aoav.org.uk/reverberating-effects-of-explosive-violence.

29 InterAction and Stanford Health Policy, Building the Evidence Base: Addressing the Reverberating Effects of Military Operations on Civilian Life, 2020, https://www.interaction.org/wp-content/uploads/2020/11/Building-the-Evidence-Base-Workshop-Report-October-2020-FINAL.pdf.

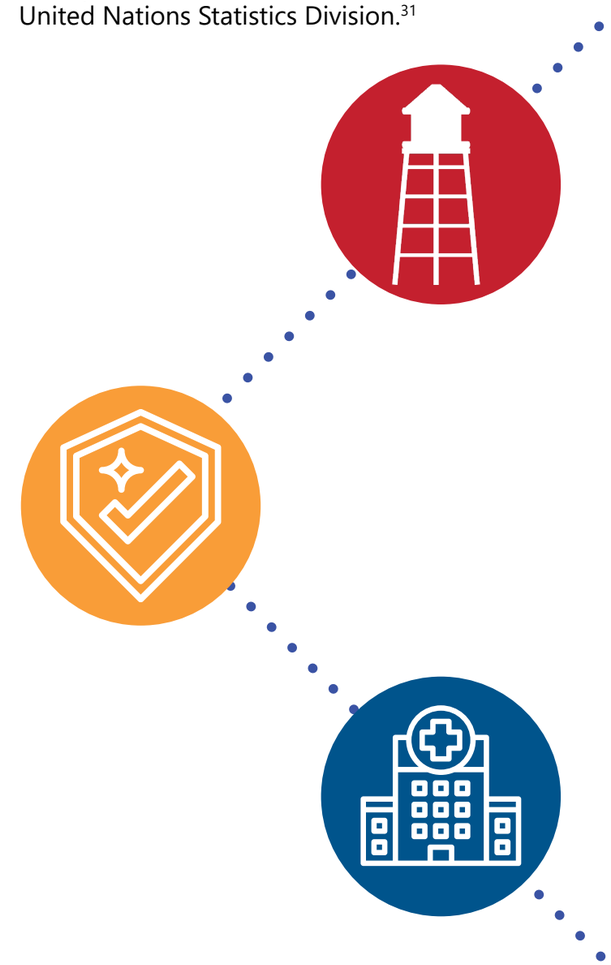
2.4 SUSTAINABLE DEVELOPMENT GOAL INDICATOR DEVELOPMENT

The 2030 Agenda for Sustainable Development recognizes that there can be no sustainable development without peace and no peace without sustainable development. It includes an indicator (16.1.2) that focuses on measuring deaths in situations of armed conflict. However, the framework does not mainstream conflict or explosive weapons-related indicators across other goals as a way of measuring how conflict, as well as damage and destruction from explosive weapons, hampers the achievement of the SDGs.

Many of the SDG indicators included in this document have been under development since 2015 within working groups for the specific areas. The aim of the framework of indicators put forward by the 2030 Agenda for Sustainable Development is to monitor global development processes based, to the greatest possible extent, on comparable and standardized national data. There is growing momentum in localizing the SDGs, with valuable granularity and disaggregation of data in public reporting.[30] However, further engagement with the SDG community is needed to consistently bring to life more disaggregated indicators at the subnational and local levels to measure specific impacts, as well as to consider the need for conflict-related indicators beyond the 2030 Agenda.

As useful as the SDG framework can be, most of the current indicators cannot be used "off the shelf" to measure the reverberating effects of explosive weapons use. Most SDG indicators are publicly available as national-level data, while reverberating effects research requires localized data for specific areas where explosive weapons have damaged and destroyed infrastructure. Therefore, the options outlined in this document use the SDG framework as a base to suggest ways to generate indicators for specific areas. Further engagement with custodian agencies and inter-agency working groups responsible for developing SDG indicators, and with political forums tasked with revising those indicators, is needed to expand on and make more widely available subnational-level data in order to map specific impacts of conflict and their relationship to development processes.

To facilitate engagement with the SDG community, focal points for each of the indicators have been appointed by the custodian agencies, reachable for queries concerning definitions, methods of computation, data or other issues. EWIPA researchers, in using the Tools discussed below, are encouraged to engage with these focal points. The full list is available from the United Nations Statistics Division.[31]



30 See https://www.global-taskforce.org/roadmap-achieving-sdgs-local-level and https://www.local2030.org/library/tools/monitoring-and-evaluation.

31 See https://unstats.un.org/sdgs/dataContacts.

3. TOOLS TO MEASURE THE REVERBERATING EFFECTS OF EXPLOSIVE WEAPONS IN POPULATED AREAS

WHAT ARE THE OBJECTIVES OF THE EWIPA REVERBERATING EFFECTS TOOLS?

- Introduce data, concepts and methods that can be used for research into reverberating effects and encourage evidence-based exchanges between different knowledge communities.
- Encourage the arms control community to use more quantitative data, as a means of generating comparable and systematic evidence.
- Build bridges between the economic development and arms control communities by using SDG indicators.
- Inform the planning, conduct of operations, and assessments of parties to conflict with a view to protecting civilians.

WHO ARE THESE TOOLS INTENDED FOR?

- These Tools are for researchers on reverberating effects and all interested stakeholders. Using this document is voluntary and carries no reporting requirements, nor does it generate any commitment. It is framed around the SDGs to help researchers benefit from global indicators and shed light on potential disruptions to development processes, but it should not be understood as limited or exclusively tied to the 2030 Agenda for Sustainable Development.

HOW SHOULD THE TOOLS BE USED?

- The Tools are a menu of ideas. Researchers are free to pick and choose specific data or indicators that fit their research projects or focus areas.
- The Tools are the starting point, not a full blueprint.
- The suggested indicators are meant to trigger ideas for new approaches. While some of the suggested indicators are taken directly from the SDG framework and therefore follow established standards, they do not need to be used exactly as specified. Researchers may follow pre-established standards or otherwise adapt the indicators to suit their needs.
- The Tools are meant to contribute to the process of thinking of urban environments as ecosystems. As more data becomes available and more researchers use it, practices will evolve, ideas may be refined, and this document might be updated.
- This document should be considered as a food-for-thought menu of indicators, meaning that its use does not guarantee that observed outcomes are causally linked to the use of explosive weapons. Rather, it is an attempt to explore the relation.

WHAT CAN BE ACHIEVED WITH THESE TOOLS?

- An evidence base to support the development of enhanced policy and practice aimed at protecting civilians and civilian structures from explosive weapons use
- Increased engagement with data to generate systematic, disaggregated and comparable evidence

TABLE 1: SUMMARY OF INDICATORS TO MEASURE THE IMPACT CHAIN OF EXPLOSIVE WEAPONS USE, PER FOCUS AREA

FOCUS AREA	LEVEL OF EFFECT	INDICATORS	LEVEL OF CERTAINTY (ANTICIPATED)
16 PEACE, JUSTICE AND STRONG INSTITUTIONS	**Primary and/or secondary effects:** Direct civilian deaths and injuries	Number of direct civilian deaths and injuries from explosive weapons , disaggregated by gender and age	Demonstrable causality
	Reverberating effects: Indirect civilian deaths and injuries	Number of indirect civilian deaths and injuries from explosive weapons, disaggregated by gender and age	Merits deeper EWIPA-related research
11 SUSTAINABLE CITIES AND COMMUNITIES	**First level:** Damage and destruction	Number or proportion of housing or shelter damaged or destroyed by explosive weapons	Demonstrable causality
		Number or proportion of cultural property damaged or destroyed by explosive weapons	
		Number or proportion of service plants and installations damaged or destroyed by explosive weapons	
		Proportion of transport network damaged or destroyed by explosive weapons	
	Second level: Changes in key services caused by the damage and destruction	Number or proportion of key services disrupted, including water, wastewater and solid waste management, electricity, transport networks, and communications	
	Third level: Changes in civilian well-being as a result of the changes in key services caused by the damage and destruction	Number or proportion of population displaced, disaggregated by gender and age	Merits deeper EWIPA-related research
		Number of deaths, missing persons and persons affected by explosive weapons per 100,000 population, disaggregated by gender and age	
3 GOOD HEALTH AND WELL-BEING	**First level:** Damage and destruction	Number or proportion of health facilities damaged or destroyed by explosive weapons	Demonstrable causality
		Number of health workers killed or injured by explosive weapons, disaggregated by gender	
		Shortages in essential medical supplies	
		Number or proportion of ambulances destroyed (locally)	
	Second level: Changes in key services caused by the damage and destruction	Number or proportion of health facilities with service disruptions	
		Health worker density and distribution per 10,000 population, compared with pre-conflict	Reasonable association
		Difference in proportion of births attended by skilled health personnel, compared with pre-conflict	
		Difference in proportion of the population with access to affordable medicines and vaccines, compared with pre-conflict	
	Third level: Changes in civilian well-being as a result of the changes in key services caused by the damage and destruction	Difference in maternal, neonatal and under-five mortality, compared with pre-conflict	Merits deeper EWIPA-related research
		Difference in mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease, compared with pre-conflict	
		Difference in reported cases of and number of deaths from preventable diseases such as cholera, measles or polio or changes in the life expectancy of HIV-positive patients, compared with pre-conflict	
4 QUALITY EDUCATION	**First level:** Damage and destruction	Number or proportion of education facilities damaged or destroyed by explosive weapons	Demonstrable causality
		Number or proportion of educators killed or injured by explosive weapons, disaggregated by gender	
	Second level: Changes in key services caused by the damage and destruction	Number or proportion of education facilities with service disruptions, including Internet	
		Number of schooling days lost	Reasonable association
		Number or proportion of children without access to schooling, disaggregated by gender and age	
	Third level: Changes in civilian well-being as a result of the changes in key services caused by the damage and destruction	Number, proportion or rate of students who drop out of schooling, disaggregated by gender	Merits deeper EWIPA-related research
		Proportion of students achieving at least a minimum proficiency level in reading and mathematics, disaggregated by gender	
		Proportion of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, disaggregated by gender	

SECTION 3.1: MEASURING CIVILIAN DEATHS AND INJURIES FROM EXPLOSIVE WEAPONS

SUMMARY TABLE: SDG 16 — PEACE, JUSTICE, AND STRONG INSTITUTIONS

LEVEL OF EFFECT	FOCUS	SUGGESTED INDICATOR	REVERBERATING EFFECTS CHAIN	HOW TO USE THE INDICATOR	TEMPORAL OBSERVATION
Primary and/ or secondary effects: Direct civilian deaths and injuries	Direct civilian deaths and injuries from the use of explosive weapons, including from blast or, for example, from falling and flying debris	Indicator I: Number of direct civilian deaths and injuries from explosive weapons, disaggregated by gender and age	The use of explosive weapons kills and injures people These deaths and injuries can be primary effects (if incurred directly from the blast) or secondary effects (if incurred from falling and flying debris) of the use of explosive weapons	To describe direct mortality from the use of explosive weapons To describe the long-term consequences for those injured by explosive weapons	Immediate –deaths and injuries caused directly by the detonation Medium term –deaths from injuries sustained in the blast or from falling and flying debris Long term – lifelong disabilities from injuries
Reverberating effects: Indirect civilian deaths and injuries	Indirect civilian deaths and injuries from the use of explosive weapons	Indicator II: Number of indirect civilian deaths and injuries from explosive weapons, disaggregated by gender and age	Damage and destruction caused by explosive weapons contribute to elevated mortality These indirect or excess deaths and injuries result from a loss of access to essential goods and services as a consequence of explosive weapons use	To describe the excess mortality or indirect civilian losses and injuries from the reverberating effects of explosive weapons use	Immediate, medium term, and long term – directly or indirectly (through the damage caused to civilian structures or the wider societal effects from deaths and injuries)

INTRODUCTION TO CASUALTY COUNTS FROM EXPLOSIVE WEAPONS USE

The blast and heat effects of explosive weapons can kill and injure civilians. The falling and flying debris and other materials from urban areas damaged by explosive weapons can also kill and injure. These are part of the primary and secondary effects of explosive weapons use in populated areas. The reverberating effects of explosive weapons that result in changes to key services due to damage and destruction contribute to elevated mortality or excess deaths. These effects can be considered a second or third-level impact within the reverberating effect impact chain. Death and injury have far-reaching consequences for families and communities, ranging from economic to mental health impacts, and constitute a third-level impact of explosive weapons use.

Casualty counts are one of the most common ways to describe the direct impact of violence from explosive weapons. Within a reverberating effects impact chain, casualty counts can also be considered within the second and third level. For example, the death rate among a particular population group, such as health care workers or educators, impacts the availability and quality of health or education services. Further, when family members are killed or injured, there are profound implications for mental health and economic losses, among other consequences. These second- and third-level impacts of deaths and injuries are considered within the indicators for the sectors of sustainable cities and communities, health, and education (section 3.2).

INDICATOR I: NUMBER OF DIRECT CIVILIAN DEATHS AND INJURIES FROM EXPLOSIVE WEAPONS, DISAGGREGATED BY GENDER AND AGE

Definition: Absolute number of civilians directly killed or injured by explosive weapons, either from blast injuries or from falling and flying debris caused by, for example, collapsing buildings, shattered windows, damaged vehicles, or damaged road or pavement surfaces.

Rationale: The number of deaths provides information on the direct loss of human life. The number of people injured, and the types of injury, captures the primary and secondary effects of explosive weapons on the civilian population.

INDICATOR II: NUMBER OF INDIRECT CIVILIAN DEATHS AND INJURIES FROM EXPLOSIVE WEAPONS, DISAGGREGATED BY GENDER AND AGE

Definition: Absolute number of indirect deaths and injuries or excess civilian deaths resulting from a loss of access to essential goods and services as a consequence of explosive weapons use.

Rationale: The number of indirect deaths and injuries as a result of damage and destruction caused by explosive weapons provides information on the loss of human life and injuries through indirect pathways. For example, a patient in critical care that passes away as a result of disruptions to the electric grid from the use of EWIPA, would be an immediate and indirect effect.

BOX 3: DIRECT DEATHS AND INJURIES AND THE REVERBERATING EFFECTS

The death of an individual can have life-altering impacts on their family: loss of income, disputed property rights, mental health consequences, and more. Similarly, injuries following the use of explosive weapons can lead to lifelong disabilities or hampered economic opportunities, spurring additional reverberating effects. The killing and injury of people from the use of explosive weapons are direct effects, while the consequences of these killings and injuries are considered reverberating effects.

AVAILABLE DATA ON CASUALTIES FROM EXPLOSIVE WEAPONS USE:

Action on Armed Violence
A commonly cited source of information on casualties from the use of EWIPA is the data collected by Action on Armed Violence. These counts cover the direct casualties from explosive weapons use, as reported in English-speaking media, complemented with other qualitative research methods. Although commonly cited, these data are likely to be underestimates owing to the nature of the methodology used (media monitoring). The information nonetheless can be used to describe the known number of people directedly affected.

Paediatric Blast Injury Partnership
Save the Children partnered with Imperial College London and a host of medical and operational experts to develop the Paediatric Blast Injury Field Manual for treating blast injuries in children. This field manual is made available to first responders, doctors and surgeons, and those providing aftercare for children in the most dangerous places in the world. The associated 2019 publication Blast Injuries: The Impact of Explosive Weapons on Children in Conflict includes some data on deaths among children caused by explosive weapons.

Similar initiatives might have disaggregated data on the reasons for the need for prosthetic devices. If such information is available, it could provide an approximate number or estimate of life-altering injuries, reductions in quality of life, costs associated with prosthetic devices, or costs associated with rehabilitation services (medium and long term), in both children and adults.

Office of the United Nations High Commissioner for Human Rights

The Office of the United Nations High Commissioner for Human Rights (OHCHR) has carried out casualty recording since 2007, individually documenting and verifying casualties. It has published casualty data from Afghanistan, the Central African Republic, the Democratic Republic of the Congo, Iraq, Libya, Mali, Somalia, South Sudan, the State of Palestine, Ukraine and Yemen, among other areas. OHCHR continues to build on this work through its engagement with the Security Council's Protection of Civilians Agenda and as a custodian for the SDG indicator on conflict-related deaths (16.1.2).

- OHCHR has developed Guidance on Casualty Recording and regularly releases data for specific countries (see the SDG indicator 16.1.2 discussion).
- OHCHR has made relevant data public for SDG indicator 16.1.2 for the period 2015–17, covering some of the deadliest armed conflicts in the world (see the SDG indicator 16.1.2 discussion below).[32]

32 However, these reports do not disaggregate conflict-related deaths caused by explosive weapons.

SDG FRAMEWORK

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

INDICATOR 16.1.2:
CONFLICT-RELATED DEATHS PER 100,000 POPULATION, BY GENDER, AGE AND CAUSE

SDG REFERENCE:
16.1.2, classified as "established methodology and standards are available, but data are not regularly produced by countries" (Tier 2)

DEFINITION:
This indicator is defined as the total count of conflict-related deaths divided by the total population, expressed per 100,000 population.

RATIONALE:
This indicator measures the impact of armed conflict in terms of loss of life.

COMPUTATION METHOD:
The indicator is calculated as the total count of conflict-related deaths of civilians divided by the total resident population in a given situation of armed conflict for the year, expressed per 100,000 population, occurring within the preceding 12 months.

The total count of conflict-related deaths includes, first, the total number of documented direct deaths, using all potentially relevant data sources (e.g. United Nations peace missions, national statistical offices, national human rights institutions, civil society organizations). Depending on the magnitude of conflict-related deaths, the capacity of data providers, and other contextual and practical considerations, statistical estimation techniques are used to include undocumented deaths directly linked to the armed conflict. Further work will be needed to include deaths indirectly linked to the armed conflict through reverberating effects (e.g. loss of access to essential goods and services). Existing data must be updated regularly and retrospectively, reflecting the emergence of new data over time.

