HiCN Households in Conflict Network
hicn.org

The bombing of hospitals and local violence dynamics in civil wars

Evidence from Syria (2017 - 2020)

Regine Schwab[1], Werner Krause[2], Samer Massoud[3]

HiCN Working Paper 403

November 2023

Abstract
The impact of civilian harm on strategic outcomes in war has been the subject of persistent debate. However, the literature has primarily focused on civilian casualties, thereby overlooking the targeting of civilian infrastructure, which is a recurrent phenomenon during war. This study fills this gap by examining the targeting of healthcare, one of the most indispensable infrastructures during war and peace time. We contend that attacks on medical facilities are distinct from direct violence against civilians. Because they are typically unrelated to military dynamics, the targeting of hospitals is a highly visible form and powerful signal of civilian victimization. To assess its effects, we analyze newly collected data on such attacks by pro-government forces and event data on combat activities in Northwest Syria (2017-2020). Applying a new approach for panel data analysis that combines matching methods with a difference-in-differences estimation, we examine the causal effect of counterinsurgent bombings on subsequent violent events. Distinguishing between regime-initiated and insurgent-initiated combat activities and their associated fatalities, we find that the targeting of hospitals increases insurgent violence. We supplement the quantitative analysis with unique qualitative evidence derived from interviews, which demonstrates that hospital bombings induce rebels to resist more fiercely through two mechanisms: intrinsic motivations and civilian pressure. The results have important implications for the effects of state-led violence and the strength of legal norms that protect noncombatants.

Keywords
civil war, collective targeting, civilian infrastructure, hospitals, rebel attacks, Syria

[1] Peace Research Institute Frankfurt, Research Department Transnational Politics, schwab@prif.org
[2] University of Potsdam, Faculty of Economics and Social Sciences, werner.krause@uni-potsdam.de
[3] Independent Researcher, sam4mass@gmail.com

"Hospitals are the most dangerous place in Syria"

Dr. Munther al-Khalil

Surgeon and former head of the Idleb Health Directorate, Syria

Around the globe, civilians and civilian infrastructure have been targeted by explosive weapons in both intra- and interstate conflicts. With these measures that often constitute war crimes, belligerents aim to break the fragile relationship between their adversaries and civilians. However, as historical examples from the Cold War era, such as the bombing campaigns by U.S. forces in Vietnam and the Soviet Union in Afghanistan demonstrate, insurgents sometimes respond to such onslaughts not with less, but with more resistance.[1] Most recently, Russia's brutal war on Ukraine has bolstered the determination of Ukrainians to resist regardless of the civilian and military costs (Dill et al., 2023).

However, existing literature on the effects of civilian harm focuses predominantly on direct civilian casualties, overlooking the broader consequences of targeting civilian infrastructure (Dell & Querubin, 2018; Kocher et al., 2011; Lyall, 2009). This is surprising as belligerents frequently aim their attacks on vital systems such as healthcare, energy, water, and food supplies (Sowers et al., 2017). To the best of our knowledge, no study has investigated the impact of the targeting of such infrastructure on subsequent conflict dynamics in civil war (but see Thomas (2006) for a discussion of its effects in interstate war).

In this study, we fill this gap by investigating the effects of indirect violence, particularly aerial bombing, on medical facilities in the Syrian civil war. Healthcare stands out as one of the most essential civilian infrastructures in war and peace time. Medical facilities and providers enjoy special protection under International Humanitarian Law, regardless of the patients they are treating.[2] This makes them different from dual-use objects such as electricity and

[1] In the following, the terms 'insurgents' and 'rebels' are used interchangeably.

[2] The principle of medical neutrality was established by the First Geneva Convention in 1864 to protect wounded and sick combatants regardless of affiliation and the medical units serving them. While the first

telecommunication that have a much closer connection to military dynamics. Despite their special status, medical facilities and their personnel are frequently targeted by belligerents across the globe (Briody et al., 2018). Condemning such attacks, the UN Security Council adopted Resolution 2286 in 2016 (United Nations, 2016).

Although civilians suffer greatly from such attacks, we argue that the targeting of medical facilities is distinct from direct violence against civilians. While governments often target civilians who are real or perceived supporters of the enemy, and target dual-use objects of value to both civilians and military actors, hospitals are far removed from any association with the military struggle. Unless such objects are transformed into military objectives through their purpose or use, the targeting of hospitals and other civilian infrastructure is not only morally unacceptable but also unnecessary from a military perspective. Instead, attacks on hospitals can be considered a highly symbolic, but even more drastic repertoire of civilian victimization than direct violence against civilians.

With this substantive focus on the targeting of medical facilities, we speak to a growing literature on the reverberating effects of war, which refer to the second-order consequences of an immediate strike. The indirect and lingering effects of civil wars in terms of death and

three conventions deal with the rights of combatants in war, the Fourth Geneva Convention defines the obligations of states towards civilians, and established concrete protections for health and humanitarian workers caring for wounded combatants from all sides. These protections are considered customary law, binding on all states (Fouad et al., 2017, pp. 2516–17). The only time a hospital could, in principle, become liable to attack is when it is used outside of its humanitarian function to commit acts harmful to the enemy. According to Article 52 of the Additional Protocol I to the 1949 Geneva Conventions, civilian objects can become military objectives if "by their nature, location, purpose or use [they] make an effective contribution to military action and whose partial or total destruction, capture or neutralization […] offers a definite military advantage." However, the legal threshold for targeting a hospital remains extraordinarily high. For example, the temporal component must be considered. Just because a hospital is once used for a military purpose does not necessarily make it a legitimate target. When in doubt, belligerents must assume that a hospital retains its protected status. Additionally, hospitals are often sprawling compounds, which do not lose protection in their entirety if only discrete parts or individual buildings are used for hostile actions. Even if a hospital is being used for military purposes, the attacker must still consider the proportionality and precautions in attack assessments. An attack on a hospital would cause major harm. Therefore, for such an attack to be justified, the military advantage gained must be substantial. In summary, there is a strong presumption that a medical facility does not meet the legal threshold for being a legitimate target. In Northwest Syria, which is the focus of our study, there is consistent evidence that hospitals were not used outside of their humanitarian function, as we discuss further below and in the appendix.

disability may equal those incurred directly and immediately (Ghobarah et al., 2003, p. 189). While patients and medical staff may be killed in a hospital bombing, the medium and long-term consequences of the destruction of medical infrastructure for civilian life are particularly severe: Healthcare workers flee. Those who remain are exposed to incredible stresses and perform tasks they are untrained for. Patients start to avoid medical facilities out of fear of being targeted. Thus, people's access to healthcare becomes compromised. As a consequence, infectious diseases spread and usually preventable diseases become deadly. Each attack on a medical facility thus can lead to hundreds of indirect deaths (Savell, 2023, pp. 20–21). The long-term impact is most severe for women, children, and the elderly (Ghobarah et al., 2003, p. 199). Finally, rebuilding healthcare systems takes long time and is often not the first priority of post-war governments. The targeting of medical facilities thus contributes substantially to both wartime and post-war casualties. It should be of crucial concern for both research and policy.

Limited knowledge exists concerning the impact of the targeting of medical infrastructure on subsequent violence dynamics. In this study, we shed light on the effects of such attacks by focusing on the Syrian civil war. Specifically, we investigate how the bombing of medical facilities by pro-government forces has affected insurgent violence. While a global phenomenon, violations of UN Resolution 2286 have been particularly egregious in Syria (Safeguarding Health in Conflict Coalition, 2019). Since the outbreak of the conflict in 2011, the Syrian war has exhibited a systematic pattern of targeting, denying, and weaponizing healthcare. According to Physicians for Human Rights, more than 600 attacks on medical facilities have been documented since 2011, with more than 90 percent of these attacks carried out by the Syrian regime and its allies. Syria is thus a critically important case to study this phenomenon. It also adds more nuance to the debate on the effects of civilian harm in counterinsurgency, since

existing studies largely focus on two cases for which fine-grained data on insurgent violence is available: Iraq and Afghanistan.[3]

To examine the relationship between attacks on medical facilities and insurgent military responses, we innovatively combine quantitative and qualitative empirical evidence. First, we use a new approach for panel data analysis that combines matching methods with a difference-in-differences estimation (Imai et al., 2021) to investigate the causal effect of hospital attacks on subsequent combat activities in affected areas. For that purpose, we rely on novel data on attacks on medical facilities in opposition-held territories in Syria from 2017 until 2020 collected by the Syrian Archive and Physicians for Human Rights, which we combine with data on military activities collected by the Armed Conflict Location & Event Data Project (ACLED). We find that the lethality of insurgent attacks is increasing, showing that – at least in the short term – attacks on medical facilities spark more violence. To investigate the causal mechanism linking hospital attacks and insurgent responses, we conducted 17 interviews with experts as well as health workers, local activists, and military actors in Northwestern Syria. We complemented this information with an analysis of primary documents issued by insurgent groups concerning attacks on civilian infrastructure. Our mixed-methods study thus triangulates between several sources of quantitative and qualitative data to understand what drives insurgent responses. Our results show that there is a convergence between civilian pressure and armed groups' intrinsic motivations to retaliate in order to signal resolve to both the local population and the counterinsurgent.

These results have important implications for the use and effects of indirect violence, particularly aerial bombing, in counterinsurgency, echoing earlier findings on its limits in both inter- and intrastate war (Allen & Martinez Machain, 2019; Horowitz & Reiter, 2001; Kocher et al., 2011; Pape, 1996). We extend this state of the literature by examining the so far unconsid-

[3]This refers to the U.S. military's "Significant Activities" (SIGACT) database on violent events during the wars in Iraq and Afghanistan (Condra & Shapiro, 2012; Condra et al., 2010; Sexton, 2016). However, several scholars have reported concerns with this data.

ered strategy of targeting civilian infrastructure, specifically medical facilities. The findings of this paper also hold significant normative implications. The targeting of medical facilities is prohibited by international law. That it occurs nonetheless could mean a potential erosion of the legal norms that protect noncombatants, which would spell further misery for civilians in conflict zones and could have permissive effects on potential perpetrators.

In the following, we discuss existing research on the effects of civilian targeting and introduce our argument of the targeting of medical facilities as a specific form of civilian victimization that is distinct from direct violence against civilians, as well as theorize its potential effects on civilians and insurgents. Next, we contextualize the targeting of hospitals in the Syrian civil war. We then proceed to the operationalization and testing of our theoretical expectations and present the empirical analyses. We conclude by outlining the academic and policy implications of our findings, as well as questions for future research.

Previous Research

Previous research has presented contradictory evidence concerning the relationship between civilian harm and counterinsurgent success. While several studies found that indiscriminate or large-scale violence can effectively suppress rebellions by diminishing their local support and recruitment capacities or outright killing civilian supporters en masse (Downes, 2008; Lyall, 2009; Stoll, 1993; Valentino et al., 2004), others contend that indiscriminate violence is counterproductive, resulting in a surge of insurgent military and political activity (Kalyvas, 2006, pp. 146–72; Dell & Querubin, 2018; Kocher et al., 2011; Mason & Krane, 1989).

On the one hand, suffering above a certain threshold could lead civilians to plead with insurgents to give up the fight (Lyall, 2009, p. 337),[4] cooperate with the government by providing

[4]This assumes that civilians can influence insurgents, which may or may not be the case (Kalyvas, 2006, pp. 158–59).

information (Condra & Shapiro, 2012; Shaver & Shapiro, 2021), organize collective action against the insurgents (Schubiger, 2021), or defect to the government altogether (Stoll, 1993). When they have the means to do so, civilians may also vote with their feet and flee. This in turn would deprive rebels of recruits and other forms of support, eventually bringing their activities to a standstill.

On the other hand, the exact opposite has also been described in the literature: state-led civilian targeting can lead to increased collaboration with the opposition – civilians may for instance withhold information about the insurgents from the state (Condra & Shapiro, 2012; Shaver & Shapiro, 2021), support, or even join armed groups themselves (Benmelech et al., 2015; Cederman et al., 2020; Goodwin, 2001; Schubiger, 2023; Wood, 2003).

Underlying such behaviors are civilian perceptions of harm. Counterinsurgent violence, particularly of the indiscriminate type, provokes strong emotional reactions, such as fear, resentment, sadness, anger, indignation, and moral outrage (Costalli & Ruggeri, 2017; Kalyvas, 2006, pp. 153–54; Pearlman, 2016; Petersen, 2002, 2017; Wood, 2003). Indiscriminate violence is also perceived as deeply unfair, as it is unrelated to what people did or could have done (Kalyvas, 2006, p. 153). As Schumann and Ross (2010, p. 1195) explain, "individuals experience distress when they have been treated unfairly." Anger, outrage, and indignation have been linked to an increased desire for revenge, which raises civilian demands for retaliation and/or increase their motivation to fight (Goodwin, 2001; Kalyvas, 2006, pp. 153–54; Petersen, 2002, p. 17; Wood, 2003).[5] "Revenge may enable victims to reduce their distress by restoring equity with the transgressor (Schumann & Ross, 2010, p. 1195)." Individuals who are personally exposed to violence often become intransigent and more likely to blame the party who hurts them or to have retributive preferences toward perpetrators (Canetti et al., 2013; García-Ponce et al., 2023; J. Hall et al., 2018; Kao & Revkin, 2021; Pechenkina et al., 2019), but may also withdraw

[5]The path from fear to mobilization is less straightforward. As Pearlman (2016, pp. 24, 26) has argued, the repression of unarmed protesters by the Syrian regime helped turn "silencing fear that encourages submission" into surmounted fear that "empowers the fight for political voice."

support from all armed actors (Fabbe et al., 2023). The desire for revenge does not necessarily translate into increased insurgent attacks when civilians blame the insurgents for provoking the government, as Lyall (2009, p. 337) shows.

These findings are important, but their inconsistency suggests several conceptual and methodological problems in the study of counterinsurgency. First, in order to evaluate the effects of state-led violence against civilians, a more careful dissection of different types of (civil) war and logics of violence is necessary: is the violence coercion or brute force (Schelling, 1966)? Is it intentional, incidental ("collateral damage") or unintended (Condra & Shapiro, 2012; Shaver & Shapiro, 2021)? When violence is intentional, is it truly indiscriminate or "random", or is it selective, and on which level (individual or collective) (Kalyvas, 2006; Kocher et al., 2011; Lyall, 2009)? Finally, is violence direct or indirect (Balcells, 2017)? While there are overlaps between these concepts, there are important differences as well in terms of the logics of violence that should not be conflated, but often are in existing studies, which might explain some of the contradictory findings. Relatedly, much of the theorizing on the effects of targeting civilians has been developed in the context of irregular civil wars. However, the consequences of targeting civilians may be different in conventional civil war, but the latter have received less attention in the literature (Krcmaric, 2018, p. 29).

Second, regardless of their own exposure to violence, civilians may interpret the actions of a particular actor in a biased manner due to pre-existing attitudes and identities (Condra & Shapiro, 2012; Lyall et al., 2015; Silverman, 2019). Such bias leads to asymmetric blame for out-group violence (as by the counterinsurgent) against the civilian population (Dyrstad & Binningsbø, 2019; Lyall et al., 2013). In line with this, there is evidence that external interveners (the U.S.) in conflicts such as Afghanistan, Iraq, and Pakistan have been punished more than domestic (insurgent) actors for inflicting violence against civilians (Condra & Shapiro, 2012; Lyall et al., 2013; Shaver & Shapiro, 2021; Silverman, 2019). While an external intervener was constructed as the dominant outgroup in these cases, such intergroup polarization

is also often based on heterogeneous identities in one country such as ethnic, religious, and political differences (Dyrstad & Binningsbø, 2019; Lyall et al., 2015). What contributes to this process of polarization is the increasing homogenization of communities throughout war, which reinforces the distinction between in-group and out-group (Wood, 2008, p. 549).

Finally, a more careful dissection of space, time, and actors is necessary. Lyall (2009) demonstrates that quasi-random shelling of Chechen villages by Russian forces was effective in suppressing rebel attacks in those villages ninety days after a strike. However, as Souleimanov and Siroky (2016) argue, this effect may be due to that prospective avengers retaliated only after a longer period of time, or chose to attack in different areas. Toft and Zhukov (2015) argue that indiscriminate force is effective in suppressing attacks by nationalists, but not Islamists. Finally, the organizational structure of insurgent groups also matters: as Kocher et al. (2011, p. 204) notice in regard to Lyall's (2009) influential study on the Chechen insurgency, a highly decentralized and local insurgency may be easier to challenge than a hierarchical, translocal organization.

Theory: The targeting of hospitals

Why do belligerents attack medical facilities and what is specific about their targeting? We argue that both the *object* that is targeted, the *type* of violence, and the *logic* of targeting matter.

Concerning the target, hospitals are civilian objects *par excellence*.[6] While governments often target civilians who are real or perceived supporters of the enemy, and target dual-use objects of value to both civilians and military actors, hospitals are far removed from any association with the military struggle. Unless such objects are transformed into military objectives through

[6]Targeting hospitals is not a new strategy. It was documented already during the Italian invasion of Ethiopia in 1935-1936 (Perugini & Gordon, 2019).

their purpose or use, the targeting of hospitals and other civilian infrastructure in the other side's rearguard has no military value. It is unnecessary from a military-strategic perspective (Balcells, 2017, p. 25). Such targeting is therefore not only morally unacceptable but also militarily unjustified.[7] Instead, attacks on hospitals can be considered a highly symbolic, but even more drastic repertoire of civilian victimization than direct violence against civilians. The targeting of hospitals is a highly visible form and powerful signal of civilian victimization for at least three reasons.

First, hospitals are highly symbolic targets. Medical facilities and their personnel enjoy an exceptionally high degree of protection in armed conflict. A deliberate attack on a hospital constitutes a war crime under the Rome Statute and the Geneva Conventions.[8] Because of their special protection under international law, medical facilities should be considered off-limits especially for governments. A violent actor attacking such sites repeatedly with impunity thus signals to the population in the enemy's territory that it is above the most fundamental norms and laws of humanity. It is a message to the civilian population that there is no safety, no respite from violence. Relatedly, violent actors may target hospitals because they consider it a more effective, and at the same time, cheaper strategy than the wholesale targeting of population centers. This is because the targeting of a hospital reverberates throughout civilian communities beyond the site of the attack. It signals to civilians that that they are all potential targets.

[7] While attacks on hospitals may also deprive enemy forces of medical care, we do not consider this to be an important reason, as armed actors are likely to have recourse to other channels of care. In Syria, rebel groups had their own medical services and personnel, according to a member of an armed group working in this field (Ahrar al-Sham member).

[8] Rule 9 of the 161 rules of customary International Humanitarian Law also states: "State practice considers civilian areas, towns, cities, villages, residential areas, dwellings, buildings and houses and schools, civilian means of transportation, hospitals, medical establishments and medical units, historic monuments, places of worship and cultural property, and the natural environment as *prima facie* civilian objects, provided, in the final analysis, they have not become military objectives."

Second, hospitals are truly "universal" sites. The treatment of patients in hospitals is highly standardized worldwide, local differences in training and equipment notwithstanding.[9] Even during armed conflict, when equipment and personnel are scarce and medical actors must improvise, this universal function remains unchanged. If anything, hospitals become more crucial during such times. As a testament to their significance, hospitals continue to perform their primary role of treating patients during war- and peacetime alike, unlike schools that are often repurposed for different activities during war (Human Rights Watch, 2016). Furthermore, local authorities can manipulate the content of education, or schools may become targets owing to the content they teach. For instance, Boko Haram has targeted coeducational schools since the education of women and girls is perceived as pro-Western (Malobisky & Moeder, 2023). A final difference between the targeting of hospitals and the targeting of schools – which are arguably the closest to hospitals in terms of their purely civilian function – is that civilian communities feel the negative effects of the latter only later. In stark contrast, when hospitals are targeted, the negative effects on civilians are felt immediately, but also unfold over the medium and long term.

Finally, attacking hospitals means not only a violation of international law and possibly a war crime. It also means breaking with the idea that even war has limits. This idea was first codified in 1864 in the *First Geneva Convention for the Amelioration of the Condition of the Wounded in Armies in the Field*, which established that injured combatants deserve protection in war. Attacking hospitals is therefore an attack on the most vulnerable – those who need the help of others, who cannot defend themselves, and who may not be able to escape. It represents an absolute disregard for human frailty and the most basic human rights and needs. As the journalist Kareem Shaheen (2022) poignantly described, "it is difficult to overstate the cruelty of hospital bombings, because the cruelty is the point. A place of healing and salves, to take refuge from pain, or to welcome new life, turned into a slaughterhouse." In this sense,

[9]There may of course be differences in terms of local customs relating to gender, etc., but this should not influence the medical treatment per se.

the targeting of medical facilities could be understood as even more brutal than the "mere" targeting of civilians. It shows that the perpetrator is truly willing to use any means necessary to achieve its goals.

Type of violence and logic of targeting

In terms of the type of violence, although hospitals may also be attacked by armed actors in a direct way, most instances of the targeting of such facilities in (civil) war occur by indirect violence in the form of aerial bombing and artillery shells, missiles, or rockets, which do not require face-to-face interactions between victims and perpetrator (Balcells, 2017, p. 22). Because it is produced unilaterally by an armed actor, civilians have very limited (if any) agency in convincing the perpetrator to stop the violence: "civilians cannot veto the dropping of a bomb from a plane or the shooting of a missile from a tank" (Balcells, 2017, p. 22). Indirect violence is inherently connected to the perpetrator's lack of territorial control and is a function of conventional warfare. Much of the theorizing on the effects of targeting civilians has been developed in the context of irregular civil wars. Conventional civil wars, such as the Syrian war, are characterized by clear frontlines and the use of heavy weapons, with military activities taking the form of pitched battles, trench warfare, and sieges (Kalyvas & Balcells, 2010, p. 419). In conventional civil wars and separatist conflicts, violence takes place in geographically segmented spaces (Pechenkina et al., 2019, p. 547).

