

Analysis of mobile clinic deployments in conflict zones

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Abstract

Purpose – This study aims to deepen the understanding of the challenges and implications entailed by deploying mobile clinics in conflict zones to reach populations affected by violence and cut off from health-care services.

Design/methodology/approach – This research combines an integrated literature review and an instrumental case study. The literature review comprises two targeted reviews to provide insights: one on conflict zones and one on mobile clinics. The case study describes the process and challenges faced throughout a mobile clinic deployment during and after the Iraq War. The data was gathered using mixed methods over a two-year period (2017–2018).

Findings – Armed conflicts directly impact the populations' health and access to health care. Mobile clinic deployments are often used and recommended to provide health-care access to vulnerable populations cut off from health-care services. However, there is a dearth of peer-reviewed literature documenting decision support tools for mobile clinic deployments.

Originality/value – This study highlights the gaps in the literature and provides direction for future research to support the development of valuable insights and decision support tools for practitioners.

Keywords Mobile clinics, Operations management, Conflict zones, Health-care access, Literature review

Paper type Literature review

1. Introduction

The aftermath of armed conflicts, herein referred to as “conflicts”, has resulted in the inception of various humanitarian organizations. For example, the International Red Cross and Red Crescent Movement (IFRC) alleviated human suffering due to the lack of health-care access during the war of Solferino in 1859 (IFRC, 2016). Similarly, the United Nations (UN) came together in response to the Second World War in 1945. At the time, UN members took notice of the need for a global health organization to provide humanitarian health-care assistance and protect human rights (UN, 2015b). In that optic, the World Health Organization (WHO) was founded (WHO, 2022). Conflicts have been contributors to causes of ill health and mortality for most of human history (Murray *et al.*, 2002). Furthermore, conflicts drive 80% of all humanitarian needs, according to the World Bank (2022). To make matters worse, up to two-thirds of the world's extremely poor are estimated to live in areas affected by conflicts (World Bank, 2022). Addressing health-care needs during and after conflicts is essential to reach the UN Sustainable Development Goals (SDGs) (Samman *et al.*, 2018). Yet, scholars of humanitarian

logistics have “ignored the area of conflicts, wars, and complex emergencies” (Altay *et al.*, 2021, p. 579). Moreover, while many authors have addressed the 17 SDGs (UN, 2015a) (Besiou *et al.*, 2021), most studies have overlooked that countries affected by conflicts are less likely to meet these goals (Garry and Checchi, 2020). Responding to the needs of people

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affected by conflicts helps directly reach: SDG1 “No Poverty”, SDG3 “Good Health and Well-Being”, SDG5 “Gender Equality”, SDG6 “Clean Water and Sanitation”, SDG10 “Reduced Inequalities” and SDG16 “Peace, Justice, and Strong Institutions”.

Although health-care needs during and after natural disasters and conflicts are similar, differences arise from the political complexities of conflicts. During conflicts, civilian populations are targets of war and subjected to human rights violations that aggravate health (Leaning and Guha-Sapir, 2013). Additionally, people affected by conflicts experience severe public health consequences driven by population displacement, food scarcity and the collapse of health-care services, giving rise to complex humanitarian emergencies (Toole and Waldman, 1997; Vass, 2001).

The availability of weapons facilitates conflict (Smith, 2004), which makes operating a humanitarian organization in a conflict zone challenging and leads to additional limitations. Unfortunately, violence and conflict endure for long periods, and combatants can target humanitarian organizations or prevent them from accessing vulnerable populations (Beamon and Kotleba, 2006). Humanitarian organizations may face many risks that force them to yield to the demands of a warring side to obtain security guarantees to help the affected populations (Weil, 2001). Health-care services are one of the daily operations affected by conflicts. In fact, conflict reduces access to health care by damaging transport and communications channels (Urdal and Che, 2013). Furthermore, the risk associated with travelling deters people from seeking health care due to the dangers and high cost (Grundy et al., 2008).

To provide humanitarian health-care relief, non-governmental organizations (NGOs) use mobile clinics (Du Mortier and Coninx, 2007b). Mobile clinics are an intermittent modality used to provide ambulatory health care and improve access to health (McGowan et al., 2020; Du Mortier and Coninx, 2007b). These clinics aim to give access to essential health-care services to populations unable to access permanent health structures (Médecins du Monde, 2017); as such, they serve as temporary solutions for those needing medical services. Often, they consist of vehicles transporting equipment and health-care providers who deliver health services at predetermined outreach posts (McGowan et al., 2020). Typically, mobile clinics offer a combination of primary services, including preventive actions (e.g. vaccination, screening and health education) and curative services (e.g. obstetric, medical and mental health interventions).

This paper aims to analyse the deployment of mobile clinics in conflict zones from an operations management and logistics perspective. Hence, it addresses three research questions (RQs):

- RQ1. What are the impact and implications of conflict zones on health-care access?
- RQ2. What are the benefits and challenges arising from the deployment of mobile clinics in conflict zones?
- RQ3. What insights and tools can be developed to support mobile clinic deployment?

This study combines an integrative literature review and an instrumental case study to answer these questions. The integrated literature review targets both conflicts and mobile clinics. The targeted review provides context on how operations and logistic decisions are affected during and after a conflict. In addition, it presents the challenges of the health-care system and its impact on the population in conflict and post-conflict zones. Moreover, it provides a perspective on the decisions involved during deployments and the various applications. Then, the case study documents the operations and challenges encountered during the Iraq War by Première Urgence Internationale (PUI), an international NGO that deploys mobile clinics to relieve the suffering of populations affected by global humanitarian crises. Finally, this study highlights the insights derived from the literature review and case study to provide direction for future research.

This paper’s contribution’s address specific literature gaps in three distinct ways. Firstly, it sheds light on the intricate challenges and consequences inherent in relief operations conducted during and after conflicts, offering a nuanced understanding of this critical phase in humanitarian logistics. Notably, while authors have surveyed the literature on mobile clinics, no prior study has delved explicitly into the peculiarities of deployments in conflict zones, making this work a pioneering effort. Secondly, it provides a comprehensive overview of the operational intricacies involved in deploying mobile clinics, focusing on conflict and post-conflict, elucidating the distinctive logistical difficulties in these contexts. This is the first study that combines a case study with two targeted literature reviews, providing a holistic perspective to illustrate the difficulties faced by mobile clinic practitioners. Finally, it lays the foundation for future research endeavours by outlining key areas where further exploration and inquiry are needed in mobile clinic deployment within conflict and post-conflict zones. Through these contributions, we aim to bridge existing gaps in the literature and advance our understanding of humanitarian logistics in these complex scenarios.

The remainder of the paper is structured as follows. Section 2 details the methodology used in this study. Section 3 presents the targeted literature review on conflicts and what they entail, highlighting the dreadful consequences on health-care systems and the health of people living in conflict zones. Section 4 provides the targeted literature review on mobile clinics, practices and standards while underscoring the role mobile clinics play during conflicts. Section 5 showcases the case of Iraq, a mobile clinic deployment by PUI during and after the Iraq War. Section 6 explores needed tools for practitioners deploying mobile clinics in conflict zones. Section 7 presents the conclusions of this study and synthesizes the proposed direction for future research.

2. Methodology

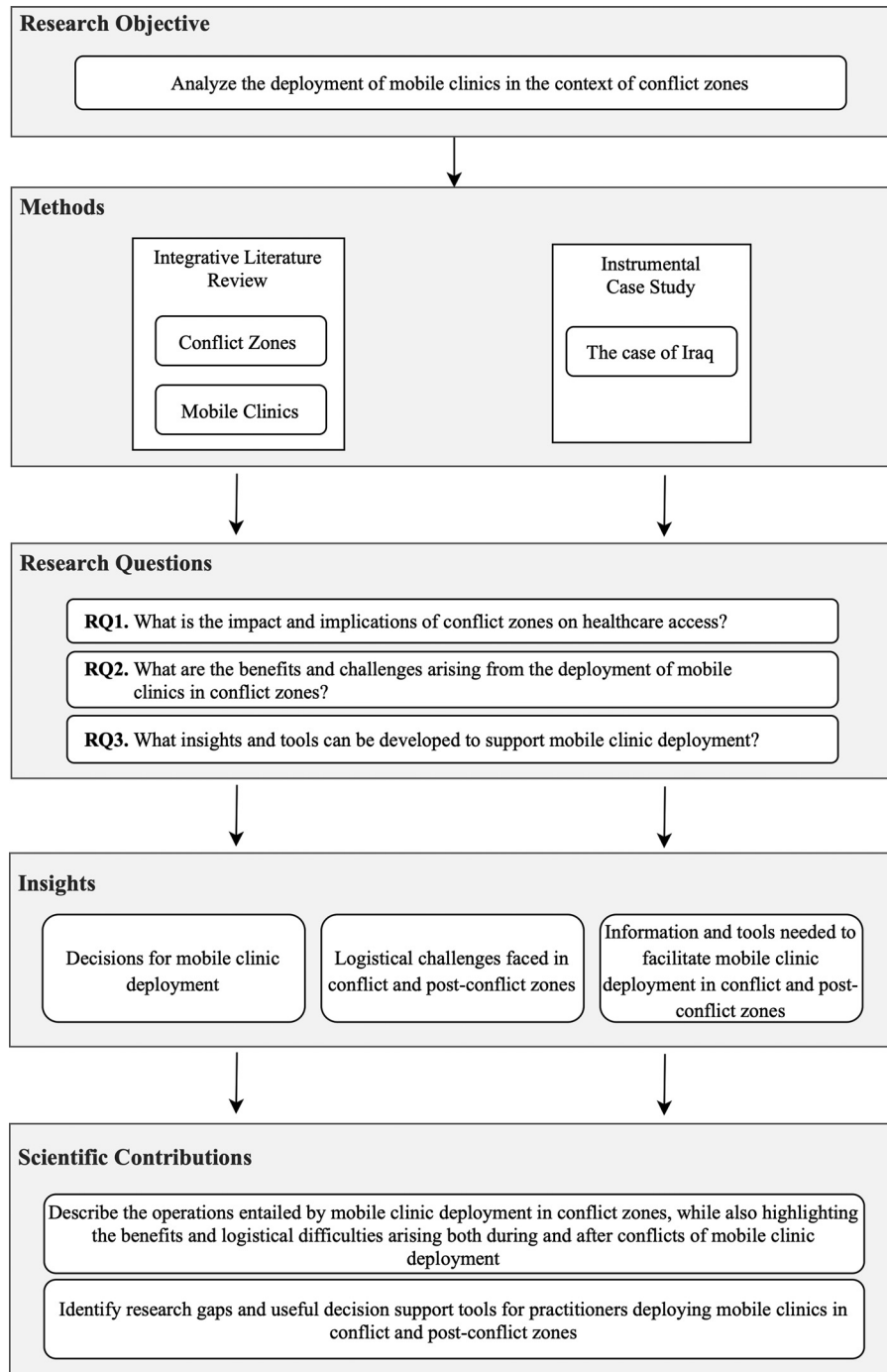
This study combines an integrated literature review and an instrumental case study. The literature review underscores recent or historically significant research studies and field reports (Cooper et al., 2006) to provide perspective on mobile clinic deployments and conflict zones. Furthermore, using multiple data collection methods (Njie and Asimiran, 2014) to expose the characteristics of a particular case of mobile clinic

deployment in conflict and post-conflict zones, we use a case study to describe the challenges faced. The methodological framework is depicted in Figure 1. We determine three RQs to analyse the deployment of mobile clinics in conflict zones. The answers obtained through the methodology described in the following sections (Sections 2.1 and 2.2) aid in deriving insights related to the decision-making process involved and what key insights and support tools would be helpful for practitioners.

We also stress the complexities and challenges faced during the deployment of mobile clinics during conflict and post-conflict.

The methodology allows us to answer the three proposed RQs. With the targeted literature review on conflict zones presented in Section 3, RQ1 is answered. Then, with the targeted literature review on mobile clinics, presented in Section 4, and the case study, in Section 5, we answer the RQ2. Finally, in Section 6, we make the connection between the

Figure 1 Research methodology, insights and contributions



Source: Figure created by authors

integrative literature review and the case study to answer *RQ3*, which provides guidance for future research in the field.