DATA DISAGGREGATION:
OHCHR-recommended disaggregation:
- Gender of person killed[33]
- Age group of victim (adult [18 years and older], child [under 18 years], unknown)
- Cause of death (heavy weapons and explosive munitions; planted explosives and unexploded ordnance; small arms and light weapons; incendiary weapons; chemical, biological, radiological and nuclear weapons; electromagnetic weapons; less lethal weapons; denial of access to or destruction of objects indispensable to survival; accidents related to conflict; use of objects and other means; unknown)
- Status of the person killed (civilian, other protected person, member of armed forces, person directly participating in hostilities, unknown)

33 The SDG Indicator, as outlined by the custodian agency, recommended sex-disaggregated data. For the purpose of this document, the recommended disaggregation has been adapted to favour gender-disaggregated data. The term gender-disaggregated data has been favoured to encourage data collectors to include and present separately all forms of gender identity.

CONCEPTS:

Conflict: According to IHL, two types of armed conflict exist: international armed conflict (IAC) and non-international armed conflict (NIAC).
IAC exists whenever there is resort to armed force between two or more States. An IAC does not exist if the use of force is the result of an error (e.g. involuntary incursion into foreign territory, a wrongly identified target) or when the territorial State has given its consent to an intervention.

NIAC comprises armed confrontations between governmental armed forces and the forces of one or more armed groups, or between such groups, arising on the territory of a State. The armed confrontation must reach a "minimum level of intensity", and the parties involved in the conflict must show a "minimum of organization".

Conflict-related deaths: Direct deaths are deaths for which there are reasonable grounds to believe that they resulted directly from armed operations and that the acts, decisions and/or purposes that caused these deaths were in furtherance of or under the guise of armed conflict.

These deaths may have been caused by (a) the use of weapons or (b) other means and methods. Deaths caused by the use of weapons include those inflicted by firearms, missiles, mines and bladed weapons. They may also include deaths resulting from aerial attacks and bombardments (e.g. of military bases, cities and villages), crossfire, explosive remnants of war, targeted killings or assassinations, or force protection incidents. Deaths caused by other means and methods may include deaths from torture or sexual and gender-based violence, intentional killing through starvation, depriving prisoners of access to health care, or denying access to essential goods and services (e.g. an ambulance being stopped at a checkpoint).

Indirect deaths are deaths resulting from a loss of access to essential goods and services (e.g. economic slowdown, shortages of medicines or reduced farming capacity that result in lack of access to adequate food, water, sanitation, health care and safe conditions of work) that are caused or aggravated by the situation of armed conflict.

Cause: The weapons, means and methods, or pathways that caused the conflict-related deaths.

Population: The total resident population in a given situation of armed conflict in a given year in a particular area. Population data are derived from annual estimates produced by the United Nations Population Division.[34]

ATTENTION:

The concept of indirect deaths is the same as deaths caused by reverberating effects. For example, maternal, neonatal, cardiovascular or cancer deaths that can be linked to the reduction in health services following the use of explosive weapons can be considered indirect deaths.

34 Note that attention should be paid to include displaced persons living in an area deemed as a situation of armed conflict in all population estimates.

COMMENTS AND LIMITATIONS:

In situations of armed conflict, a large share of deaths may not be reported. Often, registration systems are heavily affected by the presence of armed conflict. Additionally, actors may have incentives for misreporting, deflating or inflating casualties. In most instances, the number of cases reported will depend on access to conflict zones; access to information; and the motivation and perseverance of international and national actors, such as United Nations peace missions and other internationally mandated entities, national institutions (e.g. national statistical offices, national human rights institutions) and relevant civil society organizations.

NOTE:

The OHCHR data for 2015–17 include disaggregation at the level of "cause", including "heavy weapons and explosive munitions". These data, as reported for the 2015–17 period, have considerable potential to serve as a baseline for analysis and for future research to replicate and build on. Should other associated metadata be made available to independent, government or United Nations researchers, including on location, it might be useful to correlate the use of such weapons in populated areas with other indicators. Importantly, the methodology for this indicator could be promoted to standardize similar data collected by third parties, especially with respect to the disaggregation of "cause".

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 16.1.2 and Technical Guidance Note on SDG Indicator 16.1.2.

Additional guidance and resources are available from the following sources:

- Report of the Secretary-General, Progress towards the Sustainable Development Goals Statistical Annex, p. 151
- The Sustainable Development Goals Report 2020
- The Sustainable Development Goals Story Map 2020
- Web story on Indicator 16.1.2 and indicators under OHCHR custodianship

LIST OF OHCHR REPORTS PER CONFLICT:

- **Afghanistan**: Human Rights Service of the United Nations Assistance Mission in Afghanistan, accessible here
- **Central African Republic:** Human Rights Division of the Multidimensional Integrated Stabilization Mission in the Central African Republic, accessible here
- **Democratic Republic of the Congo:** United Nations Joint Human Rights Office of the Human Rights Division of the United Nations Organization Stabilization Mission in the Democratic Republic of the Congo, accessible here
- **Iraq**: Human Rights Service of the United Nations Assistance Mission for Iraq, accessible here
- **Libya**: United Nations Support Mission in Libya, accessible here
- **Mali**: United Nations Multidimensional Integrated Stabilization Mission in Mali, accessible here
- **Occupied Palestinian territory and Israel:** United Nations Office for the Coordination of Humanitarian Affairs, accessible here
- **Somalia**: Human Rights and Protection Group of the United Nations Assistance Mission in Somalia, accessible here
- **South Sudan**: Human Rights Division of the United Nations Mission in South Sudan, accessible here
- **Ukraine**: United Nations Human Rights Monitoring Mission in Ukraine, accessible here
- **Yemen**: Office of the United Nations High Commissioner for Human Rights in Yemen, accessible here

SECTION 3.2: MEASURING THE IMPACT CHAIN OF EXPLOSIVE WEAPONS USE ON CIVILIAN WELL-BEING

SUMMARY TABLE: SDG 11 — SUSTAINABLE CITIES AND COMMUNITIES

LEVEL OF EFFECT	FOCUS	SUGGESTED INDICATOR	REVERBERATING EFFECTS CHAIN	HOW TO USE THE INDICATOR	TEMPORAL OBSERVATION
First level: Damage and destruction	Damage and destruction of housing or shelter	Indicator I: Number or proportion of housing or shelter damaged or destroyed by explosive weapons	Damage and destruction of housing and shelter causes civilian deaths and displacement	To describe the scale of urban destruction	Immediate –destruction of housing and shelter
	Damage and destruction of cultural property	Indicator II: Number or proportion of cultural property damaged or destroyed by explosive weapons	Damage and destruction of cultural property affects the identity of people and place	To describe the scale of the destruction of cultural property	Immediate –destruction of cultural property and loss of associated economic activity Long term –cultural identity
	Damage and destruction of service plants and installations	Indicator III: Number or proportion of service plants and installations damaged or destroyed by explosive weapons	Damage and destruction of service plants and installations, which are interconnected to a larger infrastructural urban system, affects the services provided and hinders progress in cities and communities	To describe the scale of the destruction of service plants and installations To estimate the extent to which services are interrupted	Immediate – the destruction of service plants and installations
	Damage and destruction of transport networks	Indicator IV: Proportion of transport network damaged or destroyed by explosive weapons	Damage and destruction of the transport network affects the services provided and hinders the functioning of overall urban ecosystems	To describe the scale of the destruction of the transport network To estimate the extent to which services are interrupted	Immediate –the destruction transport networks
Second level: Changes in key services caused by the damage and destruction	Disruption of key services and transport services	Indicator V: Number or proportion of key services disrupted, including water, wastewater and solid waste management, electricity, transport networks, and communications	Disruption of key services and transport networks affects the economy, public health and living standards	To describe the scale of service disruption	Immediate –observable changes in public health, living standards and economic activity Medium term – for the duration of interruption of key services and transport networks Long term –the compounding effects on civilians
Third level: Changes in civilian well-being as a result of the changes in key services caused by the damage and destruction	Displacement triggered by explosive weapons use	Indicator VI: Number or proportion of population displaced, disaggregated by gender and age	Damage and destruction of housing, loss of access to essential services, and a shrinking economy (including loss of income and depletion of savings), as well as security risks, trigger or contribute to displacement Displacement can lead to diminished economic earnings, poor health or loss of educational opportunities	To capture the reverberating effect of displacement, which usually leads to additional reverberating effects	Immediate –displacement after specific events Medium term – numbers of displaced people Long term – the compounding effects experienced by displaced populations and neighbouring communities
	Population affected by explosive weapons per 100,000 people	Indicator VII: Number of deaths, missing persons and persons affected by explosive weapons per 100,000 population, disaggregated by gender and age	This indicator provides a high-level overview of the proportion of a given population that is affected, directly or indirectly, by the use of explosive weapons This indicator is an adaptation of the SDG indicator intended to calculate harm to the population from natural disasters	To measure the scale of civilian impact in a form that allows for comparison between different places or periods in time	Immediate –the civilian impact of individual events Medium term – the civilian impact for a short and particular period, such as a few months Long term –the cumulative civilian impact from the use of explosive weapons

INTRODUCTION TO THE EFFECTS OF EXPLOSIVE WEAPONS ON CITIES AND COMMUNITIES

Widespread destruction of residential buildings and shelters by explosive weapons deprives people of safe, adequate, affordable and available housing. Damage and destruction of cultural property and civic spaces severely affects the identity of cities and communities. Explosive weapons can damage public services and transport networks. Damage or destruction of electricity or water installations has far-reaching effects on the economy and living standards and will spark many downstream effects on access to food, water, public health and sanitation, health care, and communications, as well as damage to the environment. Damage and destruction of water plants, wastewater treatment plants, and solid waste management infrastructure reduces living standards and engenders health risks.

The use of explosive weapons in urban areas leads to casualties, injuries, displacement health risks and disease outbreaks, among other negative effects. Injuries from explosive weapons, loss of life and displacement lead to additional reverberating effects. Some of these can be measured by looking at the reverberating effects on health and education, using the SDG framework. **The indicators of SDG 11 do not include suggested measurements for mortality or displacement as a result of conflict, only as a result of natural hazards and natural hazard events. The SDG 11 indicator for mortality is listed below, adapted from natural hazard events to capture the consequences of the use of EWIPA.**

The effects that explosive weapons have on cities and communities can be primary, secondary and tertiary (or reverberating), and an adapted version of the SDG framework can be used to capture these three levels of effects of explosive weapons use. The following Tool proposes indicators to measure the impact chain of explosive weapons use on cities and communities, divided into three sections:
(A) indicators on damage and destruction
(B) indicators on the changes in key services caused by the damage and destruction, and
(C) indicators on the changes in civilian well-being as a result of the changes in key services caused by the damage and destruction. In this impact chain disaggregation, the first-level indicators (section A) look at primary or secondary effects, and the second- and third-level indicators (sections B and C) look at reverberating effects.

In sections B and C, the suggested indicators to measure the reverberating effects follow three general focus areas: *service disruption* (immediate and medium-term oriented) due to interrupted utilities; *displacement triggered by explosive weapons use* (immediate, medium, and long term oriented), focusing on numbers of displaced people and neighbouring communities; and *mortality, missing persons, injuries and disabilities from explosive weapons use* (immediate, medium and long-term oriented), focusing on the physical harm from explosive weapons use.

SECTION A: INDICATORS ON DAMAGE AND DESTRUCTION

To measure the immediate effects of the use of explosive weapons on cities and communities in terms of damage and destruction, research efforts can ask: *What amount (number or proportion) of housing or shelter is affected by explosive weapons use in particular areas? Which cultural monuments have been damaged or destroyed by explosive weapons? Which service plants and installations, and what proportion of their service, have been affected by explosive weapons use due to damage and destruction and to loss of trained staff? To what extent has the transport network been affected by the use of explosive weapons, and how has the reduction in services affected the catchment area?*

Against this background, the suggested first-level effect indicators, explained in more detail below, capture the number and/or extent of disrupted or unusable housing, utilities and transport systems due to the use of explosive weapons and the extent of damage and destruction of cultural monuments.

INDICATOR I: NUMBER OR PROPORTION OF HOUSING OR SHELTER DAMAGED OR DESTROYED BY EXPLOSIVE WEAPONS

Definition: Amount (number or proportion) of housing or shelter damaged or destroyed by explosive weapons

Rationale: The scale of damage and destruction of housing and shelter provides information on the extent to which the use of EWIPA directly and immediately affects the sustainability of cities and communities.

Data on damage and destruction of housing:
There is no readily available source of data on explosive weapons use affecting housing, shelter, and human settlements at present. Assessment of damage and destruction are carried out for specific towns or neighbourhoods by a wide range of actors, from local authorities to aid agencies. Potential information sources will be different for each location and have to be identified on a case-by-case basis. Depending on the data available, the information can be used to describe damage and destruction by geographic area, proportion of housing and shelter affected, or number of people affected.

Options to identify towns or neighbourhoods with significant destruction by explosive weapons:
- Review situation reports issued by United Nations humanitarian agencies.
- Read Airwars reports for airstrikes on specific towns (e.g. Seeing Through the Rubble: The Civilian Impact of the Use of Explosive Weapons in the Fight against ISIS).
- Contact Airwars for data on specific locations, such as Mosul or Raqqa.
- Review studies (e.g. Destruction of Raqqa) from Amnesty International and Bellingcat for relevant information on specific towns.
- Once the affected town or neighbourhood is identified, search for local partners who may have more detailed data on the housing stock damaged by explosive weapons.
- Consult national and local government offices, including cultural ministries.
- Consider satellite imagery analysis available from the the Operational Satellite Applications Programme of the United Nations Institute for Training and Research.
- Consider crowdsourcing data from open sources.

BOX 4: DESTRUCTION OF HOUSING AND THE POTENTIAL FOR CADASTRE AND PROPERTY OR LAND DISPUTES

Destruction of housing spurs a cycle of compounding impacts, including second- and third-level (reverberating) effects on the displaced populations and the communities that witness inflow or outflow of displaced persons. One such possible impact is the potential for cadastre and property or land disputes. Property and land disputes are a complex issue for communities and are triggered, prompted or worsened when housing and buildings are impacted and damaged by explosive weapons or after structural or urban neglect post-destruction. Destruction, damage or neglect create opportunities for competing claims or sources of new grievances leading to, potentially, community unrest or conflict. Similarly, the impact of explosive weapons – whether the immediate explosive blast, the effects of the blast, or as unexploded ordnance and explosive remnants of war – in making arable land unusable or unproductive accentuates or accelerates resource constraints and competition for scarce resources; this in turn can lead to community unrest or conflict. In addition, forced displacement creates further scenarios for competing claims over land or properties and strain on resources, which again can lead to community unrest or conflict. While these second- and third-level effects are beyond the scope of this framework, they ought to be considered when documenting reverberating effects and are planned for inclusion in future iterations of this framework.

INDICATOR II: NUMBER OR PROPORTION OF CULTURAL PROPERTY DAMAGED OR DESTROYED BY EXPLOSIVE WEAPONS

Definition: Absolute number or proportion of cultural property damaged or destroyed by explosive weapons.

Rationale: The scale of damage and destruction of cultural property provides information on the extent to which the use of EWIPA affects the cultural and wider identity of cities and communities. While the observed effect is direct and immediate, it can also leave long-lasting consequences for the cultural identity of the affected community. In addition, losing cultural property can affect local economies, as some installations can be a source of direct revenue for the affected area, with positive externalities for the wider economy.

Data on damage and destruction of cultural monuments:
There is no comprehensive global source of data on damage and destruction of cultural property at present. Various organizations monitor such damage and can provide information on a case-by-case basis. If the appropriate information is available, it can be used to describe damage and destruction, as well as the historical or cultural significance..

Sources to review for damage and destruction of cultural propertys:
- Blue Shield International
- UNESCO
- The news magazine of the American Historical Association
- Artnet News
- National and local government offices, including cultural ministries

INDICATOR III: NUMBER OR PROPORTION OF SERVICE PLANTS AND INSTALLATIONS DAMAGED OR DESTROYED BY EXPLOSIVE WEAPONS

Definition: Absolute number or proportion of service plants and installations damaged or destroyed by explosive weapons.

Rationale: The scale of damage and destruction of service plants and installations provides information on how interconnected cities and communities are affected by the use of EWIPA. This indicator can be used to describe or estimate the impact on the wider economy, public health and quality of life, including the immediate health consequences from inadequate water treatment and waste management. The service plants and installations in this indicator might include water installations, wastewater treatment installations, solid waste management infrastructure, electricity installations, or other service plants and utilities. They could be more broadly represented by grouping them into water, energy (production and distribution), and sanitation. This indicator captures a large proportion of the destruction and damage that causes many of the knock-on effects and severe consequences of explosive weapons use on civilians, as part of an interconnected system of cities and communities: the interruption of essential services hinders economic activity, reduces living standards, and engenders health risks.

Data on damage and destruction of service plants and installations:
There is no readily available global data source on explosive weapons affecting service plants and installations at present. Assessment of damage and destruction is carried out for specific towns or neighbourhoods by a wide range of actors, from local authorities to aid agencies. Potential information sources will be different for each location and have to be identified on a case-by-case basis. In addition, media reports can be used to document where disrupted utilities are reported.

Depending on the data available, the information can be used to describe damage and destruction by geographic area, how it affects a particular sector of the economy or human activity (including public health risks and disease outbreaks) or the quantity of services lost and/or the number of people affected by disruption or complete loss of services.

Sources that review damage and destruction of urban utilities systems as essential services:
- M. Zeitoun and M. Talhami, "The Impact of Explosive Weapons on Urban Services: Reverberating Effects across Space and Time." Also accessible here.
- World Bank Damage and Needs Assessments, available for particular conflict-affected settings, for example Iraq.

INDICATOR IV: PROPORTION OF TRANSPORT NETWORK DAMAGED OR DESTROYED BY EXPLOSIVE WEAPONS

Definition: The extent to which the transport network has been damaged or destroyed and the proportion of transport networks that have reduced operations as a result of explosive weapons use. This indicator could include bridge and road damage, fuel or electricity shortage or similar, and direct damage and destruction of bus, train and tram systems.

Rationale: The scale of reduction in transport services as a result of damage and destruction provides information on how interconnected cities and communities are affected by the use of EWIPA. This information can be used to describe or estimate the impact on the

wider economy, public health and quality of life. Transport networks are vital to the urban ecosystem and keep interconnected systems functioning. Disruption of transport networks (including delays) affect the entire functioning of an urban space and have reinforcing consequences.

