








# The human toll and humanitarian crisis of the Russia-Ukraine war: the first 162 days

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## ABSTRACT

**Background** We examined the human toll and subsequent humanitarian crisis resulting from the Russian invasion of Ukraine, which began on 24 February 2022.

**Method** We extracted and analysed data resulting from Russian military attacks on Ukrainians between 24 February and 4 August 2022. The data tracked direct deaths and injuries, damage to healthcare infrastructure and the impact on health, the destruction of residences, infrastructure, communication systems, and utility services – all of which disrupted the lives of Ukrainians.

**Results** As of 4 August 2022, 5552 civilians were killed outright and 8513 injured in Ukraine as a result of Russian attacks. Local officials estimate as many as 24 328 people were also killed in mass atrocities, with Mariupol being the largest (n=22 000) such example. Aside from wide swaths of homes, schools, roads, and bridges destroyed, hospitals and health facilities from 21 cities across Ukraine came under attack. The disruption to water, gas, electricity, and internet services also extended to affect supplies of medications and other supplies owing to destroyed facilities or production that ceased due to the war. The data also show that Ukraine saw an increase in cases of HIV/AIDS, tuberculosis, and Coronavirus (COVID-19).

**Conclusions** The 2022 Russia-Ukraine War not only resulted in deaths and injuries but also impacted the lives and safety of Ukrainians through destruction of healthcare facilities and disrupted delivery of healthcare and supplies. The war is an ongoing humanitarian crisis given the continuing destruction of infrastructure and services that directly impact the well-being of human lives. The devastation, trauma and human cost of war will impact generations of Ukrainians to come.

## INTRODUCTION

The full-scale Russian invasion of Ukraine started on 24 February 2022. Before the war, Ukraine had a population of 41.6 million.<sup>1</sup> As of 4 August 2022, 7.1 million people remain displaced – forced to flee from their

## WHAT IS ALREADY KNOWN ON THIS TOPIC?

- ⇒ The Russian attack on Ukraine has caused the biggest war in Europe since the Second World War, which triggered several crises such as a massive exodus of citizens from their homes, massive deportations of people from the occupied territories, and military violence with massive executions of citizens.
- ⇒ There is little information about the in-depth impact of the Russia-Ukraine war on healthcare and the humanitarian crisis, including destruction of infrastructure and services that impact the well-being of Ukrainians daily.

## WHAT THIS STUDY ADDS?

- ⇒ This is a first attempt to document civilian casualties by weapon type and damage to healthcare infrastructure, alongside the greater toll of destruction of civilian infrastructure and utilities.
- ⇒ This study considers the disrupted Health Service delivery and the growing humanitarian crisis due to destructions of residences, infrastructures, communications, and utilities that affect the health and well-being of human lives in Ukraine.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY?

- ⇒ This study informs public health preparedness on potential healthcare infrastructure that has been severely impacted by the war, further suggesting ways to prioritise healthcare delivery.
- ⇒ Future research on the impact of the Russia-Ukraine war on the mental health of Ukrainians is needed.

own homes by the war within Ukraine and 10.3 million refugee movements have been recorded out of Ukraine.<sup>2,3</sup> Ukraine's healthcare system was already facing difficulties such as under-funded healthcare and inequities in the distribution of resources and hospital location before the war began.<sup>4</sup>



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Since its 2014 healthcare reform, Ukraine has seen a steady decline in infant mortality.<sup>4</sup> Nonetheless, this rate in Ukraine was still 1.85 times higher than the European Union average rate in 2019 (7.2 deaths per 1000 live births in Ukraine vs 3.9 deaths per 1000 live births in the European Union).<sup>4-6</sup> Another healthcare sector that has drastically changed over the years is the pharmaceutical industry. The Ukraine has increased its production of medicines over time – moving from having a few pharmaceutical plants during the collapse of the Soviet Union in 1991 to establishing a relatively strong pharmaceutical production sector.<sup>7</sup> However, any gains over the years related to healthcare improvement and/or pharmaceutical production will likely be reversed given the current war in Ukraine.

Communicable diseases were also a major health concern in Ukraine even before the current Russian invasion. Ukraine has the fourth-highest tuberculosis (TB) rate in Europe, with 30 000 people diagnosed with TB each year.<sup>8-10</sup> Drug-resistant TB accounted for 29% of all new diagnoses,<sup>9</sup> and only 81% of the total TB cases were diagnosed and treated.<sup>11</sup> In addition to TB, it is estimated that about 152 000 of 260 000 people living with HIV in Ukraine receive antiretroviral therapy.<sup>12</sup> Challenges in diagnosing and treating various communicable diseases in Ukraine were compounded by the country's limited medical supplies.<sup>13</sup> Given the current Russian invasion of Ukraine, the WHO's (WHO) Health Emergencies programme cautions that a new COVID-19 variant could gravely impact the already vulnerable refugee population and the millions of displaced people.<sup>13</sup> The surrounding nations absorbing an influx of refugees are also likely to experience a surge in COVID-19 cases,<sup>14</sup> resulting in possible increases in hospitalisations and deaths from COVID-19.

Another area of concern is the impact of the war on the well-being of Ukrainian children. Beyond the immediate threats to life, the war in Ukraine has led to at-risk children with chronic conditions experiencing treatment disruption.<sup>15</sup> According to the International Diabetes Federation Atlas, around 6700 children and adolescents were diagnosed with Type 1 diabetes in Ukraine in 2021.<sup>16</sup> The scarce access to essential health resources for these children during military conflicts is worrisome.