Concerning the logic of targeting, in line with recent contributions, we argue that the bombing of medical facilities in the enemy's territory can be considered a form of collective targeting. Most research categorizes counterinsurgent violence into two main types: "selective," which involves the deliberate targeting of individuals based on individualized suspicion, and "indiscriminate," which refers to cases in which the attacker fails to distinguish between combatants and noncombatants, resulting in random or arbitrary targeting (Kalyvas, 2006, pp. 141–45). Several scholars have cautioned, however, that the term "indiscriminate" violence may lump together two distinct types of violence: "attacks against those who share a collective identity

such as membership in an ethnic group, a political party, or a trade union (a form of selection) and those that are truly indiscriminate in the sense of non-selective" (Gutiérrez-Sanín & Wood, 2017, p. 22; Steele, 2009). While indiscriminate violence is caused by a lack of information or care to distinguish between 'guilty' and 'innocent', "organizations may target some groups of civilians based on information about their identity, not because they lack such information" (Gutiérrez-Sanín & Wood, 2017, p. 22). Members of such groups are associated with a rival based on their ethnic, political, religious, or geographic identity and thus pose a threat to the perpetrator (Steele, 2009, p. 422). As observed by Mark Danner (1994, pp. 42–43) in the context of El Salvador and the governments' actions against the Farabundo Martí National Liberation Front (FMLN), "as the guerrillas were reduced to the status of terrorist delinquents, all civilians in certain zones were reduced to the status of [...] guerrilla supporters, and thus became legitimate targets [for the counterinsurgent]." This form of violence can thus be understood as the selective or discriminate targeting of collectives, as the terms "collective targeting" (Steele, 2009), "group-selective violence" (Straus, 2015), and "categorical violence" (Goodwin, 2006) indicate.[10]

We argue that violence against medical facilities in Syria by pro-government forces also followed the logic of collective targeting after frontlines were fixed: hospitals were targeted only in certain parts of the country (opposition-held areas). However, at the individual (unit) level, the targeting was largely indiscriminate, as hospitals were attacked anytime and anywhere in these areas. Interestingly, the perceptions of civilians and medical professionals mostly speak to the collective level – they did not perceive the targeting as arbitrary or random. According to a medical worker in the town of Kafr Hamra: "They [pro-government forces] are [...] completely focused on hospitals. In the beginning we thought it was simply indiscriminate, but there is

[10] Collective targeting can be either selective or indiscriminate at the individual level. For instance, when a bomb is dropped on a town, based on the suspicion of harboring insurgents, this is considered selective targeting at the collective, but indiscriminate targeting at the individual level. In contrast, genocidal violence could be considered selective at both levels. This also implies that pure indiscriminate targeting at the collective level should be relatively rare empirically.

repeated targeting of hospitals" (Shaheen, 2016). As an expert put it, "rebel training camps were safer than hospitals."[11]

Once the frontlines are fixed, civilians have little chance of influencing the perpetrator. As long as they remain in rebel-held territory, behaviors that signal non-affiliation with the insurgents matter little, which is further reinforced by indirect violence (Schubiger, 2021, p. 1385). In fact, due to their unilateral character, the effects of indirect and collective violence seem to amplify each other (Balcells, 2017, p. 148). Similarly, sharing information with the enemy, which has been shown to reduce anti-civilian violence in irregular civil wars (Condra & Shapiro, 2012; Shaver & Shapiro, 2021), holds little promise for civilians in this context. Civilians cannot easily switch their support to a rival actor either, as this amounts to the highly visible act of changing conflict sides (Kalyvas & Kocher, 2007, p. 178; Balcells, 2017, p. 132). However, as recent research on strategic displacement shows, belligerents may perceive staying in a place or fleeing as an act of passive collaboration or resistance (Lichtenheld, 2020, p. 260). Initially, governments target indiscriminately to force people to flee. Those who remain become "guilty by location" (Lichtenheld, 2020). From the Syrian government's perspective, it gave people time to decide whether to live in government-held or rebel-held areas (Lichtenheld & Schon, 2021, p. 5). Those who remain in the latter after a certain date are perceived as disloyal. Not only do these individuals become subject to collective targeting, but so do the objects and infrastructure on which they depend to survive.

Although we presented a plausible theory of why belligerents target medical facilities, based on the combination of their symbolic importance and the type of warfare, determining the exact motives of counterinsurgent forces remains a challenge for most researchers due to limited access to intelligence. Therefore, examining the impact of such targeting on insurgents is not only more feasible but is also critical to understanding the consequences and, thus, the "success" of such strategies. Assuming a tight relationship between insurgents and civilians,

[11] Dareen Khalifa, International Crisis Group

these attacks are expected to influence the former through two complementary mechanisms, intrinsic motivations and civilian pressure, which we discuss in the following.

Insurgent responses: Intrinsic motivations and civilian pressure

To the best of our knowledge, there is no research on the effects of the targeting of civilian infrastructure on insurgent perceptions and responses. In general, we know very little about the effects of state violence against civilians on the networks, institutions, and internal functioning of insurgent groups (Schubiger, 2023, p. 34).

We start from the observation that in conventional civil wars and separatist conflicts, insurgents and civilians inhabit the same geographically segmented context of violence. In such contexts, the close ties between the two groups may challenge the conventional divide between civilians and fighters, especially in the rearguard territories (Balcells, 2017). Several scholars have argued that under such circumstances, both become part of a broader fighting community which is united in their resistance to the common enemy (Mironova et al., 2019; Parkinson, 2022; Petersen, 2001; Wood, 2003). Under such conditions, we expect to see hardened identities and intergroup biases against the perpetrator, especially in later stages of a conflict, making shifts in loyalty highly unlikely. Territorial segmentation contributes to this process: "the longer people live under an armed group, the more likely they will collaborate with, or develop ties to, that group" (Lichtenheld & Schon, 2021, p. 3). Over time, political identity becomes territorialized (Lichtenheld & Schon, 2021, p. 5).

Under these conditions, civilians and insurgents are likely to share the same perception of the targeting of hospitals as collective and deeply unjust. There are strong reasons to assume that collective violence against civilians in general – and the targeting of medical facilities in specific – violates people's moral beliefs (Dill, 2019; Krick et al., 2023). Abrahms (2006) argues that deliberate attacks on civilians are interpreted by the target as an attempt to

destroy the collective or its values rather than to achieve specific goals. As Kalyvas (2006, p. 155) has argued, "it makes one suspect a campaign aimed at mere annihilation." Certain forms of violence can cause "moral shock" (Jasper & Poulsen, 1995), because they deviate from socially acceptable behavior. Witnessing such unjust and immoral violence as the targeting of hospitals is likely to evoke strong feelings of moral outrage and indignation, which should increase civilian demands for retribution (Wood, 2003; Kalyvas, 2006, pp. 153–54; Goodwin, 2001; Petersen, 2002, p. 17). On the one hand, assuming a tight relationship between civilians and insurgents, the latter should respond to this civilian pressure by intensifying their combat activities. On the other hand, personal exposure to violence creates or aggravates grievances that may compel civilians to join armed groups themselves.

Rather than merely responding to civilian pressure, we argue that insurgent groups have *intrinsic motivations* to escalate their combat activities in response to counterinsurgent violence because they are constantly struggling to maintain their relevance both internally and externally. As such, they fight to maintain their reputation for resolve in the eyes of two key audiences: their local constituencies (civilians and fighters) and the counterinsurgent (Lyall, 2017, p. 4).

Regarding the former, insurgents respond to civilian grievances by signaling their willingness to protect people (Goodwin, 2001; Kalyvas & Kocher, 2007; Mason & Krane, 1989). They must also demonstrate their ability to retaliate, positioning themselves as relevant actors willing and able to challenge the government's illegitimate actions. This reputation becomes particularly important when insurgent groups are deeply intertwined with the local community through social ties and networks or the provision of rebel governance, or when they are challenged by local competitors.

Moreover, insurgents must 'prove' to the incumbent power that they cannot be deterred from their struggle, regardless of the escalating costs. Instead of yielding, they may engage in a tit-for-tat cycle of violence wherein they respond to every government action with a counter-

reaction (Lyall, 2017, pp. 6–7). Even though they are limited in scale, their attacks serve a demonstration function which signals their capability and resolve, and attracts local and international attention (Kalyvas, 2005, p. 96). In the face of large power asymmetries, these attacks will not lead to victory and insurgents are likely aware of this. However, "as power asymmetries increase, the incentives for investing in one's reputations for resilience via costly war-fighting actually increase as the returns for inflicting harm accrue disproportionately to the weaker side" (Lyall, 2017, p. 5).

These motivations are also relevant to the insurgents' goal of gaining or maintaining control of the territory they claim. Targeting and potentially destroying critical infrastructure, such as healthcare facilities, pose a challenge to their governance ambitions (Arjona et al., 2015). Protecting, maintaining, and eventually rebuilding civilian infrastructure can serve as a powerful signal to both the enemy and the local population, underscoring the insurgents' determination to resist.

Importantly for our context, this reputation-based mechanism should lead to a rapid insurgent response after an airstrike or artillery shelling on a hospital. Thus, we should observe a temporary, short-term increase in insurgent attacks (Newton & Tucker, 2022, p. 233).

In contrast, grievance-based accounts suggest that civilians who have experienced violence at the hands of the counterinsurgent will join insurgent groups themselves. This may be out of a desire for revenge or because the widespread destruction of civilian infrastructure reduces the opportunity costs of joining armed groups. If the grievance-based mechanism is relevant, we should also observe an increase in insurgent attacks, but only after a longer period of time. Here, increased recruitment drives the response, but the training of new fighters takes time. Moreover, recruitment is likely to become less important over the course of a war, as the number of potential recruits declines over time due to killings and displacement (Cederman et al., 2020, p. 1210). Thus, recruitment becomes less important in later episodes of a conflict.

This is not the case for the reputation-based mechanism, which, on the contrary, should become more important over time.

Consequently, we expect that the targeting of medical facilities will activate rebels' intrinsic motivations to strike back, which will be amplified further by civilian demands for retaliation. Importantly, we expect the two mechanisms – civilian pressure and insurgent reputation-seeking – to complement each other and together lead to a short-term, net increase in insurgent attacks. The main empirical implication, which will be evaluated in the remainder of this article is the following: after an attack on a medical facility by pro-government forces, there will be an increase in insurgent attacks days or weeks after the event.

Research Design

To test the above expectations concerning the impact of strikes by pro-government forces on medical facilities in Syria, this article combines both quantitative and qualitative evidence. First, we implement a quasi-experimental research design to investigate the effect of hospital bombings on subsequent military dynamics (2017 to 2020). More concretely, we rely on a novel approach for panel data analysis that combines matching methods with a difference-in-differences estimation in order to estimate the causal effect on insurgents' combat activities (Imai et al., 2021). Second, to complement the statistical analyses and provide deeper understanding of the mechanisms, we provide unique evidence from 16 interviews with Syrian activists, health workers, and experts that we conducted between 2017 and 2023. Additionally, we analyzed primary documents issued by insurgent groups concerning attacks on civilian infrastructure.[12] The qualitative evidence helps us to identify the mechanisms through which insurgent combat activities intensify.[13]

[12] Section A4.1 in the Supporting Information (SI) provides further details on the collection and analysis of the qualitative evidence.

[13] The absence of an Institutional Review Board prevented the acquisition of IRB review. Section A4.3 discusses potential risks to the interview partners and the steps taken to minimize those risks.

Before the data sources, estimation approaches, and empirical results are discussed, we detail the case selection and give relevant information on the Syrian civil war.

The Syrian Case

While the Syrian civil war started as a peaceful uprising in 2011, it quickly escalated due to the government's violent response, as well as the arming of segments of the protestors and external support for radical Islamist groups. Initially, the ideologically and politically fragmented armed opposition – consisting roughly of non-ideological Free Syrian Army (FSA) groups, local Islamist and jihadist groups such as Ahrar al-Sham and Jabhat al-Nusra (JN)/Hayat Tahrir al-Sham (HTS), and global jihadist groups such as the Islamic State (IS) – seemed to have the upper hand, with large swathes of the country under their control since 2012/13. The tide of the insurgency began to turn with the Russian military intervention in 2015, which started a steady process of regime resurgence. In 2017, the first year of this study, only the Northwest, as well as parts of central and southern Syria remained under opposition control, as Figure 1 shows. However, the territory under rebel-control in the Northwest was still substantial: in early 2017 some 6,000 square kilometers in and around Idleb Province remained under opposition control (Lund, 2017).[14]

We focus on the three Northwestern governorates of Hama, Idleb, and Aleppo. Analyzing the consequences of bombing medical centers in these areas is instructive for four reasons.

First, while the targeting of healthcare in connection to military offensives has been a core component of the Syrian regime's counterinsurgency strategy throughout rebel-held territory, Northwestern Syria has experienced one of the heaviest bombing campaigns against medical centers and the enduring weaponization of healthcare since the beginning of the war (Fouad et al., 2017, pp. 2516–17). Different from other rebel-held areas, the Syrian army could not

[14] While rebel-controlled territories have shrunk particularly since 2019, large parts of Idleb province including its capital have remained out of government control.

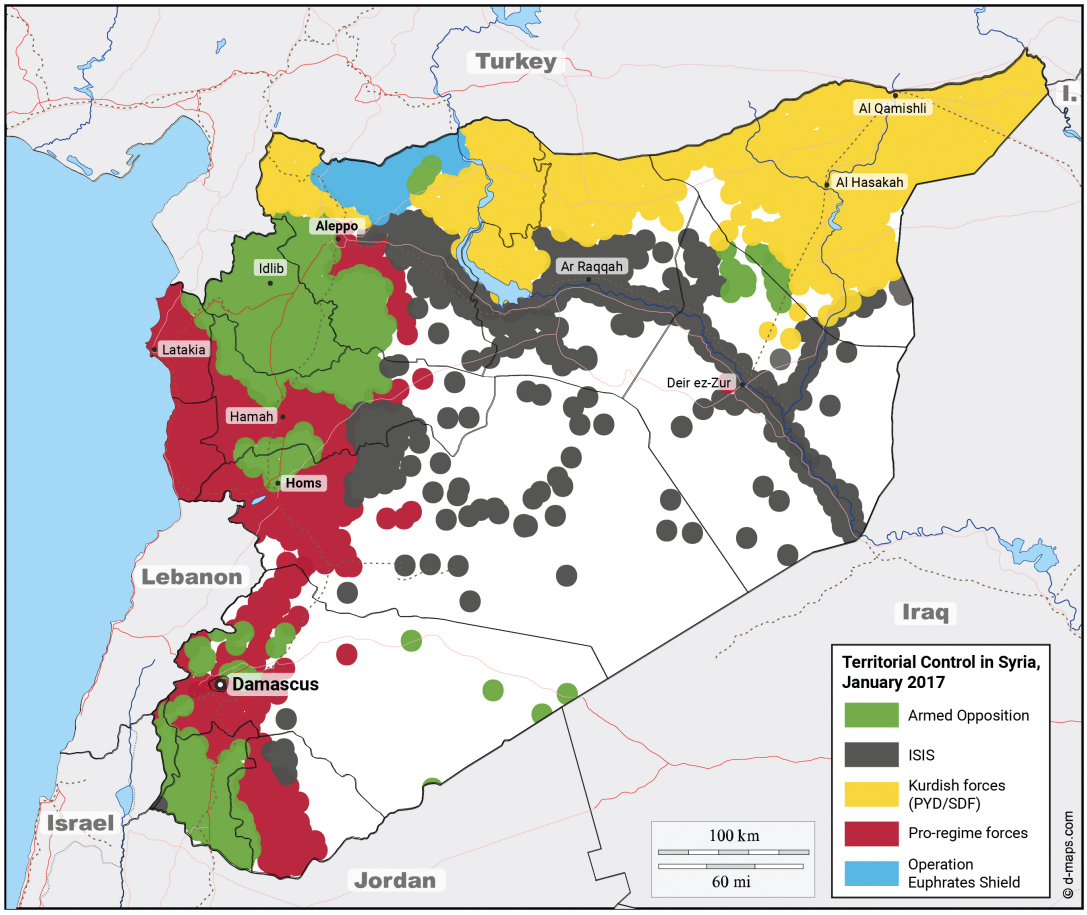

Figure 1: Territorial control of conflict parties in Syria (early 2017)

reconquer the North-West through sieges and attrition, primarily because of its proximity to Turkey (Lund, 2017). This has been recognized by Bashar al-Assad in an interview with the Russian daily Komsomolskaya Pravda in October 2016: "You cannot cut [off Turkish supplies], because Idleb is adjacent to Turkey; it's right on the Syrian-Turkish borders. So you cannot cut; you have to clean. You have to keep cleaning this area and to push the terrorists to Turkey to go back to where they come from, or to kill them. There's no other option" (SANA, 2016). As the most important ally of the Syrian regime, Russia has conducted numerous airstrikes in support of this brutal campaign since its intervention in September 2015, focusing on hospitals in particular. While other civilian infrastructures such as bakeries, schools, and water and sanitation infrastructure have also been targeted,[15] the targeting of healthcare has been the most frequent and systematic component of the Syrian and Russian counterinsurgency strategy (Browne et al., 2020; Fouad et al., 2017; N. Hall & Todman, 2022).[16] Most hospitals and health facilities were either destroyed or severely damaged, and currently less than 60% of the country's hospitals are functional (Daoudi, 2023, p. 5). As a leader of the local Islamist insurgent group Ahrar al-Sham put it, the government's "pretext is to target [the insurgent groups] but they bomb civilian facilities and hospitals."[17]

Second, the Northwest has been one of the earliest centers of the Syrian rebellion. Some of the oldest and most influential groups, such as HTS and Ahrar al-Sham, were based there. Since 2017, HTS has become the dominant force in this region. In addition to local groups, there have been several thousands of fighters from other parts of Syria that decided to leave for Idleb after the Syrian regime reconquered their areas. Many of these fighters joined local factions in order to continue their resistance (Lund, 2017). Consequently, we expect strong ties between

[15] Activist from Aleppo; activist from Eastern Ghouta

[16] However, we note that sometimes, medical facilities were located in the same building or adjacent to schools as a result of attacks on medical facilities that existed prior to the war, which necessitated their relocation (Fouad et al., 2017, p. 2520).

[17] Ahrar al-Sham spokesperson. A full list of the interviews and a description of the interview process can be found in Section A4.1.

the local population and insurgent groups, providing a favorable context for examining the causal mechanisms that make rebels react to attacks on civilian infrastructure.

Third, our theoretical argument rests on the deliberate and systematic targeting of medical facilities as a counterinsurgent strategy. Hence, hospital bombings were neither collateral damage (incidental damage as a foreseeable by-product of an attack on a military objective) nor unintended consequences (accidental damage as a by-product of such an attack) (Thomas, 2006, p. 3). Various testimonies from UN agencies and international NGOs, as well as from medical personnel in North-Western Syria confirm this judgment. We detail all relevant information in Section A1. In short, although the Syrian and Russian governments have claimed that medical facilities in opposition territories have been misappropriated by insurgent groups, which would have deprived them of protection under International Humanitarian Law (SAMS, 2022, p. 47) and would intervene with our theorized mechanisms, no evidence for these claims was provided. To the contrary, NGOs – such as the Syrian American Medical Society – as well as medical and NGO personnel have collected systematic evidence of the sole use of facilities for medical purposes (SAMS, 2022, pp. 7–8). This judgment is supported by the interviews we conducted. Although we found evidence that armed groups occasionally tried to interfere in this sector, they were pushed back both by medical personnel and local and international NGOs.[18] As a doctor and former CEO at the Union of Medical Care and Relief Organizations reported: "We would for instance threaten to close our facilities, which was a big issue for the factions, because they need to justify themselves in front of the local population."[19] Next to the local community, the armed actors and their families themselves were also dependent on these services. Hence, it was also in their interest to keep the facilities running unobstructed.[20]

[18] Fadi Aldairi, Hand in Hand For Aid and Development

[19] Dr. Zedoun al-Zoabi. This was confirmed by Dr. Munzer al-Khalil, former head of the Idleb Health Directorate.

[20] al-Zoabi

Finally, the largely rural region of Northwestern Syria and the time frame (2017-2020) make it possible to largely isolate the targeting of medical facilities from combat operations, something which may not be feasible in extremely dense urban fighting contexts, such as Israel's successive military campaigns in Gaza.

Quantitative Analysis

Data

Our units of analysis are the 18 districts in the three Northwestern governorates Hama, Idleb, and Aleppo. We use this intermediate level of aggregation (rather than sub-districts or municipalities), because the medical facilities in opposition-held territories usually served the population beyond their immediate vicinity, especially as the destruction of infrastructure progressed with war duration. Furthermore, and as we will discuss in more detail later, it is likely that insurgents generally did not "answer" in the immediate proximity of the hospitals to avoid new strikes against them (Souleimanov & Siroky, 2016).[21] For that reason, a larger geographic unit seems appropriate (but see Table 2 for alternative approaches).

To examine the tempo-spatial dynamics in the intensity of combat activities following medical facility bombings, we constructed a weekly panel data set with 3,762 observations (18 districts across 209 weeks; see Figure 2). Table A1 reports summary statistics for all variables discussed in the following.

[21] This information was confirmed by our interview partners (Aldairi; Dareen Khalifa, International Crisis Group). See also Section A3.6 for a more detailed discussion and descriptive statistics.

Dependent Variable: Combat Intensity

We look at the number of reported fatalities resulting from combat activities between rebel groups and pro-government forces. In this way, we are able to investigate whether hospital attacks were followed by more fatal clashes between these actors.

The data were drawn from ACLED (Raleigh et al., 2010), which has been used in numerous publications to study civil war violence (e.g., Newton & Tucker, 2022). We identified relevant fighting activities based on the armed actors involved. Section A3.2 in the SI gives a full list of the corresponding actors. Using primary and secondary information,[22] we coded those actors as "rebels" that showed consistent and violent opposition to the Syrian regime. In line with this definition, we did not consider activities by majority-Kurdish groups, as well as communal militias. We also excluded global Islamist groups from the analysis because we do not assume a tight relationship between these groups and local civilians (Stenersen, 2020; Toft & Zhukov, 2015).[23] Divisions of the Syrian, the Russian, and the Iranian armed forces, as well as pro-government militias, such as Hezbollah, were coded as "regime". Based on these lists, we identified all combat activities involving both regime and rebel forces and created weekly fatality counts resulting from these encounters for each of the 18 Northwestern Syrian districts.[24]

ACLED bases its data on (social) media reports and information from local collaborators. Such data are prone to biases, as several scholars have recently noted. For instance, events in more populated areas may be more likely to be covered than those in more remote areas (Dietrich & Eck, 2020; Weidmann, 2015). An event's timing may also influence its likelihood of coverage (Borzyskowski & Wahman, 2021). Particular types of violence are more likely to be covered than others; for instance, media outlets disproportionately cover more severe and

[22] Next to interviews, we relied on information from the Mapping Militants project, the Carter Center, the UCDP, as well as the "notes" column in ACLED.
[23] For our coding of global and local Islamist groups, see Section A3.2.
[24] See Section A3.2 for a list of all event types considered in the analysis.

sensational forms of violence (Croicu & Eck, 2022).[25] While we cannot completely eliminate these potential biases in the present setting, we address related concerns in a series of checks.