While transport networks tend to have alternatives that allow movement and access to continue after damage, disruption or destruction (with delays), when there are no alternatives or the alternatives are not sufficient to mitigate significant delays, the destruction of transport networks can also impact the delivery of humanitarian assistance and the ability to operate, maintain and repair other essential services like water, wastewater, electricity and health facilities. For example, disruption of a bridge might prevent the delivery of spare parts and consumables from a warehouse or a stockyard to a service installation that needs repairing, creating a reinforcing loop of negative consequences for civilians and civilian structures.

Data on damage and destruction of transport networks:
There is no readily available global data source on explosive weapons disrupting transport networks at present. Assessment of damage and destruction can be carried out for specific networks. Potential information sources will be different for each location, and they have to be identified on a case-by-case basis. Media reports can be used to document damage to the transport network for high-profile events. An alternative way of assessing the changes in transport services could be comparing timetables and service delivery before and after key explosive weapons events.

Depending on the data available, the information can be used to describe delays or reductions in available services for a particular geographic area and how this affects access to key essential services, including health and education as well as humanitarian access.

SECTION B: INDICATORS ON THE CHANGES IN KEY SERVICES CAUSED BY THE DAMAGE AND DESTRUCTION

To measure the second-level effects that resulted from the damage and destruction in cities and communities, research efforts can ask: *Which key services have been affected? Have service plants been destroyed? How profound is the disruption to key services and the transport service?*

The extent of disruption to key services and the transport network, following damage and destruction by explosive weapons, can then be used to describe the wider effects on cities and communities and their consequences for the well-being of civilians. Wider reverberating effects and negative externalities for displaced populations can be measured using indicators on health and education (see the sections on SDG 3 and SDG 4).

INDICATOR V: NUMBER OR PROPORTION OF KEY SERVICES DISRUPTED, INCLUDING WATER, WASTEWATER AND SOLID WASTE MANAGEMENT, ELECTRICITY, TRANSPORT NETWORKS, AND COMMUNICATIONS

Definition: The number or proportion of key services experiencing disruption, including a description of how profound the disruption is, and key elements that experience a decline in services as a result of damage and destruction by explosive weapons.
Rationale: The extent to which key services have deteriorated as a result of explosive weapons use is a key measure to capture the wider reverberating effects on cities and communities from explosive weapons use. Uninterrupted services and utilities are key to urban ecosystems and facilitate economic exchange, support public health mechanisms, and improve living standards. Disruptions to services will affect the interconnected structures of cities and communities. *A complementary approach to this indicator would be to map and identify the number or proportion of the civilian population affected by the disruption of key services. Measuring the affected population, using the documented catchment area or technological mapping advances, would provide important insights.*

Data on service disruption following damage and destruction by explosive weapons:
There is no comprehensive global data source on damage and destruction of key services or transport networks. The availability of such information will depend on the situation on the ground. If available, these data are key to describing the wider impact on cities and communities from the use of explosive weapons.

Sources to review for damage and destruction of key services, the transport network and other services experiencing disruption:

- Case studies of specific air strikes on components of the transport network, such as the school bus bombing in Yemen in 2018. See work by Amnesty International and Bellingcat.
- Media reports, which often document transport networks being attacked by explosive weapons, for example:
  - » New York Times on a passenger train outside of Rehovoth
  - » Los Angeles Times on a train bombing in Peru
  - » BBC on the bombing of a train in Sri Lanka
- Historical work on strategic bombing on infrastructure, which exists but tends to look at the issue from a perspective of war strategies rather than impact on civilians. For example, there is significant literature on World War II bombing campaigns.

Alternative research approaches:
The information may not be readily available. If so, research on the reverberating effects can focus on generating related indicators. The following questions could be pertinent:

- Is it possible to use commercial software to map key services or transport networks within a city and gauge the interconnectedness of these structures? If so, can researchers identify the extent of service disruption for a specific area?
- Can system dynamics offer useful insights into the consequences of disruption in interconnected structures?
- Can qualitative interviews or surveys be used to obtain information from the affected community regarding the extent to which the community experiences disruptions in key areas of urban life due to reduced access to public transportation?
- Have aid or advocacy agencies compiled any systematic reports?
- Can anecdotal information be found in media sources?
- Is it possible to identify the extent to which access to health, education and other key services has been disrupted by damage and destruction of the transport network? If so, can the health consequences and disease outbreaks be traced and linked to the disruption of the urban ecosystem?
- Is it possible to identify to what extent humanitarian access has been affected as a result of damage and destruction of the transport network?

SECTION C: INDICATORS ON THE CHANGES IN CIVILIAN WELL-BEING AS A RESULT OF THE CHANGES IN KEY SERVICES CAUSED BY THE DAMAGE AND DESTRUCTION

To measure the third-level effects, changes in civilian well-being that resulted from changes in key services caused by damage and destruction, research efforts can ask: *How many people have been affected? What are the direct and indirect pathways leadings to these effects? Are changes to the urban ecosystem driving displacement?*

INDICATOR VI: NUMBER OR PROPORTION OF POPULATION DISPLACED, DISAGGREGATED BY GENDER AND AGE

Definition: Number or proportion of the population who, as a result of explosive weapons use, left the homes they lived in prior to the start of the use of explosive weapons, or the number or proportion of the population who left a particular area following specific incidents of explosive weapons use.

Rationale: The scale of displacement provides information on the extent to which life is interrupted following the use of EWIPA. It is common for displaced people to experience further displacements and increased vulnerability to violence and other threats to their life and well-being. In addition, displacement can bring changes for the communities that host or receive the displaced populations, often neighbouring settlements – thus shifting the human environment in different settings.

Data on levels of displacement linked to explosive weapons use:
Global data on displacement do not usually provide information on the direct causes of displacement, nor is displacement necessarily caused by just one factor. Drawing causal links between the reported numbers or proportion of displaced individuals due to the use of explosive weapons is a key challenge. Nonetheless, if available, the information can be used to attribute the scale of displacement due to a shock event or to the cumulative effects from the use of explosive weapons. It could also be used to calculate the wider reverberating effects that follow displacement.

- **Guidelines to operationalize the indicators of the reverberating effects of explosive weapons:**
- Map the damage and destruction of housing and the disruption of essential services. Relate this information to the dates of specific events and identify post-shock displacement data that can be linked to these specific events.
- Use qualitative interviews or surveys among displaced populations to identify when and why they were displaced to establish the extent to which the use of explosive weapons triggered or contributed displacement.
- Consider measuring the additional (compounding) reverberating effects experienced by displaced populations as a result of explosive weapons use.
- Interview host communities to gauge how displaced populations have changed local dynamics.

INDICATOR VII: NUMBER OF DEATHS, MISSING PERSONS AND PERSONS AFFECTED BY EXPLOSIVE WEAPONS PER 100,000 POPULATION, DISAGGREGATED BY GENDER AND AGE

Definition and design: In the SDG framework, the comparable indicator measures the number of deaths, missing persons and persons affected by natural disasters per 100,000 people. This can be adapted to the study of the reverberating effects of EWIPA by substituting "natural disasters" with "explosive weapons use". To some extent, it is similar to indicator 16.1.2 on conflict-related deaths per 100,000 (see discussion on SDG 16). However, this proposed EWIPA indicator suggests including the number of missing persons and expanding what is meant by the "affected population".

The indicator considers the affected population to be those who have suffered injury, illness or other health effects; who were evacuated, displaced or relocated; or who have suffered direct damage to their livelihoods or their economic, physical, social, cultural and environmental assets. As such, the proposed EWIPA indicator is conceptually wider than 16.1.2, which focuses only on deaths and injuries caused by conflict, because it includes missing and displaced populations, as well as the public health impact and disease burden on the affected populations. At the same time, the proposed EWIPA indicator is more specific as it focuses only on explosive weapons use rather than on conflict as a whole. The proposed EWIPA indicator conceptually mirrors SDG 11.5.1 (see below).

Rationale: Calculating the number of deaths, missing persons and persons affected per 100,000 population, disaggregated by gender and age, allows us to measure the civilian impact of explosive weapons use in a such way that information becomes comparable between locations and across different periods of time. If this is done systematically and in a disaggregated manner, it can be a foundational indicator to measure longer-term civilian harm.

INDICATOR 11.5.1:
NUMBER OF DEATHS, MISSING PERSONS AND DIRECTLY AFFECTED PERSONS ATTRIBUTED TO DISASTERS PER 100,000 POPULATION

ADAPTED INDICATOR:NUMBER OF DEATHS, MISSING PERSONS AND PERSONS AFFECTED BY EXPLOSIVE WEAPONS PER 100,000 POPULATION, DISAGGREGATED BY GENDER AND AGE

SDG reference: 11.5.1, classified as "established methodology and standards are available, but data are not regularly produced by countries" (Tier 2)

DEFINITION:

This indicator measures the number of people who died, went missing or were directly affected by explosive weapons use per 100,000 population.

RATIONALE:

This indicator, as envisioned in the SDG framework, tracks deaths, missing persons and persons affected by natural disasters, per 100,000 people, and is therefore not immediately applicable to measuring the reverberating effects of explosive weapons. However, the same principles can be applied if "disasters" is substituted with "explosive weapons use".

CONCEPTS:

Death: The number of people who died during from the explosive weapons use, or directly after, as a direct result.

Missing: The number of people whose whereabouts is unknown since the use of explosive weapons. Includes people who are presumed dead, for whom there is no physical evidence such as a body, and for whom an official report has been filed with the competent authorities.

Directly affected: The number of people who have suffered injury, illness or other health effects; who have been evacuated, displaced or relocated; or who have suffered direct damage to their livelihoods or their economic, physical, social, cultural or environmental assets.

Indirectly affected: The number of people who have suffered consequences other than or in addition to direct effects, over time, due to disruption or changes in economy, critical infrastructure, basic services, commerce or work, or social, health and psychological consequences.

COMPUTATION METHOD:

$$X = \frac{(A_2 + A_3 + B_1)}{\textit{global population}} \times 100{,}000$$

Where:
A2 = number of deaths attributed to explosive weapons use.
A3 = number of missing persons attributed to explosive weapons use.
B1 = number of people directly affected by explosive weapons use.
global population = the total population living in the affected area (not the world's population).

To make a determination regarding the "global population" it is crucial to identify the number of people living in areas affected by explosive weapons use, regardless of documentation status, and taking into account the radius of explosive weapons impact and the outwards spatial rings that will be studied in the research effort.

DATA DISAGGREGATION:

- Number of deaths attributed to explosive weapons use
- Number of missing persons attributed to explosive weapons use
- Number of people directly affected by explosive weapons use

THESE FIGURES SHOULD BE BROKEN INTO:

- Geography (administrative unit)
- Gender
- Age

For a more detailed methodological discussion, see: SDG Technical Guidance for Indicator 11.5.1.

POSSIBLE RESEARCH APPROACHES

Studies carried out following natural disasters may provide useful frameworks of how to set up efforts to estimate the reverberating effects from explosive weapons use. The study below, for example, estimated the real number of deaths in Puerto Rico after Hurricane Maria by accounting for those who perished as a result of service disruption.

Using survey data, a **Harvard study** estimated a mortality rate of 14.3 deaths per 1,000 persons from 20 September to 31 December 2017. This rate yielded a total of 4,645 excess deaths or excess mortality during this period, equivalent to a 62% increase in the mortality rate compared with the same period in 2016. One third of the deaths were attributed to delayed or interrupted health care. Hurricane-related migration was also determined to be substantial. To explore this "real" death count, the Harvard study used data from 2016 as a "control" and compared those data against the mortality data for 2017 (the "intervention" year). This research design allowed researchers to conclude that mortality had increased by 62% owing to the long-term effects of Hurricane Maria. The official death count in Puerto Rico initially attributed to Hurricane Maria was 64, likely a significant underestimate now that there are data on the reverberating effects.

NOTES ON MISSING PERSONS:

The inclusion of data on missing persons can provide valuable input for mortality estimates when there are (a) concerns that bodies may never be recovered because they are, for example, completely burned or (b) damaged buildings that cannot be removed to uncover deceased persons. However, due diligence must be taken to avoid including people missing because they were detained or forcibly disappeared by parties to a conflict.

SUMMARY TABLE: SDG 3 — GOOD HEALTH AND WELL-BEING

LEVEL OF EFFECT	FOCUS	SUGGESTED INDICATOR	REVERBERATING EFFECTS CHAIN	HOW TO USE THE INDICATOR	TEMPORAL OBSERVATION
First level: Damage and destruction	Damage and destruction of health facilities	**Indicator I:** Number or proportion of health facilities damaged or destroyed by explosive weapons	Damage to health facilities forces a reduction in the available health care services, and destruction forces closure of health facilities, both of which affect access to health care	To describe the scale of damage and destruction of health infrastructure To provide information on affected areas	Immediate –damage and destruction Medium term – cumulative damage and destruction if there are multiple air strikes on the same facility over time
	Death and injury of health workers	**Indicator II:** Number of health workers killed or injured by explosive weapons, disaggregated by gender	Death and injury among health workers reduces the number of health workers and thereby affects access to and quality of health care	To describe the scale of human loss from explosive weapons use, exemplified by one professional group	Immediate –human tragedies and the effects on society
	Shortage, damage or destruction of essential medical items, spare parts or consumable needs	**Indicator III:** Shortages in essential medical supplies	Shortage, damage or destruction to warehouses or disruptions to distribution chains that deliver medical supplies affect both access to and quality of health care	To describe immediate limitations to the provision and quality of health services	Immediate –limitations in the delivery and quality of health care
	Disruption of access to health care as a result of damage and destruction of ambulances	**Indicator IV:** Number or proportion of ambulances destroyed (locally)	Lack of health transport hampers people's timely access to emergency health care when needed	To calculate the affected population with reduced access to health care, in relation to a specific area (e.g. number of ambulances serving a particular hospital, or number of ambulance providers within a town)	Medium term – for the duration of interruption of services
Second level: Changes in key services caused by the damage and destruction	Disruption of health care as a result of damage and destruction of health facilities	**Indicator V:** Number or proportion of health facilities with service disruptions	Reduction in services reduces access to health care, including specialized health care	To calculate the population affected by a reduction in access to health care	Medium term – for the duration of interruption of services
	Reduction in quality and quantity of health service due to loss of skilled personnel	**Indicator VI:** Health worker density and distribution per 10,000 population, compared with pre-conflict	A fall in the number of skilled health professionals reduces access to and quality of health care	To calculate the density of health workers per 10,000 population in a setting affected by explosive weapons, which affects the availability and quality of health care This indicator can also be used in comparison to an unaffected setting	Medium term – for the duration of interruption of services
	Reduction or other changes in access to birth attendants	**Indicator VII:** Difference in proportion of births attended by skilled health personnel, compared with pre-conflict	A fall in the number of births attended by skilled health personnel increases neonatal and maternal health risks A change in the type of birth attendance available affects neonatal and maternal health risks	To calculate how practices in birth attendance differ from previous periods or other parts of the country not affected by explosive weapons	Long term – to describe the changes over a long period of time
	Changes in access to disease prevention practices	**Indicator VIII:** Difference in proportion of the population with access to affordable medicines and vaccines, compared with pre-conflict	A fall in the proportion of the population receiving vaccines or HIV patients receiving antiretroviral therapy after the use of explosive weapons could indicate that the health system has been affected	To compare the health system after the use of explosive weapons with how it functioned prior to the conflict or how the health system functions in other parts of the country not affected by explosive weapons use	Long term – to describe the changes over a long period of time (e.g. the impact of reduced vaccination rates is unlikely to be immediately observable)

Third level: Changes in civilian well-being as a result of the changes in key services caused by the damage and destruction	When access to maternal health services is affected by the use of explosive weapons, indicators on maternal, neonatal or under-five mortality can be used to explore the human costs of damage and destruction	**Indicator IX:** Difference in maternal, neonatal and under-five mortality, compared with pre-conflict	When maternity hospitals reduce services or close owing to damage from explosive weapons, when the availability of health transport for pregnant women is affected, and when the number of skilled birth attendants declines, maternal and neonatal health risks increase	To describe parts of the human cost of the damage and destruction of health systems	Long term – the changes will happen over time
	Health outcomes related to non-communicable diseases	**Indicator X:** Difference in mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease, compared with pre-conflict	The change in mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease is an indicator of the general availability and effectiveness of the health system, compared with pre-conflict	To show the impact of changes in health services either for a specific hospital or for a population living within an area experiencing explosive weapons use, and to compare different time periods	Long term – the changes will happen over time
	Health outcomes related to preventable and treatable diseases	**Indicator XI:** Difference in reported cases of and number of deaths from preventable diseases such as cholera, measles or polio or changes in the life expectancy of HIV-positive patients, compared with pre-conflict	The difference in reported cases of diseases for which there is a vaccine can be an indication of difficulties in vaccine coverage, compared with pre-conflict The number of deaths from preventable diseases and the life expectancy of HIV patients is an indicator of the effectiveness of the health system	To show the impact of changes in health services either for a specific hospital or for a population living within an area experiencing explosive weapons use, and to compare different time periods	Long term –the changes will happen over time

INTRODUCTION TO THE EFFECTS OF EXPLOSIVE WEAPONS ON HEALTH

Explosive weapons undermine safe access to health care by destroying health care infrastructure such as hospitals, clinics and health care transport and hindering the quality of care. Hospitals under attack frequently have to be evacuated or reduce the quantity or quality of services offered, which places patients and staff at risk. The quality of health care may also be undermined by disruption to supply chains and by strain on personnel. Aid agencies providing health care services in conflict zones may be forced to close or limit operations in areas where they suffer an attack or are threatened by the use of explosive weapons. Areas affected by conflict experience compounding challenges in retaining qualified medical staff and maintaining the same level of quality of care as pre-conflict. The most valuable resources in health care are the quality of care, the attention available from qualified personnel to patients, and the continuity of care. However, quantifying quality of care requires detailed descriptions, hospital-level micro-disaggregated data, and indicators that fall outside the scope of this framework. Nonetheless, it is important for future studies and iterations of this framework to attempt to map changes in quality of care.