2.1 Integrated literature review

Snyder (2019) has identified integrative literature reviews as an adequate tool for authors to combine perspectives and insights. This paper combines perspectives and information pertinent to the deployment of mobile clinics in conflict and post-conflict zones to answer the *RQs* and, hence, we result in an integrative literature review. The scope of this study is limited to the deployment of mobile clinics in conflict zones. Although studies that concentrate on deployments for humanitarian relief during other disasters are briefly discussed, we purposely do not approach them in an extensive discussion. The literature on mobile clinic deployments in conflict and post-conflict zones is scarce. A desired outcome of this study is to provide direction for future research that supports the deployment of mobile clinics in these contexts. Torraco (2005) stresses that an integrative literature review methodology stimulates further research, which further justifies our methodology selection.

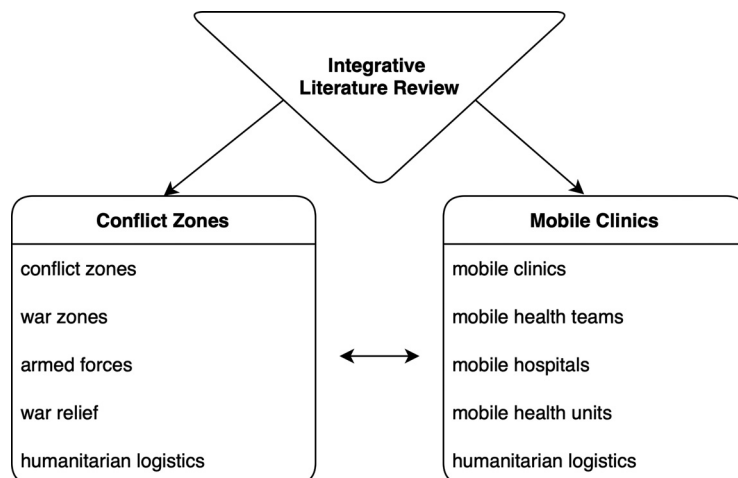
Due to the dearth of articles that study the deployment of mobile clinics, the integrative literature review is composed of two targeted literature search (Huelin et al., 2015), i.e. on conflict zones and mobile clinics, both conducted in May 2022. The literature search mainly focused on peer-reviewed journal publications using keywords in the ABI/Inform (ProQuest) database. We selected ProQuest as the database for this study, as it is a comprehensive compilation of 58 different databases, making it an ideal choice for surveying literature in our field. Searching the ABI/Inform collection enabled us to capture relevant publications broadly while minimizing the probability of overlooking important articles. The keywords included “conflict zones”, “war zones”, “armed forces”, “war relief”, “humanitarian logistics”, “mobile clinics”, “mobile health teams”, “mobile hospitals” and “mobile health units” (Figure 2). The keywords were combined using a Boolean search with the operator “OR”. This search resulted in 88,729 peer-reviewed articles for conflict zones and 49,777 peer-reviewed articles for mobile clinic deployment. Title and

abstracts of the resulting articles were analysed to determine their relevance. This was followed by reference and citation analyses to find related contributions, known as going backwards (Webster and Watson, 2002). In addition, Google Scholar was used to identify articles that cited the relevant literature, known as going forward (Webster and Watson, 2002). We excluded literature pertaining to fields other than political science, economics and management for the targeted review on conflicts. Similarly, we excluded literature focused on the medicine and medical treatment studies for the mobile clinic targeted review. We also excluded working papers and conference papers, therefore maintaining a focus on peer-reviewed articles to ensure the sample’s quality. In total, 102 and 56 articles were included for conflict zones and mobile clinics, respectively.

Benzies et al. (2006) encourage authors to use grey literature when there is little evidence. Hence, the relevant peer-reviewed publications are supplemented and synthesized with the use of grey literature. Not only have purely research-based reviews been criticized for their inability to provide meaningful conclusions (Pawson et al., 2005), but also grey literature has been praised for its relevance and likelihood to be more up to date (Rothstein and Hopewell, 2009). To identify the relevant grey literature, the websites and databases of known NGOs such as the WHO, the UN and the IFRC were used. By including grey literature, this study increased the likelihood of a comprehensive search (Benzies et al., 2006). The search keywords and boolean combinations remained the same for the grey literature. The search resulted in 10,540 and 8,329 for mobile clinics and conflicts, respectively. We excluded material pertaining to specific medical operations and military tactics on the mobile clinic targeted review and the conflicts targeted literature review, respectively. We also excluded press releases, podcasts and situation reports. Resulting in the inclusion of ten and six articles from the grey literature to the mobile clinic targeted review and the conflicts targeted literature review, respectively.

Moreover, to analyse the practices of humanitarian organizations when deploying mobile clinics in a conflict

Figure 2 Integrative literature review



Source: Figure created by authors

setting, a data extraction of project plans submitted by humanitarian organizations for funding, which included mobile health clinics, was made using the database of the Financial Tracking Service (FTS) of the UN's Office for the Coordination of Humanitarian Affairs (FTS, 2022). The search was conducted on submissions made between 2009 and 2021 for a total of 12 years. The inclusion criteria included the keywords: “mobile health team*” or “mobile clinic*” or “mobile hospital*”. This led to the first selection of 395 projects. Further coding was done to keep only projects involved in conflict zones for a final selection of 209 projects. Results from this search are presented and discussed in Section 4.3.

The findings of the integrated literature review are used to define the peculiarities of mobile clinic deployments in conflict and post-conflict zones. Firstly, the targeted literature review on conflict zones is presented in Section 3. It begins by defining conflict zones, post-conflict zones and the different degrees of conflicts. Moreover, the targeted review presents past historical data and summarizes the findings of empirical studies that concentrate on the nature, duration and onsets of conflicts. Findings by various authors related to the toll of conflict on citizens, their health and the health-care systems that serve them and its lingering effect when conflict zones transition into post-conflict zones are discussed. Secondly, in Section 4, the targeted literature review on mobile clinics is presented. Based on empirical studies found in the literature, mobile clinics are positioned as a temporary measure to satisfy the health-care requirements of populations affected by conflicts. We also present statistics compiled through the WHO's website on the various deployments of mobile clinics over the years. These statistics further illustrate the importance of research directed towards developing decision-making tools to support mobile clinic deployments in conflict and post-conflict zones.

2.2 Instrumental case study

The main goal of a case study is to extract in-depth details about an event, person or process (Njie and Asimiran, 2014). In this case study, the decision process during the mobile clinic deployment in Iraq by PUI, a not-for-profit and NGO (PUI, 2016b), is documented and described to uncover insights into challenges faced by practitioners. Stake (1995) classifies case studies into three types: intrinsic, instrumental and multiple case studies. Because the case of Iraq is examined to generalize the logistical difficulties and operations entailed in deploying mobile clinics in conflict and post-conflict zones, it can be classified as an instrumental case study. The Iraq War, ranging from 2003 to 2011, is the bounded context in which the presented case study is depicted (Miles and Huberman, 1994).

The case study arises from a series of exchanges between the infield project managers and head medical staff as part of a collaboration between the authors and the organization. The sources used for data collection included interviews, documents, archival records and observations (Stake, 1995; Yin, 1994; Leedy and Ormrod, 2005). A total of five semi-structured interviews took place in 2017 through an online conference call platform. For each semi-structured interview, a list of questions was prepared in advance to lead the discussion, and enough room was allotted to maintain the conversation based on a limited number of topics or issues. Not all meetings

were recorded due to confidentiality issues. However, minutes taken during meetings were validated with attendees to ensure all information was captured correctly. Table 1 summarizes the meetings that took place, attendees and the duration of the meetings. The collaboration was initiated in 2016 and continued until the deployment was phased out in 2019, for a total of three years. Hartley (2004) highlights that case study research “consists of a detailed investigation, often with data collected over time, of phenomena, within their context,” and additionally aims “to provide an analysis of the context and processes which illuminate the theoretical issues being studied” (p. 323).

3. Conflict zones

To fully grasp what it means to deploy mobile clinics in conflict zones, one must understand the nature and the implications of conflicts. This targeted literature review aims to provide a general understanding of the characteristics of conflict zones and the effect on the territories they take place in. To answer *RQ1*, we concentrate on how conflicts affect access to health care and the health of the populations. We start by adhering to the definition of conflicts as presented in the literature and providing a brief historical overview of documented conflicts in Section 3.1. Then, in Section 3.2, we discuss the literature that studies the effects of conflicts. In Section 3.3, the particular health-care implications of conflicts on the populations affected are exposed. Finally, this information is used to position the role of mobile clinic deployments in both conflict and post-conflict zones in Section 3.4.

3.1 Armed conflicts

Pettersson and Wallensteen (2015) define conflicts as the:

Contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 deaths must be recorded during battle (p. 536).

The same authors defined armed force using any materials (e.g. manufactured weapons, sticks, stones and water) to promote the parties' general position and resulting in deaths. Herein, conflict zones are the geographical territories in which conflicts take place. Wallensteen and Sollenberg (2000) defined four types of conflicts: minor conflicts, intermediate conflicts, wars and major conflicts, all defined by the number of deaths (Figure 3). This classification highlights that there are different enormities to conflicts. Hence, each of the four types contributes to a different level of threat and demand in the field based on the category.

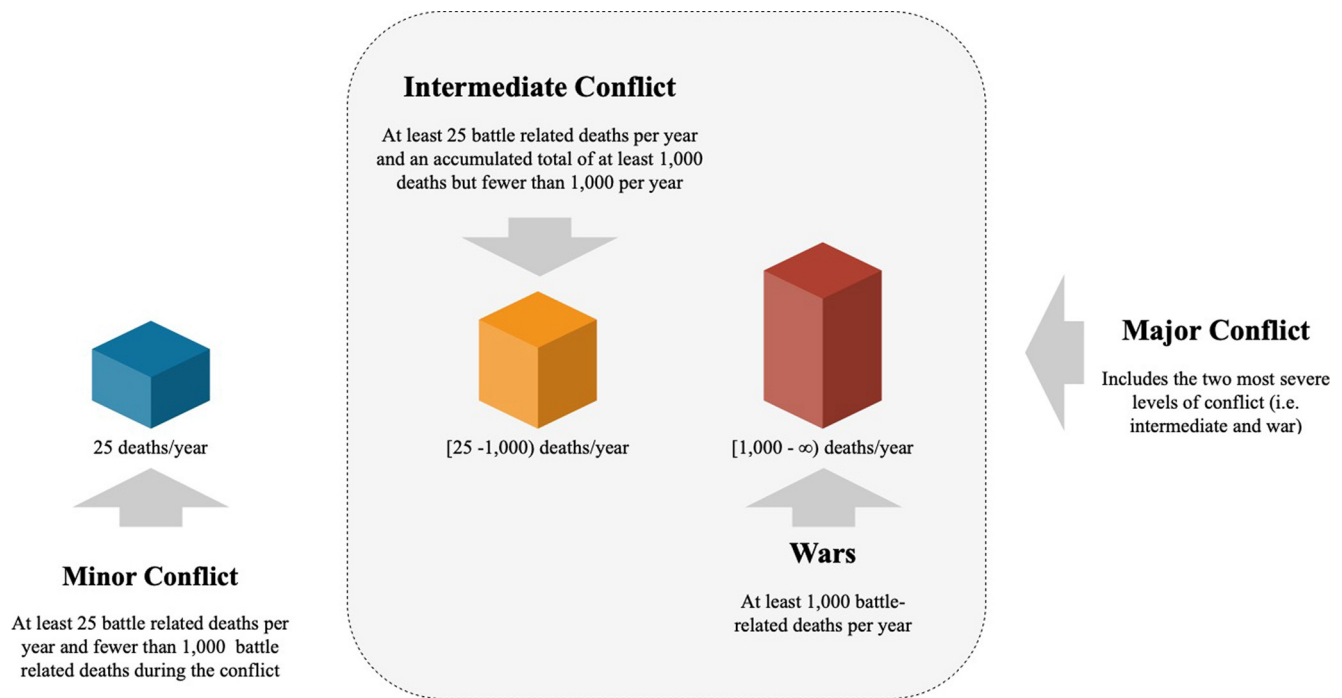
The historical occurrences of conflicts have been well-studied and documented (Smith, 2004; Themnér and Wallensteen, 2011; Cederman and Weidmann, 2017; Pettersson and Wallensteen, 2015; Strand *et al.*, 2020; Strand and Hegre, 2021). Cederman and Weidmann (2017) stressed the importance of documenting conflicts and, thus, initiated the movement of the Uppsala Conflict Data Program (UCDP). The UCDP database contains a comprehensive number of data files with historical data on different conflicts around the world starting from 1939, registering 2,506 conflicts. The authors could not find any significant evidence to indicate that conflicts would continue to decrease in the upcoming years (Kreutz, 2010;

Table 1 Semi-structured interviews with PUI

Date	Interviewees	Duration	Recorded
23 March 2017	Technical Director and Head Nurse	1 h	No
23 May 2017	Technical Director, Head Nurse and Project Manager	1 h	No
20 June 2017	Project Manager and Head Nurse	1 h	No
19 July 2017	Project Manager and Field Coordinator	1.5 h	Yes

Source: Table created by authors

Figure 3 Types of conflicts



Source: Figure adapted from Wallensteen and Sollenberg (2000)

Strand and Hegre, 2021). Cederman and Weidmann (2017) point out that the occurrence, location, frequencies and termination of conflicts are hard to forecast. Smith (2004) highlights that a combination of poor economic conditions, political repression and degradation of renewable resources are a catalyst for conflicts. Since conflicts will continue to occur through the years to follow, the need for humanitarian relief in conflict and post-conflict zones will not fade in the years to come.