Broadly, the geographic and temporal focus of our study limits some of the most serious problems: We analyze a single region so that differential reporting because of, e.g., country differences does not pose a challenge.[26] Moreover, the analyses cover a relatively short period. This minimizes the chance that the results are influenced by reporting patterns that systematically change over time. To further ameliorate problems regarding the fatality counts we employ alternative specifications, such as the log-transformed count of the fatalities as well as the number of events as reported by ACLED (Table A2). We also check the sensitivity of our analyses for different time periods (Figure A5 and Figure A6) and administrative regions (e.g., Figure A4). Moreover, we inspect whether the reporting accuracy changed following medical facility attacks (Figure A7). Lastly, we also utilize an alternative data base; UCDP's Georeferenced Event Dataset (GED) (Table A4). All tests are detailed below and in the SI. Importantly, our results remain robust to these alternative specifications.

Treatment Variable: Targeting of Medical Facilities

Our treatment variable is strikes on medical facilities. Pro-government forces used explosive weapons such as missiles, mortars, and aerial bombs to strike hospitals and related facilities.[27] We derived the strike data from two sources: the Syrian Archive and PHR. Both NGOs have done an extensive effort to document and map attacks on the medical infrastructure in Syria.[28]

[25] For Syria, in contrast to highly studied cases such as Iraq and Afghanistan, no high-quality administrative data currently exist that would allow us to assess the effects of hospital bombings on local violence dynamics.
[26] Note also that the three biggest cities in Syria are not included in our analysis.
[27] Other actors, including ISIS, opposition groups, Turkish forces, and Coalition forces, also targeted hospitals in Syria. However, it is noteworthy that government forces were responsible for the majority of these attacks.
[28] For more information, see SI. Note that we excluded all attacks with unknown or contested perpetrators (13 attacks).

Although the number of airstrikes intensified already since 2015, we restricted the period of analysis to the years 2017 to 2020 to make the data compatible with ACLED's data collection on violent events in Syria. One might argue that rebels' incentives to respond and civilian pressure becomes weaker over time as both actors can experience a habituation effect. The time frame can thus be considered a conservative test. The data ends in 2020 since a ceasefire between Turkey and Russia in March 2020 reduced attacks on Northwestern Syria.[29]

In total, 119 strikes on 80 medical facilities were recorded. The following analyses make use of a binary treatment indicator, indicating whether a medical facility was targeted at least once in a specific time period. Hence, we focus on the extensive margin of the treatment. Figure 2 displays the distribution of the attacks across the 18 districts. Nine districts were targeted at least once, although the frequency of the attacks varied across districts. For instance, Al Mara (29), Muhradah (14), and Jebel Saman (11) experienced attacks in at least ten of the 209 weeks. Other districts, such as Hama (1) or Harim (2), were targeted much less frequently. Below, we discuss various robustness checks to reveal concerns regarding the unequal distribution of the treatment variable and the potentially influential role of single districts on the empirical results.

Identification Strategy

We exploit the tempo-spatial variation in the attacks on medical facilities. Crucial for the following research design, we conducted 16 semi-structured interviews with medical workers, local activists, and experts. The interviewees confirmed the premise that attacks on medical facilities were not predictable by insurgent groups. We discuss the interviews in further detail in Section A4.1.

[29] Data collection after 2020 by the Syrian Archive is still in progress. Preliminary results suggest that attacks continued in 2021 and 2022 but on a lower scale.

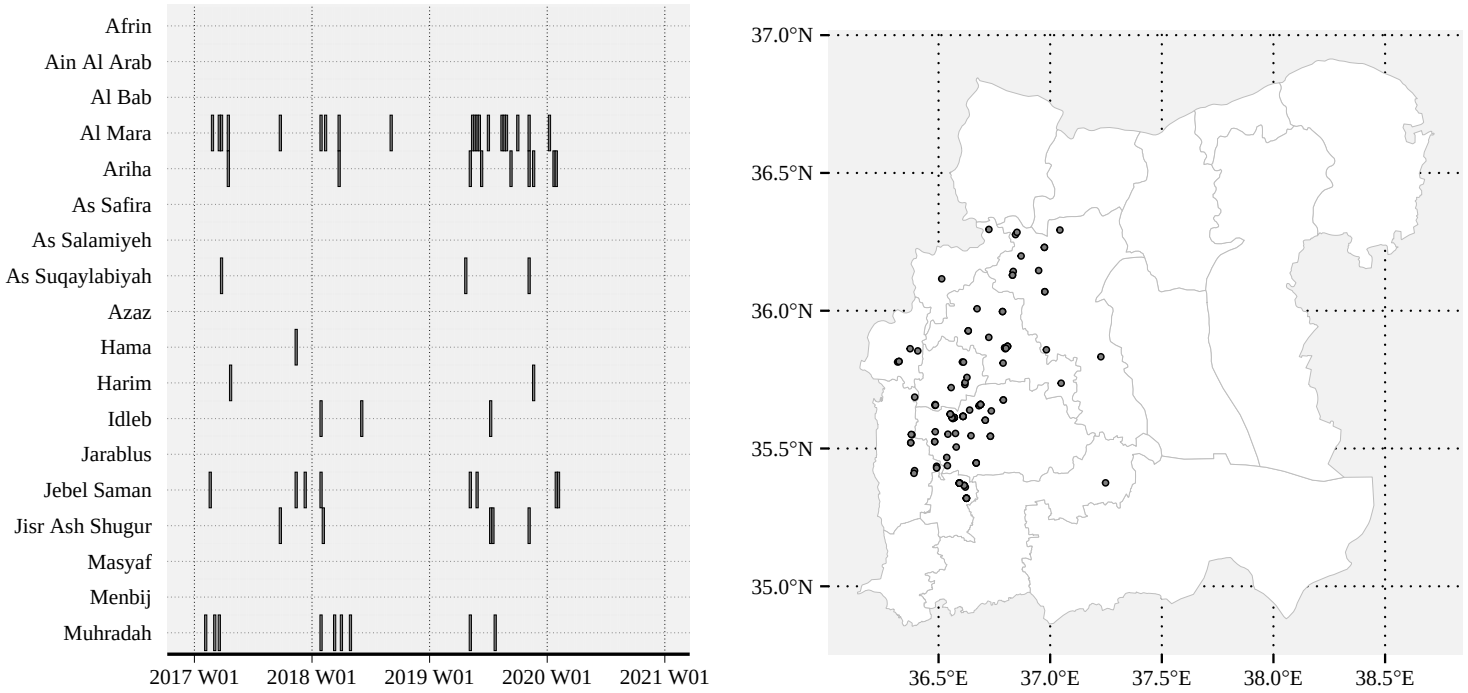

Figure 2: Temporal and Spatial Distribution of Airstrikes Against Medical Facilities in North-Western Syria

Attacks on medical facilities took the form of collective targeting as discussed above, which also implies that any health facility in opposition-held territory was a potential target, at any time.[30] As Dr. Khalil, former head of the opposition-affiliated Idleb Health Directorate, explained, "even when the Syrian regime does not plan to retake an area, they target hospitals, because it is related to their big message: you do not have a choice. The only choice you have is to come back to the Syrian regime and to accept the regime. Otherwise you can't live."[31] Hence, although some of the hospital attacks might have been starting points of larger government offensives in particular areas, the shelling of medical facilities was – by and large – uninterrupted in all opposition-held districts.[32]

Relatedly, insurgent groups lacked knowledge regarding the location and timing of regime forces' shelling of medical facilities. This assumption is supported by the fact that medical workers and activists developed a warning system designed to alert civilians immediately before an attack. From early on, voluntary flight spotters watched the movement of planes and notified civilians ahead of a likely attack.[33] In 2016, this warning system ("Sentry") was developed further when the company Hala Systems teamed up with volunteers to send automated warnings to civilians. However, the warning was for the level of the locality and not a specific facility. Furthermore, it only came a few minutes before a potential airstrike.[34] The information collected merely allowed to predict where a plane flies but not whether or where it would drop its bomb.[35]

These substantial efforts illustrate that the targeting of a specific facility was not predictable for insurgent groups. This alleviates concerns regarding potential selection effects in the following analyses. To further deal with potential biases, we account for the possibility that different

[30] al-Zoabi; Dr. Walid Tamer, former head of Syrian Doctors' Association
[31] al-Khalil
[32] al-Khalil; Tamer; Aldairi
[33] Abd al-Fatah, activist; Nabil Sheikh Omar, activist
[34] John Jaeger, Hala Systems
[35] Dan Henebery, Hala Systems; al-Fatah

combat-related factors, such as the intensity of fighting activities in a given area prior to treatment, confound the effect under study.

To estimate the effect of hospital bombing, we use a difference-in-differences approach. The long-term standard two-way fixed effects approach to estimate causal effects with panel data, however, comes with numerous methodological challenges. Importantly, this model requires researchers to assume a specific parametric form (effect linearity), treatment effect homogeneity over time, and parallel pre-treatment trends (Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021). Recently, numerous approaches have been developed to relax some of these assumptions; particularly for staggered treatment timings (Roth et al., 2023). What further complicates the estimation is that, in our setting, groups may not only get treated and leave treatment but that groups are treated for only one period. As a consequence, classic event study approaches are not feasible (de Chaisemartin & D'Haultfoeuille, 2023).

To deal with these specificities, we use a procedure that combines matching methods with a difference-in-differences estimator introduced by Imai et al. (2021). The core idea of this technique is to compare treated units at a respective time with units that have an identical pre-treatment history but did not experience treatment at the time in question. Based on the potential outcomes framework, we can estimate τ – the causal effect (ATT) of the treatment variable, X, on the outcome variable, Y:

$$\tau(F, L) = \mathbb{E}\left\{ \begin{array}{c} Y_{it+F}(X_{i,t} = 1, X_{i,t-1} = 0, \sum_{l=2}^{L} | X_{it} = 1, X_{i,t-1} = 0 \\ -Y_{it+F}(X_{i,t} = 0, X_{i,t-1} = 0, \sum_{l=2}^{L} | X_{it} = 0, X_{i,t-1} = 0 \end{array} \right\}$$

where L denotes the number of matching periods prior to treatment and F gives the number of periods after treatment for which the impact of the treatment should be estimated.

This approach comes with several advantages for our setting. First, the non-parametric matching technique relaxes the linearity assumption of the standard two-way fixed effect approach.

Second, this approach allows treatment to occur at different times in different units and multiple times for the same unit. In our case, this implies that we can take into account that multiple districts were repeatedly subject to hospital attacks. By specifying F, we are, third, able to not only estimate contemporaneous effects. We can also test how the treatment effects evolve over time, i.e., several weeks after the bombings occurred. This is crucial as rebel groups potentially needed some time to plan and execute their counter-attacks in the treated regions.[36] Fourth, by inspecting potential imbalances in the dependent variable in the pre-treatment period, we are able to examine whether the parallel trends assumption holds (see below). Fifth, we can minimize the chance that our findings suffer from spillover effects (see also below). Sixth, the proposed approach allows controlling for additional time-varying covariates. Hence, we can flexibly control for potential confounding variables without assuming particular parametric forms.

We controlled for six factors. Although medical actors and insurgent groups were not able to predict when and where pro-government forces would target medical facilities, it is possible that these attacks were systematically related to the regime's counterinsurgency strategy. For that reason, observations were matched based on districts' treatment histories prior to the treatment. Second, we also controlled for the lagged values of the dependent variable to ensure that the estimated effect is not due to some districts being more likely to be targeted because of previous combat activities. Third, we attribute increased rebel violence to hospital attacks. However, it is possible that medical facilities were struck together with other civilian objects and residential areas as part of a broader bombing campaign. For that reason, we also control for the number of regime attacks (air and drone strikes, use of chemical weapons as well as shelling, artillery, and missile attacks) against residential areas and other civilian infrastructure. In connection to this, our argument posits that the escalation of combat activities is a direct reaction to the deliberate targeting of medical facilities. To address this, we incorporate

[36] Jerome Drevon, International Crisis Group

a control accounting for instances where hospitals became collateral damage rather than the primary objective in the attacks. Fifth, we added a control for fatalities resulting from military activities by global Islamist groups. For all these variables, the rationale is that we aim to control for potential selection effects due to non-random or incidental attacks on hospitals in the districts under observation. Lastly, we followed proposals by Imai et al. (2021) and matched on the treatment history, i.e. the number of medical facility attacks, of the corresponding units' neighboring districts. In this way, we minimize the possibility of spillover effects which would violate the assumption of no interference across units.

Empirical Results

The effect of hospital bombings on subsequent combat activities

Matching is performed using four-week[37] lags as pre-treatment periods. Subsequently, the matched sets are further refined by incorporating time-varying control variables including the lagged outcome variable. The inverse propensity score weighting method (Hirano et al., 2003) is chosen for refinement as it minimizes the standardized mean differences effectively across pre-treatment periods (Figure 3). These differences remain constant over time and are smaller than .2 across all variables, indicating balanced covariates and supporting the parallel trends assumption (Imai et al., 2021, p. 16).[38]

Figure 4 presents the estimated ATTs of hospital bombings on the number of fatalities resulting from rebel-regime fights. We find that the shelling of medical facilities indeed influenced subsequent combat activities in the affected districts. While the contemporaneous effect in

[37] Figure A3 gives sensitivity tests for a broad set of lags. Overall, these tests show that the empirical results are not dependent on this modeling decision as they remain substantially unchanged for lags ranging from one to seven weeks. To further rule out the potentially influential role of single observations, we also report jackknife-like sensitivity tests. See Figure A4.

[38] We inspected whether our model results are dependent on the chosen refinement method. Figure A1 and Figure A2 show that this is not the case. The treatment effects are similar in direction and statistical significance for all refinement methods provided by the R-package 'PanelMatch' (Imai et al., 2021).

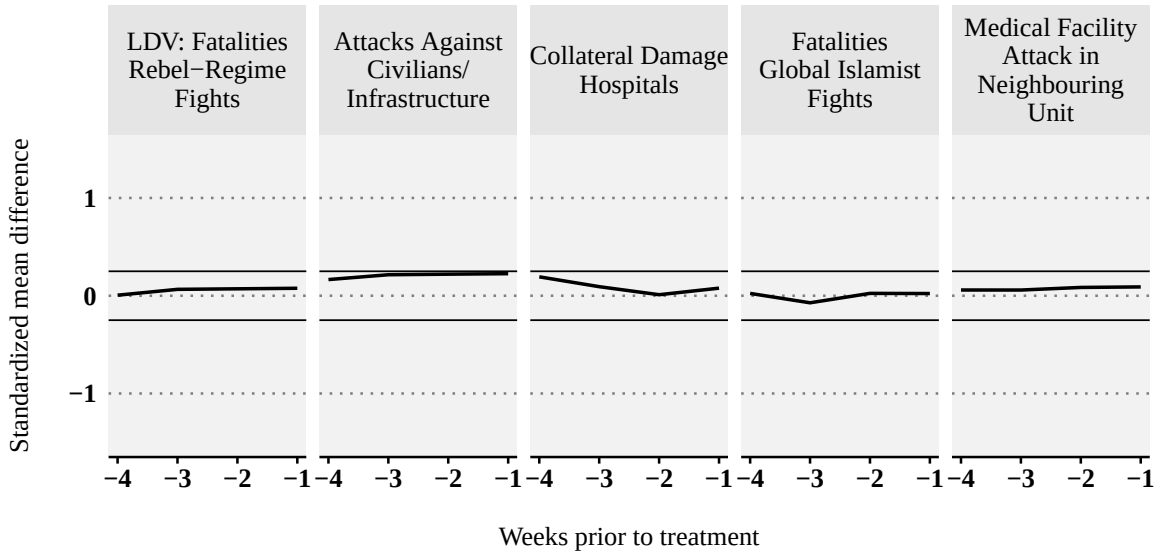

Figure 3: Pre-Treatment Trends and Covariate Balances
The plot shows the standardized mean difference for four covariates over a pre-treatment period of four weeks using propensity score weighting.

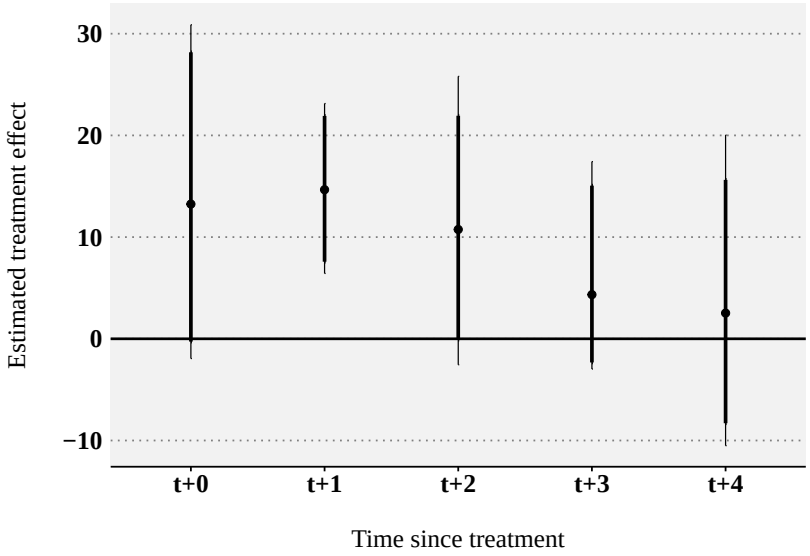

Figure 4: The Effect of the Targeting of Medical Facilities on Fighting Fatalities
The plot shows ATTs of hospital attacks adjusting for treatment and covariate histories during four weeks prior to the treatment. The vertical bars give 95% asymptotic confidence intervals based on a block boot-strapping procedure with 1000 iterations.

the week of the attack (time t+0) is positive, it fails to reach common levels of statistical significance. Importantly, the plot shows a positive and statistically significant effect one week after the shelling. This treatment effect is also substantially large: the estimate of the ATT is around 15 units, which corresponds to 0.91 standard deviations of the dependent variable. In week 3 after treatment, the effect size is close to zero. Attacks on hospitals thus resulted in a significant but timely limited increase of combat activities in the corresponding districts.

To address the possibility that we match districts that differ on relevant (unobserved) variables, we estimated treatment effects by restricting the data to districts treated at least once during the observation period. This ensures that our results are not confounded by unobserved differences between never-targeted and targeted districts which would intervene with a causal interpretation of the estimates.[39] Model 1 in Table 1 presents the results, which show similar effects despite a 50% reduction in sample size from 3,762 to 1,881 observations.

To verify that the presented results are not driven by individual districts, we conducted jackknife-like testing by sequentially excluding one of the 18 districts and re-estimating the treatment effects. Figure A4 demonstrates that the results are not dependent on any single district.

[39] For varying time periods, the never-treated districts in the North were dominated by the majority-Kurdish Syrian Democratic Forces (SDF) (Ain al-Arab/Kobani, Menbij, and parts of Azaz) or Turkish-backed rebel forces (Jarablus, al-Bab, Azaz, Afrin). The districts of As Safirah, As Salamiyeh, and Masyaf were under government control during the observation period.

Table 1: Alternative Model Specifications

F	Districts Weeks Treated Units	Grid Weeks	Radius Weeks	Subdistricts Weeks	Districts Days
t+0	13.166	11.917	1.445	2.545	−0.503
	(8.027)	(8.581)	(3.425)	(1.947)	(0.726)
t+1	14.536*	14.957*	8.864*	4.368*	−0.302
	(3.919)	(3.98)	(4.283)	(2.06)	(0.743)
t+2	10.148	3.382	−4.722	3.156	0.164
	(6.511)	(11.495)	(7.61)	(2.258)	(1.012)
t+3	3.6	−5.649	−0.749	2.536	2.156
	(4.999)	(10.459)	(7.153)	(2.555)	(1.257)
t+4	1.46	2.308	−2.625	4.095	3.922*
	(7.024)	(9.189)	(8.962)	(3.428)	(1.762)
t+5					1.252
					(0.668)
t+6					−0.852
					(1.009)
t+7					−1.269
					(1.671)
t+8					−0.445
					(0.983)
t+9					−1.014
					(1.622)
t+10					0.519
					(1.228)
t+11					0.901
					(0.908)
t+12					−1.21
					(1.335)
t+13					0.657
					(0.591)
t+14					−1.389
					(0.822)
Geographical Units	9	24	17	88	18
Time Units	210	210	210	210	1461
Observations	1890	5040	3570	18480	26298

Note: $^*p < 0.05$
Model specification based on matching approach with four (Models 1-4)/fourteen (Model 5) lags and propensity score weights. Covariates: lagged DV, regime attacks against civilians and civilian infrastructure, fatalities in fights of globalist Islamist groups, attacks in neighboring district/governorate. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

We employed three alternative strategies for creating geographic units in the panel data.[40] Model 2 utilizes a grid with 24 equally sized territorial units,[41] Model 3 focuses on the 18 district capitals and considers nearby medical facility attacks and combat activities within an 18-kilometer radius (11.2 miles) to the corresponding city's centroid, and Model 4 examines

[40] See Section A3.5 for more information on the corresponding data handling

[41] Each grid corresponds to approximately 2,500 square kilometers (965 square miles), i.e. an area of 50x50 kilometers (31x31 miles).

sub-districts in the three governorates. Here, the sample size increases to 18,183 observations (87 sub-districts x 209 weeks). These alternative specifications yield statistically significant and positive ATTs at time $t + 1$, supporting the findings presented in Figure 4.

We also examined daily data, resulting in a sample size of 26,298 observations (18 districts x 1,471 days) with fourteen-day lags and leads. Model 5 confirms our earlier findings, showing positive and statistically significant ATTs four days after the treatment indicating that rebel forces needed time to respond to attacks on healthcare units. The effect size is about 1 standard deviation of the dependent variable. The absence of contemporaneous effects supports our assumption that combat activities intensified after the bombings.

We conducted a series of further robustness and sensitivity checks.