The effects that explosive weapons have on health can be either first-, second- or third-level impacts. The first-level impacts are the damage and destruction of the health infrastructure, the death and injury of health workers, and shortages of medical supplies. The second-level impacts are the effects that infrastructure damage and destruction as well as the death and injury of health workers have on the available health services (e.g. the extent to which consultations or services are cancelled or reduced). The third-level impacts are the health outcomes that can be directly linked to changes in levels of health care provided as a consequence of the damage and destruction caused by explosive weapons. In addition, the use of explosive weapons in one area can have consequences for health care in neighbouring areas, as damage and destruction of local health facilities might lead to overwhelming the surrounding health facilities and stretching those resources as well. While indicators on overcrowded neighbouring health facilities and the associated potential health impacts fall outside the scope of this research framework, it is important for future studies and iterations of this framework to attempt to map changes in quality of care in neighbouring facilities.

Data on damage and destruction of health facilities and health transport and the death of health workers from explosive weapons are being collected by the SHCC. The second-level effect data must be collected on a case-by-case basis by focusing on specific hospitals or defined geographic areas that experience explosive weapons use. Local data availability will determine what information to use to describe the impact of damage and destruction on the available health services. The SDG indicator framework outlines a standard indicator on health worker density that could be used. The reverberating effects could be described through a mixture of SDG framework indicators on health outcomes combined with qualitative information. It is important to use the second-level effects to demonstrate that there has been a change in the specialized services needed for a specific health outcome. As many of the well-established SDG indicators focus on maternal and child health outcomes, the second-level effects work would need to demonstrate changes in maternal and neonatal health services to establish the link between the health outcome indicators and the use of explosive weapons.

The following Tool proposes indicators to measure the impact chain of explosive weapons use on health, divided into three sections: (A) indicators on damage and destruction, (B) indicators on the changes in key services caused by the damage and destruction, and (C) indicators on the changes in civilian well-being as a result of the changes in key services caused by the damage and destruction. In this impact chain disaggregation, the first-level indicators (section A) look at primary or secondary effects, and the second- and third-level indicators (sections B and C) look at reverberating effects.

SECTION A: INDICATORS ON DAMAGE AND DESTRUCTION

To measure the immediate effects of the use of explosive weapons on health, in terms of damage and destruction, research efforts can ask: *How many health facilities are affected by explosive weapons use in particular areas? Where and when were these buildings affected? Are medical facilities facing shortage in basic medical supplies? Have the storage warehouses of medical supplies or the supply chains suffered destruction or disruption? How many health workers have been killed or injured by explosive weapons? How many ambulances are damaged or destroyed by explosive weapons? Where and when was this health transport affected?*

INDICATOR I: NUMBER OR PROPORTION OF HEALTH FACILITIES DAMAGED OR DESTROYED BY EXPLOSIVE WEAPONS

Definition: Absolute number or proportion of health facilities damaged or destroyed by explosive weapons.

Rationale: The scale of damage and destruction of health facilities provides information on the extent to which the use of EWIPA affects health care. Data on health facilities damaged and destroyed can capture where and when health care has been directly affected as a result of the use of explosive weapons. **Information on the location of these health centres can then be used to identify the population in the catchment area for the affected facility, whether residents or transferred patients. Hospitals tend to have the appropriate information on number of patients and service areas, which can be used to estimate the number of people affected by reduced services.** Many health facilities are affected more than once by explosive weapons use. Information on the date of damage and destruction, and recording of the cumulative damage and destruction, is important to establish the time period during which health services were interrupted.

INDICATOR II: NUMBER OF HEALTH WORKERS KILLED OR INJURED BY EXPLOSIVE WEAPONS, DISAGGREGATED BY GENDER

Definition: Absolute number of health workers killed or injured by explosive weapons.

Rationale: The death or injury of qualified staff reduces the number of health workers available. The number of health workers killed or injured directly affects the provision of health care and stresses the most valuable resource in the provision of medicine. Furthermore, according to a WHO study, as many as 70% of health workers are women.[35] Therefore, the impact of explosive weapons on health care systems may affect women disproportionately, hence the need for disaggregated data. Further, the psychological impact on other health workers often leads to a further reduction in available staff, as health workers might be unable to continue their work under such strenuous circumstances.

35 See M. Boniol et al., Gender Equity in the Health Workforce: Analysis of 104 Countries, WHO, Working Paper 1, 2019, https://apps.who.int/iris/bitstream/handle/10665/311314/WHO-HIS-HWF-Gender-WP1-2019.1-eng.pdf.

INDICATOR III: SHORTAGES IN ESSENTIAL MEDICAL SUPPLIES

Definition: The percentage of essential medical supplies, including medical items, functioning equipment and consumable items needed to provide health care access and quality care that are currently unavailable.

Rationale: Medical supplies, including medical items, functioning equipment and consumable items, are needed to provide quality care. When warehouses are destroyed or supply routes interrupted, the ensuing shortages in essential medical supplies affect both access to and quality of health care. Should the destruction of warehouses or disruptions in supply chains be attributed to the use of explosive weapons, then the consequences can be linked to their use.
This indicator on shortages relates back to the ICRC literature on the three components necessary for service delivery, namely, people (staff), infrastructure (warehouses and equipment) and consumables (medical items). When one of these components for service delivery fails, health care is compromised.[36]

INDICATOR IV: NUMBER OR PROPORTION OF AMBULANCES DESTROYED (LOCALLY)

Definition: Absolute number or proportion of ambulances damaged or destroyed by explosive weapons in a given area.

Rationale: Damage and destruction of ambulances reduces access to health care and hinders emergency responses. A geographic mapping of the extent to which the health transport system is affected following explosive weapons use can paint a picture of changes in access to health care.[37] This work requires access to information on the total number of ambulance service providers and the number of ambulances they have within an affected area, as well as the absolute number of ambulances rendered unusable following the use of explosive weapons. This information can then be used to identify the proportion of ambulances that are no longer in service so as to describe the extent to which ambulance services have been reduced as a result of explosive weapons use at the local level. **Information on the changes in health transport can potentially be used to link observed changes in health outcomes to the noted reduction in health transport.**

Data on damage and destruction of health facilities, health transport, and health workers killed or injured by explosive weapons:
The data collected by WHO through the Surveillance System of Attacks on Healthcare (SSA) are reliable, standardized and systemic. However, the current disaggregation of attack types makes it hard to isolate the impact of explosive weapons. This is because categories such as "violence with heavy weapons" and "violence with individual weapons" both include firearms and explosive weapons. The reason the weapons categories are not as detailed as desk researchers would like is because the main reporters into the system are health care workers and health partners, and it is challenging for them to differentiate in a detailed manner between different types of weapon used, let alone under pressing circumstances.

Some data on the effects of explosive weapons can be found in the SHCC products. The annual report and data set record known cases of attacks on health care, attempt to disaggregate by weapon category, and distinguish between damage and destruction of health infrastructure and transport. They also include the number of direct deaths among health workers from explosive weapons. These data do not publicly disaggregate affected health workers by gender.

The data from the SHCC can be used to describe damage and destruction due to explosive weapons in relation to the total number of attacks on health facilities damaged or destroyed in particular countries. Additional work is required to identify the number of health facilities affected. It is common that the same health facility is hit more than once by airstrikes. However, inconsistency in reporting over time can make it complicated to identify the number of times individual health facilities are damaged by explosive weapons.

Data limitation:
The SHCC presents the limitations inherent in the information provided by contributors to the coalition's work and notes that there are more contributors from some countries than from others. Moreover, not all contributors provide access to their original sources; hence, the ability to provide more accurate and consistent classification, as well as verification, of the data is hampered. In particular, the events provided by the WHO SSA, which are included in the SHCC data set, do not provide details on the specific weapon used. Thus, the events reported by the WHO SSA cannot be classified by specific weapon category (unless this information has been reported elsewhere) and are consequently missing from the total count of health facilities damaged and destroyed by explosive weapons. As a result, reported numbers of incidents by country should not be considered in comparison with other countries without considering factors of information flow. The indicators based on these data provide an approximate overview, one that will hopefully improve over time.

Options to build on these data:
- Use the WHO SSA.
- Contact SHCC for detailed explosive weapons data subsets. The data exist; however, additional cleaning and separation by subcategories need to be carried out before the data can be released to the public.
- Review Insecurity Insight's Monthly News Brief on Attacks on Healthcare, which contains information on the weapon category used. Review Insecurity Insight's data on HDX. Contact Insecurity Insight for specific country or year data: info@insecurityinsight.org.
- Use the information from these data sets to focus future research and collaborate with local researchers to confirm hits and,

TABLE 2: Data on attacks on health care with explosive weapons in 2017, 2018 and 2019 at the global level, according to the Safeguarding Health in Conflict Coalition

	2017	2018	2019
Total attacks involving explosive weapons	**192**	**272**	**143**
Events involving explosive weapons damaging health facilities	**76**	**156**	**100**
Events involving explosive weapons damaging health transport	**51**	**60**	**21**
Health workers killed by explosive weapons	**155**	**88**	**42**

Note: These data are also available by country, upon request to the Safeguarding Health in Conflict Coalition.

36 ICRC, Urban Services during Protracted Armed Conflict: A Call for a Better Approach to Assisting Affected People, 2015, https://www.icrc.org/sites/default/files/topic/file_plus_list/4249_urban_services_during_protracted_armed_conflict.pdf.

37 Alternatively, changes in travel times due to the destruction of roads, leading to disruption of ambulance services, could be used to map changes in services to civilians.

in particular, multiple hits on the same facility and to map the consequences of this damage and destruction.
- Review reporting on United Nations Security Council resolution 2286 (2016).

Data and research approaches to mapping the changes to health transport and access to health care as a consequence of damage and destruction from explosive weapons use:
Mapping of areas where ambulances have been destroyed, combined with population figures and qualitative information of when and why ambulances are needed, could be used to show the link between damage and destruction of health transport and access to health care.

There is no standard global data source; data would have to be collected locally. Data would have to be used to assemble the picture of how transport networks are affected. Research could start by identifying the key local ambulance providers. Data on use of ambulances over time (before, during, and after instances of explosive weapons use) could be plotted on maps to show how transport routes or frequency of transport have changed. This can be supplemented by personal stories from ambulance drivers and those who needed an ambulance so as to describe some of the complexities in changes to access to emergency health care. Researchers may also want to explore how the need for ambulances is linked to particular health emergencies. This focus could be on pregnant women if maternal health indicators are available. It could also focus on people injured during instances of explosive weapons use to explore the links between health transport and death and injury ratios among civilian populations during explosive weapons use in populated areas. If it can be shown how the lack of health transport increased the death toll, then these data can contribute to the discussion of indirect deaths from the use of explosive weapons.

SECTION B: INDICATORS ON THE CHANGES IN KEY SERVICES CAUSED BY THE DAMAGE AND DESTRUCTION

To measure the second-level effects of changes in the quality and availability of health services that resulted from the death of health workers and the damage and destruction of health facilities, ambulances, and key utilities (e.g. water plants, wastewater treatment plants, solid waste management infrastructure, electricity plants) caused by explosive weapons, research efforts can ask: *Which health services have been affected by the damage and destruction and to what extent? Who is affected by this reduction in services? What are the overall changes in access to health care measured both in terms of available services and people's ability to reach and access health care when needed? How has the quality of care and attention changed?*

INDICATOR V: NUMBER OR PROPORTION OF HEALTH FACILITIES WITH SERVICE DISRUPTIONS

Definition: Absolute number or proportion of health facilities damaged or destroyed by explosive weapons that experience disruption of services.

Rationale: Damage and destruction of health facilities disrupts health care. A description of how health care is disrupted and what kinds of service are interrupted following explosive weapons use can paint a picture of changes in access to health care. **Information on the changes in health care provisions can potentially be used to link observed changes in health outcomes that depended on the services offered by the health facilities damaged and destroyed.**

Data and research approaches to mapping the reduction in health services as a consequence of damage and destruction from explosive weapons use:
From information on specific health facilities damaged or destroyed or otherwise affected by explosive weapons, researchers can document how the shock contributed to a reduction in services provided by a specific health facility. This mapping should include qualitative information on the type of services offered (paediatric, maternity, cancer care, etc.), combined with the health facility's catchment area (including information on whether there are alternative services available within the area), and an assessment of the impact on the influx of patients or the reduction in patients because of fear to seek care. Reduction in services could be measured by the number of patients seen before and after the explosive weapons event or other proxy data the health facility may be able to provide. Population figures for the health facility's catchment area can be used to identify the affected population. Depending on whether the health facility offered general or specialized services, a distinction can be made, using household surveys, between the directly affected population who would use the specialized services and the wider population affected by a family member having reduced access to specialized services. For example, if maternity services are reduced, the directly affected population would be females in a reproductive age group (e.g. 15- to 49-year-olds) living within the catchment area, while the wider effect would be on all families that include women in the reproductive age group.
There is no
standardized global data source. Research can start by identifying affected health facilities and then collaborating with local health providers and other actors to map the catchment area affected and gather the necessary level of disaggregation. Health facilities may be able to provide data. Interviews, questionnaires or surveys may be used to identify key information.

INDICATORS VI, VII AND VIII: MEASURING THE HEALTH SERVICES AVAILABLE USING THE SDG FRAMEWORK INDICATORS

Violence against health workers combined with the effects of violence against health care infrastructure, as well as the effects of the wider conflict, affect health workers' ability to effectively perform their tasks. The number of qualified health staff directly affects the quality and quantity of available services. The SDG framework offers two standard indicators that can be used to measure these factors: health worker density and proportion of births attended by skilled birth attendants.

Damage and destruction by explosive weapons to service installations disrupts health supply chains as well as health services. For example, systematic vaccination depends on the supply of vaccines that have been stored at the correct temperature (generally between 2°C and 8°C, but each vaccine requires a specific temperature and some may require continuous refrigeration at sub-zero temperatures) to remain effective when used. Disruption to electricity supply can interrupt the refrigeration chain. Furthermore, disruptions to consistent power supply can affect blood products, which are important commodities for health care delivery, in particular in conflict-affected areas, and are requires by a broad spectrum of the community. HIV-positive patients require access to antiretroviral therapy (ART), requiring a regular supply of a combination of drugs. This treatment can be interrupted by damage and destruction of health systems or difficulties in accessing health care due to damage and destruction. SDG indicator 3.b.1 on the proportion of the population with access to affordable medicines and vaccines can be adapted to measure some of the changes in such access attributable to explosive weapons use.

INDICATOR VI: HEALTH WORKER DENSITY AND DISTRIBUTION PER 10,000 POPULATION, COMPARED WITH PRE-CONFLICT

SDG FRAMEWORK

INDICATOR 3.C.1: HEALTH WORKER DENSITY AND DISTRIBUTION

SDG reference: 3.c.1, classified as "internationally established methodology and standards are available, and data are regularly produced" (Tier 1)

DEFINITION:

Density per category of health worker. The density of each subgroup of health workers (medical doctors and nurses, etc.) is defined as the number of these trained workers per 10,000 population in the given national or subnational area.

RATIONALE:

The number of health workers per 10,000 people is an indication of the extent to which health services are available and how their availability may have changed as a result of explosive weapons use (should it be linked causally via survey or other research method). The number of health workers available may decline if health workers leave the conflict area or if health providers close their services. As such, this indicator could be evaluated in comparison with the years before the use of explosive weapons in the same catchment area. A difference between the number of health workers per 10,000, as compared to pre-conflict levels, might shed light on changes in health worker density as a consequence of the use of explosive weapons.

COMPUTATION METHOD:

- Number of medical doctors (including generalist and specialist medical practitioners). Depending on the nature of the original data source, this may include practising medical doctors only or all registered and practising medical doctors.
- Number of nursing and midwifery personnel. In many countries, practitioners trained with midwifery skills are counted and reported as nurses. This makes the distinction between nursing personnel and midwifery personnel difficult to draw.
- Number of pharmacists. Depending on the nature of the original data source, this may include practising (active) pharmacists only or all pharmacists registered in the occupation.

For numbers on the official health workforce, use the Global Health Workforce Statistics, 2018 update from WHO.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 3.c.1.

INDICATOR VII: DIFFERENCE IN PROPORTION OF BIRTHS ATTENDED BY SKILLED HEALTH PERSONNEL, COMPARED WITH PRE-CONFLICT

SDG FRAMEWORK

INDICATOR 3.1.2: PROPORTION OF BIRTHS ATTENDED BY SKILLED HEALTH PERSONNEL

SDG reference: 3.1.2, classified as "internationally established methodology and standards are available, and data are regularly produced" (Tier 1)

DEFINITION:

Percentage of births attended by skilled health personnel (generally doctors, nurses or midwives). Traditional birth attendants, even if they receive a short training course, are not included.

RATIONALE:

Having a skilled attendant during childbirth is an important life-saving intervention for both women and newborns. Not having access to this key assistance exacerbates health risks, especially in vulnerable settings. The number of skilled personnel available may decline if workers leave the conflict area (affected by explosive weapons) or when health providers close their services owing to damage and destruction from the use of explosive weapons. As such, this indicator should be evaluated in comparison with years before the use of explosive weapons in the same catchment area.

COMPUTATION METHOD:

The number of women aged 15–49 with a live birth attended by skilled health personnel (e.g. doctors, nurses, midwives) during delivery is expressed as a percentage of the total of number of women aged 15–49 with a live birth in the same period.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 3.1.2.

INDICATOR VIII: DIFFERENCE IN PROPORTION OF THE POPULATION WITH ACCESS TO AFFORDABLE MEDICINES AND VACCINES, COMPARED WITH PRE-CONFLICT

Vaccination campaigns are often affected by conflict and hindered by a weakened health system. For example, polio vaccinators have been attacked in Afghanistan and Pakistan, leading to the suspension of these campaigns. Polio has re-emerged in the Central African Republic and the Niger as a result of conflict and the disruption of vaccination efforts. Vaccination coverage is a general indicator of the impact of violence against healthcare or, more generally, of a substantially weakened health system as the result of violence and destruction. It is currently unclear to what extent the use of explosive weapons affects vaccination coverage. To counter this shortage of data, indicators of changes in vaccination coverage compared with pre-conflict, where available, can be examined and mapped retroactively to measure the impact that explosive weapons may have had in such areas. Nonetheless, this research framework urges caution when linking vaccination coverage to violence, whether from the specific use of explosive weapons or the wider conflict, unless the link has been clearly identified.