Kreutz (2010) found that the terminations of conflicts involved peace agreements, ceasefires, victory or others. Conflicts ending in victory had the shortest duration, approximately a year and seven months, while conflicts ending with a cease-fire lasted the longest, approximately four years and nine months. Because the duration of a conflict extends more than a year, relief operations in conflict zones require strategic, tactical and operation plans. Kreutz (2010) also found that external peacekeeping efforts were significant to prevent a resumption of conflict after a continuous year of conflict. This displays the importance of the “Genocide

Prevention and Responsibility to Protect” adopted in 2005 by the UN to motivate states to intervene in conflicts that endanger civilians (UN, 2019). Once again, this shows the importance of humanitarian aid and external organizations during conflicts.

3.2 Consequences of conflicts and humanitarian needs

Conflicts have dreadful consequences on populations. Exposure to conflict zones creates economic, social, ecological, psychological and nutritional stressors (Clarkin, 2019). Apprehension and exposure often lead to the displacement of the population as people seek refuge and help, sometimes moving across borders. The United Nations High Commissioner for Refugees (UNHCR) identified 53.2 million forcibly displaced people in 2020 due to persecution, conflict, violence or human rights violations (UNHCR, 2021). Displaced populations often suffer from lost property or social capital, resettlement in less fertile areas, restricted mobility and are often viewed as a burden for their hosts (Al Gasseer et al., 2004; Hynes and Cardozo, 2000; Salama et al., 2004).

Clarkin (2019) remarks that those who remain fare worse than those who cross an international border. Hence, people initially located in a conflict zone face a plethora of hardships, both if they stay in the zone of conflict or if they migrate to a conflict-free zone. This explains why people still choose to stay in a conflict zone and highlights the importance of providing aid to people in conflict zones.

Civilians are subjected to wartime violence during conflicts due to various factors. Hovil and Werker (2005) found that civilians were targeted as a display of commitment to continue fighting. Researchers have observed that groups that receive support from foreign governments have few to no incentives to refrain from attacks against civilians (Salehyan *et al.*, 2014; Toft and Zhukov, 2015; Weinstein, 2006; Zhukov, 2017). Even in a post-conflict context, resentment towards groups that have collaborated with enemies can lead to ethnic violence (Bell-Fialkoff, 1993; Taras and Ganguly, 2015) and revenge (Weidmann, 2011; Balcells, 2010; Gibbs, 2018). However, Azam (2002) posits that violence against civilians is a byproduct of looting and resource competition. This aligns with the observations of Koren and Bagozzi (2017), which found higher incidents of violence against civilians in areas with more agricultural resources as governments and rebel groups compete for access to food. During conflicts, fighters engage in sustained looting against their communities and hold roadblocks for ransom (Englebert and Ron, 2004). The targeted violence towards people living in conflict zones motivates the need for health-care relief to alleviate the suffering after such unfortunate incidents.

Conflicts often conserve gender roles (Bjarnegård *et al.*, 2015) and have different effects among age and gender groups in the population. For instance, most of active combatants are males (Henshaw, 2013), which explains why men are at a higher risk of death (Zwierzchowski and Tabeau, 2010). Women are often subjected to wartime violence, such as sexual exploitation (Centre, 2005). Messer *et al.* (2001) found that children are subjected to homelessness and separation from community ties during conflicts. Most often, “breadwinners” are the ones who fall victim to landmines (Messer *et al.*, 2001). Because conflicts affect genders differently, the health-care needs will differ from females to males during the conflicts. Not to mention that age groups in the population will be more prone to specific traumas. This is something that practitioners must account for when planning mobile clinic deployments.

Landmines can hinder farming, avert economic development and also lead to casualties even decades after a conflict has concluded (Khamvongsa and Russell, 2009). Moreover, shelling and bombing can disrupt topography, form craters and alter drainage patterns (Hupy and Schaeztl, 2006). Additionally, in conflict zones, there is a reduction in access to water and sanitation services, increasing poverty (Gleick, 2019). Not to mention that reduced access to water and sanitation can lead to the deterioration of health and exacerbate existing conditions in the population. Garfinkel and Skaperdas (2007) found that valuable resources are diverted from investment and consumption. Resources go directly into obtaining arms; hence, there is a significant reduction in trade and an increasing accumulation of productive capital (Garfinkel and Skaperdas, 2007). Moreover, the insecurity posed by conflicts deters trade activities across national

borders, leading people to participate instead in less productive and more secure activities (Garfinkel and Skaperdas, 2007). Addison *et al.* (2001) signal that post-conflict economies have weak regulatory authorities, and the financial system becomes loaded with unsound loans, which leads to problems that can endanger economic recovery and peace. Hence, conflicts pose development hardships for citizens and a high cost to the international community (Ross, 2003). Hardships can prevent citizens from seeking health care due to limited resources. At the same time, high costs will make it difficult for the international community to provide efficient and effective relief to human suffering.

The horrific consequences of conflicts, both on soldiers and civilians, have shaped humanitarian aid into the systems we see today, even leading to the conception of humanitarian principles (Rysaback-Smith, 2015; Macintosh, 2000). Foreign donors attempt to alleviate the suffering during conflicts by sponsoring humanitarian aid (Wood and Sullivan, 2015). To the point where humanitarian aid has become an essential component of the international community’s response to conflicts, humanitarian organizations have taken an active role by providing vital services and security to internally displaced people (Anderson *et al.*, 1999; Duffield, 1997). This emphasizes the importance of planning and defining standard practices when delivering relief in conflict zones. Although Wood and Sullivan (2015) point out that humanitarian aid may produce short-term instability and increased violence by encouraging both rebel and government forces to engage in violence against civilians, it remains essential to save lives and help people to enjoy the most basic rights to shelter, water and enough to eat (Bryer and Cairns, 1997). Therefore, humanitarian relief must account for the peculiarities of conflict zones and be delivered to maximize the safety and well-being of the populations affected.

3.3 Health-care implications

Frost *et al.* (2017) noted that limb imputation was the most common injury sustained during conflicts. Severe disabilities can be attributed to landmines during and post-conflicts (Coupland and Korver, 1991). McPherson (2019) noted that traumatic brain injuries, associated with mental health concerns, among the population suggest landmines and explosive devices cause them. Violence also has major effects on physical and mental health, including injuries from rape, HIV, reproductive health problems and social isolation (Spangaro *et al.*, 2013; Stark and Ager, 2011). Moreover, the physical injuries and health effects last into older age and are usually worse for older women versus for older men (Ghobarah *et al.*, 2004; Massey *et al.*, 2017). Also, populations affected by conflicts often suffer mental health disorders such as post-traumatic stress disorder, stress, insomnia, anxiety and depression (Garry and Checchi, 2020). These findings show that mental health issues can affect the population exposed to conflicts long after a conflict has culminated. Also, it highlights the importance of providing mental health care as part of humanitarian relief efforts in response to a conflict.

Leaning and Guha-Sapir (2013) posit that the principal health implications of internal conflicts are not combat-related injuries and deaths. However, Murray *et al.* (2002) highlight that quantifying the health implications of conflict is

challenging because civil registration systems often cease to function during conflicts. [Levy and Sidel \(2016\)](#) identify a need for an independent, nonpartisan mechanism, established and maintained by a UN agency or a multilateral organization, to investigate, document and report on the health consequences of conflict. This dearth of documentation presents a challenge, making predicting the demand for health-care services even harder. Nonetheless, numerous studies have documented the gruesome implications of conflicts on the health of populations affected by surveys, news reports and external databases. Hence, organizations may still rely on previous studies in the literature to forecast the demand for specific health-care services. [Ghobarah et al. \(2003\)](#) found that conflicts deepen the risk of death and disability with increases in homicide, transportation accidents, other injuries and cervical cancer. [Wise and Barry \(2017\)](#) underscored the prevalence of disease outbreaks in conflict zones. [Jawad et al. \(2019\)](#) found evidence that associates conflicts with increased coronary heart disease, cerebrovascular and endocrine diseases, in addition to increased blood pressure, lipids, alcohol and tobacco use. [Kimbrough et al. \(2012\)](#) noticed that the incidence and prevalence of tuberculosis were twice as high in conflict-affected populations. The challenging environments, including attacks on health workers, mean that vaccination and eradication campaigns repeatedly fail to achieve sufficient coverage in conflict zones ([Bhutta, 2013](#); [Morales et al., 2016](#); [Wise and Barry, 2017](#)). This suggests that authors should give special attention to improve the performance of vaccination and eradication campaigns in conflict zones. Additionally, poor access to health care and lack of continuity of care during conflict has disrupted the effective care of cardiovascular and cerebrovascular conditions, diabetes, chronic respiratory diseases, cancers and other non-communicable diseases ([Bendavid et al., 2021](#)). These findings signal that researchers and practitioners must prioritize continuity of care to prevent the deterioration of the health of people suffering from non-communicable diseases.

The health-care implications on women and children have been extensively studied. [Rai et al. \(2019\)](#) documented that conflict and emergencies contribute to mortality and long-term health deterioration for females. [Wagner et al. \(2019\)](#) observed an increase in maternal mortality that is directly correlated to the intensity of the conflict. [Bendavid et al. \(2021\)](#) saw an increase in the probability of dying in women of childbearing age when exposed to conflict. This could be attributed to the reduced access to maternal and newborn health services, especially for the poorest and least educated women ([Gopalan et al., 2017](#); [Akseer et al., 2020](#)). It was observed that conflict exposure decreases fertility based on studies in Angola, Ethiopia and Eritrea ([Agadjanian and Prata, 2002](#); [Lindstrom and Berhanu, 1999](#); [Blanc, 2004](#)). Additionally, two studies observed the unmet need for family planning in conflict settings ([McGinn et al., 2011](#); [Ivanova et al., 2018](#)). Maternal mortality tends to worsen in conflict zones ([Alkema et al., 2016](#); [Kotsadam and Østby, 2019](#)). These studies serve as a testament to the need for women's health services in areas affected by conflicts. Hence, practitioners deploying mobile clinics must consider including these services. When it comes to children, [Wagner et al. \(2018\)](#) found that infants exposed to conflict in their first year had a higher chance of dying before

they reached age one. [Keasley et al. \(2017\)](#) point out the significant relationship between exposure to conflict and a detrimental effect on birth weight. Four studies demonstrated a statistically significant increase in premature births due to conflict exposure ([Arnetz et al., 2013](#); [Bodalal et al., 2014](#); [Skokić et al., 2006](#); [Keren et al., 2015](#)). Additionally, [Bendavid et al. \(2021\)](#) noted that chronic malnutrition in children is more pronounced among children near conflict zones. Therefore, practitioners pay attention to the need for infants and children's health-care services during and after conflicts. [Qadri et al. \(2017\)](#) attributed the cholera outbreak in Yemen to the bombing of water facilities. In [Table 2](#), we consolidate and provide an at-a-glance summary of the health-care implications of conflicts. All these implications lead to and justify the need for humanitarian health care in conflict and post-conflict zones.