Figure A5 in the SI presents results when considering the influence of time. We distinguish between attacks occurring in the first (2017/2018) and the second (2019/2020) half of the observation period. We also investigate whether the effect varies dependent on the frequency of the attacks within a district, using the median number of all attacks against medical facilities at the district level, which is six, as a cutoff point to construct a binary moderator variable (Figure A6). The findings consistently reveal statistically significant and positive ATTs one week after medical facilities were targeted, providing further support for our main hypothesis. However, both tests indicate that the escalation of fighting intensities is more pronounced at later points in time. One plausible explanation for this pattern is that the reduction in the availability of medical assistance becomes more severe as hospitals are targeted more frequently. This decline, in turn, prompts a more robust response from insurgents, leading to an increase in combat-related fatalities. Additionally, residents in the affected areas may exert greater pressure on insurgents to retaliate, as discussed further below in relation to the role of civilian outrage as a central mechanism.

The accuracy of fighting activities and fatality numbers is susceptible to measurement errors owing to the absence of reliable sources for corroborating all relevant information. Given that ACLED bases its data on (social) media reports and information from local collaborators, it is possible that attacks on hospitals led to heightened awareness and subsequent reporting of military engagements, rather than an actual surge in the latter. We address these concerns in three ways.

First, the SI includes two models (Table A2) using alternative operationalizations of the outcome variable. On the one hand, we log-transformed all variables involving fatality counts to reduce the influence of fights with a excessive fatality numbers. On the other hand, we used the number of fights as the dependent variable instead of their fatalities as this information might be more reliable. Both tests demonstrate that the results hold for these specifications.

Second, we inspected whether the quality of the information provided by ACLED decreased after hospital attacks (Figure A7). If true, this could imply an upswing in reports, possibly because less reliable information was considered. ACLED offers precision estimates concerning the location and timing of documented combat activities. Our analysis across various operationalizations of this information does not reveal any indication of diminished information quality subsequent to attacks on medical facilities.

Lastly, Table A4 reports results based on an alternative data set, UCDP's Georeferenced Event Dataset (Sundberg & Melander, 2013). Although the GED relies on similar sources, its data collection and processing mode differs from ACLED. Importantly, these specifications confirm the conclusions drawn Figure 4 and Table 1.[42] Hence, we find broad and robust support for the hypothesis that combat activities between rebel groups and regime forces escalated following attacks on medical facilities.

[42] We do not find a statistically significant effect for model 3 in Table 1. However, the reported ATTs remain positive and sizable.

Heterogeneous Treatment Effects: Do Hospital Bombings Increase Insurgent Activities?

The previous section has shown that the shelling of medical facilities had a substantial impact on subsequent combat activities. However, it remains open whether these intensifying levels of violence are due to increasing numbers of regime-initiated attacks on insurgent groups, or whether insurgent groups have responded to the targeting of civilian infrastructure with more lethal attacks.

We present additional evidence supporting the hypothesis that this effect is (at least partly) due to an increase in insurgent attacks on pro-government forces. We classified each combat activity involving rebel and regime forces according to its initiator. This was achieved by manually inspecting additional information provided on each activity documented in the ACLED data set. More concretely, ACLED provides event-classifications as well as short comments on each data set entry, which allowed us to code rebel- and regime-initiated combat activities.[43] Note that a third group of entries consists of fighting activities for which no clear initiator could be identified.[44] Out of 5,689 activities involving insurgent groups and regime forces, we categorized 1,631 as insurgent-initiated (28.6%), 364 as regime-initiated (6.4%), and the remaining 3,602 as non-determinable (63.3%).

Unfortunately, the number of regime-initiated clashes is underestimated as most activities were coded by ACLED as events without a clear initiator such as "armed clashes" or "territory gains". On the one hand, we present further tests that relax the strictness of our coding in the SI. These confirm the results reported in the following. Please see Section A3.7 for more details on the coding procedure. On the other hand, our main interest lies with whether insurgents

[43] For instance, on December 21, 2018, a corresponding note explicates that "Regime forces shelled rebel and Islamist factions positions in Al-Rashdeen in Aleppo, killing one rebel fighter." This entry was coded as 'regime-initiated'. Another note from April 5, 2017, states "Opposition forces targeted regime forces in Asileh in the southern countryside of Hama with Grad missiles. Neither injuries nor fatalities reported." This case was coded as 'insurgent-initiated'.

[44] For instance, for a military activity on December 22, 2018, the corresponding note explicates that "Clashes, accompanied by shelling by regime and pro-regime forces, took place between regime forces, supported by pro-regime militias, and rebel and Islamist factions in Al-Rashdeen west of Aleppo city."

intensified there combat activities. For this group, the data include a high number of attacks involving rockets, artillery or shelling.

Based on this classification, we examined to what extent increased violence after hospital attacks was due to insurgent activities. Table 2 presents model results for the following dependent variables: fatalities in (1) insurgent-initiated fights, (2) regime-initiated fights, and (3) fights for which the initiator could not be determined. As in the previous models, we match on the corresponding pre-treatment histories, and refine based on the pre-treatment fatality numbers resulting from insurgent-initiated, regime-initiated, and unidentified clashes, as well as fatalities resulting from activities of global Islamist groups, and the treatment histories of neighboring districts.

Table 2: Heterogeneous Treatment Effects

F	**Insurgent-Initiated Fights**	**Regime-Initiated Fights**	**Initiation unidentified**
t+0	0.29	1.172	8.33
	(0.721)	(1.161)	(8.392)
t+1	2.282*	1.217	9.826*
	(1.102)	(1.193)	(3.463)
t+2	0.581	−0.367	7.783
	(0.461)	(0.418)	(6.139)
t+3	−0.379	1.222	1.305
	(0.569)	(1.13)	(4.199)
t+4	0.354	−0.424	−1.03
	(0.386)	(0.414)	(7.376)
Geographic Units	18	18	18
Time Units	210	210	210
Observations	3780	3780	3780

Note: $^*p < 0.05$
Model specification based on matching approach with four lags and propensity score weights. Covariates: fatalities in insurgent-initiated fights, in regime-initiated fights, in fights whose initiator cannot be determined, in fights of globalist Islamist groups, and attacks in neighboring district. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

Table 2 gives a clear picture regarding the activities of rebel groups (Model 1). Here, the ATT is positive and significant at $t+1$ and equals about 0.83 standard deviations of the dependent variable. This finding thus speaks to the hypothesized effect that the shelling of medical facilities prompted insurgent groups to engage in more lethal combat activities. Concerning regime-initiated fights, no significant effects can be observed (effect size: 0.39). Lastly, the

category of non-identifiable clashes and fights similarly shows statistically significant ATTs at $t+1$ (effect size: 0.68). As explained above, it remains inconclusive whether these clashes were initiated by insurgent or regime troops. Importantly, these findings lend support to the idea that insurgents sought to give a military response when medical facilities were attacked.

In the SI, we report placebo tests for three alternative outcome variables for which we did not expect to find a treatment effect. First, we assume that global Islamist groups should be less inclined to respond to the bombing of medical facilities because they do not rely on local populations in order to gain legitimacy to such a degree as other insurgent groups. Second, Kurdish groups were less likely to be targeted by regime forces because they remained unaligned between the central government and the armed opposition (Baczko et al., 2017) and, for that reason, should show no response to the treatment under study. Lastly, we do not expect that the number of civilian casualties increased in the aftermath of hospital attacks. For all three outcome variables, we do not find positive treatment effects (Table A3), which we interpret as support for our theoretical argument and the validity of the causal claim of this study.

Next, we proceed with providing qualitative evidence derived from interviews and primary documents issued by insurgent groups.

Qualitative Evidence

"... and we will respond to every bombardment with its equal..."

Leader of Hayat Tahrir al-Sham (HTS)

In the following section, we shed detailed light on the mechanisms linking hospital bombing and insurgent fighting activities by relying on unique evidence derived from 17 semi-structured interviews with seven Syrian health and NGO workers, three Syrian civil society activists, two members of Ahrar al-Sham, and five experts and professionals. The health workers and

activists witnessed several attacks on hospitals and observed subsequent civilian and rebel behavior, while the experts offer specialized knowledge on conflict dynamics in Northwestern Syria. These interviews were conducted between 2017 and 2023 online and in-person. We also analyzed more than 90 videos and primary documents released by insurgent groups in response to attacks on civilian infrastructure.[45] Based on this original evidence, we are able to reconstruct the conflict dynamics after medical facilities were targeted. Overall, we find broad support for the quantitative findings explicated in the previous section. Our interview partners jointly supported the expectation that insurgents would respond to the targeting of medical facilities by intensifying their fighting activities. As summarized by an activist and aid worker from Northwestern Syria: "after each attack, there would be a reaction."[46] But what motivated the insurgents to strike back? In the following, we turn to each of the two hypothesized mechanisms – intrinsic motivations and civilian pressure – to shed light on this question.

Intrinsic Motivations

Several interviews provide valuable insights into the crucial role that insurgents' intrinsic motivations played in shaping their responses to hospital attacks. In particular, insurgents needed to increase their credibility and relevance among the local population by fighting back.[47] One expert highlighted the general need for insurgents to demonstrate their commitment to protecting the local population, explaining that "the factions have to do something because they say they are responsible for the defense of the province [Idleb], so they have to respond in a noticeable way. It is about their credibility."[48] The need to bolster their reputation was particularly relevant for local Islamists, such as HTS, who were deeply embedded within

[45] See Section A4 for further information on the interviews and the primary documents.
[46] al-Fatah
[47] Khalifa
[48] Drevon

Northwestern Syria through the provision of rebel governance and their claim to rule over the population. These groups therefore depended on continued civilian recognition and at least passive support. Arguably, retaliating after an attack on a hospital was also a 'cheap' way to generate short-term support for the rebels. Relatedly, as the former head of the Idleb Health Directorate described, "they fight back to show the people: 'we do our best to protect you'. If some facility is attacked, they will attack some area under the control of the Syrian regime to send a message to the people."[49] For instance, they would launch rockets against regime positions or attack checkpoints.[50]

Our empirical material also suggests that, in response to the targeting of civilians and civilian infrastructure, insurgents felt compelled to signal their resolve to the counterinsurgent (Lyall, 2017, p. 5). They needed to demonstrate that they would not be intimidated no matter what the cost. The former head of the Idleb Health Directorate and an expert confirmed that rebel groups typically retaliated to establish a level of deterrence and to create a balance of fear:[51] "if the regime attacks our area, we will attack your [the regime's] area."[52] In addition, the rebels used their military responses to communicate to civilians their goal of protecting the local population: "Their message was that we are attacking the regime's military centers, not civilians."[53] This could be read as a competition for virtuous reputation: in response to the bombing of hospitals, rebels claimed to be fighting pro-regime forces even harder, rather than targeting their hospitals, for example. However, several respondents also admitted that insurgents sometimes targeted civilians in government-controlled territories.[54]

These quotes from experts, doctors, and NGO workers provide firsthand perspectives that support the causal identification of intrinsic motivations. The experts emphasize the importance

[49] al-Khalil
[50] Drevon
[51] Drevon; al-Khalil
[52] al-Khalil
[53] al-Khalil
[54] Omar; al-Fatah; al-Khalil

of saving face with the local population, while the doctor's quote underscores the insurgents' signaling of resolve to the government.

Insurgent groups have also exploited the shelling for propaganda purposes. For instance, a media organization linked to JN, the predecessor of HTS, produced several videos where it filmed the destruction of hospitals and interviewed medical actors, civilians, and rescue workers.[55] As a reporter at the end of a news report produced by this organization put it: "Assad and his supporters may think that by targeting these hospitals, they will undermine the Mujahideen's resolve. Different from what they think, the Mujahideen will continue their fight even if no more hospitals remain."[56] In another video, an HTS leader announced several "revenge" operations in reaction to regime bombings on civilian infrastructure: "To the criminal Bashar [al-Assad] and his soldiers we say, an eye for an eye, and a tooth for a tooth, and for every wound a wound. And if the war is prolonged, there is no harm, because we are certain that the day when the Syrian people will take revenge on you is near."[57]

These videos and statements demonstrate how local Islamists' exploited bombing incidents to fuel their narrative, signal their resolve, and incite retaliation. The quotes effectively illustrate the causal mechanism, emphasizing the impact of bombardments on the groups' determination to continue fighting and inflict retribution.

Civilian Pressure

Concerning our second mechanism, the interviewees also confirmed that civilian outrage and demands for retribution were critical factors. The targeting of medical facilities, schools, and refugee camps not only resulted in civilian casualties but also had symbolic significance that heightened people's anger.[58] One expert elaborated on this by stating, "when you target an

[55] Videos 1-4
[56] Video 2
[57] Video 5
[58] Drevon

IDP camp, a hospital or a school, it makes people furious of the factions. People ask them, why are you not fighting more, why are you abiding by the [Turkish-Russian] ceasefire? Why are you complicit in this? (…) People on the ground blame HTS for being complicit in the targeting of civilians."[59] This assessment was echoed by the former head of the Syrian Doctors' Syndicate who highlighted the popular pressure on rebel groups to respond to these atrocities, with people demanding protection for civilians, hospitals, and other vital infrastructure.[60] One activist took to social media to criticize HTS for its perceived inaction following an attack on a refugee camp, questioning whether HTS would retaliate against the Assad regime: "will we see the convoys of Julani [the leader of HTS] […] bomb the areas of the Assad regime in retaliation for the massacre of the displaced in the camps?!" (Nedaa Post, 2022).

The uncompromising attitude of the local population may have been reinforced by the significant influx of displaced persons from other parts of the country since late 2016. According to one expert, these individuals chose to leave their home areas rather than reconcile with the regime, indicating a strong opposition to the government.[61] This was confirmed by the former head of the Idleb Health Directorate, who said that the first preference of people in Idleb was to leave the country, followed by living under rebel control. "Almost no one would voluntarily return to regime-held areas."[62] The attacks on medical facilities thus further reinforced civilian opposition to the regime.[63] This uncompromising attitude is also evident in a survey conducted by Fabbe et al (2023, p. 20) among Syrian refugees in Turkey. They found that people who had lost their homes to barrel bombs were less likely to provide life-saving assistance to a regime member in need.

[59] Khalifa
[60] Tamer
[61] Drevon
[62] al-Khalil
[63] Drevon. In line with this, civilians supported the rebel effort from behind the frontlines by providing food and helping to dig trenches (Khalifa).

Overall, the targeting of hospitals had an accelerating effect on insurgents in the short term. Based on the interviews, we find support for intrinsic motivations and civilian pressure as critical mechanisms: insurgents needed to signal resolve to both the local population and the counterinsurgent in order to maintain their relevance, but they also responded to civilian pressure to strike back. In theoretical terms, both mechanisms are complementary, but future research should further explore their specific connections.

Alternative Explanations

The evidence presented in this study also helps to mitigate the influence of alternative factors that could potentially explain the observed increase of combat activities.

On the one hand, as noted earlier, the intensification of fighting following attacks on medical facilities could be driven by the incumbent's effort to retake territory. The destruction of civilian infrastructure could therefore serve as a launching pad for broader military campaigns by pro-regime forces: "The regime and Russia use this strategy when they want to enter an area, [...] the first step is to destroy all hospitals in this area."[64] While this claim is plausible, the evidence presented contradicts such an explanation. First, the analysis of rebel- and regime-initiated fighting activities as presented in Table 2 shows that only rebel-initiated military actions significantly intensified after hospital attacks. Note also that we use attacks on civilians and civilian infrastructure as a control variable in the quantitative analysis. Hence, the results presented account for a potential increase in such incidents prior to attacks on medical facilities. By including this co-variate, we also guard against the possibility that rebels were merely responding to collateral damage rather than the intentional targeting of hospitals. Second, numerous interviews confirmed that hospitals were continuously targeted

[64] al-Khalil

in all rebel-held districts.[65] Thus, medical facilities were under constant attack, rather than being targeted only in conjunction with specific government offensives.

On the other hand, civilians sharing information with insurgents about regime positions and movements could have sparked an increase in insurgent attacks (Condra & Shapiro, 2012; Shaver & Shapiro, 2021). While we cannot directly rule out this possibility, information sharing is much less important in conventional wars, which are decided on the battlefield (Krcmaric, 2018, p. 23).[66]

A third alternative explanation could be that the attacks on medical facilities triggered a recruitment surge, leading to an influx of rebel fighters and a subsequent escalation in combat activity. This surge may have been independent of insurgents' intrinsic motivations or civilian pressure. As one expert emphasized in an interview, "before 2018, you would see a lot of recruitment by prominent jihadis in IDP camps. The narrative was that you get killed anyways, so you might as well get killed in battle and be a martyr rather than being bombed in your tent."[67] In this regard, widespread economic deterioration, for which the destruction of civilian infrastructure serves as a proxy, may also reduce the opportunity costs associated with joining armed groups (Blattman & Miguel, 2010), thereby potentially increasing overall insurgent activity.

However, if recruitment were the driving mechanism behind the increase in fighting, we would anticipate a medium- or long-term increase in combat activities, as it takes time to train new fighters. Nevertheless, our quantitative findings (Figure 4 and Table 1) indicate a prompt rebel response, suggesting that recruitment is unlikely to explain the observed patterns. Another way to look at this issue, is to focus on the type of military incidents. In Table 2, we reported an increase in insurgent-initiated activities that consisted mainly of capital-intensive fighting,

[65] Tamer; al-Zoabi; al-Muostafa

[66] The terrain also matters. In urban conflicts (such as Iraq), information flows are a critical component of counterinsurgency operations, while they are marginal in more rural insurgencies, such as in Northwest Syria (Condra et al., 2010).

[67] Khalifa

such as artillery or missile attacks, drone strikes, or suicide bombings. Hence, attacks on medical facilities triggered fighting activities that were not dependent on an increased supply of fighters. We believe that this lends further support to the idea that recruitment is not a crucial factor in explaining the identified treatment effect.

Conclusion

The Syrian civil war is one of many conflicts in which civilians and civilian infrastructure have been targeted by explosive weapons. In particular, for the years under study here, Syria has been at the top of a sad list of countries where medical infrastructure has been targeted, as documented by the Safeguarding Health in Conflict Coalition. Most prominently, in Syria, pro-government forces have attacked medical facilities in opposition-held territories as part of their counterinsurgency strategy. As the former head of the opposition-affiliated city council of Aleppo put it, "medical staff and essential services were targets to prevent people from having the means to resist."[68] That such targeting occurs despite the protection such facilities enjoy by international law and the lack of effective responses challenges the legal norms that protect civilians in conflict zones.

However, as this article shows for the case of Syria, the targeting of civilian infrastructure backfires. Based on novel statistical approaches and data sources, we examined the effect of attacks on medical facilities on subsequent patterns of combat activity. The corresponding results demonstrate that, first, local military violence increased in the aftermath of these attacks. Second, our results also indicate that this effect is driven by an intensification of rebel-initiated combat activities. Targeting medical facilities thus did not help pro-government forces to take back control of Northwest Syria. Rather, it fueled an escalatory cycle between civilians and insurgents on the one side, and the regime on the other side. As an expert

[68] Former head of opposition-affiliated city council of Aleppo

described it, the targeting of civilian infrastructure "puts them [the factions] in a very hard spot, and it makes it harder for everyone to give up, at least rhetorically, on the narrative of, we are there to fight the regime, we gonna march towards Damascus."[69] Hence, insurgent groups tended to retaliate in response to attacks on hospitals, rather than back off.

The current war in Ukraine is a stark reminder that these findings are relevant beyond Syria. As observed in a recent article published in the New York Times, "rather than break Ukrainian spirit, the [Russian] bombardments have only made Ukrainians more determined. Some 97 percent of Ukrainians surveyed now say they believe they will win the war, and 74 percent predict that Ukraine will retain all the territory within the borders internationally recognized in 1991" (Santora, 2023). Overall, the presented results lend systematic evidence in support of the observation that the targeting of civilian infrastructure backfires. They underline the limits of coercive airpower in counterinsurgency, echoing earlier findings in both inter- and intrastate war (Allen & Martinez Machain, 2019; Horowitz & Reiter, 2001; Kocher et al., 2011; Pape, 1996). Our results should be applicable to other contexts of conventional (civil) war and indirect violence. Future studies on other cases would fruitfully contribute to the debate on the effects of state-led civilian victimization, with existing contributions mostly focusing on irregular civil wars. However, apart from the possibility of generalizing the findings of this study, we also stress the importance of examining critical phenomena such as the targeting of hospitals in a single 'crucial' case such as Syria, which are in and of themselves worthy of "mere description".

As interviews with medical workers, local activists, and experts have shown, the targeting of medical facilities have strengthened the resolve of both civilians and insurgents to continue their resistance against the Syrian regime. Civilians seem to have pushed insurgents to retaliate, but these also had their own incentives to do so. Crucially, intrinsic motivations such as maintaining their reputation as well as civilian pressure translated into a relative prompt

[69] Khalifa

insurgent response. Our research did not support alternative explanations, such as increased recruitment. Our findings thus speak to recent literature that emphasizes civilian (and insurgent) moral beliefs and group identities developed or strengthened during a conflict that influence perceptions of violence next to personal exposure and emotions. Our results are also in line with effects of punishment in interstate war. As Pape (1996, p. 26) has argued, forms of 'selective' punishment (to which we could count the targeting of civilian infrastructure) create popular anger toward the attacker and demands for reprisals. Civilians (and insurgents) likely blame the perpetrator for the violence inflicted when they perceive the harm as unjust or deliberate, and hold (prior) biases against this actor. While not being able to directly test this assumption due to the lack of survey data on insurgent and civilian populations in the time frame and area we study,[70] we have provided some plausible qualitative evidence on this mechanism and hope that future research will build up on and extend our findings. Rebel perspectives and their linkage to civilian preferences should also be integrated into such a research program. Particularly the question we analyze here is difficult to answer as interviews with insurgent group members are prone to incentives to misrepresent information and to downplay own wrongdoings. In this regard, further analyzing primary documents at different points in time is a promising alternative to get a more detailed glimpse at rebels' motives.