Aside from the bombardment of hospitals and dispensaries that impact the deliveries of healthcare and health services, shelling and bombing in areas with active hostilities also destroyed homes, schools, bridges, and nuclear power plants. Due to the blockade of cities by Russian troops, wounded civilians, including mothers and newborns were unable to receive appropriate medical care.<sup>17-19</sup> Taken together, the Russian invasion not only impacts lives and safety, but the health and well-being of all Ukrainians due to the impact of the invasion on access to clean water, gas and electricity, as well as the internet and other forms of communication.<sup>20</sup> In essence, the Russian invasion has resulted in a humanitarian crisis for Ukrainians.

The war has damaged an already fragile healthcare system, caused ongoing civilian casualties, and it has involved direct attacks on healthcare facilities and residential areas. Yet, not much is known about the extent of the human and societal costs since the start of the 2022 Russian invasion of Ukraine. Thus, the purpose of this study was to determine the human toll including overall civilian casualties and injuries from attacks, casualties by different types of attack weapons, attacks on healthcare facilities – including children's hospitals and maternity wards, and the impact on health and spread of diseases. We also consider the humanitarian crisis brought on by destruction of residential areas, civilian infrastructure, communication systems, and disruptions to utility services.

## METHODS

### Data collection

We first extracted data from online and printed news published in English (live update) and Ukrainian languages. These sources included but were not limited to Al Jazeera, the BBC, CNN, Fox News, Voice of America, the Kyiv Independent, Ukrainian local newspapers, The Guardian, Reuters, Forbes, UNICEF, and the UN. The news contained data on all primary, secondary, and tertiary healthcare facilities, along with attacks on ambulances, and pharmacies, direct civilian deaths, and injuries from attacks. The data included violent deaths directly from a missile attack on hospitals, and other civilian infrastructure such as residential buildings, dams, bridges, churches, schools, television tower, theatre, and power plants. In addition, the news contained data on the impact of human rights violations including atrocities committed by the Russian military and missing or unaccounted for civilians, and the destruction of actual physical infrastructure and disruption to utility and communication services. The attacks on Ukrainian forces that did not result in civilian casualties are not counted in this dataset. To avoid duplicating data from the many mass media sources that were included in our analysis, we created a database to keep track of hospital destruction, physical infrastructural damage which destroy a facility or building, shelling, and all lethal events. Complete information on locations, dates, events, and fatalities or injuries were recorded. The approximate number of people killed in occupied and ruined cities was collected from the Ukraine Ministry of Health. Additionally, we compiled data on the number of attacks on health facilities – including children's hospitals and maternity wards, nuclear plants, residential buildings, churches, schools, dams, bridges, and food supply (i.e. running out of reserves in all large grocery stores). Data were also vetted by checking with numbers released by local Ukrainian media outlets, the Ministry of Defence, and the Ministry of Health. We also collected data from the Ukrainian Ministry of Health to describe communicable diseases impacted by the war

that had not been reported in English language sources. The injuries and fatalities data were also cross-checked with the UN sources. We used data from 24 February to 4 August 2022. We have summed each day's events (deaths and injuries with different attacks in different cities and villages in Ukraine). More details about the references are in the online supplemental file 1 (supplement texts).

### Data cleaning

During data cleaning, we cross-checked each event with multiple sources for accuracy and removed duplicate records. These sources included the Surveillance System for Attacks on Healthcare (SSA)/WHO, Office of the United Nations High Commissioner for Human Rights, online and printed news published in English and Ukrainian languages, and the Ukrainian Ministries of Health and Defence. If an inconsistency was noted, our collaborators in Ukraine would check with the Ukraine Ministry of Health, and the Ministry of Defence by phone call or email to ensure data quality. Data variables per event included the date, the name of the city, and the number of fatalities and/or injuries. We also combined fatalities and injuries that were reported on a particular date for civilians and from medical facilities. These fatalities and injuries were reported by date. We categorised weapon types used as aerial bombing, artillery, shelling, mining, Multiple Launch Rocket Systems (MLRS) and missile. We have summed each day's events (deaths and injuries with different attacks in different cities and villages in Ukraine). After finalising the data set, the data were checked for possible null values, duplicates, and errors.