3.4 Humanitarian health care in conflict zones

Since the adoption of the UN's "Genocide Prevention and Responsibility to Protect", efforts to send humanitarian aid to conflict zones have increased ([Bellamy, 2015](#)). [Leaning and Guha-Sapir \(2013\)](#) state that public health is a significant component of the larger operational framework of international relief. Public health encompasses disease control, reproductive health and maternal care, psychosocial support, short-term or emergency medical and surgical interventions and sanitation and nutritional services ([Leaning and Guha-Sapir, 2013](#)). Evidence has been found that supports the role of public health measures for peacebuilding ([Sen and Faisal, 2015](#)) and social cohesion ([Kruk et al., 2010](#)) in the aftermath of a conflict. It can not be denied that humanitarian relief efforts have been concentrated on providing health-care access to people in conflict and post-conflict zones. Authors have documented cases where access to health-care services has improved compared with pre-conflict due to humanitarian and international aid ([Gordon et al., 2010](#); [Gates et al., 2010](#)). [Devkota and van Teijlingen \(2010\)](#) state that the international community should continue to increase their support to strengthen the health sector of territories affected by conflicts. If this support continues or even increases, practitioners can use tools that would help them effectively deliver the much-needed health care in a prompt manner to those who desperately needed it.

During a conflict, the infrastructure, including buildings, medication stores, laboratories, electricity and water, may be directly targeted or looted ([Gordon et al., 2010](#); [Guha-Sapir and van Panhuis, 2002](#); [Gates et al., 2010](#); [Zwi and Ugalde, 1989](#); [Levy, 2002](#)). Health services are often severely interrupted by the destruction of infrastructure and management systems ([Ahmadani et al., 2014](#)). Continuity of care is complicated in the face of health system disruption, and health outcomes are sensitive to health-care continuity ([Buvinic et al., 2013](#); [Aebischer Perone et al., 2017](#); [Isreb et al., 2016](#)). This leaves people living in conflict and post-conflict zones more vulnerable to aggravated health-care problems that could have been prevented.

[Rubenstein and Bittle \(2010\)](#) found that despite international humanitarian laws, medical personnel and wounded are targeted during conflicts, and some countries have laws that allow the attack of medical facilities if it guarantees a military advantage for the government. Also, they

Table 2 Conflict implications on health care

Injury or trauma	Service needed	References
Mental health disorders	Psychological and psychiatric care	Jawad <i>et al.</i> (2019); Leaning and Guha-Sapir (2013), Garry and Checchi (2020)
Disease outbreaks	Prevention services and primary health care	Jawad <i>et al.</i> (2019); Wise and Barry (2017); Kimbrough <i>et al.</i> (2012); Bhutta (2013); Morales <i>et al.</i> (2016)
Maternal mortality	Mental health services and female health care	Bendavid <i>et al.</i> (2021); Wagner <i>et al.</i> (2019); Rai <i>et al.</i> (2019); Gopalan <i>et al.</i> (2017); Akseer <i>et al.</i> (2020); Alkema <i>et al.</i> (2016); Kotsadam and Østby (2019)
Infant mortality and malnutrition	Primary health care and nutrition	Bendavid <i>et al.</i> (2021); Wagner <i>et al.</i> (2018); Kearsley <i>et al.</i> (2017)
Sexual violence and rape	Mental health support, STDs treatment and prenatal/natal care	Spangaro <i>et al.</i> (2013); Stark and Ager (2011)
Brain injury	Rehabilitation and primary care	McPherson (2019)
Communicable diseases	Continuity in primary health care	Bendavid <i>et al.</i> (2021)
Limb amputation	Immediate care and post-care to prevent complications	Frost <i>et al.</i> (2017)

Source: Table created by authors

highlight that the non-governmental party involved in the conflict often targets medical personnel to gain grounds against the government. This shows that in addition to the typical operations management entailed in health-care delivery under normal circumstances, humanitarian organizations must also pay special attention to the security risk of operating in conflict zones. Coupland (1994) posits that medical personnel in conflict zones face stressful situations that demand experience and seasoned judgment beyond medical skills. Stressful exposure often leads medical personnel to flee the country (Rubenstein and Bittle, 2010). Therefore, it is essential for humanitarian organizations providing health-care relief in conflict and post-conflict zones to ensure that their staff is fully trained to handle and respond appropriately to situations in the field. Furthermore, organizations must provide their staff with adequate support to enable them to stay in the country without jeopardizing their safety.

Humanitarian organizations are challenged with effectively tackling the need for health care to treat diseases during conflicts and post-conflict (Jawad *et al.*, 2019). Practitioners are constantly faced with a need for more historical information on the chronic illnesses of the people affected by conflicts (Aebischer Perone *et al.*, 2017; Massey *et al.*, 2017; Owoaje *et al.*, 2016). The personnel also faces political and military barriers that hinder delivering humane and appropriate care (Weindling, 1998). In the midst of a conflict, international standards are difficult to adhere to due to the risks of those who provide information and collect it (Ford *et al.*, 2009). Morgan *et al.* (2006) noted that while delivering aid, broader societal issues related to humanitarian response can be neglected, such as the need to maintain respect for cultural practices regarding death and grief. Also, Iseron and Moskop (2007) signal that delivering medical aid can require population-based triage decisions that are technically complex and morally challenging. Training health-care professionals to deliver interventions during and post-conflict and ensuring continuity in the supply of common medications are key priorities (Jawad *et al.*, 2019). After surveying the literature on humanitarian operations in conflict zones, one can conclude that offering relief in a conflict

or post-conflict zone comes with its complications. Practitioners can not simply replicate standard practices previously identified and successfully implemented in other humanitarian contexts and often cannot even replicate practices implemented in other conflict zones. Conflict and post-conflict zones require adapting practices to address what is found in the field, and, as documented in the literature, often, this is only known once the relief operation begins.

4. Mobile clinics

Based on the complexity conflict zones inflict on humanitarian health-care delivery, mobile clinics are a valuable resource. Understanding how mobile clinics fit into humanitarian health-care delivery in a conflict zone requires knowing what a mobile clinic is and how practitioners have used it. Hence, as part of the integrative literature review, this section presents a general definition of mobile clinics, discusses practitioners' materials and guidelines designed to facilitate the decision-making process, and provides a general overview of various deployments that have taken place in conflict zones. Due to the dearth of literature documenting mobile clinic deployments in conflict zones, we supplement the overview with literature on deployments outside conflict zones. Firstly, we describe what mobile clinics are, based on the available academic and grey literature in Section 4.1. Then, we discuss the benefits and challenges of mobile clinic deployment in Section 4.2, specifically in conflict zones in Section 4.3. This allows us to answer *RQ2* and *RQ3* and derive specific insights on mobile clinic deployments.

4.1 What are mobile clinics?

Mobile clinics (*a.k.a.* mobile health units, mobile health teams or mobile hospitals) are an intermittent modality used to provide ambulatory health services and improve access to health care (McGowan *et al.*, 2020; Du Mortier and Coninx, 2007b). Malone *et al.* (2020) defined mobile clinics as customized motor vehicles travelling to communities to provide health care. However, this vehicle does not necessarily have to

be customized as long as it can transport equipment and health-care providers to a predetermined outreach post where services will be delivered (McGowan *et al.*, 2020). Thus, in a conflict or post-conflict zone, where resources are limited, any vehicle that can transport the personnel and medical equipment can be used as part of the mobile clinic fleet. In turn, this can make the logistics decision on the type of vehicles more flexible.

The intent of deploying mobile clinics is to promote access to health care (ICRC, 2006; Du Mortier and Coninx, 2007a) by providing primary health-care services, with the possibility of referral to nearby fixed structures for conditions not manageable with the resources of a mobile clinic (McGowan *et al.*, 2020). This allows people affected by conflicts to access health care without incurring in additional transportation costs or exposure to safety hazards. However, not all health-care needs can be met with mobile clinics. McGowan *et al.* (2020) also state that mobile clinics are better suited to offer preventive services, such as vaccination or antenatal care or outpatient-level case management of chronic conditions, including mental health problems and high-burden non-communicable diseases, among others. The services mobile clinics are suited for are often in demand in conflict and post-conflict zones, especially mental health care. Moreover, Du Mortier and Coninx (2007a) underscore that mobile clinics should be used as an exceptional modality, only deployed as a “last resort” to reach populations cut off from health services. However, in some cases, mobile clinics are the only way to deliver humanitarian health care (Du Mortier and Coninx, 2007b; Blackwell and Bosse, 2007; Gibson *et al.*, 2011; Fox-Rushby and Foord, 1996). Hence, in conflict and post-conflict zones, mobile clinics are the only means to provide health-care access to the population. The WHO has referred to mobile clinics as an exemplification of the tension between equity of health-care access and the efficient utilization of scarce resources (Roodenbeke *et al.*, 2011). This demonstrates the need for better deployment coordination and management of mobile clinics. Mobile clinics, through the literature and documented deployments, are an effective method for delivering health-care interventions and outreach activities (Shaikh, 2008). Hence, mobile clinics are a standard modality for delivering health services in humanitarian emergencies, including conflict zones (McGowan *et al.*, 2020). As conflicts continue throughout the years, humanitarian practitioners will resort to mobile clinics to provide health-care relief to those affected by conflicts.

4.2 Mobile clinic deployments: benefits and challenges

To provide an understanding of the activities of mobile clinics in conflict zones for humanitarian health care, we explore practitioners’ materials and guidelines. Although practitioners’ material on mobile clinic management is readily available, it mainly focuses on medical interventions. To set out directives relating to the use of mobile clinics, the International Committee of the Red Cross (ICRC) put forward a document in 2006 with specific guidelines for mobile clinics. This document goes beyond specific health programme considerations and discusses general management, including logistics issues (ICRC, 2006). The document highlights the difficulties practitioners face due to standards imposed by local authorities and the necessity to correctly estimate needs at the locations where mobile clinics will be deployed. Later on, in

2007, the Humanitarian Practice Network at the Overseas Development Institute commissioned another document to aid practitioners when deploying mobile clinics in emergency contexts (Du Mortier and Coninx, 2007a). Other guides have been developed by health ministries, health clusters and practitioners in the international community, such as Health Facility Briefing System (2014), Health and NUT Cluster - Iraq (2014) and National Health Mission Manipur (2012). However, these offer specific guidelines addressing the communities and adhering to their respective Ministry of Health’s (MoH) regulations. Hence, in this section, we concentrate on the ICRC’s and Overseas Development Institute’s guides.

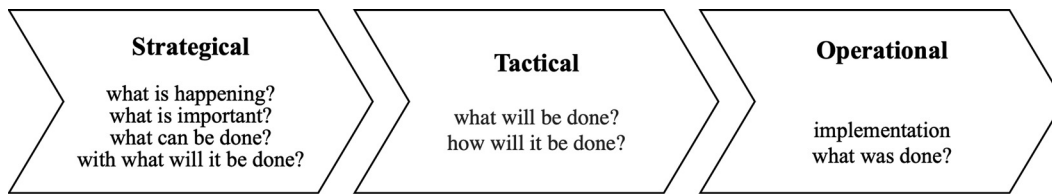
In their guide, the ICRC states that mobile clinic interventions are:

[...] an exceptional strategy, to be used only as a last resort with the aim of providing health services to population groups which have no access to a health-care system. (ICRC, 2006, p. 6).

Du Mortier and Coninx (2007a) state that mobile clinics “are often used to provide healthcare in unstable situations, such as conflicts, where fixed services cannot function for reasons of security” (p. 1). Moreover, the ICRC states that the temporary nature of mobile clinics mixed with logistical challenges (e.g. distances to be travelled, the time required, rises in water levels and weather conditions) and security challenges (e.g. agreements and checkpoints) restrict practitioners to a minimal decision time frame. Hence, decision-making tools and guidelines are more valuable and needed by practitioners, given the constraint in the decision time frame.