It is important to highlight the difficulties in attributing causal effects. Health worker density or vaccination coverage may be

strongly or only tangentially linked to the use of EWIPA. To avoid overestimations, it may be more attainable to select a very specific area where damage and destruction of health facilities and health transport, as well as injury and death of health workers from explosive weapons, are known to have occurred, even if anecdotally. Then, the indicators on professional density and vaccination rates could be obtained for these very specific areas and compared with similar areas not affected by explosive weapons or with the years before explosive weapons use in the same areas. Afterwards, it is important to follow up with qualitative work that describes how the use of explosive weapons has reduced health worker density or disrupted vaccination. It is also important to document if other health facilities or health service providers are not filling the gap that has been caused by the use of explosive weapons.

SDG FRAMEWORK

INDICATOR 3.B.1: PROPORTION OF THE TARGET POPULATION COVERED BY ALL VACCINES INCLUDED IN THEIR NATIONAL PROGRAMME

SDG reference: 3.b.1, classified as "internationally established methodology and standards are available, and data are regularly produced" (Tier 1)

DEFINITION:

Percentage of the target population for a given vaccine covered by such vaccine.

DEFINITION OF COVERAGE FOR RELEVANT VACCINES:

- **Coverage of DTP (diphtheria, pertussis and tetanus)-containing vaccine (third dose):** Percentage of surviving infants who received the three doses of DTP-containing vaccine in a given year.
- **Coverage of measles-containing vaccine (second dose):** Percentage of children who received two doses of measles-containing vaccine according to nationally recommended schedule through routine immunization services in a given year.
- **Coverage of pneumococcal conjugate vaccine (last dose in the schedule):** Percentage of surviving infants who received the nationally recommended doses of pneumococcal conjugate vaccine in a given year.
- **Coverage of HPV (human papillomavirus) vaccine (last dose in the schedule):** Percentage of 15-year-old girls who received the recommended doses of HPV vaccine. Currently, the performance of the programme in the previous calendar year based on target age group is used.

* Research efforts can also study changes in polio and cholera vaccination coverage. Particular attention could be paid to cholera vaccinations given its incidence is linked to a lack of access to fresh, clean water, which can be exacerbated by EWIPA events.

RATIONALE:

This indicator aims to measure access to vaccines, including the newly available or underused vaccines, at the national level. For monitoring disease control and impact of vaccines, it is important to measure coverage from each vaccine in the national immunization schedule, already in place for all national programmes. However, estimating the proportion of the population covered with all vaccines in the programme is only feasible if the country has a well-functioning national immunization registry; usually an electronic one will allow this coverage to be easily estimated.

CONCEPTS:

In accordance with its mandate to provide guidance to Member States on health policy matters, WHO provides global vaccine and immunization recommendations for diseases that have an international public health impact. National programmes adapt the recommendations and develop national immunization schedules based on local disease epidemiology and national health priorities. National immunization schedules and the number of recommended vaccines vary between countries, with only DTP-, polio- and measles-containing vaccines being used in all countries. The target population for a given vaccine is based on the recommended age for administration. Nonetheless, the primary vaccination series of most vaccines are administered in the first two years of life.

- **Coverage of DTP-containing vaccine** is a measure of the overall system strength to deliver infant vaccination.
- **Coverage of measles-containing vaccine** is a measure of the ability to deliver vaccines beyond the first year of life through routine immunization services.
- **Coverage of pneumococcal conjugate vaccine** is a measure of adaptation to new vaccines for children.
- **Coverage of HPV vaccine** is a measure of life cycle vaccination.

COMPUTATION METHOD:

WHO and UNICEF jointly developed a methodology to estimate national immunization coverage from selected vaccines in 2000. The methodology has been refined and reviewed by expert committees over time; relevant publications are listed below. The methodology uses data reported by national authorities, as well as data from immunization or multi-indicator household surveys.

- A. Burton et al., "WHO and UNICEF Estimates of National Infant Immunization Coverage: Methods and Processes", Bulletin of the World Health Organization, vol. 87, no. 7, 2009. Available here.
- A. Burton et al., "A Formal Representation of the WHO and UNICEF Estimates of National Immunization Coverage: A Computational Logic Approach", PLoS ONE, vol. 7, no. 10, 2012. Available here.
- D. Brown et al., "An Introduction to the Grade of Confidence in the WHO and UNICEF Estimates of National Immunization Coverage", The Open Public Health Journal, vol. 6, 2013. Available here.

DISAGGREGATION:

By geographical location (i.e. regional, national and, potentially, subnational estimates).

DATA SOURCES:

Information on immunization records can be found in national health information systems or national immunization registries. Alternatively, high-quality household surveys with an immunization module could provide important information.

COLLECTION PROCESS:

Annual data collection through an established mechanism. Since 1998, in an effort to strengthen collaboration and minimize the reporting burden, WHO and UNICEF have jointly collected information through a standard questionnaire (the Joint Reporting Form) sent to all Member States. Available here.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 3.b.1.

Data and research approaches to using the suggested SDG indicators in relation to impacts of explosive weapons use:
The standard SDG indicators should be applied to the specific health area affected by explosive weapons use. However, the data are unlikely to be disaggregated at the local level, and hence the SDG indicators might have to be used as a general indication and then adapted to the local context. Mapping of the availability of health services can be carried out through many research approaches, including interviews and surveys. Researchers can include questions on access to vaccines and medicine and the connection to damage and destruction of health infrastructure to start exploring these complex connections.

SECTION C: INDICATORS ON CHANGES IN CIVILIAN WELL-BEING AS A RESULT OF THE CHANGES IN KEY SERVICES CAUSED BY THE DAMAGE AND DESTRUCTION

To measure the third-level effects in the form of health outcomes that are linked to the changes in access to health care services as a result of damage, destruction and death caused by explosive weapons, research efforts can ask: *What are the health consequences for this population? How can the health consequences for the population be measured? Is it possible to attribute the health outcomes to changes in access to health care? What health indicators are available? Is it possible to make a causal link between changes in access to health care and observed health indicators?*

INDICATOR IX: DIFFERENCE IN MATERNAL, NEONATAL AND UNDER-FIVE MORTALITY, COMPARED WITH PRE-CONFLICT

Maternal, neonatal and under-five mortality indicators reflect, to some extent, access to health care and quality of care. Without professional health care, women might die from pregnancy-related complications, more new-borns might die, and fewer children might reach the age of five.

Mortality rate among young children is a key outcome indicator for child health and well-being and, more broadly, for social and economic development. It is a closely monitored public health indicator because it reflects the access of children and communities to basic health interventions such as vaccination, medical treatment of infectious diseases and adequate nutrition. It is, at present, unclear how exactly these health indicators are related to explosive weapons use in populated areas. The following SDG indicators can be used to explore these questions further.

SDG FRAMEWORK

INDICATOR 3.1.1: MATERNAL MORTALITY RATIO (MMR)

SDG references: 3.1.1, classified as "internationally established methodology and standards are available, and data are regularly produced" (Tier 1)

DEFINITION:
The maternal mortality ratio (MMR) is defined as the number of maternal deaths during a given time period per 100,000 live births during the same time period.

RATIONALE:
The MMR depicts the risk of maternal death relative to the number of live births and essentially captures the risk of death in a single pregnancy or a single live birth.

COMPUTATION METHOD:
The MMR can be calculated by dividing recorded (or estimated) maternal deaths by the total recorded (or estimated) live births in the same period and multiplying by 100,000. Measurement requires information on pregnancy status, timing of death (during pregnancy or childbirth, or within 42 days of termination of pregnancy), and the cause of death.

The MMR can be calculated directly from data collected through vital registration systems, household surveys or other sources. There are often data quality problems, particularly related to the underreporting and misclassification of maternal deaths. Therefore, data are often adjusted to take these data quality issues into account. Some countries undertake these adjustments or corrections as part of specialized enquiries or administrative efforts embedded within maternal mortality monitoring programmes.

RELATED CONCEPTS:
- **Maternal death:** The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management (from direct or indirect obstetric death), but not from accidental or incidental causes.
- **Pregnancy-related death:** The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death.
- **Late maternal death:** The death of a woman from direct or indirect obstetric causes more than 42 days, but less than one year, after termination of pregnancy.

RELATED STATISTICAL MEASURES OF MATERNAL MORTALITY:
- **Maternal mortality ratio (MMR):** The number of maternal deaths during a given time period per 100,000 live births during the same time period. It depicts the risk of maternal death relative to the number of live births and essentially captures the risk of death in a single pregnancy or a single live birth.
- **Maternal mortality rate (MMRate):** The number of maternal deaths divided by person-years lived by women of reproductive age. The MMRate captures both the risk of maternal death per pregnancy or per total birth (live birth or stillbirth) and the level of fertility in the population.
- **Adult lifetime risk of maternal mortality for women in the population:** The proportion of deaths among women of reproductive age that are due to maternal causes, calculated as the number of maternal deaths divided by the total deaths among women aged 15–49.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 3.1.1.

FURTHER READING:
WHO Maternal Mortality: Levels and Trends from 2000 to 2017

SDG FRAMEWORK

INDICATOR 3.2.2: NEONATAL MORTALITY RATE

SDG reference: 3.2.2, classified as "internationally established methodology and standards are available, and data are regularly produced" (Tier 1)

DEFINITION:

The neonatal mortality rate is the probability that a child born in a specific year or period will die during the first 28 completed days of life if subject to age-specific mortality rates of that period, expressed per 1,000 live births.

RATIONALE:

Mortality rate among young children is a key output indicator for child health and well-being and, more broadly, for social and economic development. It is a closely watched public health indicator because it reflects the access of children and communities to basic health interventions such as vaccination, medical treatment of infectious diseases and adequate nutrition.

COMPUTATION METHOD:

The methods most frequently used to determine this rate are as follows:

- **Civil registration:** Number of children who died during the first 28 days of life and the number of births used to calculate neonatal mortality rates.
- **Censuses and surveys**: Censuses and surveys often include questions on household deaths in the last 12 months, which can be used to calculate mortality estimates.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 3.2.2.

SDG FRAMEWORK

INDICATOR 3.2.1: UNDER-FIVE MORTALITY RATE

SDG reference: 3.2.1, classified as "internationally established methodology and standards are available, and data are regularly produced" (Tier 1)

DEFINITION:

Under-five mortality is the probability of a child born in a specific year or period dying before reaching the age of 5 years, if subject to age-specific mortality rates of that period, expressed per 1,000 live births.

RATIONALE:

Mortality rate among young children is a key output indicator for child health and well-being and, more broadly, for social and economic development. It is a closely watched public health indicator because it reflects the access of children and communities to basic health interventions such as vaccination, medical treatment of infectious diseases and adequate nutrition.

COMPUTATION METHOD:

The methods most frequently used to determine this rate are as follows:

- **Civil registration:** The under-five mortality rate can be derived from a standard period abridged life table using the age-specific deaths and mid-year population counts from civil registration data to calculate death rates, which are then converted into age-specific probabilities of dying.
- **Census and surveys:** An indirect method is used that is based on a summary birth history, a series of questions asked of each woman of reproductive age: how many children she has ever given birth to and how many are still alive. The Brass method and model life tables are then used to obtain an estimate of under-five and infant mortality rates. Censuses often include questions on household deaths in the last 12 months, which can be used to calculate mortality estimates.
- **Surveys**: A direct method is used that is based on a full birth history, a series of detailed questions about each child a woman has given birth to during her lifetime. Neonatal, post-neonatal, infant, child and under-five mortality estimates can be derived from the full birth history module.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 3.2.1.

Data and research approaches to using indicators on maternal and neonatal mortality:

It is currently unclear to what extent and how exactly the use of explosive weapons affects maternal and neonatal mortality. To attribute maternal and neonatal mortality to the use of explosive weapons, more work is needed to uncover underlying complex connections. Research that uses interviews and surveys may be well suited to exploring complex connections and how they are linked to explosive weapons use. For example, from anecdotal evidence from Yemen, it has been reported that women avoid seeking help in hospitals as they fear exposure to bombing.[38] While in the Syrian Arab Republic, an increase was reported in C-sections to allow scheduling of births at times when hospitals were not overwhelmed and when there were no specific risks to travelling to health facilities.[39] Further research could explore the complex interaction between access to and availability of maternal health services as a result of explosive weapons use and how this may be reflected in any indicators on maternal mortality.

Research could ask the following questions:

- Are there any changes in the quality or availability of maternal health services as a result of the explosive weapons use? If so, are there any changes in maternal mortality?
- Are there fewer midwives available? If so, in what way can this be linked to the use of explosive weapons?
- Are there changes in access to health structures due to explosive weapons use?
- Are there changes in the available services or nature of services?

38 See T. Brooks-Pollock, Yemen: Women Giving Birth in Caves as Civilians Hide from Saudi Air Strikes , Independent, 2 February 2016, https://www.independent.co.uk/news/world/middle-east/yemen-women-giving-birth-in-caves-as-civilians-hide-from-saudi-air-strikes-a6848456.html.

39 See Human Appeal, Risking Death to Give Birth, https://reliefweb.int/sites/reliefweb.int/files/resources/syria-report-website.pdf.

INDICATORS X AND XI: DIFFERENCE IN MORTALITY ATTRIBUTED TO NON-COMMUNICABLE AND PREVENTABLE DISEASES

Mortality attributed to non-communicable diseases (NCDs) and preventable diseases reflects, to some extent, access to health care. Without good health care, the probability of dying from cardiovascular disease, cancer, diabetes or chronic respiratory disease is higher. Without an effective public health system, vaccination coverage will be lower and preventable disease outbreaks can occur.

Without good health care, HIV-positive patients will not receive the ART that can extend their life. It is at present unclear how exactly health systems that provide these treatments are affected by the use of EWIPA. The following SDG and non-SDG indicators, modelled on the SDG framework, can be used to explore these questions further.

INDICATOR X: DIFFERENCE IN MORTALITY RATE ATTRIBUTED TO CARDIOVASCULAR DISEASE, CANCER, DIABETES OR CHRONIC RESPIRATORY DISEASE, COMPARED WITH PRE-CONFLICT

SDG FRAMEWORK

INDICATOR 3.4.1: MORTALITY RATE ATTRIBUTED TO CARDIOVASCULAR DISEASE, CANCER, DIABETES OR CHRONIC RESPIRATORY DISEASE

SDG reference: 3.4.1, classified as "internationally established methodology and standards are available, and data are regularly produced" (Tier 1)

DEFINITION:

Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease. That is, the probability of dying between the ages of 30 and 70 years from cardiovascular disease, cancer, diabetes or chronic respiratory disease, defined as the percentage of 30-year-old people who would die before their 70th birthday from cardiovascular disease, cancer, diabetes or chronic respiratory disease, assuming that they would experience current mortality rates at every age and would not die from any other cause (e.g. injuries, HIV/AIDS). This indicator is calculated using life-table methods.

RATIONALE:

Treatment of NCDs requires access to health services to prevent deaths. Cardiovascular disease, cancer, diabetes and chronic respiratory disease are the four main causes of NCD burden. Measuring the risk of dying from these four major causes is important in assessing the extent of burden from premature mortality due to NCDs in a population.

CONCEPTS:

- **Probability of dying:** The likelihood that an individual will die between two ages, given current mortality rates at each age, calculated using life-table methods. The probability of death between two ages may be called a "mortality rate".
- **Life table:** A table showing the mortality experience of a hypothetical group of infants born at the same time and subject throughout their lifetime to a set of age-specific mortality rates.

COMPUTATION METHOD:

There are several steps in the calculation of this indicator:

1. Estimation of WHO life tables, based on the United Nations World Population Prospects, 2012 revision.
2. Estimation of cause-of-death distributions.
3. Calculation of age-specific mortality rates or the four main NCDs for each five-year age range between 30 and 70.
4. Calculation of the probability of dying between the ages of 30 and 70 years from cardiovascular disease, cancer, diabetes or chronic respiratory disease.
5. For the purposes of explosive weapons research, comparison of the same figures with before conflict figures.
6. For the purposes of explosive weapons research, mapping of the link between any potential changes and the use of explosive weapons.

The methods used for the analysis of causes of death depend on the type of data available from countries:

For countries with a high-quality vital registration system including information on cause of death, the vital registration that member States submit to the WHO Mortality Database can be used, with adjustments where necessary (e.g. for underreporting of deaths).
For countries without high-quality death registration data, cause-of-death estimates can be calculated using other data, including household surveys with verbal autopsy, sample or sentinel registration systems, special studies, and surveillance systems. In most cases, these data sources are combined in a modelling framework.

DISAGGREGATION:

By gender.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 3.4.1.

INDICATOR XI: DIFFERENCE IN REPORTED CASES OF AND NUMBER OF DEATHS FROM PREVENTABLE DISEASES SUCH AS CHOLERA, MEASLES OR POLIO OR CHANGES IN THE LIFE EXPECTANCY OF HIV-POSITIVE PATIENTS, COMPARED WITH PRE-CONFLICT

Definition: The difference in reported cases of and number of deaths from preventable diseases, compared with pre-conflict.

Rationale: Prevention of diseases requires access to health services. The number of reported cases of and deaths from preventable diseases is an indicator of the availability and effectiveness of health services. If the changes in the number of cases and deaths can be linked to reported damage and destruction, compared with pre-conflict, these numbers can shed light on the indirect consequences of explosive weapons use.

Data and research approaches on preventable diseases and the link to explosive weapons use:
Data on various disease outbreaks can be obtained from WHO's surveillance systems:

- Data on cholera can be found here.
- Data on measles and rubella can be found here.
- Data on polio can be found here.
- It is generally accepted that conflict weakens health systems. However, there is a lack of data on the detailed causal chain and how these changes are linked to the use of EWIPA. Future research could explore these connections.