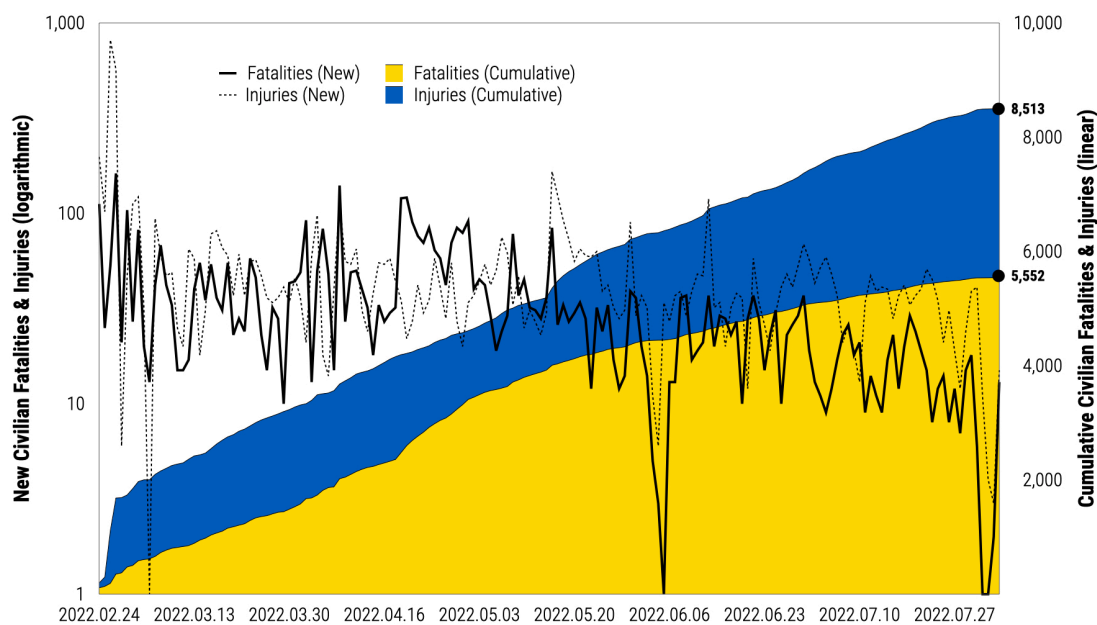
### Data analysis

We performed exploratory analyses of all the data collected, including 250 event-based attacks using descriptive statistics. Areas of focus included: (1) new and cumulative civilian fatalities and injuries; (2) casualties by weapon type; (3) casualties associated with hospital and residence attacks, including mass atrocities and missing or unaccounted civilians; (4) the destruction and disruption of hospitals and other elements of healthcare infrastructure, including children's hospitals and maternity wards; (5) description of outbreaks of key communicable diseases; and (6) the destruction of non-healthcare-related civilian structures and disruption to utilities and communication services. The analysis was performed using Excel (Microsoft, Redmond, Washington) and Anaconda Python 3.0 (Anaconda Inc., Austin, Texas). Visualisation was developed using Excel and Keynote (Apple, Cupertino, California). All dates in the figures are presented in ISO 8601 format (YYYY.MM.DD) to reduce confusion for an international audience. Our analysis is a compilation of data on deaths, injuries and factors that directly or indirectly impact the health and well-being of Ukrainians as a result of the war with Russia.

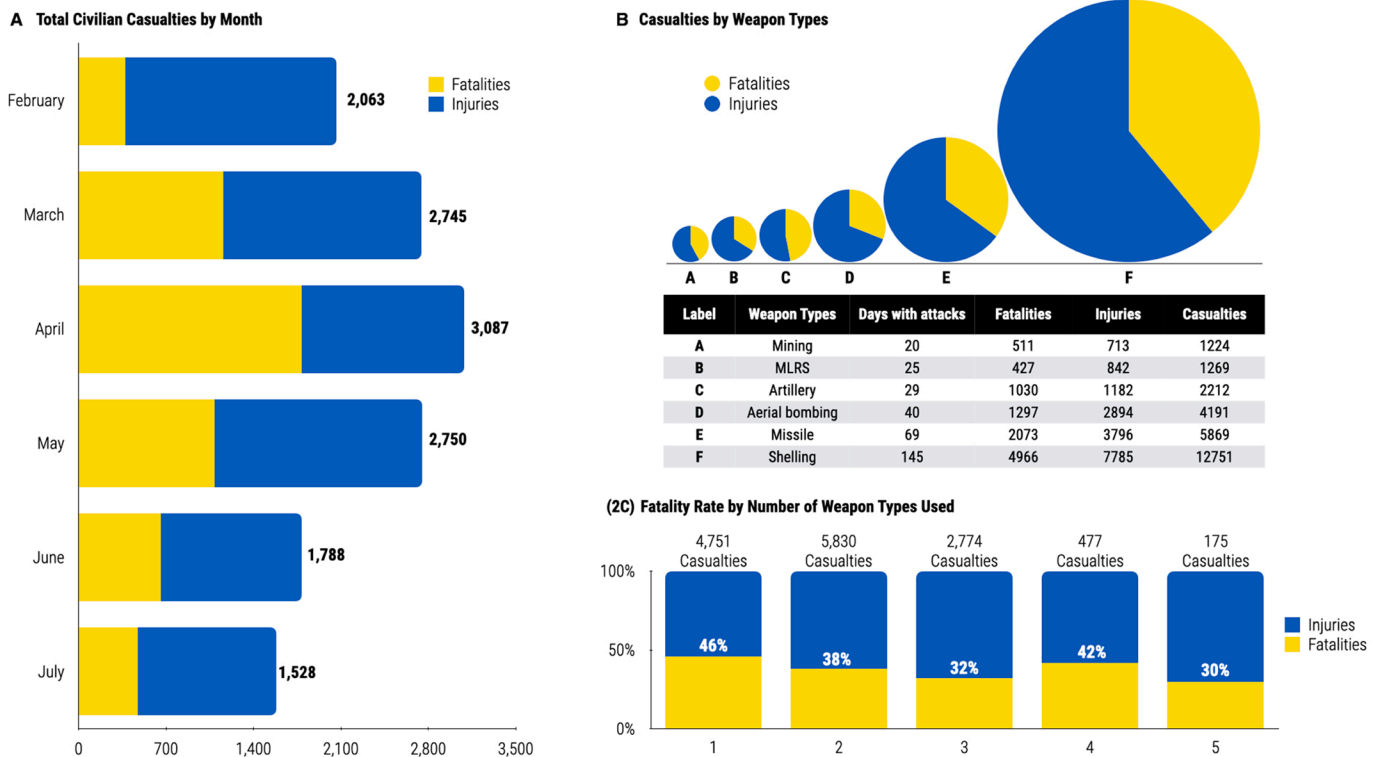
## RESULTS

### Fatalities and injuries

The results presented in this current research study are based on the sources of data that were available to our research team as of 4 August 2022, after 162 days of Russian military attacks. There were 5552 civilians directly killed and 8513 were injured in Ukraine (figure 1). A total of 2383 deaths were extracted from a single source, 1787 deaths were extracted from two sources, 743 deaths



**Figure 1** New and cumulative civilian fatalities and injuries, 24 February to 4 August 2022. New civilian fatalities and injuries are represented by lines using a logarithmic Y-axis on the left. Cumulative civilian fatalities are shown as the area under the line using a linear Y-axis on the right. Time is represented on the X-axis in 17-day increments.