Throughout both guides, the importance of planning (e.g. mode of action, human and material resources, time frame and logistics) and selecting services that will be offered (e.g. vaccination, health promotion, preventive activities, transfer of patients and curative care), is stressed. Additionally, both guides break down the decision process of mobile clinic deployments into eight key questions. These questions seek answers to strategic, tactical and operational decisions (Figure 4). During the strategic phase, decision-makers must select areas (i.e. conflict or post-conflict zones) that will receive health-care services. They must also determine the appropriate number of mobile clinics, health-care practitioners, medical equipment and the available budget (ICRC, 2006; Du Mortier and Coninx, 2007a). As for the tactical decisions, practitioners must schedule the mobile clinics, and also decide on the frequency of visits, the days and the time of day to deploy the mobile clinics to each location according to the strategic decisions. Additionally, depending on the health-care condition of the patients, more than one visit may be needed to provide the required health care. Finally, the operational phase consists of implementing the plan and evaluating the performance, i.e. action reports (ICRC, 2006; Du Mortier and Coninx, 2007a). Practitioners deploying mobile clinics face many decisions that will impact the performance of the mobile clinic deployment. Moreover, those with deployments in conflict and post-conflict zones must also consider the additional security measures needed at each planning phase.

Du Mortier and Coninx (2007a) also provide some insights and guidelines when deploying in conflict zones. They state that mobile clinics are a way of gaining protection for the populations as part of the organizations’ activities by virtue of

Figure 4 Questions to answer during the decision process for mobile clinic deployments

Source: Figure adapted from Du Mortier and Coninx (2007a)

the Statutes of the ICRC Movement (Article 5.2, paras c and d) (ICRC at Geneva, 1986). The benefits of mobile clinic deployments in conflict zones are therefore twofolded as they not only provide access to health care but also inherently their presence grants protection to populations near a deployment point. This is another aspect that must be considered when deciding on the deployment location and time of visit, adding complexity to the decision tradeoffs between ensuring the safety of the staff and protecting the populations. In addition to providing health care and protection, mobile clinic deployments in conflict zones can be used to document alleged abuses and contact armed groups involved in the conflict. Health-care workers must be well-informed of both the health and the protection objectives of their work in conflict zones. Furthermore, the WHO refers to mobile clinics as an alternative to providing health care in their guide for medical care in insecure environments (WHO, 2021). The WHO's guide highlights the importance of coordination to ensure equity across communities, with no missed or under-served communities, and easy-to-reach communities not over-served by multiple and potentially contradictory medical visits. It also states the importance of logistics to ensure mobility during conflicts to avoid targeted attacks on personnel and beneficiaries in conflict zones. Therefore, logistic decisions must consider the multiple goals and benefits of mobile clinic deployments when choosing the population points at which these will serve.

Authors have documented how mobile clinics can be used to overcome common access barriers such as time, geography, system complexity and trust, and how they result in improvements in health outcomes and reductions in costs (Oriol et al., 2009; Malone, 2010; Song et al., 2013; Brown-Connolly et al., 2014; Drake et al., 2015; Taylor et al., 2016; Malone et al., 2020). This can be useful in a conflict or post-conflict setting, as barriers often exist in these contexts. McGowan et al. (2020) points out that mobile clinics can be efficient and can be used to increase service coverage. Authors have also studied contexts in which mobile clinics play an integral part in a health-care system, providing accessible and sustainable care with quality that matches traditional health-care settings (Edgerley et al., 2007; Guruge et al., 2010; Iredale et al., 2011; Guruge et al., 2010). Mobile clinics can provide vital access to quality health care for individuals impacted by conflicts, even in areas where there may be ongoing conflict or in the aftermath. Pottie et al. (2015) underscore that mobile clinics play a pivotal role in supporting the mental health and social needs of vulnerable immigrants who are too afraid or unable to come to reach stationary facilities after falling victim to violence and extortion. Other studies have also shown that

mobile clinics can produce both cost savings and improved health outcomes (Chen et al., 2020; Hill et al., 2014; Song et al., 2013; Yu et al., 2017). Mobile clinics are also associated with cost savings generated by effective prevention (Ali, 2022). Moreover, mobile clinics are an effective solution for providing health care in settings where financial resources are limited and cost-effective options are necessary. They allow for quick response and flexibility due to their ability to change locations (Wray et al., 1999), and they can be equipped to respond to several issues (Blackwell and Bosse, 2007). Campos and Olmstead-Rose (2012) have highlighted that mobile clinics are highly effective in offering urgent care, providing preventative screenings and initiating chronic disease management. Krol et al. (2007) sustain that another advantage of mobile clinics lies in the ability to provide a diverse services for various groups, such as people with social problems in both urban and rural areas, at all levels and for acute and chronic diseases. Mobile clinic deployments offer practitioners the flexibility to provide in-demand health-care services and quickly adapt and change the services offered as needed. Patients have reported that mobile clinics, as an alternative to other health-care models, help them navigate the more convoluted systems of the broader health-care system and allow them to connect with the medical and social resources in their communities (Aung et al., 2015; Rodriguez et al., 2007). Also, mobile clinic patients have reported increased confidence and ability to manage their chronic conditions (Aung et al., 2015; Hill et al., 2012; de Jesus Diaz-Perez et al., 2004; Jani et al., 2012). The presence of mobile clinics in conflict and post-conflict zones can provide people in need with the confidence and ease to seek health care after experiencing the trauma of war crimes.

Mobile clinics can improve the overall quality of medical services and access to basic medical needs (Aljasir and Alghamdi, 2010). Mobile clinics can improve health situation in locations where they are used for screening and prevention (Prasad et al., 2008). They also effectively prevented hospitalizations (Guo et al., 2001). Moreover, they provide underprivileged patients access better health care and medical equipment (ICRC, 2006). Hence, these vehicles could have the same beneficial effects in conflict and post-conflict zones by aiding victims in reducing their risk of developing complications or failing to detect treatable illnesses promptly. In rural areas, due to the quality and conditions of roads and lack of proper transportation, there is a need for mobile clinics to provide health care to populations that need constant medical attention, such as elderly patients, pregnant women and children (Aljasir and Alghamdi, 2010). Mobile clinics primarily serve people living in areas lacking proper health-care infrastructure, such as conflict and post-conflict zones, as well

as those unable to seek medical attention elsewhere (Aljasir and Alghamdi, 2010). Mobile clinics can also encourage vulnerable populations to seek their needed health care by removing the difficulties of scheduling an appointment, long waiting lines and a complex administrative process (Campos and Olmstead-Rose, 2012; Diao et al., 2016; de Jesus Diaz-Perez et al., 2004; Dasgupta et al., 2015; Kennedy et al., 2014; Harris et al., 2011). Furthermore, the literature supports mobile clinics as a successful and cost-effective model of health-care delivery uniquely positioned to assess and fulfill the needs of underserved populations (Yu et al., 2017). Therefore, mobile clinics can encourage individuals affected by conflict to seek cost-effective health care for both the organizations deploying mobile clinics and the people they serve.

On the downside, mobile clinics are expensive compared to other delivery strategies, logistically onerous and time-inefficient (due to medical resources remaining idle throughout a substantial travel time), and in addition, they rarely demonstrate a lasting impact (Du Mortier and Coninx, 2007a; ICRC, 2006; Roodenbeke et al., 2011). Due to sustainability issues and typically low frequency of visits, mobile clinics may not be capable of fully addressing chronic diseases and acute illnesses (McGowan et al., 2020). While mobile clinics are temporary, they remain a great choice to provide essential health-care services to victims of conflict and post-conflict situations. As conflict and post-conflict aid are not permanent, mobile clinics can bridge the gap between emergency health-care services and longer-term health-care provision, ensuring that people receive the care they need. Kohli et al. (2012) observed that mobile clinics do not perform better than fixed facilities and, thus, highlight the importance of only using them as an exception in the absence of a permanent health-care facility (ICRC, 2006). Krol et al. (2007) also point out that sometimes, the population may show unwillingness to use the services provided by mobile clinics. In remote communities (e.g. conflict zones and refugee camps), mobile clinics attract large numbers of people, creating a considerable risk of more infections (McGowan et al., 2020). Other weaknesses of mobile clinics include repeated changes in the macro level of medical policies, lack of sufficient feasibility evidence, presence of interfering factors (e.g. other health-care institutions), potential lack of government commitment to funding and improper distribution of resources, absence of planning about periodical evaluation, insufficient equipment for disabled patients and scarcity of dedicated funding and professional personnel (Song et al., 2013; Prasad et al., 2008; Al-Attar, 2009). Abujaber et al. (2021) highlight that medical personnel “run away from mobile clinics” due to the difficult conditions and lack of equipment during deployments. Moreover, it has been documented that medical personnel is subjected to poor quality of life during deployments and they perceive a lack of interest in their well being due to the shortfalls in coordination at the strategic and tactical level (Tuhkanen et al., 2008). Also, it is costly to train the medical personnel of a mobile clinic (Fox-Rushby and Foord, 1996). Lehoux et al. (2007) point out that since mobile clinics tend to be temporary, there needs to be more documentation. In addition, authors have observed that there can be clashes of authority between nurses and doctors due to the lack of documented procedures for mobile clinics (Fox-Rushby and Foord, 1996; Lehoux et al., 2007). After deploying

mobile clinics for several decades, WHO practitioners have identified weaknesses in their reliability. Humanitarian intervention experts have expressed concerns that mobile clinics tend to break down and run out of gas, which can become an insurmountable complication in certain settings, such as conflict zones (Ali, 2022). Additionally, the effectiveness of mobile clinics depends on various factors. Regardless of these drawbacks, the WHO endorses the use of mobile clinics for humanitarian crises by agencies and donors who are eager to support their implementation (WHO, 2016b). “Benefits and Challenges” summarizes the benefits and challenges of deploying mobile clinics. Although we have listed more challenges than benefits, the benefits outweigh the challenges. Overall, mobile clinics are crucial in responding to health-care needs in humanitarian situations and can provide necessary health-care services to people, even in challenging and volatile environments:

Benefits:

- Ability to offer diverse health-care services enables practitioners to meet a broader range of beneficiary needs (Du Mortier and Coninx, 2007a; Blackwell and Bosse, 2007; Krol et al., 2007).
- Help to overcome access barriers (Oriol et al., 2009; Malone, 2010; Song et al., 2013; Brown-Connolly et al., 2014; Drake et al., 2015; Taylor et al., 2016; Malone et al., 2020).
- Can be used to document war crimes and abuses (ICRC at Geneva, 1986).
- Increased service coverage (McGowan et al., 2020).
- Provides beneficiaries cost savings and improved health outcomes (Chen et al., 2020; Hill et al., 2014; Song et al., 2013; Yu et al., 2017; Ali, 2022).
- Allow for quick response and flexibility (Wray et al., 1999)
- Encourage vulnerable populations to seek their needed health care (Campos and Olmstead-Rose, 2012; Diao et al., 2016; de Jesus Diaz-Perez et al., 2004; Dasgupta et al., 2015; Kennedy et al., 2014; Harris et al., 2011).

Challenges:

- Treatments that require large equipment are difficult to deliver (ICRC, 2022).
- Tendency to over-serve communities if not carefully planned (WHO, 2021).
- Expensive compared to other delivery strategies (Fox-Rushby and Foord, 1996).
- Logistically onerous (Song et al., 2013; Prasad et al., 2008).
- Rarely demonstrate a long-lasting impact (Du Mortier and Coninx, 2007a; ICRC, 2006; Roodenbeke et al., 2011).
- Not capable of fully addressing chronic diseases and acute illnesses (McGowan et al., 2020).
- Underperform compared to fixed facilities (Kohli et al., 2012).
- Attract large numbers of people, creating a considerable risk infections (McGowan et al., 2020).
- Temporary nature leads to dearth of documentation (Lehoux et al., 2007; Tuhkanen et al., 2008).
- Not Reliable (e.g. can break down and run out of gas) (Ali, 2022).

Source: table created by authors

4.3 Deployments in conflict zones

Despite decades of humanitarian health-care delivery with mobile clinic deployments (Ali, 2022), there needs to be more studies on the use of mobile clinics in humanitarian responses (McGowan *et al.*, 2020). Most studies relating to mobile clinics take place outside conflict zones and the majority of the peer-reviewed literature is on mobile clinics deployed in the USA (Yu *et al.*, 2017). This motivates the need for further exploration and documentation of mobile clinic deployments.

