ST open

RESEARCH ARTICLE

The impact of war on the practice of cytopathology in Ukraine

Oksana Sulaieva, Pavlina Botsun, Olena Koshyk, Iryna Omelianenko, Mariia Burkatska, Igor Panko, Tetyana Meged, Svitlana Pischanska, Valentyna Korpachova, Oleksandr Dudin

Medical Laboratory CSD, Kyiv, Ukraine

Aim: To investigate the impact of Russian invasion on Ukrainian healthcare services related to cytopathology screening and diagnostics.

Methods: The workload and output of the cytopathological laboratory located in Kyiv before and during 8 months of Russian invasion were analyzed. The laboratory performance was assessed by the total number of cytologic cases, the turn-around time (TAT) index, and the percentage of timely reported test results. The geographic distribution of cases was also analyzed.

Results: There was a significant decline in the workload of the laboratory during the first two months of the war, and the numbers of cytopathology specimens fell to less than one third of prewar levels, and the TAT was prolonged. Since May 2022, the efficiency and quality of cytopathologic testing has been largely restored in most parts of Ukraine, only to be affected again by increased Russian bombardment toward the end of summer 2022. The number of cytology specimens was reduced and the source of cytology specimens changed from the prewar conditions reflecting the relocation of the CSD Lab to western Ukraine.

Conclusion: Cytolopathological screening and diagnostics were seriously disrupted in Ukraine during the Russian invasion resulting in a decreased volume of cytology specimens received in the CSD Lab during the early months of the war. By adapting to the war conditions and reorganizing the cytology services, CSD Lab has continued providing cytology services at a level of efficiency similar to those of the prewar period. However, the volume of cytology specimens remains much smaller than before war, indicating that the cytology services have been adversely affected by the war.

Keywords: cytopathology; health disparities; PAP-test; oncology; Ukraine; war terror

Correspondence to:
Oksana Sulaieva
Medical Laboratory CSD, Vasylkivska street, 45. Kyiv, Ukraine
o.sulaieva@csd.com.ua

Cite as:
Sulaieva et al. The impact of war on the practice of cytopathology in Ukraine. ST-OPEN. 2023; 4: e2023.2219.3.

DOI:
https://doi.org/10.48188/so.4.1

Introduction

The Russian invasion of Ukraine and the unprovoked war that followed heavily affected the life and health of the entire Ukrainian population [1]. Active military actions and bombings have resulted in a loss of thousands of civilian lives, and even more civilians were wounded and evacuated [2]. Tragically, most of those wounded or killed were elderly, women, and children. and other vulnerable groups of the population. By now more than 7.8 million people became refugees and over 6.5 million people were internally displaced [3].

Currently, about 20% of the territory of Ukraine is occupied by Russian aggressors denying the inhabitants of occupied regions access to medical care. The humanitarian disaster caused by Russian invasion is further exacerbated by the low functionality and viability of healthcare facilities – many hospitals were destroyed in missile attacks and shelling, while many clinics were abandoned due to combat activity or occupation [4].

Damage inflicted to the infrastructure and daily facilities and continuous military attacks directed at the civilian populations have dramatically changed the daily life of most Ukrainians. War related injuries and stress related pathology have affected people's health; they have also imposed new demands on the delivery of health care services, which had to adjust to new realities of war time medicine. In most hospitals and ambulatory facilities priority had to be given to trauma surgery and the care for wounded and incapacitated people. The care for chronic disease patients had to be restructured reduced and adapted to cover only the basic needs of the population. In this context it is quite understandable that the war had profound effect on the oncology services and the consequences of the practice changes that had to be instituted might not be easily assessed for some time to come.

Laboratory testing is crucial for early diagnosis of cancer and this ancillary service is an important aspect of prevention of cancer. It has been well established that about 70% of clinical decisions are based on screening and diagnostics provided by laboratory services [5]. Cytopathology plays an essential role in preventive oncology and modern medicine cannot be imagined without the input provided by laboratory services and cytopathology services in particular [5].