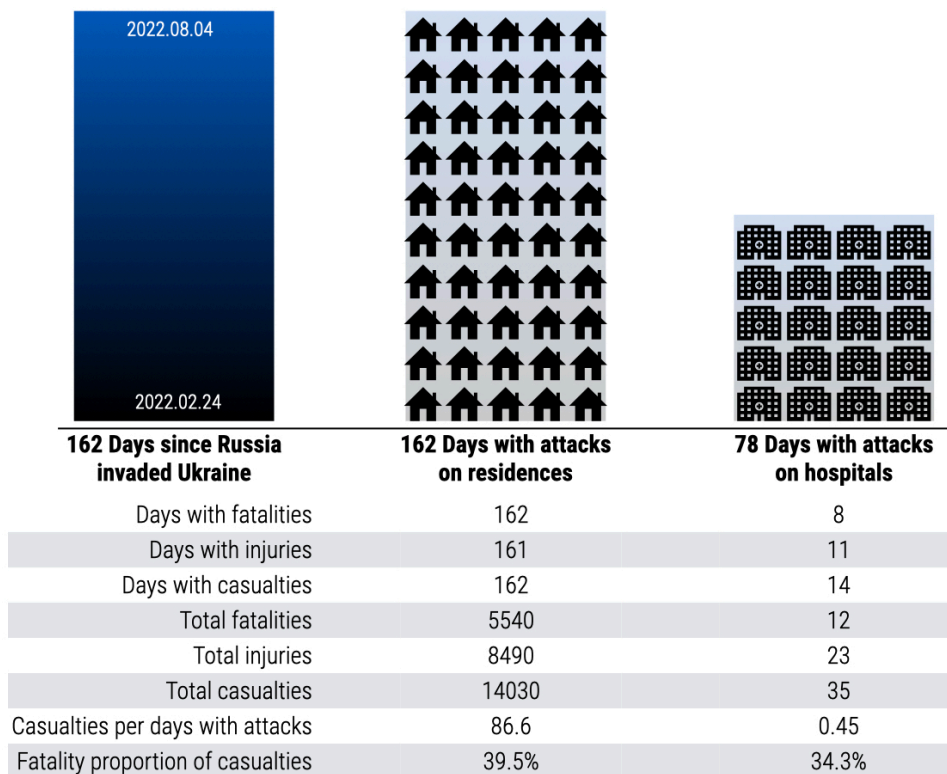
**Figure 2** Civilian casualties by weapon type used by Russian forces, 24 February to 4 August 2022. The research database included information about which weapon types (aerial bombing, artillery, mining, missiles, MLRS, shelling) were used in association with attacks resulting in casualties. Some of these casualties also happened with other weapon types such as guns or bullets but cannot be quantified here. Figure 2A shows all civilian casualties by month August data not shown). Figure 2B shows casualties for attacks in which specific weapon types were involved. The size of the pie charts is proportional to how often that weapon type was used. Figure 2C shows the fatality rate by the number of weapon types documented in a given attack.

were extracted from three sources, and 639 deaths were extracted from four sources. Among them, 18 medical workers died as a result of rocket attacks and shelling, and more than 50 were injured.<sup>21</sup> Most of the civilians killed were from Cherkasy, Chernihiv, Kharkiv, Kherson, Kyiv, Mariupol, Mykolaiv, Odesa, Sumy, Zaporizhzhia, Dnipro, and Zhytomyr. The highest, single-day number of civilian fatalities (162) was reported on 27 February (figure 1). Shelling was the most common weapon type documented, used in 145 out of 162 days of hostilities (figure 2). Attacks that involved shelling were the deadliest, resulting in 4966 fatalities, or nearly 90% of all deaths. Hospitals were attacked on 78 out of 162 days, and residences were attacked every day (figure 3). There was 1 day, 5 March, during which all casualties from residential attacks were deaths. Attacks on residences resulted in more total fatalities and injuries than attacks on hospitals. In addition, attacks on residences had a slightly higher proportion of fatalities relative to casualties compared with attacks on hospitals, 39.5% vs 34.3%. Finally, using low estimates from the Ukrainian Ministry of Health, approximately 24328 people were killed by mass atrocities or were unaccounted for in Bucha, Irpin, Kharkiv, Kherson, Kreminna, Mariupol, Popasna, and Trostianets. This was overwhelming so in Mariupol<sup>22</sup> (figure 4).

### Healthcare infrastructure and disruption to delivery of healthcare and health services

In addition to the civilian casualties, we identified 32 major hospitals in Ukrainian cities that were attacked during the study period (figure 5). These included a maternity hospital, a Red Cross healthcare facility, a cancer hospital, and multi-disciplinary hospitals in Mariupol. All these confirmed attacks on hospitals and healthcare facilities are reported as direct Russian attacks. We reviewed the SSA/WHO's report and identified 445 attacks on healthcare facilities, with 374 attacks that impacted healthcare facilities and included 109 attacks that impacted supplies (figure 6). All different types of health facilities such as primary, secondary, tertiary care,<sup>23</sup> and other facilities were also attacked (table 1).