In recent years, mobile clinics have become increasingly visible due to the COVID-19 pandemic as they are well suited to fill health-care needs during an epidemic (Ali, 2022; Alcendor *et al.*, 2022; Levy *et al.*, 2021; Leibowitz *et al.*, 2021). Authors have also documented the usefulness of mobile clinics to target underprivileged populations (Wray *et al.*, 1999; Blackwell and Bosse, 2007; Whelan *et al.*, 2010; Aljasir and Alghamdi, 2010; Gibson *et al.*, 2011; Limaye *et al.*, 2018; Beks *et al.*, 2020; Guillot-Wright *et al.*, 2022; Breve *et al.*, 2022). Mobile clinics are suitable for various uses and situations (Samakouri *et al.*, 2022; Murphy *et al.*, 2000; Phillips *et al.*, 2017) with the necessary equipment and medical personnel (Hill *et al.*, 2012). McGowan *et al.* (2020) highlight that they may function in tandem with and support of existing providers (i.e. community health workers, hospitals and clinics) to extend access to services further. Mobile clinics have become increasingly visible in less fraught settings they are a familiar sight in conflict zones (Ali, 2022). They can be used to provide many health-care services needed by the population in conflict and post-conflict zones. However, there is a dearth of studies to document mobile clinic operations in conflict and post-conflict zones. Only one study was found that documented the use of mobile clinics in post-conflict zone. Abujaber *et al.* (2021) document the deployment of mobile clinic to address the internally displaced populations in Syria caused by the war in 2011. They highlight that due to security protocols NGOs resulted to the deployment of mobile clinics from neighboring countries such as Jordan, Lebanon and Turkey. However, this logistical decision further enhanced the need for data availability and analysis systems to support the decision-making process.

Despite a paucity of peer-reviewed articles documenting and studying mobile clinic deployments in conflict zones, international humanitarian organizations continue to report the use of mobile clinics to serve populations affected by conflicts. In 2020, MSF reported mobile clinic deployments in 23 countries, with 13 of these deployments in countries being affected by conflicts (MSF, 2021). In 2021, the ICRC reported 21 million doses of COVID-19 vaccines administered by mobile clinics in areas impacted by conflicts (ICRC, 2022).

We conducted a data extraction on the Financial Tracking Service (FTS) database of the UN's Office for the Coordination of Humanitarian Affairs (FTS, 2022) to identify projects plans that included mobile health clinics in conflict settings. A total of 209 projects that were involved in conflict zones were identified. Of these 209 projects, 93 used mobile clinics as the exclusive aid delivery method, with all other projects including other types of medical activities along with the mobile clinics. Also, most of these projects included the combination of mobile clinics with an existing permanent health-care facility. This confirms the notion that mobile clinics

in a health response need to be used in conjunction with a fixed facility (ICRC, 2006). The WHO also highlights the importance of using fixed medical facilities to support mobile clinics in creating sustainable outreach services (SOS): “The logistics base of these teams, or the ‘hubs’ of SOS, will have to be equipped for transport and equipment maintenance and supplies storage. SOS Hubs may be established at district or regional health offices or at strategic points, such as rural hospitals where there is electricity for the cold chain, secure storage and transport maintenance facilities, and reliable telecommunications” (Department of Vaccines and Biologicals, 2000, p. 18). The projects' activity descriptions were further coded to identify the characteristics of services offered by mobile clinics in the project plans. Table 3 highlights the type of health-care services linked to mobile clinics according to the number of projects founded. The most common health-care services for humanitarian relief offered with mobile clinics included staff training and primary health-care services. These findings align with the health-care services populations seek when in a conflict zone (as seen in Section 3) since there are usually no permanent facilities that offer primary care and medical personnel are scarce.

5. The case of Première Urgence Internationale in Iraq

This instrumental case study aims to derive insights into logistical difficulties and operations entailed in the deployment of mobile clinics in conflict and post-conflict zones by examining the deployment of mobile clinics by PUI in Iraq. Mobile clinics have been deployed by the MoH and their partners, including PUI, in response to the Iraq War since 2014 (Iraq Health Cluster, 2014). To understand the motivation and reasoning behind PUI's deployment in Iraq, we must explore the nature of the Iraq War as well as the foundations and decision-making process of PUI. Therefore, this section starts with an overview of PUI's organization and presence in humanitarian relief. This is followed by a briefing on the origins and events of the Iraq War and its effect on health. Then, we fully describe the mobile clinic deployment in Iraq based on the exchange between the authors and PUI's staff. These conversations and exchanges took place between 2016 and

Table 3 Health-care services delivered by mobile clinics

Service	# of projects
General health services	98
Outreach	53
Primary health care	113
Preventive action	51
Health promotion	23
Curative care	17
Sum of referrals	22
Mental health	37
Food security	19
Social services	41
Emergency health services	6
Staff training	169

Source: Table created by authors

2018. It included interviews with two project managers, two head nurses and three headquarters staff members. By describing PUI's deployment during and after the Iraq War, we provide a complete description of the operations entailed in mobile clinic deployments in conflict zones. Hence, this section seeks to complement the answer to *RQ2*.

5.1 Mobile clinic deployment in Iraq by Première Urgence Internationale

For more than 20 years, PUI has carried out humanitarian work in 38 countries, in areas affected by conflicts, natural disasters and forgotten crises (PUI, 2022). As of 2022, 15 of their missions included the deployment of mobile clinics that directly benefited populations affected by conflicts (PUI, 2022), including missions in Ukraine, Mali, Libia, Niger, Yemen and Iraq. In 2014, the deteriorating humanitarian situation resulting from an ongoing conflict, internal displacement of the population and an influx of Syrian refugees, forced the health cluster in Iraq to address the lack of health-care access in hard-to-reach areas and the added burden on existing health-care facilities with mobile clinics (Iraq Health Cluster, 2014). PUI was one of the various NGOs that participated as a partner of the health cluster and delivered primary health care and mental health services in various regions of Iraq (PUI, 2016b).

Iraq has suffered 40 years of continual conflict that has had severe consequences on the population's health and the Iraqi health systems and infrastructure (Lafta and Al-Nuaimi, 2019). On top of the immediate casualties, the widespread violence in Iraq created long-term circumstances that affected the population's health through disruption of access to health care, as well as the availability of medicines, transportation, safe water supply, sewage disposal, electricity and other infrastructure components (Lafta and Al-Nuaimi, 2019). The invasion by a US-led coalition in March 2003 overthrew the government of Saddam Hussein and temporarily replaced it with a Coalition Provisional Authority that was slow to address health-care needs and struggled to provide security (Medact, 2008). The Iraq War officially ended in 2011 (Britannica, 2022); however, it was not until 2018 that the humanitarian logistics cluster commenced the closure of its operation, with the Logistics Cluster deactivation scheduled between 2019 and 2020 (Logistics Cluster Iraq, 2019). Iraqi civilians have borne the consequences of war and violence over the past decades, suffering adverse effects on their health, well-being, basic needs and years of life lost (Lafta and Al-Nuaimi, 2019).

From 2014 to 2018, PUI deployed mobile clinics in the regions of Mosul, Erbil, Duhok, Baghdad, Al-Fallujah and their population settlements, as depicted in Figure 5. These mobile clinic deployments were intended to serve citizens who otherwise would not have easy access to health care in their regions and served as a temporary solution for those with chronic diseases and needing medical services (Iraq Health Cluster, 2014). A representative from each NGO deploying mobile clinics in Iraq would attend the monthly health cluster meeting, along with the MoH's and WHO's representatives, where regions identified by the MoH would be assigned to NGO's partners according to the services provided (PUI, 2017f). In the case of PUI, they offered the following services with every mobile clinic deployment in Iraq: patient triage (i.e.

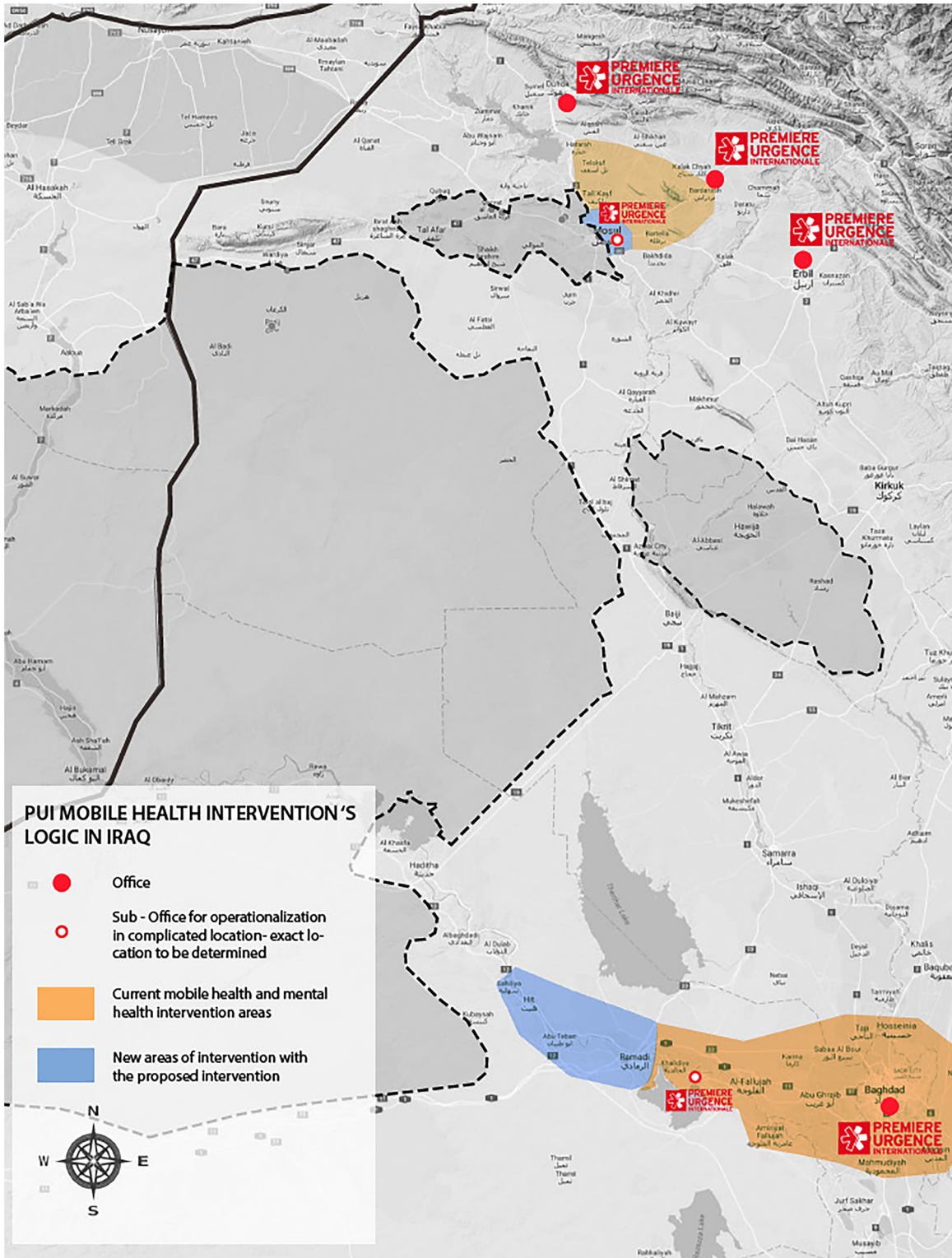
vital signs assessments), general primary health-care consultations for uncomplicated acute conditions and acute conditions in children, oral rehydration solutions, screening for chronic non-communicable diseases for diabetes and hypertension, treatment of chronic diseases, stabilization and immediate referral for secondary care for emergency cases, nutrition for children 6 to 59 months and pregnant lactating women, health education, assessment of immunization status of all children and pregnant women and reproductive health (PUI, 2017c). In addition, some mobile clinics were equipped to provide mental health services, test for diseases and dispense medications as prescribed by medical staff (PUI, 2017c).