It is also crucial to consider under which conditions civilian emotions, moral beliefs, and outgroup biases will translate into insurgent reactions. In the context of collective targeting, conventional civil war, and indirect violence as in Syria, civilians can hardly convince the government to stop the violence. Unless they leave insurgent-held territory altogether, they will not be spared when they change their behavior. In the case of Syria, as likely in other cases of conventional civil war, the importance of wartime informing identified in other studies (Condra & Shapiro, 2012; Shaver & Shapiro, 2021) is also relatively marginal (Balcells, 2017, p. 25). When the intent is collective targeting (which in our case is selective at the collective

[70]Survey research under conditions of armed conflict also comes with fundamental ethical challenges.

but indiscriminate at the unit level), the government is less dependent on information about potential targets. More cynically, the government is likely not interested in a differentiation between military objectives and civilian objects in the first place. More specifically in the case of medical facilities in Syria, neither the Syrian nor the Russian government needed information from civilians on the locations of hospitals, as they received many coordinates from the UN (Hill & Hurst, 2019). Our research thus shows that more information on civilians and the infrastructure they depend on may lead to *more* rather than less violence, which is in line with recent research on strategic displacement (Lichtenheld & Schon, 2021).

In order to move forward research on the effects of state-inflicted civilian harm, we are also explicit about the type of violence we study, that is, coercive, intentional, indirect violence which took the form of collective targeting. Findings may thus differ for other types of violence, i.e., brute force (Schelling, 1966) or "eliminationist victimization" (Downes & McNabb Cochran, 2018, p. 288); incidental ("collateral damage") or unintended violence (Condra & Shapiro, 2012; Shaver & Shapiro, 2021); or indiscriminate or "random" violence (Kalyvas, 2006; Kocher et al., 2011; Lyall, 2009). These different forms of violence may be perceived differently by civilians and insurgents, and thus elicit different emotional and moral responses.

An intriguing question for further research is why governments continue to rely on coercive airpower, particularly punishment strategies, despite their disputed effectiveness. While a complete account would require insights into the decision-making of Syrian and Russian forces, a preliminary answer is that, particularly selective aerial bombing and artillery shelling is relatively cheap in contrast to sustained ground offensives. As long as insurgent responses do not directly threaten incumbents, they may thus be willing to pay the price of a tit-for-tat cycle of violence. Furthermore, while our study primarily investigates the short-term effects of bombing medical facilities, anticipated long-term consequences likely also play an important role. It is plausible that effects evolve over time and with repeated attacks. While our research does not provide direct support for this idea, it remains a crucial task for future studies to

disentangle the complex, long-term relationship between targeting civilian infrastructure and subsequent violence dynamics. This requires employing appropriate methodological tools to comprehensively examine the evolving effects of multiple attacks on different aspects of the conflict. Such research can also inform policy debates and aid in developing more effective strategies for mitigating the impact of armed conflict on civilian populations. For now, our results show that, rather than contributing to incumbent victory or a negotiated settlement, the targeting of medical facilities in Northwestern Syria has fueled insurgents' resistance and thus makes ending the conflict less likely.

While we have examined the effect of targeting medical facilities on insurgent activity, we can think of no good reason why similar results should not hold for other civilian infrastructure, most notably schools, places of worship, food production, and drinking water and irrigation systems. Future research should investigate this in Syria and beyond.

Finally, our research speaks to a growing literature on the reverberating and cumulative effects of war (Lubell & Cohen, 2020; Savell, 2023), which go far beyond direct physical damage to a target or immediate civilian and combatant fatalities. Literally, each attack on a medical facility can lead to hundreds of indirect deaths even after a war has ended (Savell, 2023, pp. 20–21; Ghobarah et al., 2003). The targeting of medical facilities thus contributes substantially to both wartime and post-war casualties and for this reason, should be a main concern of scholars and practitioners.

Ultimately, the targeting of civilian infrastructure could mean the "emergence of a new, indirect, more deniable" way of civilian victimization (Downes, 2008, p. 257). While the mass killing of civilians attracts intense political and media attention, the tragic, longer-term consequences of targeting civilian infrastructure are often overlooked, even though they can be just as severe.

References

Abrahms, M. (2006). Why terrorism does not work. *International Security*, *31*(2), 42–78.

Allen, S. H., & Martinez Machain, C. (2019). Understanding the impact of air power. *Conflict Management and Peace Science*, *36*(5), 545–558.

Arjona, A., Kasfir, N., & Mampilly, Z. C. (Eds.). (2015). *Rebel governance in civil war*. Cambridge University Press.

Baczko, A., Dorronsoro, G., & Quesnay, A. (2017). *Civil war in syria: Mobilization and competing social orders*. Cambridge University Press.

Balcells, L. (2017). *Rivalry and revenge: The politics of violence during civil war*. Cambridge University Press.

Benmelech, E., Berrebi, C., & Klor, E. F. (2015). Counter-suicide-terrorism: Evidence from house demolitions. *The Journal of Politics*, *77*(1), 27–43.

Blattman, C., & Miguel, E. (2010). Civil War. *Journal of Economic Literature*, *48*(1), 3–57.

Borzyskowski, I. v., & Wahman, M. (2021). Systematic measurement error in election violence data: Causes and consequences. *British Journal of Political Science*, *51*(1), 230–252.

Briody, C., Rubenstein, L., Roberts, L., Penney, E., Keenan, W., & Horbar, J. (2018). Review of attacks on health care facilities in six conflicts of the past three decades. *Conflict and Health*, *12*, 19.

Browne, M., Triebert, C., Hill, E., Hurst, W., Gianordoli, G., & Khavin, D. (2020). Hospitals and Schools Are Being Bombed in Syria. A U.N. Inquiry Is Limited. We Took a Deeper Look. [newspaper]. *The New York Times: World*.

Callaway, B., & Sant'Anna, P. H. C. (2021). Difference-in-Differences with multiple time periods. *Journal of Econometrics*, *225*(2), 200–230.

Canetti, D., Hall, B. J., Rapaport, C., & Wayne, C. (2013). Exposure to political violence and political extremism: A stress-based process. *European Psychologist*, *18*(4), 263–272.

Cederman, L.-E., Hug, S., Schubiger, L. I., & Villamil, F. (2020). Civilian victimization and ethnic civil war. *Journal of Conflict Resolution*, *64*(7), 1199–1225.

Condra, L. N., Felter, J. H., Iyengar, R. K., & Shapiro, J. N. (2010, July 1). *The Effect of Civilian Casualties in Afghanistan and Iraq*. NATIONAL BUREAU OF ECONOMIC RESEARCH CAMBRIDGE MA.

Condra, L. N., & Shapiro, J. N. (2012). Who Takes the Blame? The Strategic Effects of Collateral Damage. *American Journal of Political Science*, *56*(1), 167–187.

Costalli, S., & Ruggeri, A. (2017). Emotions, ideologies, and violent political mobilization. *PS: Political Science & Politics*.

Croicu, M., & Eck, K. (2022). Reporting of non-fatal conflict events. *International Interactions*, *48*(3), 450–470.

Danner, M. (1994). *The massacre at El Mozote: A parable of the Cold War*. Vintage Books.

Daoudi, S. (2023, October 10). *The public health effects of normalization with syria*.

de Chaisemartin, C., & D'Haultfoeuille, X. (2023). Difference-in-Differences Estimators of Intertemporal Treatment Effects. *NBER Working Paper Series*, *29873*, 1–74.

Dell, M., & Querubin, P. (2018). Nation Building Through Foreign Intervention: Evidence from Discontinuities in Military Strategies. *The Quarterly Journal of Economics*, *133*(2), 701–764.

Dietrich, N., & Eck, K. (2020). Known unknowns: Media bias in the reporting of political violence. *International Interactions*, *46*(6), 1043–1060.

Dill, J. (2019). Distinction, necessity, and proportionality: Afghan civilians' attitudes toward wartime harm. *Ethics & International Affairs*, *33*(3), 315–342.

Dill, J., Howlett, M., & Müller-Crepon, C. (2023). At any cost: How ukrainians think about self-defense against russia. *American Journal of Political Science*, *n/a*.

Downes, A. B. (2008). *Targeting civilians in war*. Cornell University Press.

Downes, A. B., & McNabb Cochran, K. (2018). It's a crime, but is it a blunder? the efficacy of targeting civilians in war. In A. Barros & M. Thomas (Eds.), *The civilianization of war: The changing civil–military divide, 1914–2014*. Cambridge University Press.

Dyrstad, K., & Binningsbø, H. M. (2019). Between punishment and impunity: Public support for reactions against perpetrators in guatemala, nepal and northern ireland. *International Journal of Transitional Justice*, *13*(1), 155–184.

Fabbe, K., Hazlett, C., & Sinmazdemir, T. (2023). Threat perceptions, loyalties and attitudes towards peace: The effects of civilian victimization among syrian refugees in turkey. *Conflict Management and Peace Science*, 07388942231172754.

Fouad, F. M., Sparrow, A., Tarakji, A., Alameddine, M., El-Jardali, F., Coutts, A. P., El Arnaout, N., Karroum, L. B., Jawad, M., Roborgh, S., Abbara, A., Alhalabi, F., AlMasri, I., & Jabbour, S. (2017). Health workers and the weaponisation of health care in Syria: A preliminary inquiry for The Lancet–American University of Beirut Commission on Syria. *The Lancet*, *390*(10111), 2516–2526.

García-Ponce, O., Young, L. E., & Zeitzoff, T. (2023). Anger and support for retribution in mexico's drug war. *Journal of Peace Research*, *60*(2), 274–290.

Ghobarah, H. A., Huth, P., & Russett, B. (2003). Civil wars kill and maim people—long after the shooting stops. *American Political Science Review*, *97*(2), 189–202.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, *225*(2), 254–277.

Goodwin, J. (2001). *No other way out. state and revolutionary movements, 1945-1991*. Cambridge University Press.

Goodwin, J. (2006). A theory of categorical terrorism. *Social Forces*, *84*(4), 2027–2046.

Gutiérrez-Sanín, F., & Wood, E. J. (2017). What should we mean by "pattern of political violence"? repertoire, targeting, frequency, and technique. *Perspectives on Politics*, *15*(1), 20–41.

Hall, J., Kovras, I., Stefanovic, D., & Loizides, N. (2018). Exposure to violence and attitudes towards transitional justice. *Political Psychology*, *39*(2), 345–363.

Hall, N., & Todman, W. (2022). Russia waged a cheap war in Syria. Here's what those tactics might look like in Ukraine. *Washington Post*.

Hill, E., & Hurst, W. (2019). The U.N. Tried to Save Hospitals in Syria. It Didn't Work. [newspaper]. *The New York Times: World*.

Hirano, K., Imbens, G. W., & Ridder, G. (2003). Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score. *Econometrica*, *71*(4), 1161–1189.

Horowitz, M., & Reiter, D. (2001). When Does Aerial Bombing Work?: Quantitative Empirical Tests, 1917-1999. *Journal of Conflict Resolution*, *45*(2), 147–173.

Human Rights Watch. (2016, February). *Studying under fire. attacks on schools, military use of schools during the armed conflict in eastern ukraine*.

Imai, K., Kim, I. S., & Wang, E. H. (2021). Matching Methods for Causal Inference with Time-Series Cross-Sectional Data. *American Journal of Political Science*, *n/a*(n/a).

Jasper, J. M., & Poulsen, J. D. (1995). Recruiting strangers and friends: Moral shocks and social networks in animal rights and anti-nuclear protests*. *Social Problems*, *42*(4), 493–512.

Kalyvas, S. N. (2005). Warfare in civil wars. In I. Duyvesteyn & J. Ångstrom (Eds.), *Rethinking the nature of war* (pp. 88–108). Frank Cass.

Kalyvas, S. N. (2006). *The logic of violence in civil war*. Cambridge University Press.

Kalyvas, S. N., & Balcells, L. (2010). International system and technologies of rebellion: How the end of the cold war shaped internal conflict. *American Political Science Review*, *104*(3), 415–429.

Kalyvas, S. N., & Kocher, M. A. (2007). How "Free" is Free Riding in Civil Wars?: Violence, Insurgency, and the Collective Action Problem. *World Politics*, *59*(02), 177–216.

Kao, K., & Revkin, M. R. (2021). Retribution or reconciliation? post-conflict attitudes toward enemy collaborators. *American Journal of Political Science*.

Kocher, M. A., Pepinsky, T. B., & Kalyvas, S. N. (2011). Aerial Bombing and Counterinsurgency in the Vietnam War. *American Journal of Political Science*, *55*(2), 201–218.

Krcmaric, D. (2018). Varieties of civil war and mass killing: Reassessing the relationship between guerrilla warfare and civilian victimization [Publisher: SAGE Publications Ltd]. *Journal of Peace Research*, *55*(1), 18–31.

Krick, B., Petkun, J., & Revkin, M. (2023, October). *What determines military legitimacy? evidence from the battle for mosul in iraq* (Working Paper No. 402).

Lichtenheld, A. G. (2020). Explaining population displacement strategies in civil wars: A cross-national analysis [Publisher: Cambridge University Press]. *International Organization*, *74*(2), 253–294.

Lichtenheld, A. G., & Schon, J. (2021). The consequences of internal displacement on civil war violence: Evidence from syria. *Political Geography*, *86*, 102346.

Lubell, N., & Cohen, A. (2020). Strategic proportionality: Limitations on the use of force in modern armed conflicts. *International Law Studies*, *96*(1).

Lund, A. (2017, March 28). *Trapped: How northwestern Syria became a cage for hundreds of thousands of civilians*. IRIN. http://www.irinnews.org/analysis/2017/03/28/trapped-how-northwestern-syria-became-cage-hundreds-thousands-civilians

Lyall, J. (2009). Does Indiscriminate Violence Incite Insurgent Attacks? Evidence from Chechnya. *Journal of Conflict Resolution*, *53*(3), 331–362.

Lyall, J. (2017, September 3). *Bombing to Lose? Airpower, Civilian Casualties, and the Dynamics of Violence in Counterinsurgency Wars* (SSRN Scholarly Paper No. ID 2422170). Social Science Research Network. Rochester, NY.

Lyall, J., Blair, G., & Imai, K. (2013). Explaining Support for Combatants during Wartime: A Survey Experiment in Afghanistan. *American Political Science Review*, *107*(4), 679–705.

Lyall, J., Shiraito, Y., & Imai, K. (2015). Coethnic bias and wartime informing. *The Journal of Politics*, *77*(3), 833–848.

Malobisky, J., & Moeder, R. (2023, December 12). *Education wars: The destabilizing effect of violent extremist attacks on schools in africa* [New lines institute]. Retrieved December 12, 2023, from https://newlinesinstitute.org/state-resilience-fragility/education-wars-the-destabilizing-effect-of-violent-extremist-attacks-on-schools-in-africa/

Mason, T. D., & Krane, D. A. (1989). The political economy of death squads: Toward a theory of the impact of state-sanctioned terror. *International Studies Quarterly*, *33*(2), 175–198.

Mironova, V., Mrie, L., & Whitt, S. (2019). Risk tolerance during conflict: Evidence from aleppo, syria. *Journal of Peace Research*, *56*(6), 767–782.

Nedaa Post. (2022, November 6). *rad 'skary ḍ'yf 'la majzara kafr jālis yuthīr istīā' alsūrīīn*. . https://tinyurl.com/4wpk2s6y/

Newton, C., & Tucker, C. (2022). The Efficacy of Airpower in Counterinsurgency. *Security Studies*, *31*(2), 218–250.

Pape, R. A. (1996). *Bombing to win: Air power and coercion in war*. Cornell University Press.

Parkinson, S. E. (2022). *Beyond the lines: Social networks and palestinian militant organizations in wartime lebanon*. Cornell University Press.

Pearlman, W. (2016). Narratives of fear in syria. *Perspectives on Politics*, *14*(1), 21–37.

Pechenkina, A. O., Bausch, A. W., & Skinner, K. K. (2019). How do civilians attribute blame for state indiscriminate violence? *Journal of Peace Research*, *56*(4), 545–558.

Perugini, N., & Gordon, N. (2019). Between sovereignty and race: The bombardment of hospitals in the italo-ethiopian war and the colonial imprint of international law [Publisher: Pluto Journals]. *State Crime Journal*, *8*(1), 104–125.

Petersen, R. D. (2001). *Resistance and rebellion: Lessons from eastern europe*. Cambridge University Press.

Petersen, R. D. (2002). *Understanding ethnic violence: Fear, hatred, and resentment in twentieth-century Eastern Europe*. Cambridge University Press.

Petersen, R. D. (2017). Emotions as the residue of lived experience. *PS: Political Science & Politics*, *50*(4), 932–935.

Raleigh, C., Linke, A., Hegre, H., & Karlsen, J. (2010). Introducing ACLED: An Armed Conflict Location and Event Dataset, Special Data Feature. *Journal of Peace Research*, *47*(5), 651–660.

Roth, J., Sant'Anna, P. H. C., Bilinski, A., & Poe, J. (2023, January 9). *What's Trending in Difference-in-Differences? A Synthesis of the Recent Econometrics Literature*.

Safeguarding Health in Conflict Coalition. (2019). *Impunity Remains: Attacks on Health Care in 23 Countries in Conflict in 2018*. Safeguarding Health in Conflict Coalition.

SAMS. (2022, May). *A Heavy Price to Pay: Attacks on Healthcare Systems in Syria 2015-2021*. Syrian American Medical Society Foundation (SAMS).

SANA. (2016, October 14). *President al-Assad's interview given to Russia's Komsomolskaya Pravda newspaper-VIDEO*. Syrian Arab News Agency. https://sana.sy/en/?p=90442

Santora, M. (2023). How Ukraine's Power Grid Survived So Many Russian Bombings [newspaper]. *The New York Times: World*.

Savell, S. (2023, May). *How death outlives war: The reverberating impact of the post-9/11 wars on human health*.

Schelling, T. C. (1966). *Arms and influence*. Yale University Press.

Schubiger, L. I. (2021). State violence and wartime civilian agency: Evidence from peru. *The Journal of Politics*, *83*(4), 1383–1398.

Schubiger, L. I. (2023). One for all? state violence and insurgent cohesion. *International Organization*, *77*(1), 33–64.

Schumann, K., & Ross, M. (2010). The benefits, costs, and paradox of revenge. *Social and Personality Psychology Compass*, *4*(12), 1193–1205.

Sexton, R. (2016). Aid as a tool against insurgency: Evidence from contested and controlled territory in afghanistan. *American Political Science Review*, *110*(4), 731–749.

Shaheen, K. (2016). Airstrikes hit two Syrian hospitals, with Turkey condemning 'obvious war crime'. *The Guardian: World news*.

Shaheen, K. (2022, March 11). *Russia's Long History of Bombing Hospitals*. New Lines Magazine. https://newlinesmag.com/newsletter/russias-long-history-of-bombing-hospitals/

Shaver, A., & Shapiro, J. N. (2021). The effect of civilian casualties on wartime informing: Evidence from the iraq war. *Journal of Conflict Resolution*, *65*(7), 1337–1377.

Silverman, D. (2019). What shapes civilian beliefs about violent events? experimental evidence from pakistan. *Journal of Conflict Resolution*, *63*(6), 1460–1487.

Souleimanov, E. A., & Siroky, D. S. (2016). Random or Retributive?: Indiscriminate Violence in the Chechen Wars. *World Politics*, *68*(4), 677–712.

Sowers, J., Weinthal, E., & Zawahri, N. (2017). Targeting environmental infrastructures, international law, and civilians in the new Middle Eastern wars. *Security Dialogue*, *48*(5), 410–430.

Steele, A. (2009). Seeking Safety: Avoiding Displacement and Choosing Destinations in Civil Wars. *Journal of Peace Research*, *46*(3), 419–429.

Stenersen, A. (2020). Jihadism after the 'Caliphate': Towards a new typology. *British Journal of Middle Eastern Studies*, *47*(5), 774–793.

Stoll, D. (1993). *Between two armies in the Ixil towns of Guatemala*. Columbia University Press.

Straus, S. (2015, March 15). *Making and unmaking nations: War, leadership, and genocide in modern africa*. Cornell University Press.

Sundberg, R., & Melander, E. (2013). Introducing the UCDP Georeferenced Event Dataset. *Journal of Peace Research*, *50*(4), 523–532.

Thomas, W. (2006). Victory by duress: Civilian infrastructure as a target in air campaigns. *Security Studies*, *15*(1), 1–33.

Toft, M. D., & Zhukov, Y. M. (2015). Islamists and nationalists: Rebel motivation and counterinsurgency in russia's north caucasus. *American Political Science Review*, *109*(2), 222–238.

United Nations. (2016, May 3). *Security Council Adopts Resolution 2286 (2016), Strongly Condemning Attacks against Medical Facilities, Personnel in Conflict Situations*. Retrieved July 21, 2021, from https://www.un.org/press/en/2016/sc12347.doc.htm

Valentino, B., Huth, P., & Balch-Lindsay, D. (2004). "Draining the Sea": Mass Killing and Guerrilla Warfare. *International Organization*, *58*(2), 375–407.

Weidmann, N. B. (2015). On the accuracy of media-based conflict event data. *Journal of Conflict Resolution*, *59*(6), 1129–1149.

Wood, E. J. (2003). *Insurgent collective action and civil war in El Salvador*. Cambridge University Press.

Wood, E. J. (2008). The social processes of civil war: The wartime transformation of social networks. *Annual Review of Political Science*, *11*(1), 539–561.

Supporting Information: The bombing of hospitals and local violence dynamics in civil wars. Evidence from Syria (2017–2020)

A1 Intentionality of attacks

While Syria is one of many countries in which healthcare is subjected to violence in armed conflict, the frequency and extent of violations in the country has been unprecedented. As an expert put it, "rebel training camps were safer than hospitals. A doctor told me he switched locations 25 times in 2019. Every place he worked in was targeted."[1]

The intentionality of attacks on medical facilities can be established in several ways. First, on the legal level, the Syrian regime considers hospitals operating without its permission as illegal and by extension, legitimate targets. Already in 2012, the Syrian government introduced counter-terrorism laws that effectively criminalized the provision of health care to 'terrorists' – a label the regime has used for both protestors and armed insurgents (Jabbour & Fardousi, 2022, p. 409). Furthermore, the laws had the effect of criminalizing any medical facility operating without government permission. Requests for obtaining such approval for facilities in opposition territory were ignored, effectively making illegal all hospitals in these areas (Syrian Archive, 2017). Based on these laws, the Syrian government has considered hospitals operating without its permission as legitimate targets (Shaheen, 2016).