Under normal conditions, cytological specimens such as PAP smears are obtained routinely for cancer screening. Non-gynecology cytopathology (NGC) specimens obtained mostly by fine needle aspiration biopsy are an important part of the cancer diagnostic work-up and for monitoring of neoplastic diseases, as well as for the follow up and prognostic evaluation of treated cancer patients [6]. Since the beginning of the Russian invasion, most cytopathologic screening procedures (including cancer screening) in Ukraine were minimized or postponed [7], jeopardizing the ability of medical personnel to provide means for early detection of cancer. However, even so, laboratory professionals are still expected to provide timely diagnoses for patients with suspected cancer and premalignant conditions since the delay of diagnosis may seriously imperil their health.

We work at the CSD Lab in Kyiv, one of the largest private medical laboratories in Ukraine. We provide a wide range of services in clinical and anatomical pathology, including cyto-

pathology. Cognizant of our responsibilities to the society but also aware of the problems imposed by the Russian invasion, we have tried to provide the best possible cytopathology services in Ukraine during this war. In the present paper we analyze the functioning of our cytopathology services in Ukraine during the first few months of the war. We show how the war has affected our cytopathology service and how we have adapted to the less-than-optimal conditions to provide the essential services to our compatriots.

Methods

We routinely collect data on all aspects of our laboratory services. These data are stored electronically in our files. We have retrieved these records and from them we have analyzed the activities of the cytopathology laboratory before and during first 8 months of the Russian invasion. These data were analyzed using the GraphPad Prism 8.0 software (V. 8.0.2, GraphPad Software, San Diego, CA, USA). The following parameters were used for the assessment of the laboratory workload and performance:

1) the total number of cases in gynecological (exfoliative) and non-gynecological cytopathology (NGC),

2) turn-around time (TAT) and the percentage of timely reported tests,

3) the geographic distribution of cases.

Results

Due to the immediate threat of missile attacks and combat action near Kyiv during the first few weeks of Russian invasion, CSD Lab's our emergency plan called for the relocation of facilities to the Lviv area in the western part of Ukraine. The relocation of lab facilities (including the safe accommodation for staff members) was completed by the beginning of March 2022. Following the rearrangement of the supply chain for cytological specimens, CSD Lab became fully operational within days of translocation providing screening and diagnostic services at the new site.

Dynamics of cytological testing during the wartime

Before the Russian invasion, cytopathologists of the CSD Lab performed between 11000 and 13000 PAP tests per month (i.e., about 3000 cases per week) (**Figure 1**). Since the beginning of the invasion, the number of cytological cases, including PAP and NGC was reduced significantly, reaching the nadir in mid-March 2022. The numbers of cytology specimens increased but remained at the level of one third from the prewar times. The relative increase of NGC cytology specimens in April was more pronounced than the increased of PAP cytology tests probably reflecting the greater need for diagnostic cytology procedures than for gynecologic cytology screening (**Figure 1**).