During the deployments PUI had between four and five mobile clinics (PUI, 2016a). In addition, PUI oversaw the operation of two primary health-care facilities and several offices and sub-offices from which clinics could depart (PUI, 2016a). These clinics consisted of a pickup truck and a subcontracted driver that served as a security personnel, medical personnel and the required medical and set up equipment (PUI, 2017f, e). The mobile clinics would often be installed in abandoned residencies, communal spaces or the residence of the contact person (PUI, 2017f). Figure 6 presents two examples of the mobile clinics set up at the locations. It can be observed that the clinics were set up with the use of folding tables, chairs, tents and dividers. This means that deployments by PUI in Iraq required set up and clean up times for every location visited.

The human resources required to deploy PUI's mobile clinics in Iraq varied based on the type of clinic (i.e. primary health or primary health and mental health). Each office or departure point had a deputy project manager and a health officer to oversee the deployment. The deputy project manager was responsible for ensuring the effective, safe and timely implementation of mobile primary health-care activities (PUI, 2017a). The health officer was in charge of ensuring standards were respected in all deployments as well as coordinating with health, civil and security actors on the field (PUI, 2017b). All mobile clinics had a nurse, a doctor, a pharmacist and a health assistant (PUI, 2017f). When the mobile clinic provides mental health services, it would have, in addition a team leader, a psychosocial worker and a psychologist (PUI, 2017e).

For their deployments, PUI designed a weekly schedule for the mobile clinics, in which, based on the number of available clinics and the vulnerability, they would select locations that can be visited and in an equitable way, distribute the load between the available clinics (PUI, 2017f). Furthermore, these clinics had to comply with standards established by the Ministry of Health, including limitations on the maximum number of patients each clinic could serve (Iraq Health Cluster, 2014). PUI deployed mobile clinics in conflict zones and post-conflict zones in Iraq. A location is considered in a conflict zone if it is located 8 km from the front lines, has been affected by a security incident within the previous three days, or presents difficult access due to insecurity or checkpoint restrictions (PUI, 2017j). In contrast, post-conflict zones do not adhere to these criteria. Despite clinic health-care service operations similarities in both contexts, there were additional security protocols for the personnel when it is deployed to a conflict zone.

Figure 5 PUI deployments in Iraq



Source: Courtesy of PUI (PUI, 2017d), reproduced with permission

Figure 6 PUI mobile clinic set up in Iraq



Source: Courtesy of PUI (PUI, 2022, 2017d), reproduced with permission

5.2 Specificities of deployments in conflict zones

To ensure the safety of personnel and people seeking health care, PUI had in place a standard operating procedure based on guidelines established by the MoH (Iraq Health Cluster, 2014). When clinics were to be deployed to a conflict zone, the project manager and health officer must ensure that appropriate documentation is obtained to pass security checkpoints, constant monitoring is maintained on the security situation and the driver assigned had appropriate knowledge of the roads and locations (PUI, 2017j). The project manager or the health officer must establish communication with their point of contact at the location 24 h before the visit to confirm that the zone is still secure for health delivery (PUI, 2017j). On the day of the scheduled visit, teams deployed to conflict zones had to report earlier to the departure point and depart at earlier times than teams deployed to post-conflict zones (PUI, 2017d). Throughout their deployment, they had to maintain constant communication, i.e. security checks at departure, checkpoint arrival and location arrival, every 60 min while providing services, when leaving the location, the return to the checkpoint and return to base (PUI, 2017j). When arriving at a security checkpoint, it is possible that access is denied and the team has to return to the departure point (PUI, 2017d, 2017j), but when possible, the team could be reassigned to a different location for that day. This change of plan ran the risk of low demand due to an unplanned visit (PUI, 2017f). The health officer and the project manager highlighted the fact that the main challenges faced during the deployment to a conflict zone were related to the change in security status without warning, that the information regarding the needs at the location can be misleading (i.e. needs might have been underestimated), and that the locations for set up might be contaminated (e.g. mines bombs) (PUI, 2017e). Although, post-conflict zones do not present the same security threats during deployments, they still presented an uncertainty in the demand and access to the location from where services would be provided. Hence,

deploying mobile clinics in conflict zones requires more time invested in security, verification and it also comes with the added uncertainty of not knowing that the location can be serviced.

The resources assigned to a mobile clinic must tend to administrative tasks, which takes time away from health-care services. Teams deployed to post-conflict zones still had to report at the departure point before and after deployment (PUI, 2017f). Once they arrive at the location where services would be provided, they must set up prior to providing services and clean up after at every location (PUI, 2017g, 2017d). The needs at post-conflict locations could also be misleading as internally displaced people may be returning to their previous homes (PUI, 2017e). Also, if an abandoned residence was selected as the point of service and the family members returned to the location the clinic would be relocated to another public location or an occupied residence (PUI, 2017e). Additionally, pharmacists had to do an inventory before and after deployment (PUI, 2017h). The medical doctor and psychologist were responsible for providing an after-action report when returning to the departure point (PUI, 2017g, 2017i). These reports were used to report incidents (i.e. injury and mortality) to the MoH and health cluster (PUI, 2016a).

Based on the insights from PUI's operations in Iraq, it becomes evident that deploying mobile clinics in conflict and post-conflict zones demands an allocation of additional time and resources. This peculiarity underscores the intricate relationship between deploying mobile clinics in conflict and post-conflict zones and humanitarian logistics. These zones introduce a heightened level of uncertainty across various facets, including demand fluctuations, the availability of suitable setup locations and the availability of necessary funds (as highlighted in PUI, 2016a, 2017f). Moreover, it is essential to note that the availability of funds often lies beyond the control of practitioners, as these resources come from external donors and sponsorships. Consequently, when deploying

mobile clinics, practitioners face the challenge of effectively managing the available funds to maximize the impact of their deployment, an aspect integral to the broader scope of humanitarian supply chain management. These intricacies underscore the importance of meticulous planning and evaluation when orchestrating a mobile clinic deployment in conflict and post-conflict zones. Such planning should encompass robust contingency measures, such as alternative setup locations and replacement options, to ensure the mission's success within the broader framework of humanitarian logistics and supply chain management.

6. Insights and research gaps

The WHO and its partners often resort to mobile clinics to provide health-care services to isolated and vulnerable groups during crisis responses, including conflicts (WHO, 2016a). Despite the numerous benefits and endorsements of mobile clinic deployments for humanitarian health care, their usage involves several logistics challenges (e.g. limited resources and security issues) and is costly to operate (ICRC, 2006). Not to mention the additional complications added when providing humanitarian health care in conflict zones (Department of Vaccines and Biologicals, 2000) that enhance the “logistical nightmare” of mobile clinic deployments (Du Mortier and Coninx, 2007a). This motivates the need to develop decision support tools to facilitate the deployment and management of mobile clinics by humanitarian field practitioners in conflict and post-conflict zones. In this section, we first consolidate the insights gained from the integrative literature review and case study. This aims to reiterate the answers to RQ1 and RQ2. Then, we clearly depict the direction future studies' direction and the development of support tools that can prove useful for mobile clinic deployments in conflict and post-conflict zones. It aims to answer RQ3 and provide further practical insights.

6.1 Insights discussion

The theme of conflicts has been a constant presence throughout human history. While data shows that the frequency of conflicts has decreased over time, there is no indication that they will completely disappear or become shorter in duration (Kreutz, 2010; Strand and Hegre, 2021; Strand et al., 2020). Various authors have documented the devastating impact of conflicts on the health care of affected populations, highlighting the specific injuries and traumas suffered. In Table 2, we have provided a summary of the most common health-care implications in conflict and post-conflict zones. This information can help researchers determine what factors to consider when deploying mobile clinics to treat affected individuals. For instance, when providing women's health and prenatal care to victims of war crimes, the gender of the health-care professional delivering services should be taken into account to ensure the beneficiary feels comfortable and seeks the services. Additionally, different health-care services require specific equipment, which impacts the selection of vehicles used for transportation. Practitioners who deploy mobile clinics in conflict zones must pay special attention to maximizing the impact of their deployments while providing necessary health-care services.

Practical guides have underscored the value of mobile clinics in areas that lack permanent health-care facilities (ICRC, 2006; Du Mortier and Coninx, 2007a). These guides also highlight the logistical complexity involved in setting up these clinics. Traditional supply chain management practices are challenging to implement in humanitarian supply chains due to their unique nature (Oloruntoba and Gray, 2006). While there are shared principles with humanitarian logistics in disaster scenarios, it is essential to recognize the unique challenges that conflict zones present. Unlike in traditional business supply chains, the humanitarian supply chain cannot be activated until the territory's government approves the entry of NGOs (Kovács and Spens, 2009). This process that can be even more complicated during a conflict. Additionally, security concerns, access limitations and the unpredictability of conflict dynamics further complicate supply chain management in these settings. Therefore, the challenges inherent in humanitarian logistics are compounded when providing aid in conflict or complex emergencies (Altay et al., 2021). Readers interested in a review of the literature on supply chain management and humanitarian logistics can refer to the following reviews: Leiras et al. (2014), Overstreet et al. (2011), Daud et al. (2016) and Banomyong et al. (2019). Practitioners and researchers must consider security and risk when planning mobile clinic deployments in conflict and post-conflict zones. This is emphasized throughout the case study and literature, and it must be considered to ensure the safety and well-being of both health-care providers and beneficiaries. Researchers can refer to “Benefits and Challenges”, where we summarize the challenges and implications of mobile clinic deployments in conflict zones. This provides a comprehensive overview of the unique aspects that future studies must pay attention to.

6.1.1 Case study vs literature review

Analysing the case study on PUI's mobile clinic deployment efforts in conflict and post-conflict zones in Iraq, it becomes evident that such deployments are protracted endeavours. Mobile clinics in these contexts often span through the years and necessitate different levels of risk mitigation. This case study underscores the complexities faced in complex emergencies. It emphasized the importance of adaptability given the dynamic and often unpredictable nature of conflict and post-conflict zones. Moreover, the case study highlights the need for mobile clinic teams to possess the ability to make adjustments to their plans. It also shows how administrative tasks and security measures considerably consume medical personnel's time. This emphasizes the criticality of meticulously planning schedules to maximize the aid that can be offered efficiently. The case study also emphasizes the importance of maintaining continuous communication throughout the deployment for the safety and well-being of the staff. In addition, through the case study the challenge in the reliability of information regarding the availability of infrastructure and the identification of communities in need of assistance is documented. This uncertainty adds another layer of complexity to the logistics of mobile clinic deployments in conflict and post-conflict settings. Furthermore, the case study underscores that the health clusters, including multiple NGOs deploying mobile clinics, often continue to function for years after the conflict ends. This is also due to the delayed process of

restoring medical facilities to meet the health-care needs of affected populations in conflict-affected zones.

Turning to the literature review, a distinct set of insights emerges. The review focusing on conflicts reveals that certain illnesses are prevalent among conflict-affected populations. This shows that health-care interventions in these settings should be targeted to the needs of the populations affected by war. Additionally, it is evident that conflicts are enduring events with repercussions that extend beyond the conflict’s lifespan. This prolonged impact can also be attributed to the deliberate targeting of health-care facilities and medical personnel, resulting in a substantial deficit in health-care resources.

On the other hand, the literature review centred on mobile clinics provides a different perspective. It accentuates the logistical challenges inherent in deploying mobile clinics in various environments. However, it also highlights the numerous benefits of mobile clinic deployments. Despite these logistical challenges, mobile clinics have demonstrated their ability to effectively address a wide range of health-care needs, reach underserved communities and provide cost-saving solutions to those in need. Their flexibility and capacity for rapid response make them particularly valuable in conflict and post-conflict zones. Moreover, mobile clinics can encourage populations to seek needed medical services, improving health-care access.

When examining these insights collectively, a compelling argument emerges. Mobile clinics should be considered integral to health-care provision in conflict and post-conflict settings. Their adaptability and ability to cater to diverse health-care needs align perfectly with the exigencies of conflict zones. Despite their operational and logistical challenges, their benefits far outweigh the drawbacks. This analysis underscores the convergence of findings between the case study and the literature review, reinforcing the rationale for integrating mobile clinics into health-care strategies for conflict-affected regions. See [Table 4](#) for a detailed comparison of the insights derived.