BOX 5: EXAMPLES OF PREVENTABLE DISEASE OUTBREAKS THAT MERIT DEEPER EWIPA-RELATED RESEARCH –BASED ON ANECDOTAL EVIDENCE

CHOLERA IN YEMEN

A cholera outbreak began in Yemen in October 2016. According to the assessment of WHO, the cholera outbreak could be attributed to two years of heavy conflict. Collapsing health, water and sanitation systems had cut off 14.5 million people from regular access to clean water and sanitation, increasing the ability of the disease to spread. Rising rates of malnutrition had weakened children's health and made them more vulnerable to disease. An estimated 30,000 local health workers who played the largest role in ending this outbreak had not been paid their salaries for nearly ten months.[1] Yet causal attribution of the cholera outbreak to the use of explosive weapons against hospitals and critical water or electricity infrastructure (or incidental harm from such use) remains challenging. Nonetheless, explosive weapons undoubtedly contributed, through direct and/or indirect pathways, to the challenges of addressing the outbreak.

MEASLES IN UKRAINE

Measles remains a significant cause of death among children despite the availability of effective vaccination. Ukraine, which experienced explosive weapons use in the eastern part of the country, reported an increase in measles cases between 2015 and 2019 due to the accumulation of significant pockets of non-immune populations.[2] While researchers believe that there is a link to the conflict, the connections are not clear yet, and further work is needed to identify the chain of connections between the use of explosive weapons and the ability of health systems to ensure sufficient vaccine coverage.[3] It is at present unclear whether the violence in eastern Ukraine affected health reporting systems, whether displacement was a significant factor in spreading the diseases or whether other complex connections contributed to the spread of the disease.

ERADICATION OF POLIO

A public health effort to permanently eliminate all cases of poliomyelitis (polio) infection around the world began in 1988. Cases have been substantially reduced. However, the 175 cases of wild poliovirus detected in Afghanistan and Pakistan in 2019, represented the most cases reported since 2014.[4] Among the greatest obstacles to complete global polio eradication are shortcomings in basic health infrastructure, which limits vaccine distribution and delivery; the crippling effects of civil war and internal strife; and the sometimes oppositional stance that communities take against what is perceived as outsiders. Another challenge has been maintaining the potency of live (attenuated) vaccines in extremely hot or remote areas. The oral polio vaccine must be kept between 2– 8°C (36–46°F) for vaccination to be successful. There is currently no clear link between the polio eradications and the use of explosive weapons. However, should polio resurface in a country that is experiencing explosive weapons use, this link could be explored.

DATA ON ANTIRETROVIRAL THERAPY

ART is the core of HIV/AIDS treatment and care. Timely provision of ART to people living with HIV saves lives and prevents the development of infections, including active tuberculosis. ART is also an effective intervention in the prevention of sexual transmission of HIV in discordant couples. Changes in availability of ART would have an immediate impact on the population that needs it. Should changes in availability be mapped pre- and post-explosive weapons use, and the causal change demonstrated, then attributing an increase in HIV-positive deaths to explosive weapons use could be possible.

Attributing diseases or indirect deaths to conflict, and explosive weapons in particular, is difficult. The field of conflict epidemiology is exploring methods to measure deaths due to the emergence and transmission of infectious diseases during periods of violence, such as Conflict and Emerging Infectious Diseases by Michelle Gaver, Dominique Legros, Pierre Formenty and Maire Connolly. The Global Health Observatory by WHO provides an extensive number of global health indicators that could be useful for conflict epidemiology or in settings affected by explosive weapons to measure changes in health outcomes.

1 See UNICEF, "Statement from UNICEF Executive Director Anthony Lake and WHO Director-General Margaret Chan on the Cholera Outbreak in Yemen as Suspected Cases Exceed 200,000", 2017, https://www.unicef.org/press-releases/statement-unicef-executive-director-anthony-lake-and-who-director-general-margaret.

2 See R. Rodyna, "Measles Situation in Ukraine during the Period 2017-2019", European Journal of Public Health, vol. 29, no. 4, 2019, https://academic.oup.com/eurpub/article/29/Supplement_4/ckz186.496/5623877.

3 See T. M. Fazal, "Measles, Ukraine, and Civil War: The Missing Links", CSS ETH Zurich, 12 August 2019, https://isnblog.ethz.ch/health/measles-ukraine-and-civil-war-the-missing-links.

4 See WHO, "WHO Results Report Programme Budget 2018-2019: Driving impact in every country", p. 4, https://www.who.int/about/finances-accountability/reports/results_report_18-19_final1.pdf

SUMMARY TABLE: SDG 4 — INCLUSIVE QUALITY EDUCATION, LIFELONG LEARNING OPPORTUNITIES FOR ALL

LEVEL OF EFFECT	FOCUS	SUGGESTED INDICATOR	REVERBERATING EFFECTS CHAIN	HOW TO USE THE INDICATOR	TEMPORAL OBSERVATION
First level: Damage and destruction	Damage and destruction of school buildings	Indicator I: Number or proportion of education facilities damaged or destroyed by explosive weapons	Damage to school buildings reduces access to education, which affects educational attainment over time	To show the scale of the damage and destruction To provide information on affected areas	Immediate – for the education facilities directly affected by explosive weapons Medium term – for the duration of closure as a consequence of damage or destruction
	Death or injury of educators by explosive weapons	Indicator II: Number or proportion of educators killed or injured by explosive weapons, disaggregated by gender	The number and the physical and mental well-being of educators affects the availability and quality of education	To show the impact on schools and students To provide information on the affected communities and catchment area	Immediate – the educators who have been killed or injured Long term – the absence period of an educator
Second level: Changes in key services caused by the damage and destruction	Educational disruption	Indicator III: Number or proportion of education facilities with service disruptions, including Internet	Poor facilities negatively impact the learning environment, which leads to disruption of education, which affects educational attainment over time	To link the reverberating effects on education to the wider downstream effects of explosive weapons use Must establish the time period to calculate, for example, education days lost or to attribute attainment measures to damage from explosive weapons	Medium term – for the duration of interruption of utilities and Internet access
		Indicator IV: Number of schooling days lost	The number of schooling days lost owing to damage and destruction by, or fear of, explosive weapons directly affects students' educational attainment	To measure the number of schooling days lost from the perspective of the institution (e.g. the number of schooling days an education facility was closed owing to damage or out of safety concerns of students and teachers)	Medium term – for the duration of the closure of the education facility
		Indicator V: Number or proportion of children without access to schooling, disaggregated by gender and age	The number and proportion of students unable to access education due to damage and destruction by, or fear of, explosive weapons reduces access to learning opportunities and has a gendered impact, leading to possible lifelong consequences	To measure the number of children who are missing education To capture loss of education due to (a) school closure, (b) students not attending school because of safety and security concerns, (c) damage to transport networks or (d) displacement of students because of destruction of housing	Medium term – for the period that students' education was disrupted Long term –for the lifelong disadvantages of missing schooling

Third level: Changes in civilian well-being as a result of the changes in key services caused by the damage and destruction	Educational achievements	Indicator VI: Number, proportion or rate of students who drop out of schooling, disaggregated by gender	Dropping out of school will have life-long disadvantages for the students and for the community Dropout rates will have a differential gendered impact	To measure the long-term change compared with the medium-term change of inability to access schooling	Immediate –for school-aged people currently out of the schooling system Long term –for the lifelong disadvantages of missing a formal education
		Indicator VII: Proportion of students achieving at least a minimum proficiency level in reading and mathematics, disaggregated by gender	The impact of loss of education from damage and destruction can be measured through changing proportions of children and adults who fail to achieve minimum proficiency in key educational competences	To measure shortcomings in attainment levels, as a consequence of the use of EWIPA, and estimate the gendered impact	Medium term – for the period that students are falling behind in educational competences Long term –for the lifelong disadvantages of underperformance in educational competences
		Indicator VIII: Proportion of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, disaggregated by gender		To measure shortcomings in attainment levels, as a consequence of the use of EWIPA, and estimate the gendered impact This indicator is only measurable several years after the use of explosive weapons It is crucial to attribute observed proficiency levels to the disruption of education as a direct consequence of explosive weapons use in populated areas	

INTRODUCTION TO THE EFFECTS OF EXPLOSIVE WEAPONS ON EDUCATION

Explosive weapons can damage and destroy education facilities and thereby undermine the quality of and access to education from primary through to university level. When education facilities are damaged or destroyed, or access to utilities is interrupted, the facilities become inadequate for use, and the situation hinders the learning environment. Over an extended period of time, disrupted schooling and school closures affect educational attainment. This may lead to lifelong disadvantages for individuals and the wider society, yet the causal relationship between the use of explosive weapons and long-term educational attainment and societal losses often goes undetected. The SDG framework can provide a benchmark to measure progress or lack of thereof in education. If these indicators are used to measure changes in areas affected by the use of explosive weapons, they could shed light on the long-term effects that explosive weapons use has had on civilians.

The effects that explosive weapons have on education can be either first-, second- or third-level effects. The SDG framework can be used to capture the third-level effects, yet it can also inform options to measure first- and second-level effects. The following Tool proposes indicators to measure the impact chain of explosive weapons use on education, divided into three sections: (A) indicators on damage and destruction, (B) indicators on the changes in key services caused by the damage and destruction, and (C) indicators on the changes in civilian well-being as a result of the changes in key services caused by the damage and destruction. In this impact chain disaggregation, the first-level indicators (section A) look at primary or secondary effects, and the second- and third-level indicators (sections B and C) look at reverberating effects.

SECTION A: INDICATORS ON DAMAGE AND DESTRUCTION

To measure the immediate effects of the use of explosive weapons on educational facilities in terms of damage and destruction, research efforts can ask: *How many education facilities are affected by explosive weapons use in particular areas? Where and when were these facilities affected? How many educators have been killed or injured by explosive weapons use in particular areas?*

The suggested first-level indicators, explained in more detail below, capture the nominal number of unusable educational facilities and the number of educators killed or injured as a result of the use of explosive weapons.

INDICATOR I: NUMBER OR PROPORTION OF EDUCATION FACILITIES DAMAGED OR DESTROYED BY EXPLOSIVE WEAPONS

Definition: Absolute number or proportion of education facilities rendered unusable by explosive weapons.

Rationale: The scale of damage and destruction of education facilities provides information on the extent to which the use of EWIPA affects education. Data on education facilities damaged and destroyed can capture where and when education has been directly affected as a result of the use of explosive weapons. Further, information on the location of these education facilities can then be used to identify the areas for which the reverberating effects on access to education and education outcomes can be collected. The aim of this process is to better understand the long-term impact that disruptions have on educational attainment. It also provides information on the time period for which loss of education can be calculated.

TABLE 3: Attacks on education in 2018, as documented by the Global Coalition to Protection Education from Attack

INDICATOR	AFGHANISTAN	SYRIAN ARAB REPUBLIC	YEMEN
Total number of schools or education facilities attacked	**151**	**106**	**72**
Total number of schools or education facilities damaged by explosive weapons	**67**	**93**	**48**
Percentage of attacks on education that involved explosive weapons use among all reported attacks on education	**44% (67/151)**	**88% (93/106)**	**66% (48/72)**

Data on damage and destruction of education facilities:
There is no readily available source of data on explosive weapons use against education facilities at present. GCPEA includes information on weapons use in its monitoring of all attacks on education. For the purpose of this document, GCPEA made data available on the total number of schools damaged or destroyed by explosive weapons, documented in 2018, for Afghanistan, the Syrian Arab Republic and Yemen (Table 3).

The data points presented above can be used to describe damage and destruction due to explosive weapons in relation to the total number of education facilities damaged or destroyed, by country. Used in conjunction with GCPEA's global data on attacks on education, these data points can also be used to calculate the extent to which explosive weapons are responsible for the global burden of damage and destruction of education facilities. Used over multiple years, the data can be used to monitor the changing impact of explosive weapons in education facilities.

Options to build on these data:

- Review GCPEA reports for additional information for more recent years or additional countries. GCPEA's reporting covers all attacks on education. Contact GCPEA for country-specific data, disaggregated by weapon category.
- Review Insecurity Insight's Monthly News Brief on Education under Attack, which contains information on the weapon category used. Review Insecurity Insight's data on HDX. Contact Insecurity Insight for specific country or year data.

INDICATOR II: NUMBER OR PROPORTION OF EDUCATORS KILLED OR INJURED BY EXPLOSIVE WEAPONS, DISAGGREGATED BY GENDER

Definition: Absolute number or proportion of educators killed or injured by explosive weapons.

Rationale: Educators being killed or injured affects the availability and quality of education, with consequences ranging from the direct loss of an educator to reduced attendance, increased dropout rates, and mental health concerns. **The aim of this indicator is to set the basis for understanding the long-term impacts on educational attainment due to disruptions to the schooling system from explosive weapons. As with**

health workers, in many countries, women represent a large proportion of educators, and disaggregated data by gender could further clarify the differential impact of explosive weapons on women. This indicator would also provide information on the time period for which loss of education can be calculated. This indicator does not include information on students killed by explosive weapons, because the impact from these tragic deaths on the educational system is less direct than those of educators. However, this framework recognizes that the death and injury of students will affect dropout rates and mental health, and where appropriate, such data should be included in the discussion of attendance rates under indicator IV, for example.

Data on damage and destruction of educators:
There is no readily available source of data on educators killed or injured by explosive weapons. GCPEA includes information on weapons use in its monitoring of all attacks on education. Insecurity Insight publishes some of these data in its Monthly News Brief on Education in Danger.

SECTION B: INDICATORS ON THE CHANGES IN KEY SERVICES CAUSED BY THE DAMAGE AND DESTRUCTION

To measure the second-level effects that follow from the damage and destruction of educational facilities, research efforts can ask: *Have many days of school have been lost? How many children are out of school? How many educational facilities have lost access to essential services?*

From information on where and when schools have been damaged or destroyed by explosive weapons, indicators on the reverberating effects caused by this damage can be collected. It is important to identify the areas of damage and destruction within cities and towns and use data for the specific catchment area to describe the impact.

In addition, temporal considerations are particularly important for the reverberating effects on education. Immediate impacts occur when schools are damaged or access to utilities, such as electricity, water or Internet, are interrupted, or from the loss of school meals and protection that some educational facilities provide. Medium-term impacts in the form of days of lessons missed occur for the duration of school closure due to damage, disrupted access to electricity, fear of further risks of explosive weapons use, or displacement. Over a significant period of time, the lack of access to education becomes apparent in educational attainment. Indicators of student proficiency can be used as long-term indicators of the reverberating effects of damage to schools and infrastructure from the use of EWIPA. However, it is important to demonstrate the causal link between levels of educational attainment and the interruption of education due to explosive weapons use.

Explosive weapons are, on some occasions, used against school buildings after these have been taken over by parties to the conflict. When schooling had already been interrupted as a result of the military occupation, there might be no immediate measurable effect from explosive weapons use on education. However, the damage may contribute to long-term disruptions in education (days lost, for example) when the structural damage to the building hinders the return to normal schooling after occupation ends.

The suggested indicators on the reverberating effects are divided into two general focus areas: educational disruption (discussed here in section B), including days lost, students affected, and interrupted utilities, and educational achievements (section C), focusing on dropout rates and diminished proficiency in reading and mathematics due to reduced attendance. It could be argued, under causally demonstrated conditions, that shortcomings in educational achievements are a direct consequence of educational disruptions caused by destruction and damage to the infrastructure. Such a causal chain of events would highlight the ripple effects of the use of EWIPA that yield long-term negative consequences for development.

INDICATOR III: NUMBER OR PROPORTION OF EDUCATION FACILITIES WITH SERVICE DISRUPTIONS, INCLUDING INTERNET

Definition: The number and percentage of schools by level of education (e.g. primary education) without access to electricity and water (referred to as "services" and "facilities" in the SDG indicator) and without access to the Internet.

Rationale: This indicator measures access in schools to basic services and facilities necessary to ensure a safe and effective learning environment for all students. Ideally, each school should have access to all necessary services and facilities, but in an interconnected environment the use of explosive weapons can hinder educational facilities' connectivity to services and impede progress in education.

SDG FRAMEWORK

INDICATOR 4.A.1: PROPORTION OF SCHOOLS OFFERING BASIC SERVICES, BY TYPE OF SERVICE

SDG reference: 4.a.1, classified as "established methodology and standards are available, but data are not regularly produced by countries" (Tier 2)

DEFINITION:
The percentage of schools by level of education with access to the given facility or service.

RATIONALE:
The indicator measures access in schools to key basic services and facilities necessary to ensure a safe and effective learning environment for all students. A high value indicates that schools have good access to the relevant services and facilities. Ideally, each school should have access to all these services and facilities.

KEY SERVICES AND FACILITIES:

a. electricity,
b. nternet for pedagogical purposes,
c. computers for pedagogical use,
d. appropriate infrastructure and materials (textbook and consumables) for all students, including students with disabilities,
e. basic drinking water,
f. basic sanitation facilities, and
g. basic handwashing facilities.

COMPUTATION METHOD:
The number of schools in a given level of education with access to the relevant facilities is expressed as a percentage of all schools at that level of education.

$$PSn,f = \frac{(Sn,f)}{Sn} \times 100$$

where:
PSn,f = percentage of schools at level n of education with access to facility f
Sn,f = schools at level n of education with access to facility f
Sn = total number of schools at level n of education

DISAGGREGATION:
- By level of education
- By type of service

LIMITATIONS:
The indicator measures the existence in schools of the given service or facility, but not the service or facility's quality or operational state. In addition, a significant number of schools might have not had these services to begin with or prior to the use of explosive weapons. As such, it is crucial to use this indicator in comparison to available services in the same school or education facility under consideration from before the use of explosive weapons –in order to accredit the observed changes to the use of explosive weapons and avoid confusing results with preceding shortcomings.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 4.a.1.

Data and research approaches to map schools' access to electricity, Internet and water:
Data for this indicator may not be readily available at the national level or at the local level. Hence, the data might have to be collected from scratch and then calculated for the specific area that experienced explosive weapons use.
If it is not possible to calculate the specific indicator, research on the reverberating effects can focus on collecting absolute numbers:
- Is information available on the extent to which utilities have been affected, overall, within in the city?
- Is it possible to map whether school buildings are within an affected area that experienced power cuts, water shortages or wastewater problems? If so, how is this affecting attendance from both students and teachers?
- Can qualitative interviews provide examples of how the absence of electricity and water in schools affect children's learning?
- Is anecdotal data published in media reports?

INDICATOR IV: NUMBER OF SCHOOLING DAYS LOST

Definition: The number of schooling days lost owing to school closure following damage and destruction caused by explosive weapons or as a precautionary measure out of concern for student or teacher safety and security due to explosive weapons use, measured by individual institution or all institutions within an education zone.