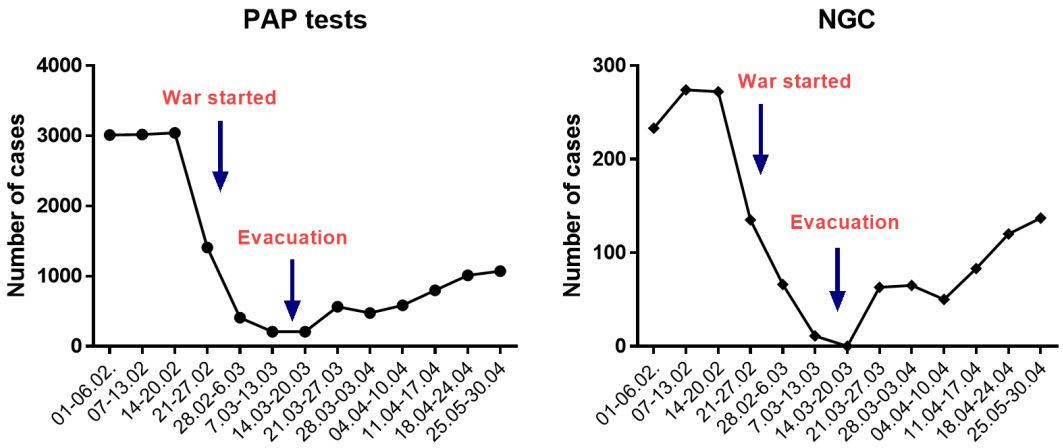

Figure 1. The weekly dynamics of PAP smears and NGC (non-gynecologic cytopathology) tests performed in the CSD Lab. The onset of the war and the evacuation of the laboratory to Western Ukraine are marked by arrows.

The number of performed PAP tests and NGC tests in March and April 2022, i.e., during the first two months after the beginning of the Russian invasion was substantially lower compared to the same period in 2021. In March and April 2022, the number of PAP tests was reduced to 1391 (March 2022) and 2503 (April 2022) which was 9 times (12800) and 5.5 times (11178) lower than in March and April 2021, respectively. A similar trend was recorded for NGC specimens (**Figure 2**). However, in May 2022 the number of PAP tests and NGC tests slowly increased and reached about 70% of the number of PAP tests and NGC tests from the same period in 2021 and kept increasing till August 2022. By that time, the total number of PAP tests and NGC tests was comparable to the pre-war figures (**Figure 2**). Due to renewed Russian missile attacks on civilian targets and infrastructure during September and October 2022, the numbers of cytological specimens received in the CSD Lab dropped again.

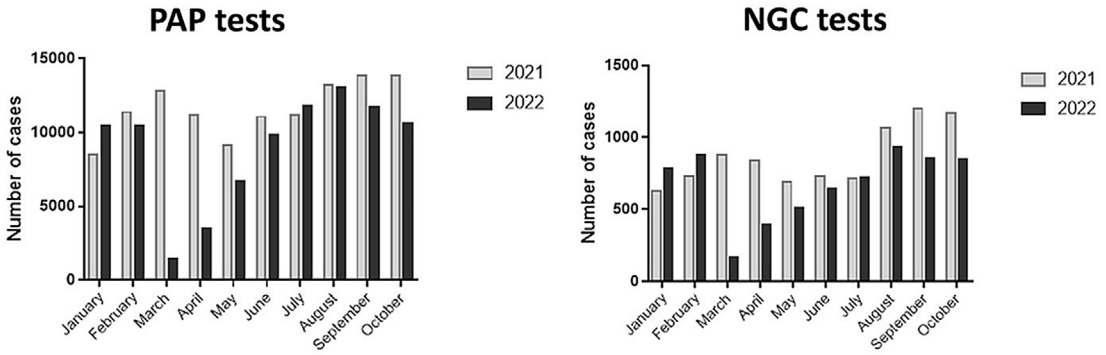

Figure 2. CSD Lab cytopathology workload from January till October in 2021 and 2022.

Maintenance of laboratory services in wartime conditions

The wartime conditions have affected many aspects of CSD Lab operations including sample collection, delivery of consumables, working hours, and work schedules. This was reflected in the parameters measuring routinely the laboratory performance indicators, such as TAT and the percentage of reports dispatched on time (**Figure 3**).