Concerning disruption in deliveries of healthcare and health services, pharmacy data<sup>24</sup> shows that the total number of working pharmacies in Ukraine dropped by 19% (n=3695) between 23 February and 4 June 2022 (figure 7). The most critical humanitarian situation was in Mariupol (not shown in figure 8), which had no pharmacy and no access to essential medicines, as of 4 June 2022. Only 13% of pharmacies were operating and dispensing medicines in Chernihiv and 35% of pharmacies were operating in Kharkiv. However, the number of pharmacies



**Figure 3** Civilian casualties associated with attacks on hospitals and residences by Russian forces, 24 February to 4 August 2022. The bars at the top of the figure represent the total number of days with attacks on hospitals vs residences. The tabular data below list the number of days with fatalities, injuries, casualties, and the total numbers of each.

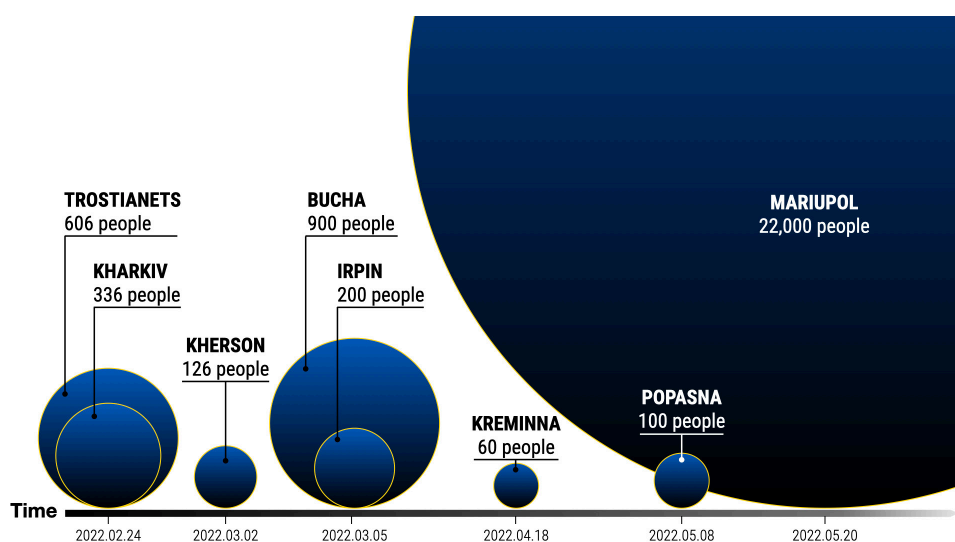
operating in Kyiv increased; as of 4 June, 62% of pharmacies were operating.

During wartime, infectious disease outbreaks are more likely to occur,<sup>25–28</sup> possibly from delayed or interrupted vaccinations or disruption to clean sources of water, as well as crowded quarters. Botulism outbreak was reported, 23 people were infected and two people died.<sup>29–30</sup> The polio vaccination campaign was stopped<sup>31</sup> and 950 434 patients were diagnosed with COVID-19 during the war resulting

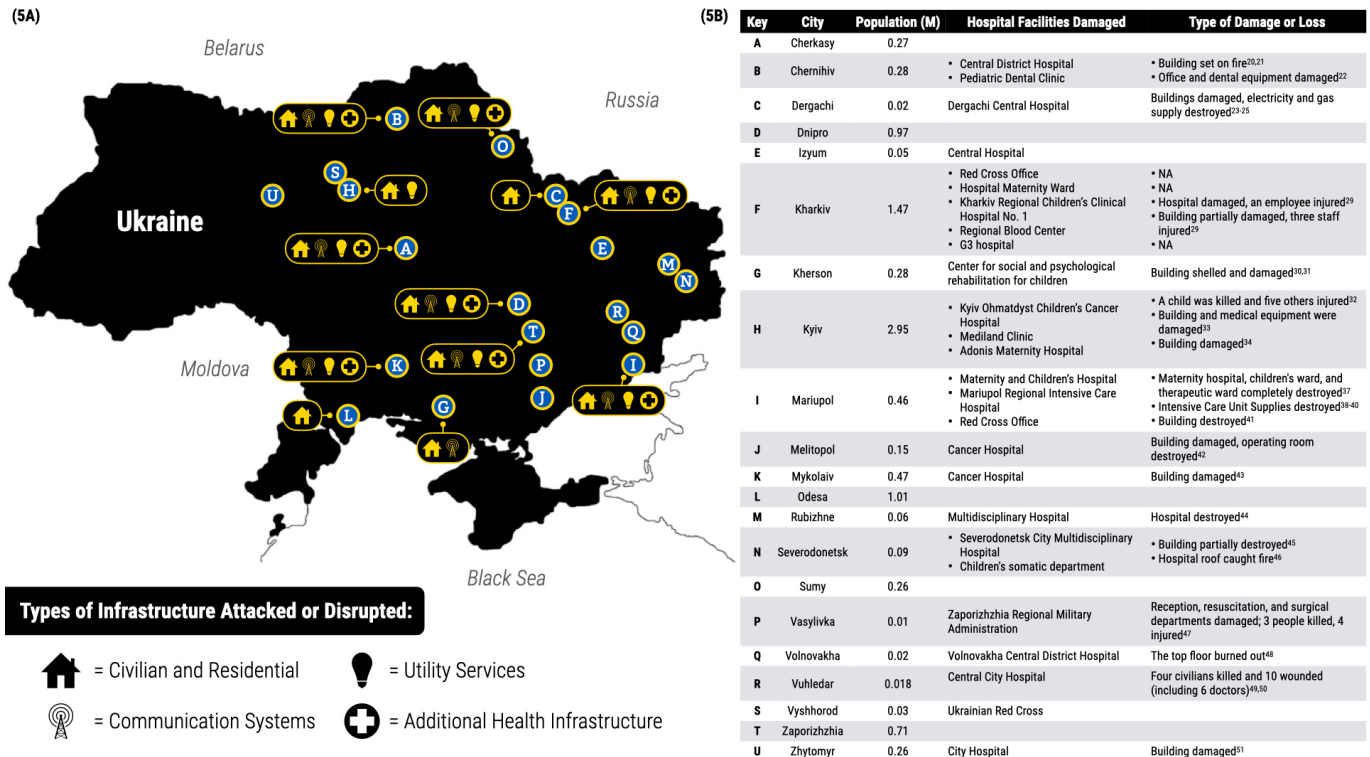
in 8402 deaths in Ukraine.<sup>32–33</sup> Meanwhile, 6837 people were also diagnosed with tuberculosis, and 3393 with HIV/AIDS.<sup>32</sup>