Rationale: This indicator measures the extent to which education was disrupted by the use of explosive weapons, owing to both actual damage and fear of the harm explosive weapons may do.

Data and research approaches to map schooling days lost within an area affected by explosive weapons:
This indicator is not part of the official SDG indicators, and data may not be readily available. In some countries, these data may be available from the education cluster. In other countries, the data might have to be collected and then calculated for individual schools, schools within an education zone or for a specific area that experienced explosive weapons use.

Where such data are available, it is advisable to classify school closures by causes, distinguishing, for example, between closure due to lack of utilities (power or water), closure due to structural damage and closure as a precautionary measure to keep students and teachers safe.

INDICATOR V: NUMBER OR PROPORTION OF CHILDREN WITHOUT ACCESS TO SCHOOLING, DISAGGREGATED BY GENDER AND AGE

Definition: The number or proportion of children who cannot access education either because schools are closed owing to damage or destruction, disruption of services, availability of teaching personnel, safety concerns or fear or explosive weapons, or because transport networks have been interrupted through the use of explosive weapons so that students are unable to reach and/or stay in schools.

Rationale: This indicator measures the extent to which lost schooling days affect a generation of children. The number of days of schooling lost has a direct association with longer-term negative consequences for the affected students.

Data and research approaches to map the numbers and proportion of children who cannot access education:
This indicator is not part of the official SDG indicators, and data may not be readily available. In some countries, these data may be available from the education cluster. In other countries, the data might have to be collected from scratch.

There are different possible entry points for such research, which include identifying a denominator:
- All children enrolled in one specific school or within a specific education zone
- All children living within a specific geographic area

Both designs may miss children who have moved out of the area, potentially as a result of explosive weapons use.

If questionnaires or surveys are used, it is important to clearly specify the applicable period for which the lost school days are measured. This time frame could run from a particular date (e.g. a well-known event of explosive weapons use or the start of a particular year) or be for a specific period (e.g. last month). It is important to remember that people may not accurately recall when they took a particular decision or, if interruptions are sporadic, how frequently they missed school. Another option is to recruit study participants for a school access dairy, where a group of students is asked to daily report on their access to school over a specific period of time and then extrapolate to the entire population.

If such data are collected, it is advisable to classify the reasons why students were unable to access school, distinguishing between school closure or destruction, disruption of services, parental decision related to safety and security or other environmental factors, and to disaggregate these data by gender and age.

SECTION C: INDICATORS ON THE CHANGES IN CIVILIAN WELL-BEING AS A RESULT OF THE CHANGES IN KEY SERVICES CAUSED BY THE DAMAGE AND DESTRUCTION

To measure third-level effects that follow changes in key services from the damage and destruction of educational facilities, research efforts can ask: *What are the lifelong implications for those whose education was interrupted? What are the gendered dynamics of dropout rates? Is it possible to capture losses in attendance due to damaged facilities? Can reduced proficiency in key education competences be attributed to the use of explosive weapons?*

INDICATOR VI: NUMBER, PROPORTION OR RATE OF STUDENTS WHO DROP OUT OF SCHOOLING, DISAGGREGATED BY GENDER

Definition: The number, proportion or rate of students who drop out of schooling as a consequence of the use of explosive weapons.

Rationale: This indicator measures the longer-term impact of school closures and disruptions, concerns over safety and security, and displacement on access to education. Dropping out of school will have lifelong consequences for the affected population.
Data and research approaches to map number and proportion of students who drop out of schooling:

This indicator is not part of the official SDG indicators, and data may not be readily available. In some countries, these data may be available from the education cluster. In other countries, the data might have to be collected from scratch.

There are different possible entry points for such research, which include identifying a denominator:

- The number or proportion of students enrolled in a specific school at a particular point in time who dropped out before finishing their education.
- The number or proportion of students enrolled in a specific education zone at a particular point in time who dropped out before finishing their education.
- A survey of a defined population living in a specific area, including in sites for displaced persons, documenting the number of years of schooling completed and dropout rates. Such surveys could include all inhabitants under 30 years old, for example, if the time period covered is sufficiently long.

If such data are collected, it is advisable to classify the reasons students dropped out of school and whether this decision was preceded by prolonged educational disruption or displacement or other environmental factors, including financial. It is important to disaggregate these data by gender, as the impact of school closures or educational disruption on dropout rates is likely to be highly gendered. A key challenge is to map the observed dropout rate to the use of explosive weapons rather than to other conflict or personal factors.

INDICATOR VII: PROPORTION OF STUDENTS ACHIEVING AT LEAST A MINIMUM PROFICIENCY LEVEL IN READING AND MATHEMATICS, DISAGGREGATED BY GENDER

Definition: Proportion of students in grades 2/3 achieving at least a minimum proficiency level in reading and mathematics, disaggregated by gender. (For the minimum proficiency levels specific to grade 2/3 students, see the SDG indicator 4.1.1 box.)

Rationale: Minimum proficiency levels are the benchmark of basic knowledge in key development domains such as mathematics and reading, measured through learning assessments. However, until August 2018, there was no globally agreed definition of minimum proficiency level.

SDG FRAMEWORK

INDICATOR 4.1.1: PROPORTION OF CHILDREN AND YOUNG PEOPLE: (A) IN GRADES 2/3; (B) AT THE END OF PRIMARY; AND (C) AT THE END OF LOWER SECONDARY ACHIEVING AT LEAST A MINIMUM PROFICIENCY LEVEL IN (I) READING AND (II) MATHEMATICS, BY GENDER

SDG reference: 4.1.1, classified as "established methodology and standards are available, but data are not regularly produced by countries" (Tier 2)

DEFINITION:

Percentage of children and young people achieving at least a minimum proficiency level in (i) reading and (ii) mathematics during primary education (Grade 2 or 3), at the end of primary education, and at the end of lower secondary education, by gender.

RATIONALE:

The indicator aims to measure the percentage of children and young people who have achieved the minimum learning outcomes in reading and mathematics during or at the end of the relevant stages of education.

CONCEPTS:

Minimum proficiency level (MPL) is the benchmark of basic knowledge in a domain (mathematics, reading, etc.) measured through learning assessments. In September 2018, an agreement was reached on a verbal definition of the global minimum proficiency level of reference for each of the areas and domains of indicator 4.1.1 as described in the Minimum Proficiency Levels (MPLs): Outcomes of the Consensus Building Meeting (the proposal for MPLs is accessible for download following the link).

The global MPL definitions for the domains of reading and mathematics are presented in the following table.

MINIMUM PROFICIENCY LEVELS DEFINED BY EACH LEARNING ASSESSMENT

READING	
EDUCATION LEVEL	**DESCRIPTOR**
GRADE 2	They read and comprehend most of written words, particularly familiar ones, and extract explicit information from sentences
GRADE 3	Students read aloud written words accurately and fluently. They understand the overall meaning of sentences and short texts. Students identify the texts' topic
GRADES 4 & 6	Students interpret and give some explanations about the main and secondary ideas in different types of texts. They establish connections between main ideas on a text and their personal experiences as well as general knowledge
GRADES 8 & 9	Students establish connections between main ideas on different text types and the author's intentions. They reflect and draw conclusions based on the text
MATHEMATICS	
EDUCATION LEVEL	**DESCRIPTOR**
GRADES 2–3	Students demonstrate skills in number sense and computation, shape recognition, and spatial orientation
GRADES 4–6	Students demonstrate skills in number sense and computation, basic measurement, reading, interpreting, and constructing graphcs, spatial orientation, and number patterns
GRADES 8 & 9	Students demonstrate skills in computation, application problems, matching tables and graphs, and making use of algebraic representations

Source: UNESCO Institute of Statistics (UIS)

Comments and limitations: Learning outcomes from cross-national learning assessment are directly comparable for all countries that participated in the same cross-national learning assessments. However, these outcomes are not comparable across different cross-national learning assessments or with national learning assessments. A level of comparability of learning outcomes across assessments could be achieved by using different methodologies, each with varying standard errors. The period of 2020–2021 will shed light on the standard errors' size for these methodologies.

The comparability of learning outcomes over time has additional complications, which require, ideally, advance design and implementation of a set of comparable items as anchors.

COMPUTATION METHOD:

The number of children and/or young people at the relevant stage of education (n) in year (t) achieving at least the pre-defined proficiency level in subject (s), expressed as a percentage of the number of children and/or young people at stage of education (n), in year (t), in any proficiency level in subject (s).

$$MPL_{t,n,s} = \frac{(MP_{t,n,s})}{P_{t,n}} \times 100$$

where:

$MPL_{t,n,s}$ = percentage of children at a particular stage of education who achieve the minimum proficiency level in a determined subject

$MP_{t,n,s}$ = number of children and young people at stage of education n, in year t, who have achieved at least the minimum proficiency level in subject s

$P_{t,n}$ = total number of children and young people at stage of education n, in year t, in any proficiency level in subject s

n = the stage of education that was assessed

s = the subject that was assessed (reading or mathematics)

DISAGGREGATION:

Disaggregated by domain (reading and mathematics) and by gender.

For a more detailed methodological discussion, see SDG Technical Guidance for Indicator 4.1.1 and part B.

INDICATOR VIII: PROPORTION OF POPULATION IN A GIVEN AGE GROUP ACHIEVING AT LEAST A FIXED LEVEL OF PROFICIENCY IN FUNCTIONAL (A) LITERACY AND (B) NUMERACY SKILLS, DISAGGREGATED BY GENDER

Definition: The proportion of youth (aged 15–24 years) and of adults (aged 15 years and above) who have achieved or exceeded a given level of proficiency in literacy and numeracy. The minimum proficiency level will be measured relative to new common literacy and numeracy scales currently in development.

Rationale: The indicator is a direct measure of the skill levels of youth and adults in the two key areas: literacy and numeracy. There is only one threshold of proficiency: above or below minimum level. The fixed level of proficiency is the benchmark of basic knowledge in a domain (literacy or numeracy) measured through learning assessments. Currently, there are no common standards validated by the international community or countries. The indicator shows data published by each of the agencies and organizations specialized in cross-national learning assessments.

SDG FRAMEWORK

INDICATOR 4.6.1: PROPORTION OF POPULATION IN A GIVEN AGE GROUP ACHIEVING AT LEAST A FIXED LEVEL OF PROFICIENCY IN FUNCTIONAL (A) LITERACY AND (B) NUMERACY SKILLS, BY GENDER

SDG reference: 4.6.1, classified as "established methodology and standards are available, but data are not regularly produced by countries" (Tier 2)

DEFINITION:

The proportion of youth (aged 15-24 years) and of adults (aged 15 years and above) who have achieved or exceeded a given level of proficiency in (a) literacy and (b) numeracy. The minimum proficiency level will be measured relative to new common literacy and numeracy scales currently in development.

RATIONALE:

The indicator is a direct measure of the skill levels of youth and adults in the two areas: literacy and numeracy. Only one threshold divides youth and adults into above and below minimum level:

- Below minimum level is the proportion of youth and adults who do not achieve the minimum standard as set up by countries according to the globally defined minimum competencies.
- Above minimum level is the proportion of youth and adults who have achieved the minimum standard. Owing to heterogeneity of performance levels set by national and cross-national assessments, these performance levels will have to be mapped to the globally defined basic and proficiency levels. Once the performance levels are mapped, the global education community will be able to identify for each country the proportion of youth and adults above and below minimum level.

CONCEPTS:

The fixed level of proficiency is the benchmark of basic knowledge in a domain (literacy or numeracy) measured through learning assessments. Currently, there are no common standards validated by the international community or countries. The indicator shows data published by each of the agencies and organizations specialized in cross-national learning assessments.

COMMENTS AND LIMITATIONS:

The measurement of youth and adult skills requires some form of direct assessment. Using household surveys to measure learning can be costly and difficult to administer and may underestimate learning in areas that are critical to daily life but are harder to assess in standardized approaches. The result may be inaccurate representations of what youth and adults know and can do, especially in relation to applying skills that may vary across contexts.

COMPUTATION METHOD:

Proportion of population in a given age group achieving above the minimum threshold of proficiency as defined for a determined large-scale (sample representative) adult literacy assessment.

DATA SOURCES AND COMPUTATION METHOD:

This indicator, as reported by the UNESCO Institute for Statistics, compiles data from different sources, the Programme for the International Assessment of Adult Competencies from the Organisation for Economic Co-operation and Development (OECD) being the most important one. The OECD programme is an international assessment survey that measures key cognitive and workplace skills.

DISAGGREGATION:

By age group, gender, location, income and type of skill. Disability status is not currently available in most national and cross-national learning assessments.[40]

For a more detailed methodological discussion, see SDG Technical Guidance for Indicators 4.6.1.

40 The SDG Indicator, as outlined by the custodian agency, recommended sex-disaggregated data. For the purpose of this document, the recommended disaggregation has been adapted to favour gender-disaggregated data. The term gender-disaggregated data has been favoured to encourage data collectors to include and present separately all forms of gender identity.

OTHER SOURCES:

- UNESCO Data for Sustainable Development Goal 4 (The Official Source of Internationally Comparable Education Data)
- OECD Programme for the International Assessment of Adult Competencies

GUIDELINES TO OPERATIONALIZE THE INDICATORS OF THE REVERBERATING EFFECTS OF EXPLOSIVE WEAPONS

- Map the number of education facilities damaged in a subregion.
- Review the geolocation data on attacks on education facilities with explosive weapons that GCPEA or Insecurity Insight might be able to provide.
- Explore the use of satellite imagery, as it may be helpful in determining the extent of damage where the location of specific education facilities is known.
- Measure changes in a representative subset of the affected population and, with a valid research design, explore extrapolating or estimating outcomes for the larger universe of affected students.

BUILD ON THE DATA OF THE FIRST-LEVEL EFFECTS:

- Map the extent to which utilities around education facilities are affected, including education transport systems, such as school buses and bus depots. This is particularly important if education facilities are only partially damaged and remain open.
- Map the catchment area for affected education facilities. This can be used to estimate the number of students affected by education facility closure.
- Identify the period and extent of education facility closure. This can be used to estimate the number of schooling days, months or years lost. It can also be a key factor in the description of how educational attainment is linked to the loss of education following the use of explosive weapons.
- Measure levels of educational attainment several years after the use of explosive weapons. Educational attainment among people affected by education facility closure due to explosive weapons use could be measured in the population living in the catchment area for closed education facilities or among populations displaced by explosive weapons use.
- Assess the causal link between educational attainment as a direct consequence of explosive weapons use using a statistical counterfactual from a non-affected area.

ALTERNATIVE RESEARCH APPROACHES:

- The indicators may not be readily available. If so, alternative research can focus on generating some conceptually related indicators. For example:
- Identify the affected radius, such as one or two towns, or one or two neighbourhoods, and conduct a detailed mapping to understand the extent of the damage inflicted on education facilities and their catchment areas. Once the precise area is identified, review with local authorities and organizations on the ground what data are available that could help show the reverberating effects.
- The UNESCO Data for Sustainable Development Goal 4 can be a starting point.
- If no educational attainment data are available, collaborate with organizations that can provide or administer attainment tests among selected target groups – such as displaced or formally displaced populations or cohorts of year groups – or by geographic area. Be sure to verify that the respondents included in the survey were in education in this very area at the time explosive weapons were used against education facilities.

POSSIBLE APPROACHES TO ATTRIBUTE THE OBSERVED PROFICIENCY TO EXPLOSIVE WEAPONS USE:

- Can qualitative interviews be used to explore the connection between skill levels and the extent to which education was interrupted during periods of explosive weapons use against education facilities?
- Is it possible to compare the proficiency level in education for two or more groups, for which varying degrees of education were interrupted as a result of explosive weapons? And can this difference be clearly established?
- Are there possibilities to compare educational attainment for different year groups? For example, those who graduated before the start of the use of explosive weapons and those who graduated after key years of their schooling were interrupted through explosive weapons use?
- Are there possibilities to compare educational attainment among population groups who received education in different geographic areas within the same country?
- Is it possible to identify a sample of people who received most of their education in catchment areas heavily affected by damage and destruction of education facilities and compare their educational attainment with a group of people with similar socioeconomic circumstances within the same country who attended school in an area unaffected by explosive weapons use?

4. THE WAY FORWARD

Measurable information on the reverberating effects of explosive weapons is important for improving policy and practice to avoid such effects in the future and/or for taking meaningful steps to mitigate the humanitarian and developmental impacts that have occurred. Advances in research and case studies within the explosive weapons use and related communities over the past years have generated valuable insights for building an innovative framework to capture and measure these effects. Still, substantially more work is needed to systematically piece together causal chains, and this document seeks to contribute to the discussion around the criteria and challenges in mapping causal relations.

The way forward suggests efforts in the following areas:

4.1 IMPROVING DATA AND INFORMATION

4.1.1 Recommendations for systematic collection of data after instances of explosive weapons use and documentation of the damage and destruction that explosive weapons cause

- Invest in long-term projects dedicated to the collection of detailed data to help shed light on the reverberating effects (e.g. epidemiological data) and include data collection practices into country offices and field presences to ensure sustainability of data collection efforts.
- Engage with experts in the field of system dynamics, since they have specialized knowledge and techniques to understand complex problems arising from interdependence, dynamic interactions, feedback loops and circular causality. Such expertise will be useful to efforts to more clearly map reverberating effects in complex urban ecosystems.
- To develop consistency in data standards and facilitate the exchange of methodologies, where possible, provide substantial support to interested stakeholders and release methodological approaches and limitations with transparency.
- Engage with all data collectors on the importance of collecting data disaggregated by gender and age, where appropriate and relevant, to highlight the differential impact at all levels of explosive weapons use on different demographic groups.
- Engage with the SHCC and GCPEA to receive regular documentation of instances of damage and destruction of health facilities and transport, as well as death of health workers and damage and destruction of education facilities.
- Engage with communities and local service providers who can help provide information on the destruction of housing, cultural monuments, public transport systems and utilities. However, avoid duplicating requests by coordinating with interested international actors. Leverage information to support local efforts to ensure that essential services are still accessible to the civilian population.
- Engage with communities who document displacement to encourage the use of standard questions that could help collect data on where explosive weapons triggered displacement. Consequently, leverage the information to identify the population displaced as a direct result of explosive weapons use.
- Engage with the wider "conflict casualty community" to discuss the benefit of data disaggregated by weapons category.
- Engage with on-the-ground aid providers and develop standard questions that could be included in surveys.