Second, and on a more technical level, the intentionality of attacks on medical facilities can also be deduced from the ways in which attacks occurred, including the locations and timings of the attacks. Pro-government forces carried out "repeated attacks on the same facilities; attacks on isolated facilities; attacks at the start of military campaigns to retake territory; double- or triple-tap attacks whereby a health facility is attacked again once rescuers gather to help victims after an initial attack;[2] and attacks on multiple facilities within the same geographical area and within a limited time period" (Jabbour & Fardousi, 2022, p. 411). Furthermore, the use of discriminate weapons (mortars, missiles, rockets, etc.) and the attack of facilities in isolated or sparsely populated areas away from other buildings also points to the intentionality of targeting (Briody et al., 2018, p. 4). There was no systematic difference in targeting between areas. As an activist working in the medical sector in Aleppo reported, "in Aleppo the hospitals were in the city, between the people. In Idlib they were sometimes far away from civilians and military points, even underground, but they were still bombed."[3] According to Dr. Munther al-Khalil, former head of the Idlib Health Directorate,

"in Southern Idlib (Jabal al-Zawiya), they [pro-government forces] destroyed all hospitals in 2019. We tried to establish a small hospital in a cave. After 3 hours they destroyed it. After that we established a very basic emergency medical point, they destroyed it after 4 hours. We understand that this is a red line, it is not allowed for us to establish any medical facility in Jabal al-Zawiya. In this area there are almost 200,000 people. Today, no emergency medical point is left there."[4]

[1] Dareen Khalifa, Internationl Crisis Group

[2] After a bombing by pro-government forces, rather than staying away, civilians in the area usually come to the site to offer their support. This made a second or even third attack so deadly (Dr. Walid Tamer; Ali al-Muostafa).

[3] Abd al-Fatah

[4] Dr. Munther al-Khalil

Another example that shows the intentionality of the targeting of medical facilities is the 2017 chemical attack in Khan Sheikhoun, which was most likely carried out by Syrian government forces (Ali Hage 2017). As Dr. Khalil who worked in the area at that time reported,

"in the night before the attack on Khan Sheikhoun, they bombed Maarat al-Numan hospital which is the biggest hospital in Southern Idlib and also another hospital in Maarat Hurma. In the morning they attacked Khan Sheikhoun. And they watched the ambulance cars' movements. At that point we had a small hospital in a mountain near Khan Sheikhoun for emergency services, and next to this hospital there was a civil defense center. After two or three hours they destroyed this hospital."[5]

With this, pro-government forces denied victims from the chemical attack lifesaving care, which likely led to more fatalities.

Already in 2013, the United Nations Independent Commission of Inquiry, which was created to investigate alleged war crimes in Syria, found that attacks on hospitals are used systemically by the Assad regime as a weapon of war (Syrian Archive, 2017). In a report in 2018, the commission repeats this assessment: "The lack of warnings and the absence of military objectives within and near hospitals demonstrate that pro-Government forces deliberately target medical infrastructure as part of their war strategy, which constitutes the war crime of intentionally targeting protected objects" (Independent International Commission of Inquiry on the Syrian Arab Republic, 2018, p. 16).

Third, intentionality can also be established based on a voluntary humanitarian deconfliction mechanism the UN Office for the Coordination of Humanitarian Affairs (OCHA) has established in September 2014 to identify and protect to the best extent possible humanitarian staff, facilities, and sites. OCHA informs the Coalition Forces, the Republic of Turkey and the Russian Federation, and the United States of either humanitarian static locations or humanitarian movements (OCHA, 2018). As several doctors and others working in the administration of the health sector reported, medical actors were pushed to share the coordinates of medical facilities with OCHA, and donors threatened to stop their support for facilities that would not comply. Most facilities decided to participate in this mechanism, also because they hoped it would better protect them.[6]

Quite to the contrary of what the mechanism aimed at achieving, there are numerous reports that suggest that Russia has used the information shared with it to attack medical facilities, either by bombing the sites itself or sharing information with the Syrian Armed Forces (Hill & Hurst, 2019; Lund, 2019). In fact, at least 69 attacks on no-strike sites have been recorded by local sources by the end of 2019 since the Russian military intervention began in October 2015, most of them likely committed by Russian or Syrian forces (Hill & Hurst, 2019). According to Dr. Khalil, all locations in South Idlib that were deconflicted were targeted.[7] Several facilities on the deconfliction list were also attacked more than once. Others were attacked both before

[5] al-Khalil
[6] al-Khalil
[7] al-Khalil

and after they were put on the list, suggesting that their clear protected status did not prevent the continuation of attacks. In addition, several facilities that were targeted were well known health facilities, even before the conflict began (SAMS, 2022, pp. 7–8).

Probably in reaction to the condemnations from the international community, the Syrian and Russian governments have claimed that medical facilities in opposition territories have been used for military purposes, which could, in principle, make them liable to attack. In July 2019, the Syrian government stated that "all health-care facilities in Idlib Governorate had been overrun by terrorist groups, that they no longer served their original purpose, that they could not be considered hospitals, health-care centres or even civilian objects under international humanitarian law and that they had been converted by armed terrorist groups into military posts, prisons, arms depots, workshops for manufacturing weapons and explosives, sharia courts and launch pads from which to fire shells and rockets at residential districts and safe areas" (Guterres, 2020, pp. 9–10).

The government of Syria also noted that they have informed the UN of "medical facilities that have been decommissioned and are being used by terrorists, and that therefore no longer enjoy their former status" (SAMS, 2022, p. 47). In June 2020, Russia announced that it would withdraw from the humanitarian deconfliction mechanism, claiming that some of the listed facilities were used by terrorists. According to Russian UN Envoy, Vasily Nebenza, "our probes repeatedly demonstrated that some of the deconfliction facilities were actually used as terrorists' headquarters, so they could not be granted humanitarian status" (cited in (2020). These responses show that the Syrian and Russian governments had a clear understanding of their legal obligations. However, they have not provided any evidence for their claims, while NGOs and medical personnel have collected systematic evidence of the sole use of facilities for providing medical care (SAMS, 2022, pp. 7–8). Furthermore, "many of these facilities were supported by institutional donors, or by the Syria humanitarian pool fund, operated by OCHA, which provides strong credibility for their case as non-military entities" (SAMS, 2022, p. 36).

The correct use of medical facilities and the lack of infiltration by armed actors is supported in the interviews we conducted with medical actors and local activists. Although armed groups occasionally tried to interfere in this sector, they were pushed back immediately both by medical personnel and local and international NGOs.[8] As a doctor recounted, "there were some individual interferences which we stopped collectively. […] We did not allow any faction to have a presence close to a hospital. Each hospital had its own guards that belonged to the hospital, not the factions."[9] As the CEO of the NGO Hand in Hand for Aid and Development said, "in our facilities, no guns are allowed. The armed groups respect that. There were only individual interferences, for instance when someone was unsatisfied with the treatment received, which we could solve quickly by talking to the leadership of the groups."[10] Some

[8] Fadi Aldairi
[9] Tamer
[10] Aldairi

NGOs even decided to put CCTVs at the entrance of their facilities in order to document and proof that no armed actor entered.[11]

Another doctor and former CEO of the Union of Medical Care and Relief Organizations noted that the armed groups tried to impose their rule several times, but the strong unity and cooperation between the facilities and the NGOs prevented that. "We would for instance threaten to close our facilities, which was a big issue for the factions, because they need to justify themselves in front of the local society why the hospital has closed its doors."[12] In one occasion, HTS tried to impose a religious dress code on the female medical workers in a facility in Idlib. Immediately, the management of the hospital ceased its work, just continuing emergency services. "We told people that we stopped because HTS entered our hospital and started to interfere in our work. After one or two hours, HTS contacted us, apologizing and saying that it was just an individual action."[13] Next to the pressure from the local community, the NGOs, and the medical workers, the armed actors and their families themselves were also dependent on these services. So it was also in their interest to keep the facilities running unobstructed.[14]

To conclude, there is credible evidence showing that the targeting of medical facilities by pro-government forces was intentional and deliberate. There is no evidence supporting the claim by Syrian and Russian forces that hospitals were transformed into military objectives which could, in principle, make them liable to attack.

[11] Aldairi
[12] Dr. Zedoun al-Zoabi
[13] al-Khalil
[14] al-Zoabi

A2 Early warning system (Sentry)

In this section, we give further information on the early warning system developed by the company Hala Systems together with volunteers. Sentry gathered information about takeoffs and flight directions from observers on the ground, open-source intelligence, and sensors. An algorithm then modeled potential targets for airstrikes.[15] Based on its predictions, Sentry sent warnings to civilians via sirens, social media messengers (Telegram and temporarily Facebook), and radio. In 2018, it also started to equip medical facilities, schools, and protection centers with warning lights.[16] Important for our analysis, the information collected merely allowed Sentry to predict where a plane flies but not whether and where it would target.[17] As an activist and volunteer working in the medical field in Aleppo recounted, based on the warning, "they could only say that there is a plane towards a specific town. But there were always planes on the sky. That there were planes did not mean that there would be shelling."[18]

[15] Dan Henebery, Hala Systems

[16] Henebery, Razan Alam, Hala Systems

[17] In most cases, more precise information on the target was not revealed. Only in very few cases did spies receive information that a specific facility will be targeted. But even if medical actors received this very specific information, the reaction would have to be prompt. Medical actors usually only had a few minutes to evacuate the facility (Fadi al-Dairi; Nabil Sheikh Omar). Furthermore, these warnings were not from an official source, so it was not possible to know whether this information was reliable or not (Ali al-Muostafa; al-Khalil). As a doctor working in the hospital of Kafr Zita in Northern Hama recounted, once they evacuated the hospital because there was a warning that it will be bombed, which likely came from Turkey. But this was the only one time he received such a warning, although he had worked in the medical sector in opposition territories since 2011 (Tamer).

[18] Abd al-Fatah

A3 Quantitative Analysis

A3.1 Treatment Variable – Sources and Coding Remarks

For our independent variable, we used attack data from the Syrian Archive and Physicians for Human Rights (PHR). We rely on these data to determine relevant information for each strike such as the date, the location, and the alleged perpetrator.

The data collections by the Syrian Archive and PHR followed best practices in the field (e.g., using open source-information, triangulation with additional sources, and corroboration with satellite images and partners in-country) to ensure that the resulting data set is as reliable as possible.[19]

The databases by PHR and the Syrian Archive only contain incidents that could be independently verified. Although the number of attacks on medical facilities included in our analyses is staggering, it thus likely under-represents the true extent to which medical facilities have been targeted since 2011.

The datasets by the Syrian Archive and PHR only register the name of the shelled facility (often including its location) and the corresponding first administrative division (governorate), PHR in addition also lists the location. Therefore, in order to determine the relevant administrative level (district), next to considering the name of the hospital, we checked other relevant sources such as videos and reports, as well as the official Facebook pages of the facilities.

[19] For more detailed information on the methodology underlying both data collections, see: https://medical.syrianarchive.org/methodology and https://syriamap.phr.org/#/en/methodology.

A3.2 Coding Remarks - ACLED

For our dependent variable, we rely on the Armed Conflict Location & Event Data Project (ACLED).

A3.2.1 Coding of Military Activities

The following actors in ACLED were used to identify military activities involving insurgent groups and pro-regime forces:

Insurgent Groups:

- Unidentified Armed Group (Syria), Opposition Rebels (Syria), Suquor al Sham, Jaysh al Izza, Islamist Militia (Syria), Malhama Tactical, Jabhat Fateh al Sham, Islamist Rebels (Syria), JSH: Free Syrian Army, AAS: Ahrar al Sham, Army of Mujahideen, HNDZ: Nour al Din al Zinki Movement, HTS: Hayat Tahrir al Sham, JWS: Syrian National Army, Al Sham Corps, Jaysh al Nasr, Free Idlib Army, Al Wosta Division, Muntasr Billah Battalion, FaR: Al Rahman Corps, JaS: Levant Front, Abu Amara Brigade, 23rd Division, JaT: Army of Revolutionaries, 13th Division, JaF: Army of Conquest, Homs Operation Room, Al Shamal Brigade, Hamza Bin Abdul Muttalib, Liwa al Hurriyah al Islami, JaN: Elite Army, 1st Coastal Division, Jaysh Osama, Jaysh al Thani, FSA Fighters Brigade, Repel the Invaders Operation Room, JTS: Syria Liberation Front, Hamza Brigade, 4th Legion, Daraya Unit, National Front for the Liberation of Syria, Abu Amara Brigade: Special Task Brigade, Jaysh al Ahrar, Kataib Nusra Dar'a, JTW: National Liberation Front, Ma'arrat An Nu'man Military Council, Jaysh al Islam, Al Fath Al Mubeen Operation Room, Faylaq al Majd, JTS: Syrian Revolutionaries Front, Liwa al Haqq (Idleb), Ajnad al Sham Islamic Union, Islamic Freedom Brigade, Shuhada al Islam, Ajnad al Sham, LaF: Battalion of Conquest, Farouq Battalions, Sultan Murad Division, Hamza Division - Aleppo, 1st Regiment, Jaysh al Tawhid, Ahrar al Sharqiyah, Idlib Martyrs' Brigade, Jund Badr 313, 3rd Corps, 2nd Coastal Division, Jaysh al Nukhba, Jaysh Al Ahfad, Thuwar al Sham Battalion, JFS: Al Nusra Front (Muhammad Brigade), JWS: Syrian National Army- 1st Brigade, Saraqeb Revolutionary Front, Former Operation Olive Branch

Pro-regime Forces:

- Military Forces of Syria (2000-), Military Forces of Russia (2000-), Hezbollah, Militia (Pro-Government), Military Forces of Iran (1989-), QDW: National Defence Forces, Military Forces of Syria (2000-) Syrian Arab Air Force, Allied Syrian and/or Russian Forces, LaQ: Quds Brigade, Military Forces of Syria (2000-) Air Force Intelligence Directorate, QSF: Qalamoon Shield Forces, QaL: Galilee Forces, Military Forces of Syria (2000-) 11th Armored Division, Militia (Pro-Iran), Popular Committees, Police Forces of Syria (2000-) State Security, Fatemiyoun Brigade, Military Forces of Iran (1989-) Islamic Revolutionary Guard Corps, Military Forces of Syria (2000-) 4th Armored Division, Military Forces

of Syria (2000-) 5th Assault Corps, Military Forces of Syria (2000-) Tiger Paramilitary Forces (Qawat al Nimr), Military Forces of Syria (2000-) Military Intelligence, Military Forces of Russia (2000-) Special Forces, Military Forces of Syria (2000-) 25th Armored Division, Police Forces of Syria (2000-), Military Forces of Syria (2000-) 8th Division, Qaterji Militia, Liwa al Baqir, Military Forces of Syria (2000-) Prison Guards, Liwa al Mukhtar Al Thaqafi, Al Bustan Association, Military Forces of Syria (2000-) Syrian Republican Guard, Military Forces of Russia (2000-) Military Police, Liwa al Safira, Military Forces of Syria (2000-) 3rd Armored Division

The following groups in ACLED were used to identify military activities involving global Islamist groups:

- Islamic State (Syria), TIP: Turkistan Islamic Party, Islamist Militia (International), Al Qaeda, Jund al Aqsa, Liwa al Aqsa, Ansar al Islam, AAK: Ajnad al Kavkaz, Hurras al Deen, Duat al Jihad Center, Ansar al Din Front (Syria), Wa Harredh al Moa'mineen Operation Room, Abu Bakr as-Siddiq Army, Ansar al Tawhid, Jabhat Ansar al Islam, Fathbatou Operation Room, JMA: Army of Emigrants and Supporters

We exclude external state military forces such as Turkish and American forces.

A3.2.2 Considered (Sub-)Event Types

We included all event and sub-event types that clearly referred to military activities. More concretely, the following event and sub-event types were part of the analysis:

- Battles: "Armed clash", "Government regains territory", 'Non-state actor overtakes territory'
- Explosions/Remote violence: "Chemical weapons", "Air/drone strike", "Suicide bomb", "Shelling/artillery/missile attack", "Remote explosive/landmine/IED", "Grenade"
- Strategic developments: "disrupted weapons use"
- Violence against civilians[20]

All other events that did not involve combat activity such as "Riots", "Protests", or "Strategic developments" (with the exception of "Disrupted weapons use") were not considered.

[20] Note that violence against civilians does not include airstrikes by regime forces, only "direct" violence against civilians for instance by gun fire.

A3.3 Summary Statistics

Table A1: Summary Statistics - Main Analysis

Statistic	N	Mean	St. Dev.	Min	Max
Medical Facility Attack	3,780	0.022	0.148	0	1
Fatalities Rebel-Regime Fights	3,780	3.445	16.187	0	333
Regime Attacks Against Civilians/Infrastructure	3,780	1.178	3.361	0	43
Collateral Damage - Hospitals	3,780	0.034	0.263	0	8
Fatalities Global Islamist Fights	3,780	0.832	6.315	0	123
Medical Facility Attacks in Neighbouring Unit	3,780	0.171	0.653	0	9

A3.4 Robustness Checks

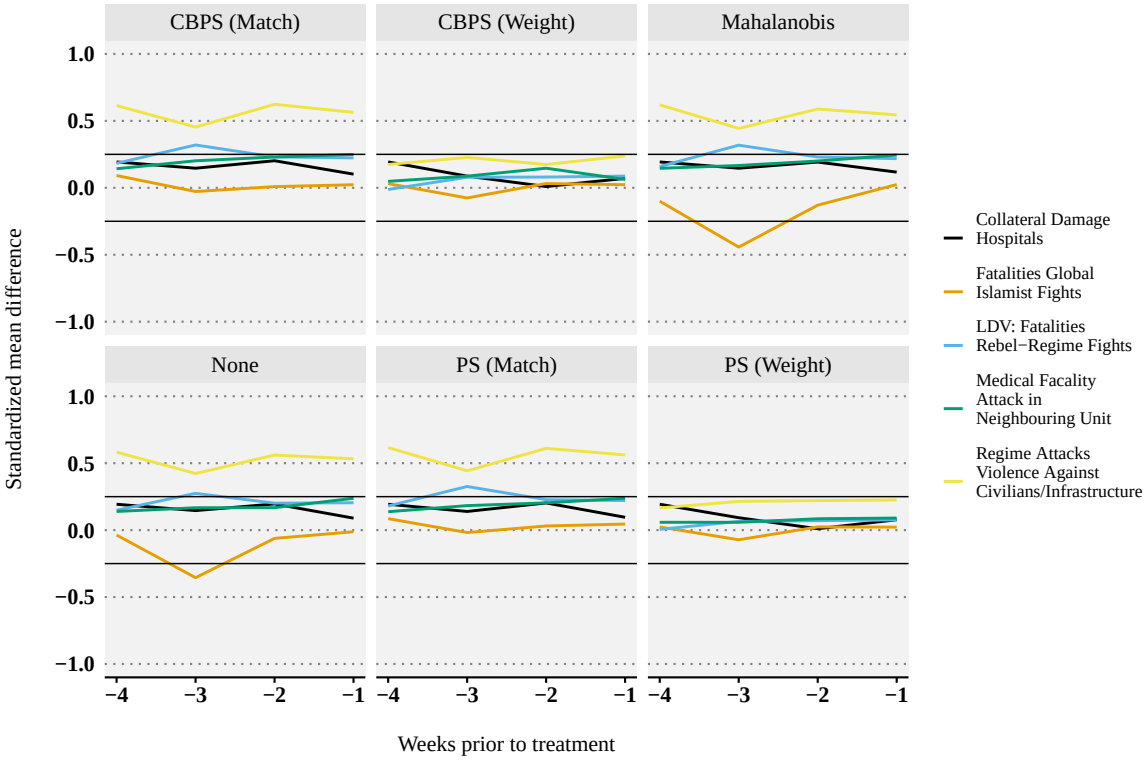

Figure A1: Pre-Treatment Trends and Covariate Balances Across Six Refinement Methods
The graphics show the standardized mean differences for five covariates over a pre-treatment period of four weeks. CBPS = covariate balanced propensity scores, PS = propensity scores.

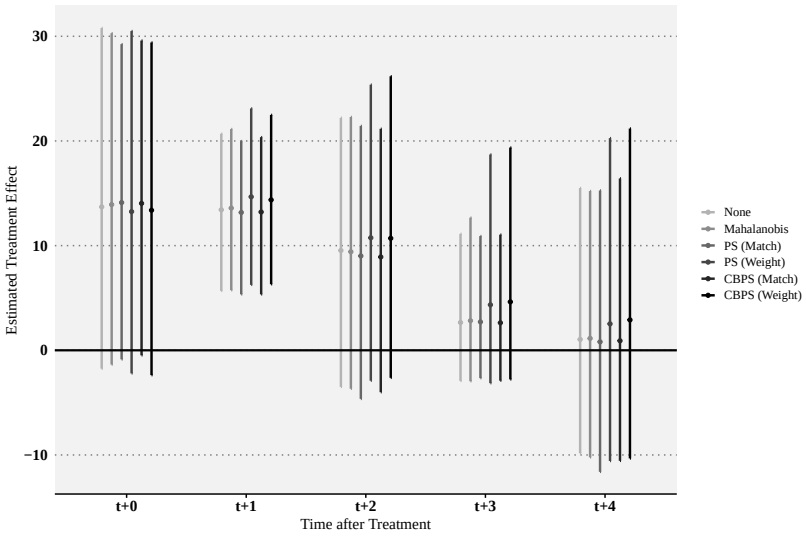

Figure A2: Sensitivity Across Six Refinement Methods

Each point/error bar shows results based on different refinement methods. Estimates are based on a matching approach adjusting for treatment and covariate histories prior to the treatment. Vertical bars are 95% asymptotic confidence intervals based on block bootstrapping procedure with 1000 iterations.

