Evidence of Widespread and Systematic Bombardment of Ukrainian Healthcare Facilities

SUMMARY

17 MAY 2022

EXECUTIVE SUMMARY | The Yale Humanitarian Research Lab (HRL) has identified 22 healthcare facilities in Ukraine that sustained damage from apparent Russia-aligned bombardment between 24 February and 29 March 2022. The HRL verified damage through cross-corroboration of very high resolution satellite imagery and open source information. Based on a review of nearly 300 facilities across five cities and regions, the HRL has concluded that Russia-aligned forces have engaged in widespread and systematic bombardment of Ukrainian healthcare facilities.

The HRL’s full report was provided to the Organization for Security and Co-operation in Europe’s (OSCE) Moscow Mechanism mission of experts.1 The following summary presents the key findings of the full report, including a more detailed explanation of the methodology used by HRL and a geographic breakdown of where apparently damaged facilities have been identified. Only the summary is being released due to the highly sensitive nature of the location data contained within the full report transmitted to the OSCE.

OVERVIEW | The Yale Humanitarian Research Lab (HRL) has identified 22 healthcare facilities in Ukraine that sustained damage from apparent Russia-aligned bombardment between 24 February and 29 March 2022. The HRL verified damage through cross-corroboration of very high resolution satellite imagery and open source information. Based on a review of nearly 300 facilities across five cities and regions, the HRL has concluded that Russia-aligned forces have engaged in widespread and systematic bombardment of Ukrainian healthcare facilities.

The HRL’s full report was provided to the Organization for Security and Co-operation in Europe’s (OSCE) Moscow Mechanism mission of experts. Due to the report’s granularity and the potential use of sensitive information for targeting purposes, only this summary and examples of annotated imagery depicting damage to seven (7) of these health facilities (including before/after imagery, 20 images total) are being released publicly. The full report will be made available as needed to international accountability mechanisms.

The HRL verified visible damage at approximately eight percent of the 277 facilities. The total assessment classified facilities as sustaining “no visible,” “minimal,” “partial,” “significant partial,” or “total” damage based on available satellite imagery at the time. The initial report does not attempt to determine whether an individual incident of a healthcare facility being bombarded is the result of indiscriminate fire or intentional targeting. It is important to note that both indiscriminate and intentional targeting of healthcare facilities can constitute a war crime.

LEGAL CONTEXT | Healthcare facilities and medical personnel are protected by international humanitarian law (IHL). These protections are enshrined in the 1949 IV Geneva Conventions. Violations of prohibitions against attacking these protected objects can constitute a war crime under the Rome Statute of the International Criminal Court (ICC).

FINDINGS | A total of 277 healthcare facilities were identified and examined in Mariupol, Kharkiv, Kyiv Oblast, Chernihiv, and Izyum. As stated above, the HRL verified damage sustained by 22 of those 277 facilities (approximately 8 percent). The HRL classified levels of damage based

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on satellite imagery analysis. Based on damage visible in satellite imagery captured between 24 February and 29 March 2022, three (3) healthcare facilities sustained total damage while nineteen (19) facilities sustained significant, partial or minimal damage. Eleven (11) facilities were classified as having surrounding visible damage. The evidence of bombardment-related damage to healthcare facilities presented below was universally not visible in satellite imagery captured prior to 24 February 2022.

### SUMMARY STATISTICS

<table>
<thead>
<tr>
<th>Location of facility</th>
<th>Locations Identified</th>
<th>Imagery Available</th>
<th>Apparently Damaged Facilities Present in Imagery</th>
<th>Damage to Surrounding Area Present in Imagery</th>
<th>Supporting Open Source Material</th>
<th>Open Source and Imagery Cross-Corroborate Damage to Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mariupol</td>
<td>22</td>
<td>22</td>
<td>Total = 1&lt;br&gt;Significant Partial = 3&lt;br&gt;Partial = 6&lt;br&gt;Minimal = 4&lt;br&gt;No visible damage = 2</td>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Kharkiv</td>
<td>63</td>
<td>61</td>
<td>No visible damage = 63</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Kyiv Oblast</td>
<td>172</td>
<td>118</td>
<td>Total = 1&lt;br&gt;Partial = 2&lt;br&gt;No visible damage = 167</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Chernihiv</td>
<td>17</td>
<td>17</td>
<td>Significant Partial = 2&lt;br&gt;Partial = 1&lt;br&gt;No visible damage = 12</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Izyum</td>
<td>3</td>
<td>3</td>
<td>Total = 1&lt;br&gt;Partial = 1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>277</strong></td>
<td><strong>221</strong></td>
<td><strong>22</strong></td>
<td><strong>11</strong></td>
<td><strong>15</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>