#### Attacks on civilian Infrastructure and disruption to utilities and communication services

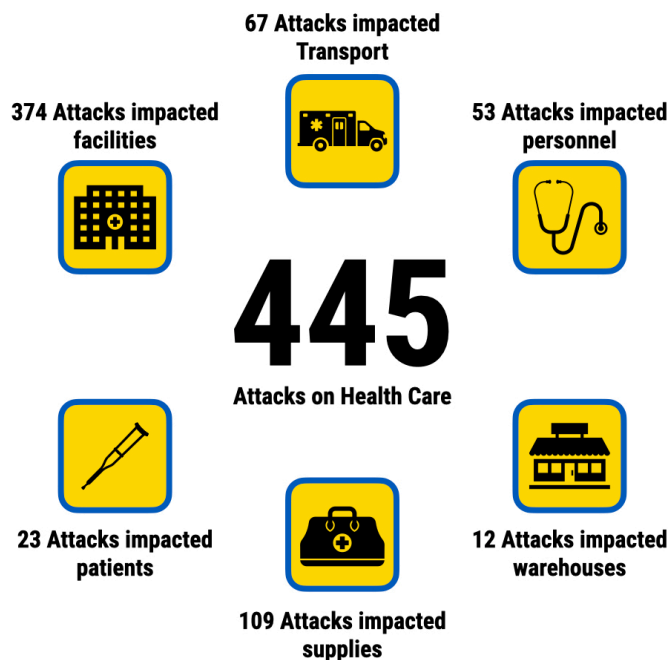
In addition to casualties of war and disruption to delivery of healthcare and health-related services, there were at least 250 attacks on non-healthcare civilian



**Figure 4** People were killed by mass atrocities or unaccounted for across eight cities in Ukraine. Time is represented along the X-axis. The area of each circle is proportional to the number of people killed or not traceable.



**Figure 5** Attacks and disruption to key civilian and healthcare infrastructure across Ukraine, 24 February to August 5, 2022. Figure 5A shows a map of Ukraine with 21 cities labelled that experienced major attacks or disruptions. The legend at the bottom of the figure shows the icons representing civilian and residential infrastructure, communication systems, utility services, and additional health infrastructure (e.g. medical supplies). The letters on the map in Figure 5A correspond to the cities listed in Figure 5B. Individual hospitals attacked and the type of damage they experienced is detailed in Figure 5B.



**Figure 6** Infographic summarising the data for Ukraine in the WHO's surveillance system for attacks on Healthcare, 24 February to August 5, 2022.

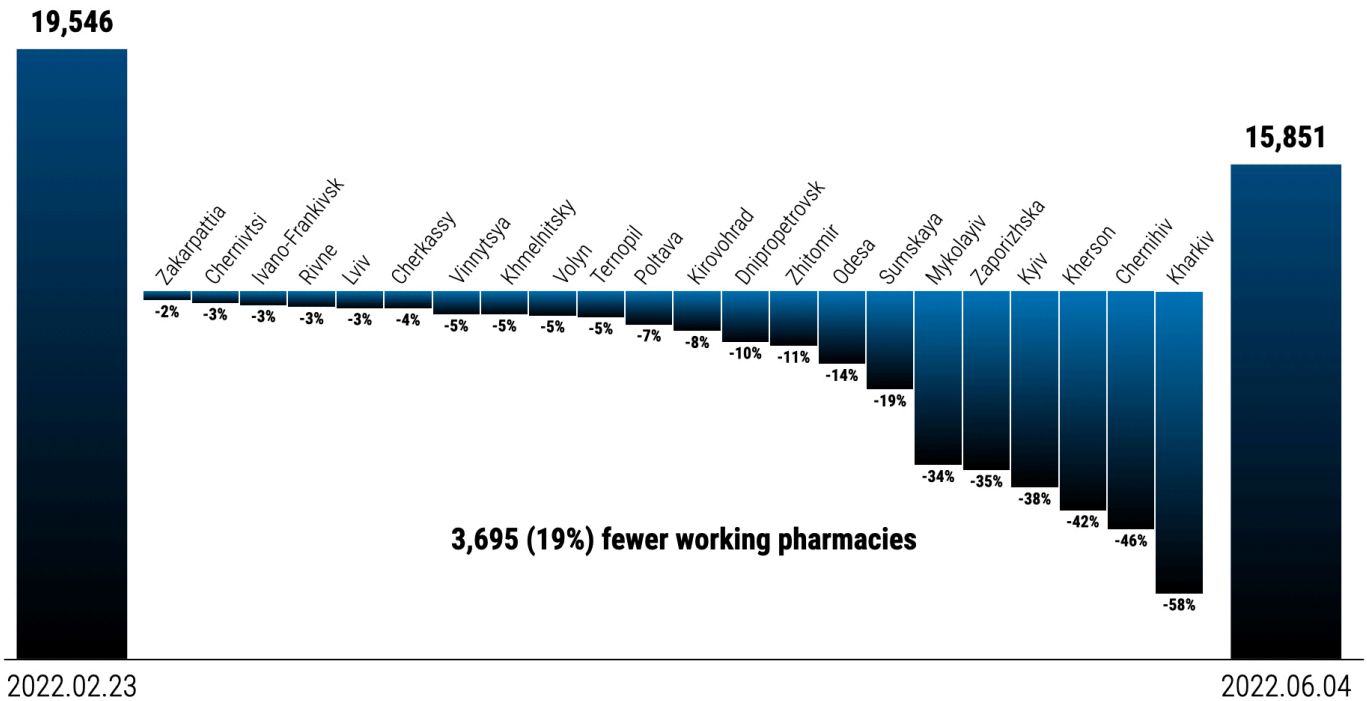
cities, villages, and municipalities; targets ranged from museums (n=9) and playgrounds (n=2) to bridges (n=13) and airports (n=3). There were also five attacks on nuclear plants: three attacks in Zaporizhzhia, and two in Chernobyl. An additional small-scale research reactor in Kharkiv also came under attack. Attacks on ammonia warehouses and the use of phosphorous bombs were also reported. Four attacks on food supply reserves were observed at Mariupol, Kherson, and Chernihiv. There