Before the invasion, cytological specimens received from Kyiv residents were processed and reported to the senders in Kyiv and its surroundings within 2 days (48 hours) from receipt. It took up to 3 days (72 hours) to fully process cytological specimens from other regions of Ukraine. The overall TAT of PAP-tests was 41.62±4.11 hours, and the percentage of timely reports was 97.9%. During the first 2 months following Russian invasion, the processing time for cytological specimens was extended up to 5 days. TAT was also extended to 56.8±5.9 hours, amounting to a prolongation of the processing/reporting period by 37%. Furthermore, the percentage of timely reports dropped to 31% for PAP tests, and 12.5% for NGS tests relative to pre-war standards. By optimizing the transportation of cytological samples during April 2022, the laboratory performance indices were significantly improved, and by May 2022, the percentage of timely reports was 95% which was comparable to the pre-war standards. However, another prolongation of TAT was recorded in September and October 2022, albeit less significant than in March and April 2022. This coincide with an increased level of missile attacks on civilian targets and infrastructure which disrupted electric power and water supply and interfered with the daily logistics of our laboratory.

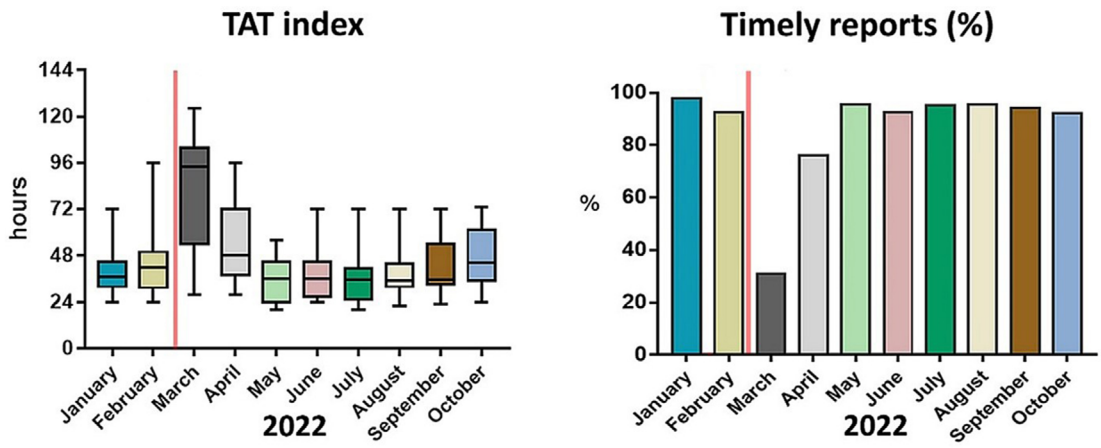

Figure 3. Turn-around time (TAT index) and percentage of timely reports as indicators of CSD Lab performance in 2022. Periods before and during the Russian invasion are separated by the red vertical line.

Geographic distribution of customers for cytological services before and during the Russian invasion

In the prewar period CSD Lab has been receiving routinely cytopathology samples from governmental and private clinics from all regions of Ukraine. Before the invasion, about half of all cytopathological samples arrived from the northern regions of Ukraine including the greater Kyiv area and the capital itself. The remaining specimens were collected from eastern (17.4%), western (12.5%), southern (13.5%), and central (6.3%) regions of

Ukraine (**Figure 4A**). During the first two months of the Russian invasion samples from western Ukraine increased to 41% of all specimens received by the CSD Lab probably reflecting in part the fact that the laboratory was relocated to western parts of Ukraine (**Figure 4B**). The proportion of cytopathological samples from other parts of Ukraine decreased proportionately. The decrease was most prominent in the eastern part of Ukraine, reflecting the severity of combat activities in that part of the country. CSD Lab offices in cities occupied by Russians (such as Kherson, Mariupol, and Melitopil) were closed and became nonoperational.

Since May 2022, the demand for CSD Lab services from Kyiv and other cities in northern Ukraine increased proportionally. The number of specimens from eastern provinces remained low amounting for less than one half of prewar numbers for that region. We think that this reduced influx of cytology specimen was caused mostly by severe military activities in the eastern regions (**Figure 4C-I**).