**ASSESSMENT & METHODOLOGY** | This report defines healthcare facilities as hospitals, clinics, and other types of medical treatment facilities. The HRL examined healthcare facilities located in Mariupol, Kharkiv, Kyiv Oblast, Izyum, and Chernihiv. The HRL classified the evidence of damage to healthcare facilities through satellite imagery as “not visible,” “minimal,” “partial,” “significant partial,” or “total” damage. This damage scale aligns with damage scales used by the United Nations Satellite Centre (UNOSAT) for complex emergencies. Additionally, sites were classified as having “surrounding visible damage” if there was damage within a 400 meter radius of the healthcare facility, but no visible damage to the facility itself was assessed. This reflects the potential impact of aerial bombardment within approximately 400 meters of a facility, which can lead to blown out windows and doors, as well as damage to exterior walls that may not be readily apparent in satellite imagery.

The investigative methodology for this report combines very high resolution (VHR) satellite imagery analysis and open source investigation. The VHR imagery used to support this investigation was unclassified, commercially available imagery captured by Maxar Technologies, Planet Labs, and other commercial satellite imagery providers. The high level of spatial and temporal resolution in this imagery allowed analysts to closely assess changes in infrastructure and the natural environment, both of which often visibly reveal the impacts of war.

Healthcare sites in the five (5) cities and regions were identified using open source datasets and map products. Specific alleged incidents of bombardment were identified using photographic and videographic evidence from open sources. This methodology relied on identifying, re-verifying and citing the work of other open source investigative groups whose fact-checking practices were
clearly documented. The team utilized current best practice standards in open source geolocation consistent with training by the Human Rights Center at UC Berkeley School of Law, including the use of specific visual identifiers, building features, and other visually apparent data (and available metadata) across multiple media sources to confirm the precise coordinates of a site and its function as a medical facility.

The HRL reviewed satellite imagery to assess visible damage based on the timeline and location of incidents identified. Multiple geospatial analysts analyzed available satellite imagery for each facility across a range of pre- and post-incident dates. The analysts assessed the imagery and noted if the facility and/or its surroundings were visibly damaged and to what extent, while also commenting on any limitations related to image quality, availability, obscuration by trees or clouds, and angle of capture. Open source investigation provided additional verification of incidents using publicly available materials.

Building damage assessments conducted primarily using satellite imagery limit what is visible to analysts and may not always show damage, even extensive damage, to a structure’s sides and interior. Off-nadir satellite imagery provides additional angles for assessment. This report provides a conservative estimate of damage at the sites located. Combining this data with ground-level assessments and additional sensors would more accurately capture the full scope and degree of damage, and should be expected to return higher figures and more detailed ratings overall.

The HRL investigated 277 health facilities. The full report includes:

- Legal context, background of events documented, full methodology, challenges and limitations;
- Case files with supporting documentation of geolocation, methodologies used, and imagery analysis annotation;
- Annex of sites identified and classification of visible building damage;
- Annotated imagery with satellite source, acquisition date, ground sampling distance, off-nadir angle, damage classification, key findings showing pre- and post-impact of apparent bombardment on structures; and
- Image files (unannotated) and complete associated metadata.

**IMAGERY** | Imagery provided under US Department of State NextView license to the Humanitarian Research Lab at Yale University School of Public Health.

All imagery © 2021, 2022 Maxar, NextView License

Image from 2022.03.18 shows the roof of the hospital (no visible damage) prior to observations of damage in the area.
Image from 2022.03.29 shows damage to the roof of the hospital and debris along the hospital's southeastern side, along with damage to structures located roughly northeast and southwest of the facility.