- Engage with the United Nations System and field missions to encourage the standardization and systematization of data collection efforts across this area of work.
- Engage with the SDG data collection community to improve access to subnational data for researchers documenting EWIPA reverberating effects.

4.1.2 Recommendations for using case studies of causal chain research that aim to link the documented damage and destruction to indicators from or related to the SDG framework for selected reverberating effects

- Review available instance data for possible case studies and collaborate with local researchers to test which and what kind of indicators can be linked to the observed damage, using a wide range of tools from quantitative indicators to qualitative studies. Case studies must explore the chain and causal connection between the instance of explosive weapons use, damage and destruction, disruption of service and the impact on people's well-being.
- Consider two or more parallel studies in different locations or covering different time periods for which the same selected SDG indicators are calculated. Use instance data to identify areas or time periods of heavy, low, or no use of explosive weapons and examine the differences in the indicators. Use the area with no use of explosive weapons as a "control" or "counterfactual" to gauge differences in observed outcomes.
- When discussing the links between observed reverberating effects from the use of EWIPA, one possible approach is to subdivide indicators into three categories, depending on how closely the causal pathway is proven, for example: (a) demonstrable causality, (b) reasonable association, and (c) merits deeper EWIPA-related research.

4.2 PROCESS-RELATED RECOMMENDATIONS

Collaboration between research communities is encouraged to ensure that past work and methodologies are available for future research projects. This will require building relationships that are based on the mutual benefit of research collaboration and exchanges in methodological practices. There is also a need for better connection between researchers on reverberating effects and aid responders on the ground, who could include additional key questions in their surveys.

Possible actions:

- Explore bridges with other knowledge communities, since their methodologies might be applicable to EWIPA research. For example, research after natural hazard events could be methodologically similar to research aimed at measuring the impact of explosive weapons.
- Explore emerging fields, such as forensic architecture, which is currently being pioneered at Goldsmith University in the United Kingdom.[41] This field brings together open source investigation with a host of digital and architectural tools to recreate incidents of explosive weapons use and their first- and second-level effects in order to investigate claims of international human rights law and IHL violations.
- Consider a working group that meets annually/biannually to establish long-term permanent relationships of data exchange between key communities and that reviews, adjusts and updates the indicators as needed.
- Consider a data sharing site to bring together the available data, possibly on the Humanitarian Data Exchange (HDX).
- Consider a web page where indicator data can be shared publicly in a library to allow researchers to compare their indicators with those generated by other projects.

41 For more about the field of forensic architecture and its relevance to EWIPA. see https://forensic-architecture.org/about.

4.2.1 Recommendations for influencing the development of policy and practice

- Leverage information on reverberating effects research in forums where governments, international organizations and other stakeholders discuss policies on how to strengthen the protection of civilians and compliance with IHL.
- Leverage information from reverberating effects research to identify the foreseeable pattern of harm and thus introduce these effects under the reasonable foreseeability threshold.
- Use newly generated data to assist users of explosive weapons to review their relevant policies and practices in order to reduce civilian harm.

4.2.2 Recommendations on presentation of reverberating effects research results for policy purposes

- Streamline reverberating effects available data in a single online library or platform where those seeking information can find the data, methodologies, conclusions and references easily and quickly.
- Explore the feasibility of formatting the growing body of knowledge on the reverberating effects into a checklist of foreseeable consequences that would strengthen the protection of civilians in the context of operational decision-making by militaries, as well as an understanding of diverse urban context and cultural patterns of civilian behaviour.
  - » Please note that under IHL, parties are under an obligation to do everything feasible to anticipate the civilian harm (direct or indirect/reverberating) of their attack. So, while a checklist could be useful, it cannot and should not substitute further efforts by the parties to anticipate the effects of their attacks (e.g. through collateral damage estimation). Please note that there may well be reverberating effects that are not in the list but that are reasonably foreseeable in certain cases and the checklist cannot be used as justification of failures to follow obligations.
- Develop a list of indicators to include in battle damage assessments that seek to determine the wider impact of the strikes and encourage the standard and systematic use of such assessments.

4.3 ROLL-OUT AND UPTAKE RECOMMENDATIONS

4.3.1 Recommendations for international organizations and non-governmental organizations

- Pilot the suggested research framework in partnership with country teams and seek to work across different United Nations offices in multidisciplinary teams. If it is deemed valuable, pursue institutional approaches that ensure the sustainability of data collection efforts.
- Share and aggregate findings and data from pilots in order to build a standardized evidence base.
- Tailor existent data gathering practices (e.g. surveys, case studies, reports) to the required level of disaggregation.
- Engage closely with the 2030 Agenda for Sustainable Development as the data collected may provide a starting point to shed light on the challenges faced in attaining the SDGs. In addition, since these data are already being collected, seek to streamline efforts to avoid increasing reporting requirements for national authorities.
- Engage with journalists and media outlets that report on damage and destruction from explosive weapons, since media documentation and analysis could be an important source of aggregate data.

4.3.2 Recommendations for national governments

- Build awareness of the utility of collecting these data through national committees (e.g. armed forces chiefs of staff, development, and health committees).
- Encourage local offices to collect disaggregated data on the suggested indicators and by gender.
- Document civilian harm narratives and stories, as these might help clarify the reverberating effects of EWIPA.
- If applicable, announce interest in partnering with research organizations to conduct case studies.

This framework seeks to offer indicators to document knock-on effects and potentially inform and influence policy and practice. The reverberating effects that the use of EWIPA have on civilians and civilian structures hinder wellbeing and represent an impediment to sustainable development processes. By using the proposed indicators to identify generalized patterns of harm from the use of EWIPA, the community of practice can better inform ongoing efforts aimed at enhancing the protection of civilians and attaining the 2030 Agenda for Sustainable Development.

Finally, for any interested user, reach out to UNIDIR to discuss ways to use this research framework; share results after using it; suggest updates, edits, or corrections; explore future iterations with different SDGs; and start building a standardized evidence base from case studies. Please share your interest with cap-unidir@un.org.

5. ANNEXES

5.1 DIFFERENCE-IN-DIFFERENCES STATISTICAL APPROACH TO CAPTURE CAUSALITY

Most research on EWIPA focuses on the direct and secondary effects of the detonation and blast. Little is known about the structural implications of the reverberating (or tertiary) effects on urban ecosystems. **Further, causality between observed reverberating effects is debatable since, in some instances, the structures were precarious ex ante and/or influenced by unaccounted exogenous factors.**

To counter this limitation, EWIPA research could contribute to the community of policy and practice by generating knowledge on reverberating effects and **presenting hypotheses based in empirical relations to attribute causality,** which would shed light on exact patterns of harm and capture the extent of such harm. To that end, the difference-in-differences statistical approach assesses both the conditions ex ante and the counterfactual.

This statistical approach relies on the following steps:

1. Collecting data on specific indicators ex ante and ex post in the radius affected by explosive weapons to calculate outcomes after explosive weapons use against (minus) the conditions in situ before the attack. This first difference cleans the result of context-specific outcomes that were going to happen regardless, explosion or not. This is a filter that directly addresses outcomes due to existent failures in the observed urban structures.
2. Repeating the exercise in a radius unaffected by explosive weapons use in order to assess the counterfactual and deduct any observed outcomes from those in the affected area. This second difference answers the question of what would have happened if the victimized area had not been bombed and, at the same time, cleans the result of outcomes driven by exogenous factors at the national level. In statistics, the comparison with the counterfactual relies on the assumption of parallel trends; that is, had the explosion not happened, both radiuses would have maintained parallel trends for observed outcomes.

In short, the difference-in-differences methodology cleans the observed outcomes twice in order to claim that the end result has a causal relationship with the use of explosive weapons in a determined radius.

To pilot the difference-in-differences statistical methodology, one area that seems promising is educational attainment. Researchers might be able to compare literacy rates in the affected zone before it was affected and then after the shock. Afterwards, an unaffected zone in the same region, if it complies with the assumption of parallel trends, could be used as a counterfactual.

5.2 ESTIMATING EXCESS MORTALITY

As described by the Organisation for Economic Co-operation and Development (OECD), excess mortality looks at the total number of deaths over and above what could normally be expected for the time of year [or the average over the previous five years] .[42] In other words, it is a numerical difference between the *observed number of deaths* for a specific time period and the *baseline number of deaths* documented from a previous time period. Computing excess mortality could be an important measure to estimate the combined

42 Morgan, D., Ino, J., Paolantonio, G., and Murtin, F., OECD Health Working Paper No. 122 - Excess mortality: measuring the direct and indirect impact of COVID-19 , Organisation for Economic Co-operation and Development (OECD), 2020, https://www.oecd-ilibrary.org/docserver/c5dc0c50-en.pdf?expires=1612275639&id=id&accname=guest&checksum=F3F55E516981A446B77D2E9BB59C3915

total of direct and indirect deaths from a shock event, such as conflict or the change in use of explosive weapons during conflict. Thus, excess mortality is a noteworthy measure as it might shed light on the 84 full impact of a shock event, at least regarding mortality, by not only comparing deaths that are directly attributable to the [shock], but also by taking into account indirect mortality. [43] Computing excess mortality could also lead to an estimation of indirect deaths, if direct deaths are known and if other exogenous factors are controlled for. When conducting quantitative research, it is of utmost importance to complete an environmental scanning and control for any other variables that might be influencing the number of deaths to avoid attributing unrelated casualties to the shock under study. As challenging at it is, for explosive weapons research, the concept of indirect deaths, and the efforts to estimate it, are important. This is because indirect deaths may reflect some of the fatalities from changes in key services caused by the damage and destruction (second level impacts) and changes in civilian well-being as a result of the changes in key services caused by the damage and destruction (third level impacts), generally referred to in this framework as reverberating effects. For example, the death of a patient due to power losses in a hospital, after the electric grid was shelled, could be considered an indirect death due to the use of explosive weapons, even though the patient was not directly injured by the blast or fragmentation from the explosive weapon. Casualty counts or estimates, however, tend to only capture direct deaths.

Excess mortality computation method: observed deaths minus baseline deaths yields excess mortality.

Indirect deaths computation method: If the excess mortality figure is then reduced by the documented number of direct deaths (and other variables are controlled for) then researchers might have an estimation of indirect deaths.[44]

5.3 OTHER RESEARCH METHODS: CIVILIAN HARM BASED AND INSTANCE BASED

5.3.1 Research approaches to mapping the reverberating effects of explosive weapons use: Civilian harm based and instance based

Research approaches aimed at mapping reverberating effects could start with a focus on civilian harm or on the instances of explosive weapons use. Reverberating effects research that starts with a focus on **civilian harm (civilian harm-based research)** seeks to explain the origin of this harm and retroactively map the links to the use of explosive weapons. Research focused on the instances of **explosive weapons use (instance-based research)** seeks to determine how impacts from one or multiple cases of explosive weapons use spread outwards into society.

Research that starts with a focus on civilian harm requires access to information on harm, which can be provided by individuals who may have observed or experienced the harm themselves. Qualitative research methods can then be used to explain the connection between the personal or societal experiences and explosive weapons use.

Instance-based research requires structured data on incidents of explosive weapons use as well as data on civilian harm. Researchers using an instance-based approach seek to demonstrate a causal chain from the use of explosive weapons to the impact on civilians.

43 Ibid, p. 14.

44 Methodological discussions between the authors and health experts. Please note that controlling for other variables or exogenous factors is of utmost importance to reach reliable estimates.

BOX 6: CIVILIAN HARM-BASED AND INSTANCE-BASED APPROACHES TO DOCUMENT THE IMPACT OF EXPLOSIVE WEAPONS USE AGAINST MEDICAL FACILITIES

The two examples presented below highlight how the two approaches can study broadly the same health impacts from explosive weapons use. The examples focus on maternal and kidney failure mortality to illustrate the causal chain that the research seeks to uncover.

Example 1: Civilian harm-based research framework for reverberating effects on health care

The research may start with documenting specific preventable medical problems, such as maternal or kidney failure mortality rates. Research then focuses on identifying the contributing factors that led to elevated mortality rates. It can focus on access to medical services and quality of care, for example, seeking to identify whether a reduction in dialysis of maternal services and reduced availability of health specialists in conflict settings contributed to the observed excess mortality. Researchers will then attempt to map retroactively the impact chain from the use of explosive weapons, seeking to document the extent to which damage and destruction by explosive weapons reduced access to health services and hampered quality of care, if at all. This research approach may identify a reduction in services at the hospital but may also capture wider factors, such as difficulties in regularly attending medical appointments due to damage inflicted on the transport network or power cuts forcing a reduction in dialysis service in hospitals that did not experience direct damage from explosive weapons.

Strength and weaknesses

In civilian harm-based research, the starting point is the civilian harm experience, and the research describes or retroactively maps how explosive weapons use may have affected the ability of individuals to access the necessary care. A key challenge of the civilian harm approach is showing how the effects, including in excess mortality or indirect deaths, are related to the use of explosive weapons, rather than the larger conflict, general economic downturn, or overall weakened health systems. Civilian harm-based research draws on an implicit theory of change of how explosive weapons cause harm. That is, causal links are assumed because they seem to follow a logical pattern, or the cause-and-effect relationship has been described as such by the affected community.

Example 2: Instance-based research framework for reverberating effects on health care

The research starts with documenting instances of explosive weapons use that caused damage to, for example, a health facility. Research then focuses on identifying which medical services had to be reduced, and to what extent, as a direct consequence of the damage. Afterwards, information on the catchment area of the health facility and the duration of the reduction or closure of service is used to estimate the number of affected patients, including excess death rates. These calculations must control for suitable alternative health services (if they were available), changes in health-seeking behaviour, impact of the conflict on the health of the population, and all relevant factors that could have influenced excess death rates in an attempt to isolate and measure the effect of the disruption to one health facility. Based on the type of services that are reduced, researchers can use medical data to outline the consequences for specific groups of patients, such as pregnant women or patients requiring dialysis treatment, as opposed to the general population. This methodology can also be applied to any other life-saving specific service no longer offered. In the instance-based research approach, the starting point is the event of explosive weapons use, and impact documentation describes how this shock to the urban

ecosystem affected the ability of systems and professionals to provide the needed services and thus sparked a chain of civilian harm.

Strength and weaknesses

An instance-based research approach focuses on demonstrating the specific outcome of the use of explosive weapons in a place and time, and then drawing the specific causal link between an instance of explosive weapons use and the impact on the health care system, for example. As the research is set out along a linear cause-and-effect chain, an instance-based approach may miss wider factors related to explosive weapons use that were not included in the original assumed impact chain, such as the impact of damage to transport networks or overall economic downturn. However, since this research approach essentially examines specific urban systems, what works, how, in which conditions and for whom, it might be overall better suited to producing case studies that allow for comparison between different events or locations. By comparing different time periods or using different geographic areas as counterfactuals, this research approach can show the specific long-term damage caused by explosive weapons use. In addition, as the focus is on the health care system rather than the patient, it is also better suited to providing recommendations on how to mitigate the consequences of explosive weapons use and build resilient systems. If there are multiple studies from different locations and periods in time, all using the same indicators and methodology, future studies interested in the same indicator could use them as a benchmark. As such, every research effort will represent a building block that together, over time, will construct a body of evidence to support systematic evaluations on specific civilian harm impacts caused by the use of explosive weapons.

5.4 WHAT ARE EXPLOSIVE WEAPONS, AND WHO USES THEM?[45]

There are many types of explosive weapons currently in use. These include air-dropped bombs, artillery projectiles, missiles and rockets, mortars, and improvised explosive devices. Some are launched from the air, while others are ground launched. While different technical features dictate their accuracy of delivery and explosive effect, these weapons generally create a zone of blast and fragmentation with the potential to directly kill, injure or damage anyone or anything within that zone. This makes their use in populated areas such as towns, cities, markets and camps for refugees and displaced persons particularly problematic. The problems increase further if the weapons effects extend across a wide area either because of the scale of the blast that they produce, their inaccuracy, the use of multiple munitions across an area, or a combination thereof. For the purposes of this research framework, the impacts of unexploded ordnances and explosive remnants of war should also be considered when conducting research on the reverberating effects.

Explosive weapons are used by State and non-State actors. Most explosive weapons are either deployed in the context of armed conflict or attacks commonly labelled by States and the media as acts of terrorism . The data collected systematically on civilian casualties from explosive weapons show a year-on-year increase in reported numbers of casualties.[46]

45 This definition and discussion was retrieved verbatim from C. Wille and J. Borrie, Understanding the Reverberating Effects of Explosive Weapons: A Way Forward, UNIDIR, 2016, p. 7, http://www.unidir.org/files/publications/pdfs/reverberating-effects-research-agenda-en-653.pdf.

46 Action on Armed Violence explosive weapons monitor: https://aoav.org.uk/explosiveviolence. Action on Armed Violence data include casualties from all explosive weapons, including improvised explosive devices, reported in English-speaking media since 2011.

REFERENCE FRAMEWORK:

MENU OF INDICATORS TO MEASURE THE REVERBERATING EFFECTS ON CIVILIANS FROM THE USE OF EXPLOSIVE WEAPONS IN POPULATED AREAS

The impacts of explosive weapons use in populated areas are much wider and longer lasting than the shock waves of the explosive blast. The use of explosive weapons sets in motion a series of complex knock-on effects that spread out over time and space in urban ecosystems, with negative consequences for civilian well-being and the environment in which people live. These "reverberating effects" manifest across a wide range of interlinked sectors, including urban infrastructure, public health, education, culture and heritage, food security, economic prospects, and adverse environmental impacts. The purpose of this research framework is to offer indicators to document knock-on effects and potentially inform and influence the policy and practice of parties to conflict. This document aims to shed light on the generalized pattern of harm from the use of explosive weapons in populated areas (EWIPA). By using a standardized set of indicators, the data generated can be leveraged to build a comparable evidence base reflecting the consequences to civilian well-being of the use of EWIPA and to inform high-level decision-making on policy and practice.

VERSION 1