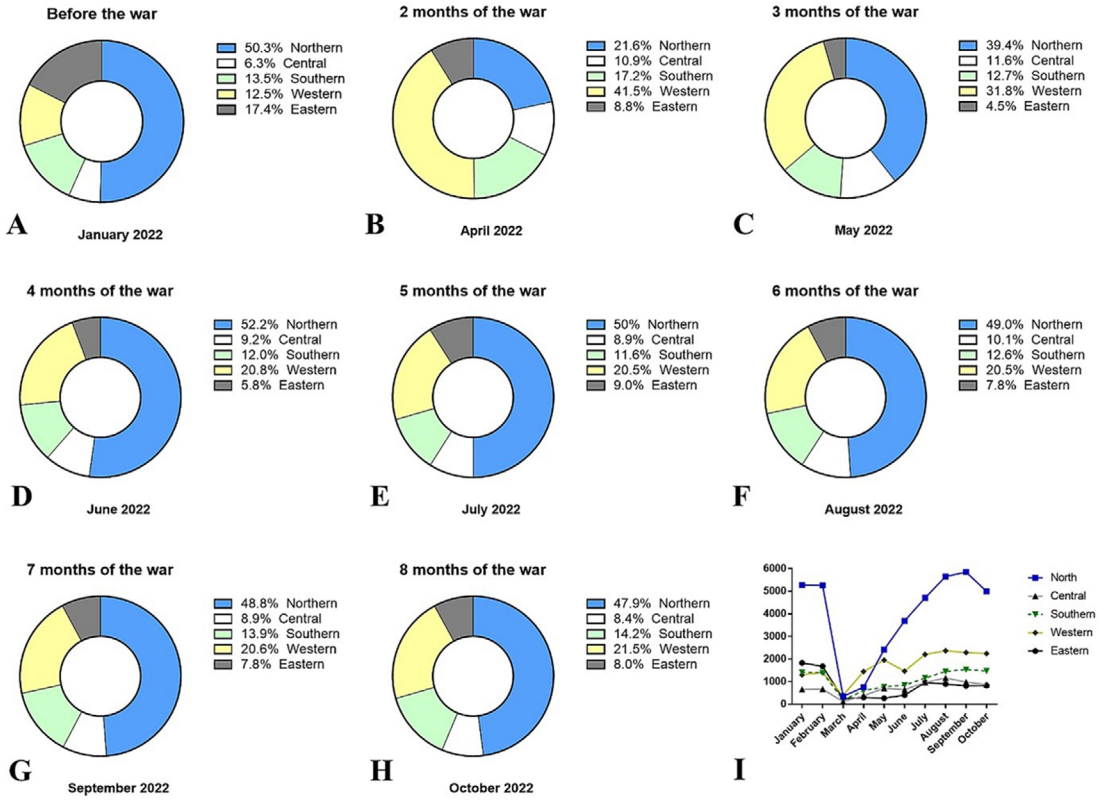

Figure 4. Geographical distribution of cytopathological samples processed in CSD Lab before (A) and during 8 months of the Russian invasion (B-I).

Discussion

The unprovoked war initiated in February 2022 by the Russians and followed by an invasion of large parts eastern Ukraine and bombing of infrastructure and civil populations in the entire country caused a major tragedy and affected the lives of all Ukrainians [8]. This humanitarian disaster was followed also by changes in the delivery of healthcare services [9]. Due to military actions, millions of Ukrainian people had to leave their homes, emigrated abroad, or became internally displaced in Ukraine. These population changes

were particularly challenging for those with chronic illnesses and systemic conditions, such as oncology care patients [10].

According to the Ukrainian National Cancer Institute (NCI), at the onset of Russian invasion, about 139 000 individuals in Ukraine were living with recently diagnosed cancer [9]. Many oncology patients under medical care were relocated to European countries where they are currently treated. However, most Ukrainians suffering from malignancies still reside in Ukraine and need regular medical treatment. Some cancer treatment services, including inpatient and outpatient chemotherapy, urgent surgery, and palliative care, have been available at the Ukrainian NCI and other regional Ukrainian centers for cancer treatment [9]. Unfortunately, the services of cancer diagnostics and screening were not available in many centers for cancer treatment. Many healthcare institutions were damaged due to missile attacks and military actions, others ceased to operate because of frequent air raids and the risk of destruction [11]. Furthermore, many physicians and laboratory technicians had to be relocated causing staff shortages [1].