Table A2: Alternative Dependent Variable

F	**Fatalities (log)**	**Fights**
t+0	0.434*	5.505*
	(0.179)	(2.477)
t+1	0.673*	5.402*
	(0.223)	(3.039)
t+2	0.481	4.329*
	(0.351)	(1.99)
t+3	0.157	1.399
	(0.25)	(1.752)
t+4	−0.053	1.286
	(0.327)	(1.746)
Geographic Units	18	18
Time Units	210	210
Observations	3780	3780

Note: $^*p < 0.05$

Model specification based on matching approach with four lags and propensity score weights. Covariates: lagged DV, regime attacks against civilians and civilian infrastructure, (fatalities in) fights of globalist Islamist groups, attacks in neighboring district/governorate. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

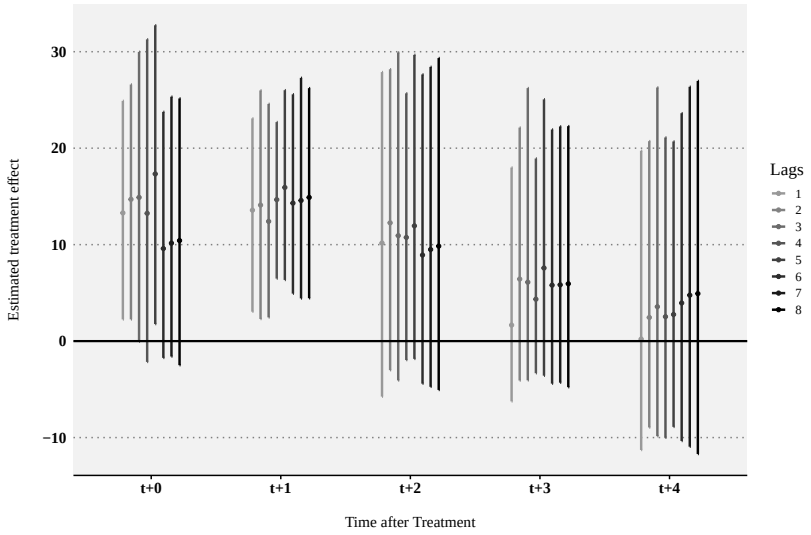

Figure A3: Sensitivity Test – Number of Lags

Each point/error bar shows results based on different numbers of lags ranging from one to eight. Estimates are based on a matching approach adjusting for treatment and covariate histories prior to the treatment. Vertical bars are 95% asymptotic confidence intervals based on a block boot-strapping procedure with 1000 iterations.

Table A3: Placebo Outcomes

F	**Global Islamist Groups**	**Kurdish Groups**	**Civilian Fatalities**
t+0	−0.971	−0.113*	0.085
	(0.914)	(0.083)	(1.278)
t+1	−0.525	−0.107*	−0.329
	(0.821)	(0.067)	(1.129)
t+2	0.503	−0.024	0.762
	(0.611)	(0.09)	(1.618)
t+3	−1.298*	−0.262*	−0.688
	(0.703)	(0.167)	(0.921)
t+4	−0.719	−0.212*	−0.022
	(0.492)	(0.163)	(1.189)
Geographic Units	18	18	18
Time Units	210	210	210
Observations	3780	3780	3780

Note: $^*p < 0.05$

Model specification based on matching approach with four lags and propensity score weights. Covariates: lagged DV, fatalities in fights of regime forces with rebel involvement, regime attacks against civilians and civilian infrastructure, fatalities in fights of globalist Islamist groups, attacks in neighboring district/governorate. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

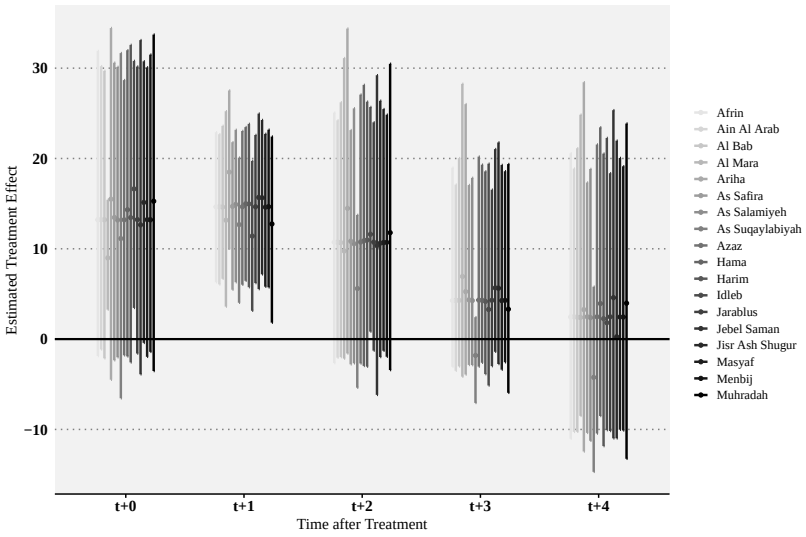

Figure A4: Jackknife-Like Test

Each point/error bar shows results when each of the 18 districts is excluded from the analysis. Estimates are based on a matching approach adjusting for treatment and covariate histories prior to the treatment. Vertical bars are 95% asymptotic confidence intervals based on a block bootstrapping procedure with 1000 iterations.

Table A4: Alternative Estimations Based on GED/UCDP Data

F	Districts Weeks	Districts Weeks Treated Units	Grid Weeks	Radius Weeks	Subdistricts Weeks	Districts Days
t+0	20.338	20.141	21.049	6.794	10.515*	3.194
	(13.665)	(13.461)	(11.409)	(6.68)	(3.676)	(2.75)
t+1	18.852*	18.796*	33.647*	13.861	8.392*	2.854*
	(7.18)	(7.652)	(17.218)	(10.673)	(4.186)	(0.872)
t+2	10.851	10.044	3.949	−2.554	5.618*	4.523*
	(8.084)	(8.196)	(20.317)	(10.854)	(2.854)	(2.002)
t+3	2.673	3.065	3.845	−0.748	1.522	5.258*
	(5.72)	(5.984)	(11.571)	(9.783)	(2.5)	(1.881)
t+4	2.303	2.071	6.764	−3.629	1.985	3.747
	(8.09)	(7.912)	(22.638)	(14.225)	(3.774)	(2.425)
t+5						3.506
						(2.454)
t+6						2.129
						(3.088)
t+7						2.87
						(2.331)
t+8						1.931
						(1.833)
t+9						0.645
						(1.592)
t+10						2.753
						(1.802)
t+11						1.22
						(1.424)
t+12						−0.639
						(1.443)
t+13						2.233
						(1.792)
t+14						−0.667
						(1.209)
Geographical Units	18	9	24	17	88	18
Time Units	210	210	210	210	210	1461
Observations	3780	1890	5040	3570	18480	26298

Note: $^*p < 0.05$

Model specification based on matching approach with four (Models 1-4)/fourteen (Model 5) lags and propensity score weights. Covariates: lagged DV, regime attacks against civilians and civilian infrastructure, fatalities in fights of globalist Islamist groups, attacks in neighboring district/governorate. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

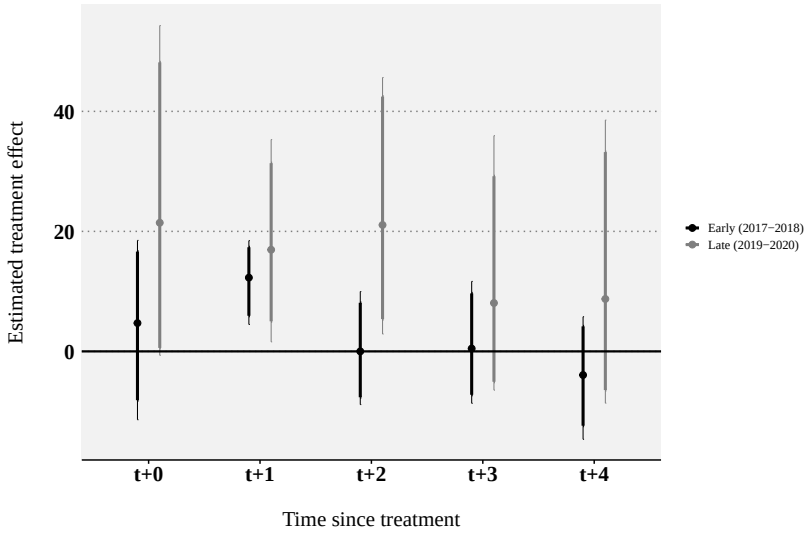

Figure A5: The Effect of the Targeting of Medical Facilities on Fighting Fatalities Conditional on the Time Period

Estimates are based on a matching approach adjusting for treatment and covariate histories prior to the treatment. Vertical bars are 95% asymptotic confidence intervals based on a block bootstrapping procedure with 1000 iterations.

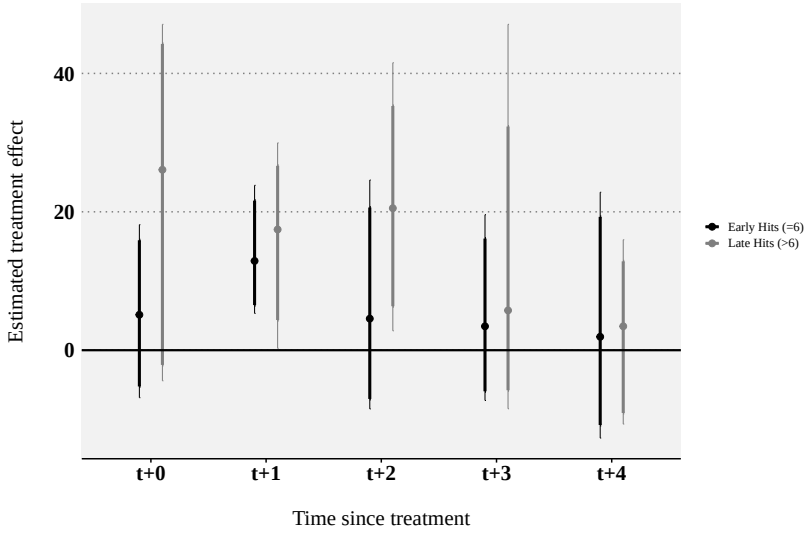

Figure A6: The Effect of the Targeting of Medical Facilities on Fighting Fatalities Conditional on Frequency of Attacks

The moderator variable distinguishes between "early" and "late" attacks. Cut-off point is the median number of the cumulative sum of the attacks (6). Estimates are based on a matching approach adjusting for treatment and covariate histories prior to the treatment. Vertical bars are 95% asymptotic confidence intervals based on a block bootstrapping procedure with 1000 iterations.

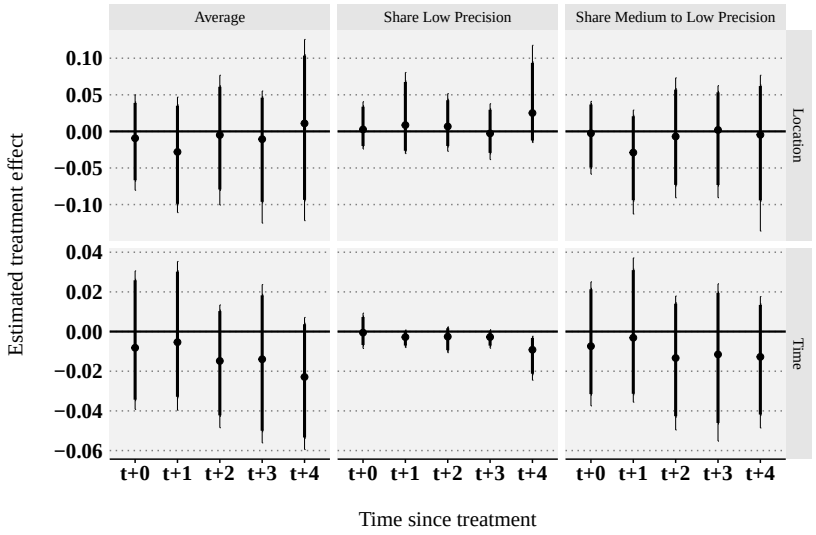

Figure A7: Effect of the Targeting of Medical Facilities on ACLED Reporting Quality

ACLED provides information on the accuracy of the location and the date of military activities. These variables range from "1" (highest precision) to "3" (lowest precision). The first column in the plots above uses the average of these precision codes across military activities as the dependen varbiale. The second column utilizes the proportion of events with precision code "3", while the last column employs the percentage of events associated with precision codes "2" and "3." Estimates are based on a matching approach adjusting for treatment and covariate histories prior to the treatment. Vertical bars are 95% asymptotic confidence intervals based on a block bootstrapping procedure with 1000 iterations.

A3.5 Alternative Geographic Units

In Table 1 in the main text, we presented alternative geographic units to estimate the treatment effect of attacks on medical facilities on subsequent violence dynamics. Our main approach (Figure 4) focused on treatment effects within each of the 18 Northwestern Syrian districts. This came with the strong assumption that rebel groups' responses to hospital bombings took place within pre-defined district limits. To relax this assumption and investigate the robustness of our results, we redefined our units of analysis. Models 1, 2, and 5 in Table 1 continued to focus on administrative units at the district (Figure 2) and subdistrict level (Figure A8, right plot).

For model 3, 24 equally sized quadratic grids were created using the `st_make_grid` function provided by the R-package `sf`. Each geographic has a size of about 2,500 square kilometers (965 square miles), i.e. an area of 50x50 kilometers (31x31 miles). The corresponding grids can be seen in Figure A8 (left plot). Note that some of the grid cover only a small part of the area under observation, which will result in few or no military activities and medical facility attacks documented for the corresponding geographic unit. Nevertheless, it is important to keep in mind that the matching and weighting approach utilized automatically discounts these units in the analyses.

For model 4, we have counted all hospital bombings and fighting activities within an 18 kilometers (11.2 miles) radius of each of the 18 district capitals. Figure A8 (center plot) shows the corresponding capitals and their "treatment areas".[21] As can be seen, this approach comes with two disadvantages. On the one hand, 31 medical facility attacks remained unconsidered since they occurred too far away from each of the district capitals. On the other hand, six hospital bombings fall within the treatment areas of two distinct cities. Obviously, we are not able to fix one shortcoming without reinforcing the other, i.e, a larger radius would allow us to include more bombardments, but would also result in a higher number of 'double treatments', and vice versa.

[21] The capitals of Idleb and Ariha, located just 14 km apart, were considered a joint capital for the purpose of analysis. The midpoint between their centroids served as the reference point for the corresponding analyses.

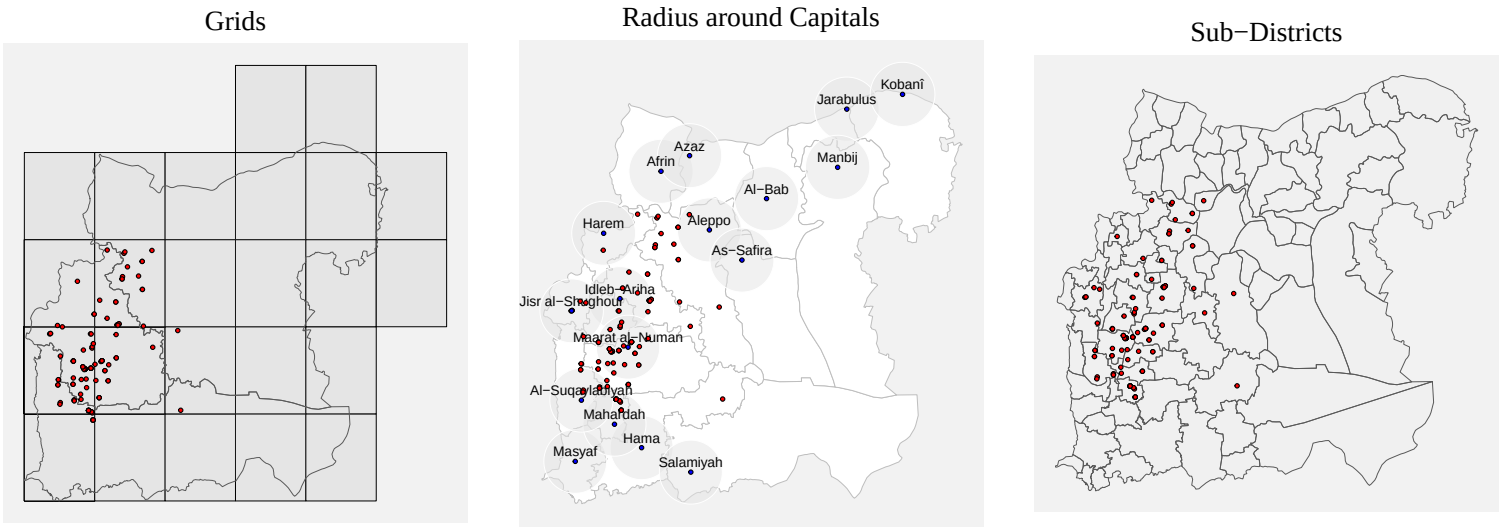

Figure A8: Alternative Geographic Units – Spatial Distribution of Attacks On Medical Facilities

A3.6 Hospital Attacks and Rebels' Responses - Distances to Attack Sites

Figure A9 supports the intuition that insurgents' military responses to attacks on medical centers did not only take place in the immediate vicinities of the targeted facilities. Both plots show the number of fatalities of insurgent-initiated fights (see Table 2) within a 14-day window after each attack. In the upper plot, each attack on a medical facility is located at the center of the plot (x: 0; y: 0). The grey points give all fighting activities and the corresponding number of fatalities within 50 kilometer (31.07 miles) radius. More informatively, the bottom plot gives the number of fatalities per square kilometer within a specified distance to the corresponding medical facility attack. The figure indicates that this number was highest within a distance between 10 and 15 kilometers (6.2 to 9.3 miles). However, the plot also shows that the number remained relatively consistent up to a distance of 25 kilometers (15.5 miles), demonstrating that significant fighting activities occurred in locations farther from the attack sites. Considering that most North-Western Syrian subdistricts encompass an area of less than 400 square kilometers (154 square miles), our analyses primarily concentrate on the district level.

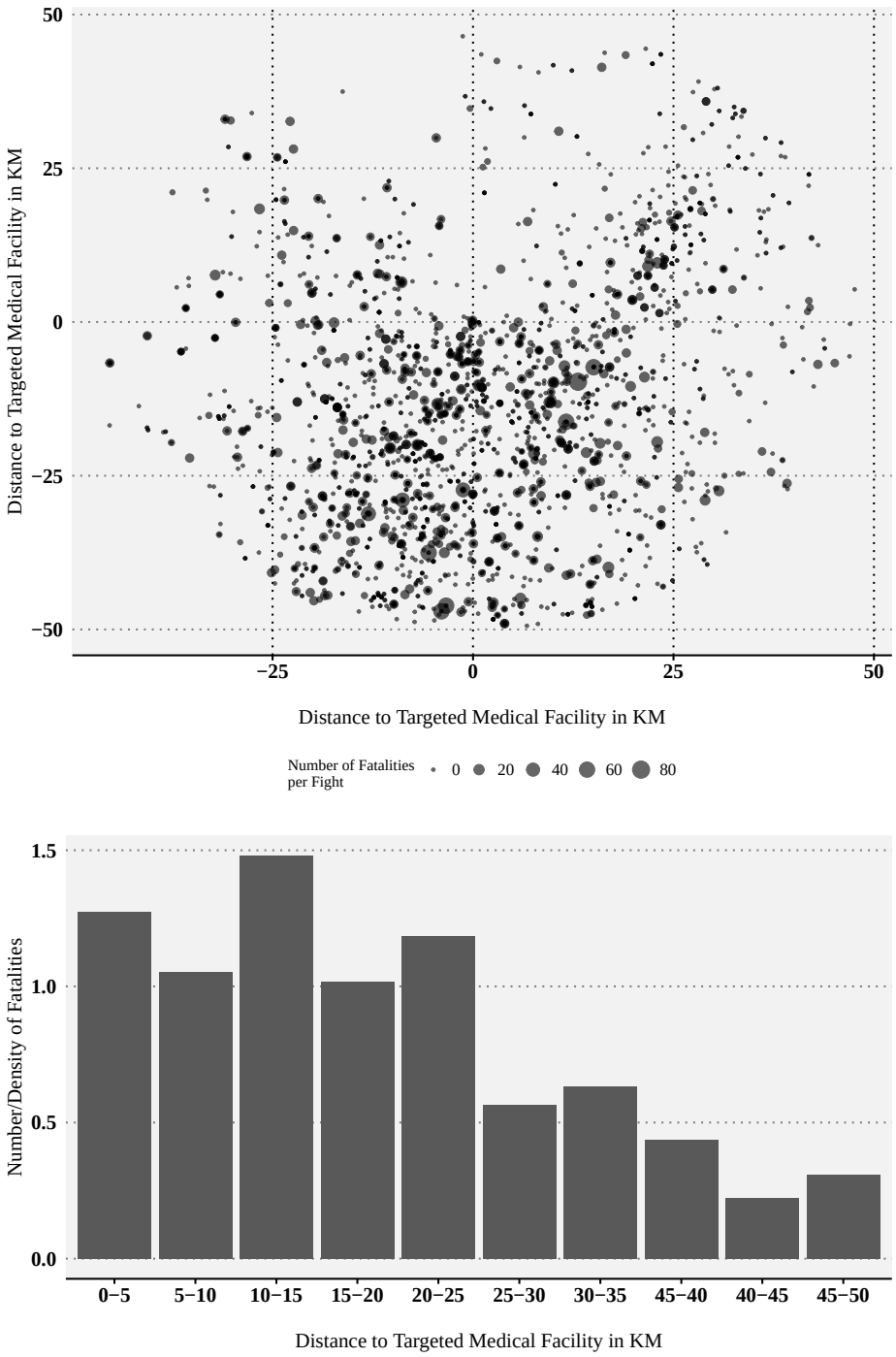

Figure A9: Insurgent-Initiated Combat Activites and Distances to Attack Sites

The upper plot shows the spatial distribution of fighting activities initiated by rebel groups within a 14-day window after each attack on a medical facility. Each attack is located at the center of the plot.

The bottom plot shows the total number of fatalities per square kilometer of all attacks on medical facilities within a 14-day window grouped by their distance to the medical center.

A3.7 Initiation of Military Clashes

We manually coded which actor initiated an event by relying on sub-event types and accompanying notes provided by ACLED. Table A5 lists the distribution of the identified cases across the sub-event types as classified in ACLED.

We proceeded in two steps. First, we classified all military activities categorized as "Armed clashes", "Government regains territory" or "Non-state actor overtakes territory" by ACLED as non-identifiable as the corresponding information did not allow to clearly determine the initiator of the military activity. An exemplary note reads as follows:

> Clashes broke out in Al-Mallah between regime forces backed by allied militias and rebel forces backed by Islamist militias. Regime forces also shelled the area. No fatalities were reported. (2017-01-17, Data-ID: 8354750)

Second, we manually coded all fighting activities categorized as "Air/drone strike", "Disrupted weapons use", "Remote explosive/landmine/IED", "Shelling/artillery/missile attack", and "Suicide bomb". For that purpose we relied on additional information provided by ACLED in the "notes" column. A typical event coded as insurgent-initated reads as follows:

> Al Wosta Division fired a missile killing 8 fighters with government and allied militia forces in Zalaqit. (2017-05-12, Data-ID: 8343909)

The following exemplary entry was coded as a regime-initiated fight:

> On 11 January 2017, 3 fighters of Liwa al Haqq were killed in a Russian airstrike on Teftnaz town in Idleb countryside. 3 fatalities. (2017-01-11, Data-ID: 9198132)

A fourth group of entries was classified as "Time Unclear" based on the sub-event type "Remote explosive/landmine/IED". While these events were initiated by insurgents, especially with regard to landmines it is rarely possible to determine exactly when they were placed and to what extent this placement occurred after an attack against a medical facility. For that reason, we do no consider them part of insurgent-initiated attacks. However, the results are robust to including this category (Table A6).