6.1.2 Need for empirical studies and practical guidelines

Due to the scarce academic literature that studies mobile clinic deployments in conflict zones, authors should further

document them. Empirical studies should aim to shine a light on the best practices and suggest directions for standardization of deployments of mobile clinics in complex emergencies such as conflict zones. Even though the situations in conflict zones can be unpredictable and may require adjusting plans as the relief is delivered, as shown in Section 3, standard guidelines to aid in the three planning phases (i.e. strategic, tactical and operational) can result in a more effective deployment. Also, such studies should analyse further the differences between conflict and post-conflict zones to justify practices and services offered. Moreover, a study that documents the demands for specific services provided by mobile clinics can aid practitioners when selecting the services offered and the resources allocated. We show in Section 3 that information on the health-care needs of the populations affected by conflicts is not easily accessible. Therefore, studies that document or propose guidelines to estimate the demands before a humanitarian relief delivery would allow practitioners to meet the needs of those affected. As pointed out by [Du Mortier and Coninx \(2007a\)](#), there are studies documenting the health operations of mobile clinics. However, the logistic element needs to be improved in the literature, especially in conflict and post-conflict zones. Studies should focus on developing and proposing frameworks that are easy to use and implement by practitioners and that would serve both to plan deployments at a strategic, tactical and operational level and to justify the resources needed. Finally, more studies and insights are derived from the academic literature researchers can strive to consolidate knowledge and provide a complete framework for mobile clinic deployments in conflict and post-conflict zones.

6.1.3 Need for decision support tools

The challenges identified in the literature review and case study underscore the need for decision support tools. These tools are essential to address recurring logistical complexities faced by practitioners in conflict and post-conflict zones, as highlighted in the case study, given the dynamic and unpredictable nature of these environments. Factors like security risks, demand volatility and resource constraints significantly impact the success of mobile clinic deployments. Drawing insights from

Table 4 Contrasting findings: case study vs literature review

Aspect of analysis	Case study findings	Literature review findings
Deployment duration	Prolonged deployments spanning several years	Conflicts are enduring events with repercussions that extend beyond their lifespans
Risk mitigation	Varied levels of risk mitigation strategies required	Deliberate targeting of health-care facilities and personnel in conflicts creates a substantial health-care resource deficit
Adaptability	Mobile clinic teams must think on their feet and make real-time adjustments	Mobile clinics provide flexibility and quick response capabilities
Time allocation	Administrative tasks and security measures consume medical personnel’s time	Mobile clinics incentivize populations to seek medical services, improving health-care access
Communication	Continuous communication is vital for staff safety	Certain illnesses are prevalent among populations affected by conflicts, necessitating health-care interventions
Information reliability	Uncertainty in infrastructure availability and identification of communities in need	Logistical challenges in deploying mobile clinics in complex environments
Health cluster	Health clusters operate for years after conflicts, delaying the restoration of medical facilities	Mobile clinics effectively address diverse health-care needs, reach underserved communities and provide cost savings

Source: Table created by authors

the literature review, we have identified key challenges that decision support tools can address at strategic, tactical and operational levels. These tools would facilitate real-time data sharing to manage demand fluctuations and security risks while optimizing resource allocation and routing strategies for enhanced impact. The proposed decision support tools align closely with the literature's findings and the case study, offering an evidence-based framework for informed decision making in real-world scenarios.

In subsequent sections, we will provide detailed information on these tools, outlining their functionalities and direct relevance to the challenges identified in the literature. This integration aims to create a seamless link between the literature review and practical recommendations, offering a comprehensive guide for supporting mobile clinic deployments in conflict-affected areas.

6.1.3.1 Strategic decision support tools. The strategic decisions practitioners are forced to make, after the deployment of mobile clinics are identified as viable and often the only solution (Du Mortier and Coninx, 2007a; ICRC, 2006), is the appropriate number of mobile clinics, health-care practitioners and medical equipment, as well as the available budget (Du Mortier and Coninx, 2007a). As pointed out by Leseure et al. (2010) “unfortunately, in a world of scarce resources, although humanitarian action has no price, it has a cost, and an improved management of this cost influences the ability to send relief [...]” (p. 0.337). Moreover, the case study of mobile clinic deployments in Iraq, discussed in the previous section, offers crucial insights into humanitarian operations, emphasizing the need for decision support tools. Despite the war's official end in 2011, humanitarian clusters continued until 2020, necessitating a health cluster to distribute the humanitarian relief workload among various NGOs. PUI's mobile clinic setup followed strict criteria based on health service needs, with compliance to Ministries of Health standards. Different security protocols must be enforced in post-conflict and conflict zones, requiring documentation, local road knowledge and vigilance. Administrative tasks drained medical personnel's time, and donor funding needed rigorous optimization. Practitioners faced the challenge of crafting robust deployment plans adaptable to both contexts. This case study underscores the need for decision support tools in mobile clinic deployments within humanitarian logistics and supply chain management, especially for relief of conflict-affected populations.

Therefore, tools that concentrate on maximizing the outreach or potential for humanitarian health-care relief based on limited budgets will prove helpful for practitioners, particularly in conflict zones with limited resource availability (Garfinkel and Skaperdas, 2007). Such tools can be developed as a mathematical model, simulator or cost-effectiveness analysis framework to support budget allocation. These tools will not only be helpful in the strategic decision-making process but also when elaborating proposals or annual reports to sponsors, as the organization can justify specific needs based on a scientific method and concrete evidence.

Furthermore, allocating the available budget creates constraints for the number of mobile clinics, health-care practitioners and medical equipment. Even if the mobile clinics (i.e. vehicles) and medical equipment are in-kind donations

and health-care practitioners are volunteers, there will still be a cost associated with maintenance and per diem limiting the available resources. Practitioners could benefit from a tool that evaluates different scenarios with varying resources for deployment. Such tools could take the form of simulators, allowing decision-makers to make educated decisions and correctly plan the resources required throughout the deployment based on the organization's goals and the status of the conflict. Additionally, measuring the effectiveness of health-care resources, such as mobile clinics, health-care practitioners and medical equipment, will result in transparent and consistent decision-making (Eichler et al., 2004).

The final strategic-level decision would be selecting the locations that will receive health-care services from the mobile clinics. Based on the deployment's capacity dictated by the resource allocation, practitioners may need to select a subset of the locations that require health care. Optimization models can assist practitioners in identifying the set of locations that can offer access within a 1-h walk for at least 80% of the affected population to comply with humanitarian standards (Sphere Association, 2018). Coverage maximization problems and facility location problems, among others, can be adapted to support the location decision of mobile clinic deployments while considering the health-care needs and vulnerability of the population. Another alternative is a detailed framework or assessment tool for location selection based on community's needs and available resources.

6.1.3.2 Tactical decision support tools. At the tactical level, practitioners must consider strategic decisions made earlier when scheduling and deploying mobile clinics. This includes determining the frequency of visits, the days and the time of day to deploy the mobile clinics to each location (Du Mortier and Coninx, 2007a; ICRC, 2006). It is crucial to consider the frequency with which the same communities can be visited, as this will determine whether the mobile clinic should offer care or referral for acute illnesses (McGowan et al., 2020). Infrequent or unpredictable visits can discourage communities from seeking early care, worsening acute illness outcomes (McGowan et al., 2020). While decision support tools have been developed to determine the frequency of visits for mobile clinics, these tools do not consider the additional complexities posed by conflict and post-conflict zones, such as uncertainty and security risks (De Vries et al., 2021b, 2021a; Gordon et al., 2010; Guha-Sapir and van Panhuis, 2002; Gates et al., 2010; Zwi and Ugalde, 1989; Levy, 2002; Rubenstein and Bittle, 2010; Hovil and Werker, 2005). There is a need for decision support tools and frameworks that consider the risks of transporting medical equipment and personnel in insecure areas. Although scheduling and routing decision support tools for mobile clinics have been addressed in the literature, these tools have not yet adequately addressed the security risks faced in conflict zones (Hodgson et al., 1998; Doerner et al., 2007; Maghfiroh and Hanaoka, 2022; Santa González et al., 2023). The WHO has provided a guide for medical interventions with mobile clinics in conflict zones. However, there is still a need for more decision support tools or frameworks that take into account the risks associated with deploying mobile clinics in insecure areas (WHO, 2021).

6.1.3.3 Operational decision support tools. At the operational level, practitioners must implement their plans and evaluate the

outcomes by producing after-action reports (McGowan *et al.*, 2020; ICRC, 2006). However, need for standardized guides for mobile clinic deployments can pose a challenge for practitioners. To address this, more literature detailing and standardizing procedures is needed (Leibowitz *et al.*, 2021), along with empirical research such as case studies, longitudinal studies or Delphi analyses that seek to standardize practices or highlight directions towards standardization. Additionally, developing standard indicators for evaluating mobile clinics' use in conflict zones and complex emergencies can provide more insight and aid in standardizing performance metrics (McGowan *et al.*, 2020). Therefore, researchers can contribute by developing a framework for practitioners to standardize performance indicators and metrics during mobile clinic deployments in conflict and post-conflict zones.

Although this study's decision support tools are categorized by decision level, authors should aim to develop tools that address all three levels. Ideally, a comprehensive framework encompassing all decision levels would provide practitioners with the necessary support. However, this task can be challenging and may require more literature to achieve a "one size fits all" solution for mobile clinic deployments in conflict and post-conflict zones.

7. Conclusions

The deployment of mobile clinics in conflict zones needs more documentation in the literature. Despite the creation of humanitarian organizations aimed at alleviating the suffering of conflict victims (Rysaback-Smith, 2015), literature documenting mobile clinic deployments in conflict zones is lacking (McGowan *et al.*, 2020; Du Mortier and Coninx, 2007a; ICRC, 2006). To address this gap, we conducted a multi-methodology study, combining an integrative literature review and a case study, to develop tools for supporting mobile clinic deployment in conflict zones. One limitation of this study is the reliance on ABI/INFORMS ProQuest for the literature search.

This study illustrates the operational challenges in deploying mobile clinics in conflict and post-conflict zones, highlighting the logistical difficulties practitioners face. While mobile clinics in conflict zones face the same logistical challenges as those in non-conflict areas (Du Mortier and Coninx, 2007a), they also face additional security risks, economic constraints and uncertainty (Gordon *et al.*, 2010; Guha-Sapir and van Panhuis, 2002; Gates *et al.*, 2010; Zwi and Ugalde, 1989; Levy, 2002; Garfinkel and Skaperdas, 2007). To address these challenges, decision support tools are necessary to assist practitioners in making feasible strategic, tactical and operational decisions. These tools can also aid in evaluating the performance of different alternatives, contributing to more efficient health-care delivery and justifying strategic decisions. This paper serves as a roadmap for researchers interested in contributing to the literature on mobile clinic deployment in conflict and post-conflict zones, emphasizing the need for more documentation of mobile clinic deployments and the development of decision support tools. As researchers gain more insights from academic literature and studies, they can work towards consolidating various tools and creating a comprehensive framework for deploying mobile clinics in these challenging environments.

Our study has significantly contributed to understanding mobile clinic deployments in conflict and post-conflict zones. It fills critical gaps in the existing literature by being the first to delve into the unique challenges faced in these environments. By combining a comprehensive case study with two extensive literature reviews, our work offers a pioneering perspective on the complexities faced by mobile clinic practitioners. Through our contributions, we have advanced the understanding of humanitarian logistics in conflict and post-conflict zones, providing valuable insights for future research and enhancing the effectiveness of mobile clinic operations in challenging environments. However, a limitation of this study is the reliance on ABI/INFORMS ProQuest for the literature search. While we have endeavoured to provide a comprehensive overview of the available literature, it is possible that some relevant sources may not have been included in our analysis. Future research can explore additional databases and sources to enrich the knowledge in this area. We also acknowledge another limitation of this study, which is the constrained data collection process and the confidentiality of the data shared by PUI. These constraints prevented us from conducting a more extensive longitudinal or multi-case analysis. Authors interested in expanding this research can explore a multiple case study methodology to identify differences and commonalities among various mobile clinic deployments in conflict zones. Despite these limitations, our findings have important implications for practitioners and researchers alike, offering a foundation for more effective mobile clinic deployments in conflict-affected regions.

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