**Table 1** Total number of facilities attacked

Facility type	Total attacks	Attack (%)	Total injured	Total death
Primary & preventive care	123	32.71%	3	2
Secondary care	152	40.43%	49	12
Tertiary care	18	4.79%	3	1
Mobile clinic	1	0.27%	0	1
Pharmacy	9	2.39%	0	0
Warehouse	7	1.86%	0	2
Others*	66	17.55%	17	63
<b>Total</b>	<b>376</b>	<b>100%</b>	<b>72</b>	<b>81</b>

\*Ambulance, Centre for Emergency Care, Nursing homes, Rehabilitation centres, Blood transfusion, Bureau of Forensic Medical Examination, and Disaster Medicine.

infrastructure that impacted the safety and well-being of Ukrainians and compounded the humanitarian crisis in Ukraine (figure 8). We recorded attacks in 82 different



**Figure 7** Change in the number of working pharmacies in Ukraine between 23 February and 4 June 2022. Data available for 22 oblasts shown. The first vertical bar represents 19 546 pharmacies in the 22 oblasts the start of the invasion, and the vertical bar on the right represents 15 851 pharmacies as of 5 August 2022 (the end date of our data collection).



**Figure 8** Attacks on non-healthcare civilian infrastructure by Russian forces, 24 February to 4 August 2022. The chart plots the total number of attacks on civilian infrastructure documented per week. In the background, an image typical of the destruction caused by Russian forces is visible.

was disruption to the electricity supply in 15 cities; and to the water supply in 8 cities.

Most Ukrainian cities that came under Russian military attacks experienced multiple challenges from damage to civilian infrastructure that resulted in disruption to utility services such as gas and electricity, as well as communication services. The map in figure 5 shows the location of at least 21 cities that experienced significant disruption to utility and communication services.

## DISCUSSION

There has been a continuous increase in civilian fatalities and injuries since the Russian invasion of Ukraine on 24 February 2022. The Russian army's occupation of certain territories however, prevented appropriate registration of all deaths and injuries as some remains were left unclaimed in the streets. In addition, the killing of Ukrainian civilians or kidnappings by Russian troops additionally violated human rights and contributed to the trauma of war. The impact of this trauma will affect future generations of Ukrainians.

Our data showed that, shelling was the most common and major cause of death and injury. In addition, the indiscriminate use of explosive weapons in residential areas was responsible for the largest proportion of civilian casualties and the destruction of critical civilian and healthcare infrastructure. The myriad of healthcare consequences and the aftermath of the war are expected to take an even greater toll on Ukrainians. With healthcare facilities being the most attacked infrastructure during the war, coupled with destruction of civilian infrastructure that impact the safety and well-being of Ukrainians, this stands to cripple Ukraine's healthcare reform and compound the humanitarian crisis in Ukraine.

A targeted attack on a children's and maternity hospital in Mariupol prompted international outrage. Many international organisations have called these attacks war crimes that are in direct violation of the Geneva Conventions of 1949,<sup>34</sup> which prohibit targeting residential areas and healthcare facilities.<sup>35</sup> Our findings indicate continuous targeting of health facilities and residences over the 162 days included in this study. Both the constant attacks on residential areas and the high proportion of attacks on healthcare facilities are highly unlikely to be random and are consistent with a pattern of intentional targeting.

Moreover, patients and people who were injured or suffering from chronic diseases have limited access to medical care and medications during the current conflict. For example, people living with HIV and tuberculosis have not been able to receive the drugs they need promptly.<sup>36</sup> Because of bombardment of hospitals, factories, and dispensaries, the distribution system needed for the timely delivery of medications and needed drugs was disrupted. Due to destroyed roads, constant shelling, and threats, many pharmaceutical companies have faced the daunting challenges of little or no access to raw materials and difficulty in delivery of pharmaceutical products.