Although the main interest of our study is whether insurgent-initiated fighting activities increased as a consequence of attacks against medical facilities, it is evident from Table A5 that the number of regime-initiated fights is comparatively low. This is due to the likely fact that many regime-initiated fights were classified as "Armed Clashes" or "Government regains territory". With regard to the second category, we run additional models where we consider the event types "Government regains territory" as regime initiated and "Non-state actor overtakes territory" as insurgent-initiated (Table A7). Again, we only find statistically significant ATTs for the group of insurgent-initiated fights.

To further validate our findings, we assessed the sensitivity of the results to variations in the reported number of fatalities. First, we employed the logarithm of the fatality numbers

(Table A8), and second, we focused on the overall number of violent events rather than the associated fatalities (Table A9). Both models affirm the earlier-reported results: there is a statistically significant and substantial increase in insurgent-initiated military activities one week after hospitals are targeted. In the case of regime-initiated activities, a significant effect is observed only in the model examining the number of violent events rather than their fatalities. However, this effect surfaces two weeks after the treatment and may potentially be a response to escalating insurgent activities. Overall, these tests enhance the credibility of our findings, indicating that insurgents, in particular, intensified their military efforts in response to attacks on medical facilities.

Table A5: Initiation of Military Activities by ACLED Subevent Type

Subevent Type	Initiator Unclear	Time Unclear	Insurgents	Regime
Air/drone strike	0	0	9	184
Armed clash	2560	0	0	0
Disrupted weapons use	0	0	12	14
Government regains territory	844	0	0	0
Non-state actor overtakes territory	198	0	0	0
Remote explosive/landmine/IED	0	92	0	0
Shelling/artillery/missile attack	0	0	1604	166
Suicide bomb	0	0	6	0

Table A6: Heterogeneous Treatment Effects - with Sub-Event Type "Remote explosive/landmine/IED"

F	**Insurgent-Initiated Fights**
t+0	0.484
	(0.818)
t+1	2.082*
	(1.188)
t+2	0.548
	(0.516)
t+3	−0.519
	(0.601)
t+4	0.391
	(0.541)
Geographic Units	18
Time Units	210
Observations	3780

Note: $^{*}p < 0.05$

Model specification based on matching approach with four lags and propensity score weights. Covariates: fatalities in insurgent-initiated fights, in regime-initiated fights, in fights whose initiator cannot be determined, regime attacks against civilians and civilian infrastructure, in fights of globalist Islamist groups, and attacks in neighboring district. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

Table A7: Heterogeneous Treatment Effects - with Territory Gains

F	Insurgent-Initiated Fights	Regime-Initiated Fights	Initiation unidentified
t+0	0.126	4.291	6.2
	(1.946)	(4.038)	(3.583)
t+1	3.709*	4.032*	5.745*
	(1.848)	(2.062)	(1.597)
t+2	1.204	3.356	3.446
	(1.121)	(2.931)	(4.374)
t+3	2.052	−1.352	2.525
	(1.336)	(1.462)	(3.601)
t+4	0.149	−3.614	1.939
	(1.775)	(3.962)	(4.105)
Geographic Units	18	18	18
Time Units	210	210	210
Observations	3780	3780	3780

Note: $^*p < 0.05$

Model specification based on matching approach with four lags and propensity score weights. Covariates: fatalities in insurgent-initiated fights, in regime-initiated fights, in fights whose initiator cannot be determined, in fights of globalist Islamist groups, and attacks in neighboring district. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

Table A8: Heterogeneous Treatment Effects - Log of Fatality Numbers

F	Insurgent-Initiated Fights	Regime-Initiated Fights	Initiation unidentified
t+0	0.111	1.26	0.262
	(0.095)	(1.085)	(0.198)
t+1	0.331*	1.201	0.522*
	(0.151)	(1.23)	(0.24)
t+2	0.121	−0.333	0.382
	(0.087)	(0.361)	(0.335)
t+3	−0.115	1.187	0.088
	(0.118)	(1.1)	(0.338)
t+4	0.092	−0.478	−0.113
	(0.095)	(0.368)	(0.398)
Geographic Units	18	18	18
Time Units	210	210	210
Observations	3780	3780	3780

Note: $^*p < 0.05$

Model specification based on matching approach with four lags and propensity score weights. Covariates: fatalities in insurgent-initiated fights, in regime-initiated fights, in fights whose initiator cannot be determined, in fights of globalist Islamist groups, and attacks in neighboring district. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

Table A9: Heterogeneous Treatment Effects - Number of Fights

F	**Insurgent-Initiated Fights**	**Regime-Initiated Fights**	**Initiation unidentified**
t+0	0.453	0.217	4.432*
	(0.268)	(0.125)	(2.177)
t+1	0.992*	0.219	3.977
	(0.524)	(0.153)	(2.534)
t+2	0.504	0.382*	3.268*
	(0.329)	(0.226)	(1.559)
t+3	0.067	−0.033	0.897
	(0.262)	(0.111)	(1.501)
t+4	0.196	−0.056	0.91
	(0.579)	(0.061)	(1.072)
Geographic Units	18	18	18
Time Units	210	210	210
Observations	3780	3780	3780

Note: $^*p < 0.05$

Model specification based on matching approach with four lags and propensity score weights. Covariates: fatalities in insurgent-initiated fights, in regime-initiated fights, in fights whose initiator cannot be determined, in fights of globalist Islamist groups, and attacks in neighboring district. Standard errors (in parentheses) based on a block boot-strapping procedure with 1000 iterations.

A4 Supporting Information: Qualitative Evidence

A4.1 Interviews

In total, we conducted 16 interviews. Of these, four were conducted in 2017 and 2018 in Turkey and France within the context of another research project conducted by one of the authors. Ten interviews were conducted between November 2022 and March 2023 online. Two interviews were conducted via email in March 2023. The interview partners were recruited via snowball sampling. We had two initial independent contacts who then recommended additional candidates. The interviews were conducted in English and Arabic. The interview questions followed a semi-structured protocol for each target group (medical and NGO workers, activists, experts and professionals). All interviewees gave oral consent to be interviewed and were aware that the information collected would be used for academic research and publication. Most interviewees also gave the permission to use their full names. We recorded all interviews with the permission of our interview partners. The average duration of an interview was 72 minutes. All interviews were transcribed with the program Maxqda.

In-person interviews:

- Activist from Aleppo, Gaziantep, 2017/09/22
- Spokesperson of Ahrar al-Sham, Istanbul, 2017/10/10
- Member of Ahrar al-Sham in Idlib, phone, 2017/11/05
- Former head of opposition-affiliated city council of Aleppo, Paris, 2018/03/20

Interviews conducted online:

- Activist from Eastern Ghouta, 2018/01/31
- Dr. Zedoun al-Zoabi, 2022/11/05, former CEO at Union of Medical Care and Relief Organizations
- Fadi Aldairi, 2022/11/07, Country director at Hand in Hand For Aid and Development (HIHFAD)
- Dareen Khalifa, 2022/11/08, Senior Analyst on Syria, International Crisis Group
- Abd al-Fatah, 2022/11/09, activist and aid worker in Northwest Syria
- Dr. Munzer Khalil, 2022/11/30, medical surgeon, co-founder and head of opposition-affiliated Idleb Health Directorate from 2013 to 2020
- Nabil Sheikh Omar, 2022/12/02, activist and medical professional working in Northwest Syria
- Ali al-Muostafa, 2022/12/08, security coordinator for Hand in Hand for Aid and Development
- Dr. Jerome Drevon, 2022/12/15, Senior Analyst in Jihad and Modern Conflict, International Crisis Group
- Dr. Walid Tamer, 2023/02/01, physician, former head of opposition-affiliated Syrian Doctors' Syndicate in the North
- Dan Henebery, 2023/03/30, data analyst at Hala Systems

Interviews conducted via email:

- John Jaeger, March 2023, CEO Hala Systems, March 2023
- Razan Alam, March 2023, Syria Country Director, Hala Systems

A4.2 Primary documents

We collected relevant primary documents through the blog "Jihadology.net" (a repository for jihadist primary source material for academic purposes), searching for the following terms: "reveng(e)", "aveng(e)", "civilian", "child", "woman", "hospital", "health", "innocent", "retribution", "bomb(ing)." Based on these search terms, we retrieved 91 videos and primary documents covering the period from 2012 to 2022, of which 57 were issued by JN/HTS or related groups. Of these, 24 described military reactions by these groups to attacks by regime forces on civilians and civilian infrastructure, while 13 documented or discussed the targeting of civilians, civilian infrastructure, and medical facilities by regime forces.

Sources of videos cited in main text:

Video 1: Zelin, Aaron. 2016. "New Video Message from Jabhat Fataḥ Al-Shām: 'Ḥamāh: Report About the Suffering of the Hospitals in the Liberated Areas.'" https://jihadology.net/2016/08/30/new-video-message-from-jabhat-fata%e1%b8%a5-al-sham-%e1%b8%a5amah-report-about-the-suffering-of-the-hospitals-in-the-liberated-areas/ (June 13, 2023).

Video 2: Zelin, Aaron. 2016. "New Video Message from Jabhat Al-Nuṣrah: 'Report About the Russian and Nuṣayrīs Planes Targeting Hospitals in Idlib and Its Countryside.'" https://jihadology.net/2016/07/16/new-video-message-from-jabhat-al-nu%e1%b9%a3rah-report-about-the-russian-and-nu%e1%b9%a3ayris-planes-targeting-hospitals-in-idlib-and-its-countryside/ (June 13, 2023).

Video 3: Zelin, Aaron. 2016. "New Video Message from Jabhat Al-Nuṣrah: 'Russian Planes Bomb Hospitals and Residences in Idlib City.'" https://jihadology.net/2016/05/30/new-video-message-from-jabhat-al-nu%e1%b9%a3rah-russian-planes-bomb-hospitals-and-residences-in-idlib-city/ (June 13, 2023).

Video 4: Zelin, Aaron. 2016. "New Video Message from Jabhat Al-Nuṣrah: 'Russian Warplanes Targeting a Hospital in Rural Ḥamāh.'" https://jihadology.net/2016/02/15/new-video-message-from-jabhat-al-nu%e1%b9%a3rah-russian-warplanes-targeting-a-hospital-in-rural-%e1%b8%a5amah/ (June 13, 2023).

Video 5: Zelin, Aaron. 2022. "New Video Message from Hay'at Taḥrīr al-Shām's Abū al-Zubayr al-Shāmī: 'Operation of Revenge for the Martyrs of the IDP Camps Massacre.'" https://jihadology.net/2022/11/07/new-video-message-from-hayat-ta%e1%b8%a5rir-al-shams-abu-al-zubayr-al-shami-operation-of-revenge-for-the-martyrs-of-the-idp-camps-massacre/ (June 13, 2023).

A4.3 Research Ethics and Data Security

Our manuscript follows a mixed-methods research design, incorporating semi-structured interviews with medical and NGO workers, civil activists, opposition representatives, as well as experts. For an overview of the interviews conducted, see Section A4 in the Supporting Information. In the following we describe the procedures we took in order to make sure that our research meets the highest ethical standards and that it follows APSA's Principles and Guidance for Human Subjects Research. For this purpose, we provide answers to several questions concerning IRB policy.

1. Who were the human subject participants in the research? Were vulnerable populations recruited (e.g., children, prisoners, pregnant women, victims of violence, etc.)?

In our mixed-methods study, we included two groups of human subject participants. The first group comprised 11 individuals, including Syrian medical and NGO workers, civil activists, and opposition representatives. The second group consisted of three non-Syrian experts on the Syrian civil war. For the purpose of this report, we will focus solely on the measures implemented for the first group, as we do not anticipate any potential negative repercussions for the second group.

The research participants lived in or moved to opposition-held territory in Northwest Syria after the civil war erupted in the country in 2011. At the time of the interviews, most of our interview partners resided in Turkey or were commuting between Northwest Syria and Turkey, while some resided in West European countries. Most of the research participants had worked in the medical sector in Northwest Syria as doctors, nurses, directors, managers, volunteers, or coordinators of medical aid. Before starting our research, we anticipated that our research participants had witnessed violence by Syrian governmental and allied forces in the form of aerial bombing and artillery shelling. This required us to take special measures in order to minimize the potential for re-traumatization, as we outline further below.

2. How were the subjects recruited? If you provided compensation or there were other benefits from participation, was the opportunity to participate made available fairly?

The subjects were recruited through several ways. First, through contacts that two of the authors had established from prior research on Syria. Second, they were recruited through a colleague that had conducted research on the medical sector in Syria before. We started with these initial contacts and then enlarged the circle of our interview partners through snowball-sampling. Eleven of the interviews were conducted online via a telecommunications application. There was no compensation provided for taking part in the interviews. However, our interview partners perceived the participation in the interviews as a benefit, as many of them stated that they appreciated our research and wanted to contribute to it with their knowledge and experiences. They thus likely viewed our study as an opportunity to tell their stories to a broader audience than they could otherwise reach.

3. Did subjects participate voluntarily? E.g., did students feel obligated to participate by a professor in a course, or employees by their employer?

At the beginning of the interviews, we informed our interview partners that participation is voluntary, and that they could take a break, skip a question, or end the interview at any time without negative consequences. As the majority of the interviews were conducted via video call, the participants always had the opportunity to end them easily by leaving the conversation. Our research is thus grounded on the premise of voluntary participation by the interviewees.

4. What are the risks posed to human subjects from participating in the research? It is expected that most research poses minimal risk, meaning there is little chance of upset, distress, physical harm, or discomfort greater than would be encountered in daily life. This minimal risk category includes benign behavioral interventions ("brief in duration, harmless, painless, not physically invasive, not likely to have a significant adverse lasting impact on the subjects, and the investigator has no reason to think the subjects will find the interventions offensive or embarrassing").

The research participants may be vulnerable to harm as a result of their participation in the interviews. Foremost, they may be experiencing emotional distress or trauma as a result of their recent exposure to violence. Hence, before conducting the interviews we carefully contemplated the risk of re-traumatization through recounting painful memories (such as airstrikes on hospitals in which patients and colleagues have died) and how we could minimize it. We followed APSA's "Principles and Guidance for Human Subjects Research"[22] from which we cite in the following (sections in bold were particularly relevant for our research):

> "Research may generate painful emotional or psychological responses from participants, as they are exposed to or asked to discuss sensitive topics. In some instances, the research study itself could cause trauma. In other cases ("re-traumatization"), **the research may ask participants to recall past injuries, such as human rights abuses. Trauma may be more likely when research involves war** or sexual violence, but trauma may emerge in a wide range of research settings. **Political scientists should understand that not all research that asks participants to recollect past events – even traumatic ones – necessarily deepens trauma. Consenting participants may judge that their narration of past events is beneficial to themselves or others even though doing so may be painful or traumatic.**"

One way how we minimized the potential for re-traumatization was to inform our interview partners about the purpose and content of our research and by foreshadowing what topics the interview questions would cover. This information was already given at the early stage of establishing contact through email and mobile messenger devices. This enabled our research participants to make an informed decision about whether they wanted to participate in the

[22] https://www.apsanet.org/Portals/54/diversity%20and%20inclusion%20prgms/Ethics/Final_Principles%20-with%20Guidance%20with%20intro.pdf?ver=2020-04-20-211740-153

interview. At the beginning of the interviews, we again explained what our research was about and what topics the interview questions would cover. We sought oral consent from all our interview partners as described below.

Most of the interviews were conducted in tandem by a non-Syrian and a Syrian researcher. This implies that our interview team always consisted of a male and a female interviewer and one native speaker. This enabled us to observe our interview partners closely and detect potential signs of distress. We did not observe participants experiencing trauma or re-traumatization. However, we acknowledge that the way of conducting the interviews (video call) might have reduced the potential to immediately detect distress compared to in-person interviews. At the same time, the interview format gave the participants the opportunity to end the conversation with minimal hurdles. After the interviews, we repeatedly checked on our interview partners through email and messenger devices to understand whether our measures to avoid negative consequences for the research participants were effective and to, potentially, adjust our interview strategy.

When constructing our semi-structured questionnaire, we also decided to avoid certain questions that could have elicited detailed descriptions, and thus, memories of violence. More concretely, we did not ask about the specifics of situations directly impacted by violence, such as the shelling of medical facilities. Instead we focused on those components that were of direct importance to our research question. Hence, we first asked about the situation of the health sector in Northwestern Syria in general. Second, we asked whether the respondents and insurgent groups were aware of where and when pro-government forces would strike medical facilities. Third, we sought to comprehend the dynamics after the attacks by asking how insurgents, medical actors, and the civilian population in general reacted to those attacks.

From the beginning, we also decided against interviewing local civilians still residing in Northwestern Syria because we perceived these persons as more vulnerable than our interview partners that either moved to West European countries, Turkey, or commuted between Turkey and Northwestern Syria.

We also decided to stop the interviews after the devastating earthquake that shock Turkey and Syria in the beginning of February 2023. We checked on our interview partners, assuring that they were in safety and asking whether we could provide any support.

One of the researchers conducting the interviews also attended a training in how to conduct research in violent contexts ethically in 2017.

5. What are the risks posed to human subjects from accidental disclosure of original data? Is the original data fully anonymous, or, is it possible to identify subjects from the original data? Beware that combinations of multiple demographic categories, IP addresses, IDs from websites such as MTurk, etc. can all be considered identifiable. If the original data is identifiable or potentially identifiable, what risks to subjects would accidental disclosure of the data pose, and what security steps have been taken to limit the risk of accidental disclosure? For example, do the original data contain sensitive personal information (e.g., identity card numbers) or data which could put subjects at risk of embarrassment or civil or criminal liability?

We judge the risks posed to human subjects from accidental disclosure of original data to be minimal. After explaining the purpose and content of our research, as well as foreshadowing the content of the interview questions, our interview partners explicitly agreed to record the interviews. The resulting recordings and transcripts are stored in accordance with the European Union's General Data Protection Regulation. Thus, data are stored in a way which secures the integrity and confidentiality of the data. The original data is not fully anonymous, as they might include the names and a self-description of the professional activities of our interview partners. However, they do not include other personal information. In the beginning of the interviews, we assured our interview partners that we would cite them in the manuscript intended for publication in the way in which they preferred, i.e., by name or in a pseudonymized way. At the end of the interview, we asked our interview partners what their preferred way of citation was. Most of the research participants explicitly decided to be cited by name. Before submitting the manuscript, we again contacted our interview partners, notifying them that we would now submit the manuscript to an academic journal. All of them affirmed their earlier decision to be cited by name. Pseudonymization was used for four participants who preferred to be cited without name. Their data were stored in an anonymized format which prevents their re-identification.

6. Was informed consent obtained from research participants, and if so, how? Note that informed consent is not necessarily required for minimal risk studies if not obtaining consent does not adversely affect the welfare or rights of subjects, if it is impractical to obtain consent, and if debriefing subjects would not be appropriate.

Informed consent was obtained from all research participants by providing them with comprehensive information regarding the purpose and content of the research and the topics covered by the interview questions. This information was provided in shorter form when first contacting the research participants and in complete form before starting the interviews. This information was presented in a form which provided sufficient details regarding the research, and was organized and presented in a way that facilitated the research participants' understanding of the research and the reasons for why they might or might not want to participate, including potential risks or discomforts. The presentation also included an explanation that the interview data would be stored in a way which would maintain the integrity and confidentiality of records. All research participants were also given the opportunity to ask questions before making a decision. Each interviewee provided oral consent to participate, acknowledging that the gathered information would be used for academic research and publication. Throughout the interviews, we renewed consent by asking whether the interviewees still wanted to continue the interview. All interviews were recorded with the explicit permission of the participants.

7. Did the research take place in a country which requires government ethics review of human subjects' research, and if so was such an approval obtained?

The research did not take place in a country which requires government ethics review of human subjects' research.

References

Apte, J. (2020, August 11). *Humanitarian Deconfliction and the Struggle to Protect Civilians in Syria*. Statecraft. https://www.statecraft.co.in/article/humanitarian-deconfliction-and-the-struggle-to-protect-civilians-in-syria

Briody, C., Rubenstein, L., Roberts, L., Penney, E., Keenan, W., & Horbar, J. (2018). Review of attacks on health care facilities in six conflicts of the past three decades. *Conflict and Health*, *12*, 19.

Guterres, A. (2020). Summary by the Secretary-General of the report of the United Nations Headquarters Board of Inquiry into certain incidents in northwest Syria since 17 September 2018 involving facilities on the United Nations deconfliction list and United Nations supported facilities.

Hill, E., & Hurst, W. (2019). The U.N. Tried to Save Hospitals in Syria. It Didn't Work. [newspaper]. *The New York Times: World*.

Independent International Commission of Inquiry on the Syrian Arab Republic. (2018, February 1). *Report of the Independent International Commission of Inquiry on the Syrian Arab Republic* (A/HRC/37/72).

Jabbour, S., & Fardousi, N. (2022). Violence against health care in Syria: Patterns, meanings, implications. *British Journal of Middle Eastern Studies*, *49*(3), 403–417.

Lund, A. (2019, June 13). *The UN Made a List of Hospitals in Syria. Now They're Being Bombed*. The Century Foundation. https://tcf.org/content/report/un-made-list-hospitals-syria-now-theyre-bombed/

OCHA. (2018, February 21). Turkey|Syria: Humanitarian Deconfliction Mechanism for Humanitarian Organisations Operating in Syria.

SAMS. (2022, May). *A Heavy Price to Pay: Attacks on Healthcare Systems in Syria 2015-2021*. Syrian American Medical Society Foundation (SAMS).

Shaheen, K. (2016). Airstrikes hit two Syrian hospitals, with Turkey condemning 'obvious war crime'. *The Guardian: World news*.

Syrian Archive. (2017). *Medical Facilities Under Fire. An investigation about attacking 8 Syrian hospitals in Idlib*.