Damage: Significant Partial
Image shows in closer definition the severe partial damage to the roof of the hospital as well as damage to surrounding structures.

Damage: Significant Partial
Image from 2022.03.14 shows the roof of the hospital without visible damage.
MARIUPOL MATERNITY HOSPITAL No.2

Damage: Partial

Image from 2022.03.29 shows damage to the roof of the hospital, and to many of the structures in the immediate surroundings.
MARIUPOL MATERNITY HOSPITAL No.2

Date: 2022.03.29
Source: WV03_VNIR
Ground Sampling Distance: 34 cm
Off-Nadir: 18.1501

Image shows damage to the roof of the hospital.

APPARENT DAMAGE TO HOSPITAL ROOF

Damage: Partial
Image from 2021.06.21 shows the appearance of the hospital before the start of the full-scale invasion on 2022.02.24.
Image from 2022.03.13 shows debris scattered on the southern side of the hospital and two buses appearing to block the road to the hospital’s south.

Damage: Partial
Image shows debris scattered on the southern side of the hospital, buses appearing to block roads to the hospital's south and northwest, and damage to nearby buildings north and east of the hospital. Damage to the hospital's southern facade appears consistent with direct impact.

Damage: Partial
Image shows more closely evidence of debris scattered on the southern side of the hospital and buses appearing to block the road to the hospital's south. Damage to the south-facing facade appears consistent with direct impact.

Damage: Partial
MARIUPOL CITY
HOSPITAL No.2

Date: 2022.03.29
Source: WV03_VNIR
Ground Sampling Distance 38 cm
Off-Nadir: 27.186735

Image from 2022.03.29 shows apparent debris scattered on the southern side of the hospital and a vehicle blocking access to the hospital's northwest.

Clusters that appear consistent with groups of people appear outside.

Damage: Partial

Satellite imagery
©2022 Maxar, NextView License
MARIUPOL TERRITORIAL MEDICAL ASSOCIATION
FOR CHILD AND WOMEN’S HEALTH

Date: 2022.03.09
Source: WV03_VNIR
Ground Sampling Distance: 43 cm
Off-Nadir: 33.761036

Image from 2022.03.09 shows the hospital building prior to observations of damage.

NO VISIBLE DAMAGE OR DEBRIS
Image from 2022.03.23 shows apparent debris on the east side of hospital building.

Damage: Minimal
Image shows apparent debris on the east side of hospital building and damage consistent with direct impact on other hospital buildings.

Damage: Minimal
Date: 2022.03.14
Source: WV02
Ground Sampling Distance: 50 cm
Off-Nadir: 32.9965

Image from 2022.03.14 shows no visible damage.
Image from 2022.03.29 shows extensive debris, apparent scarring on southernmost rooftop.

Damage: Minimal
Image from 2022.03.18 shows no visible damage to the Ukrainian Red Cross office and surrounding area.
Image from 2022.03.29 shows the appearance of the total damage to the Red Cross Ukraine office and surrounding area.

Damage: Total

UKRAINIAN RED CROSS OFFICE

Date: 2022.03.29
Source: WV03_VNIR
Ground Sampling Distance: 38 cm
Off-Nadir: 27.1867
Close up image from 2022.03.29 shows the appearance of the total damage to the Red Cross office and surrounding area.

Damage: Total

NO ROOFS OR FUNCTIONAL STRUCTURES APPARENT
Image from 2022.03.20 shows the clinic prior to destruction, though there is apparent damage to structures east and northeast of the clinic before the clinic’s destruction.
Image from 2022.03.24 shows that the roof, previously blue, was completely destroyed. Damage was also observed to structures approximately 200 meters west.

IZYUM CITY POLyclinic/Center for Primary Health

Damage: Total

- Roof destroyed
- Damage to at least 3 structures
- Approx. 200m W of Polyclinic
IZYUM CITY POLYCLINIC/ CENTER FOR PRIMARY HEALTH

Image from 2022.03.24 shows that the clinic sustained severe damage, including a large hole measuring approximately 30x10 meters on the building’s eastern side.

Damage: Total

HOLE, APPROX. 30 X 10 METERS

TOTAL DAMAGE: ROOF DESTROYED