Also, production is significantly reduced due to frequent air alarms and the lack of safety for employees. In places where there are active hostilities and shelling, some pharmacies have closed due to safety concerns and this has restricted access to pharmacy workers (figure 8).<sup>37</sup> Thus, critical supplies, including oxygen, insulin, and cancer treatments are in short supply.<sup>38</sup> Moreover, storage facilities for pharmaceuticals located near Kyiv were destroyed by a rocket strike and had damage costing up to 1.5 billion hryvnias (approximately 50 million US dollars).<sup>39</sup> Disruption of these pharmaceutical and pharmacy services due to the current Russian invasion may result in shortages of medicines and supplies, which may further result in life-threatening complications for children and adults.<sup>40</sup> Certain areas of Ukraine may be even more impacted by these shortages in medicines due to an overwhelming displacement of 7.1 million people within Ukraine.<sup>2</sup>

The occurrence of infectious diseases is expected to worsen owing to destroyed healthcare facilities, lack of or delayed treatment as a result of the war, displacement of people into shelters, and overcrowded spaces with limited or no access to water and sanitation facilities. Further, the campaign to vaccinate against COVID-19 was halted during the Russian invasion.<sup>41</sup> The availability of hospital beds for COVID-19 patients decreased and the 7-day average number of polymerase chain reaction (PCR) tests increased significantly as a direct result of war.<sup>17</sup> However, the data on the case-fatality rate from COVID-19 in Ukraine (3.24%) may be an overestimation. This is due to the possibility of lower occurrence testing given the ongoing war or possibly under-reporting of cases by media or government sources. Nations surrounding Ukraine that experienced an influx of refugees will also be likely to experience a surge in COVID-19 cases,<sup>14</sup> resulting in possible increases in hospitalisations and deaths from COVID-19. Other infectious diseases, including the pre-existing high level of mortality and disability from tuberculosis and drug-resistant tuberculosis in Ukraine, are expected to worsen because of the war.

Beyond the reported number of physical injuries and deaths from war, and disruption in delivery of healthcare and health services, there may be an additional health burden as a result of the 2022 Russia-Ukraine War. While we have no data to present on issues related to mental health, past war experiences included post-traumatic stress disorders, which affect veterans and civilians. Even before the war, few Ukrainians had access to mental health services.<sup>12 13</sup> The war will likely exacerbate the mental healthcare needs of both young and old Ukrainians.<sup>42</sup>

Ecological and environmental destabilisation also leaves behind unintended lasting impacts. Fires at oil depots and/or nuclear sites, and ammonia leaks at industrial sites (Sumy region) can lead to exposure sites retaining toxic chemicals and radiation, as well as air pollution. Such exposures can pose a threat to long-term respiratory and other chronic diseases. Also, Russian troops occupied the Chernobyl nuclear power



plant, dug trenches in the most contaminated part of the Chernobyl exclusion zone, used “significant doses” of radiation, and contaminated the vast areas they travelled.<sup>43</sup> Another source of radiation pollution may be the Zaporizhzhia nuclear power plant, which is the largest in Europe. The plant was shelled by Russian tanks on 4 March; the condition of its five power units remains unknown.

As a result of shelling and bombing in areas with active hostilities, vital infrastructure was destroyed that could impact the safety and well-being of Ukrainians. Disruptions in utilities such as electricity, gas, and water, as well as communication services will have a major impact on the quality of life and well-being of Ukrainians. Nearly 30% of Ukrainian physical infrastructure may have been damaged or destroyed during the timeframe used for our study.<sup>44 45</sup> As of 1 August 2022, nearly 123 000 houses were destroyed by Russian attacks.<sup>46 47</sup>

The strengths and limitations of this study warrant discussion. It is possible that news outlets reported fewer cases or lost track of the actual number of cases during the war. Furthermore, our study was descriptive, as the data presented in the figures do not fully reflect the full human cost of war in Ukraine. The data on mortality and injury did not come solely from government surveillance. While government surveillance data may be more comprehensive and standardised in times of peace, such data may not likely be accurate in times of war, particularly if the national defence is at stake. The data are likely an underestimation given that we may not have 100% coverage of the entire Ukraine population during the war. One component of this study provides data on deaths and injuries from direct attacks. The aggregate number of people reportedly injured compared with people reportedly killed in this study suggested either high lethality or significant under-reporting of injuries, which is a possibility. Also, this study provides data on more obvious types of attacks, for example, missile attacks, and attacks resulting in violent deaths that are more likely to be reported or covered by the media. Previous reporting by Hagopian<sup>48</sup> for example, found that shootings were the most common type of killing event, which is different from our findings and others.<sup>49 50</sup> In addition, our study would not be able to represent violent deaths directly from executions, beatings, or rape by military forces, because these are less likely to be quantified, reported, or recorded. This is likely the result of incomplete newspaper or media reporting.<sup>49 50</sup> We do not have further details regarding the Ukrainian government’s method(s) of data surveillance. Lastly, the exact number of injured and dead may never be fully known given unmarked mass graves.<sup>51</sup> However, our data are timely, and from multiple reliable sources verified by Ukrainian newspapers and collaborators.

## CONCLUSION

In conclusion, the impact of the recent Russian invasion of Ukraine has caused massive injuries and deaths, destroyed infrastructure and healthcare systems, and prevented timely production and delivery of pharmaceuticals and medical supplies. In addition, the bombing and shelling of healthcare facilities and residential homes, the killings, and countless civilians unaccounted for, are immense human rights violations. This war will have a long-term impact on the physical and mental health of generations of Ukrainians. Ukraine’s infrastructure, health, utility and other essential systems must be rebuilt to ensure appropriate recovery for the country and its people. Continued surveillance and support is imperative to help mediate the long-term effects of the war and to rebuild Ukraine.

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