In this paper we show that even the cytopathology services were negatively affected and even partially disrupted by the war. This has also been demonstrated by the substantial drop in routine diagnostics and screening services in cytopathology such as PAP tests [6, 12]. It should be noted that even before the Russian invasion, the prevalence of cervical cancer in Ukraine was very high due to the lack of national anti-HPV vaccination and cervical screening programs [13]. Comprehensive healthcare reforms were initiated in 2014 to mitigate these issues [7]. However, the reforms (which included financial investments in medical facilities) were disrupted by the Russian invasion. Consequently, most "non-emergency" medical services and procedures were either postponed or suspended. This includes cervical screening and non-gynecological cytological diagnostics.

Impaired logistics and a shortage of consumables also contributed to the lower performance of medical laboratories throughout Ukraine. However, as demonstrated by the example of the CSD Lab presented here, a gradual adaptation of operations to wartime conditions is possible. As a result, the laboratory performance can be increased so that reliable cytological diagnostics and screening can be provided to patients despite ongoing military activities.

In summary, the Russian invasion has severely affected cytologic practices resulting in a reduced number of PAP cytologic and non-gynecologic cytologic diagnosis. The war slowed down the processing and reporting of cytology specimens, but these aberrations were rapidly corrected as the CSD Lab personnel adjusted to the wartime conditions. The uninterrupted functioning of the CSD Lab during the war is a guarantee that this laboratory could resume its full-time activities once the war ends.

Provenance: Submitted. This work is part of the Translational Research in Biomedicine (TRIBE) doctoral program project "Giving voice" aimed at helping Ukrainian authors to publish their war-related experiences.

Peer review: Externally peer reviewed.

Received: 18 January 2023 / **Accepted:** 22 February 2023 / **Published online:** 5 April 2023.

Funding: This research received no specific grant from any funding agency in public, commercial or not-for-profit sectors.

Authorship declaration: OS, PB, OK, IO, MB, IP, TM, SP, VK, OD participated in the definition of a work topic and conducted all the experimental parts of the work and thus contributed to the collection, analysis, implementation of the estimate, and interpretation of the data. OS et. al wrote the first version of the manuscript and contributed to the revisions. OS et.al devised the original work topic and contributed to the experimental design, research concepts, data collection, analysis, and interpretation. They all participated in manuscript revisions.

Competing interests: The authors completed the ICMJE Unified Competing Interest form (available upon request from the corresponding author), and declare no conflicts of interest.

ORCID

Oksana Sulaieva https://orcid.org/0000-0002-9614-4652

References

1. Gordiichuk P, Kliusov O, Gordiichuk M, Kondratenko A, Ponomarova O, Grushynska T, et al. A view on the problem of providing oncological aid during the war in Ukraine. Contemp Oncol (Pozn). 2022;26(3):191–5.
2. OHCHR. Ukraine: civilian casualty update 2022 [cited 2022 18th November]. Available from: https://www.statista.com/statistics/1293492/ukraine-war-casualties/.
3. UNHCR. Operational data portal, Ukraine situation Flash Update #35. Unated nations High Commissioners for Refugees 2022 [cited 2022 20th November]. Available from: https://data.unhcr.org/en/documents/details/96923.
4. Shkodina AD, Chopra H, Singh I, Ahmad S, Boiko DI. Healthcare system amidst the war in Ukraine. Ann Med Surg (Lond). 2022;80:104271.
5. Troncone G, Roy-Chowdhuri S. Modern Cytopathology: An evolving field. Cytopathology. 2021;32(5):560–561. doi: 10.1111/cyt.13000.
6. Vigliar E, Cepurnaite R, Alcaraz-Mateos E, Ali SZ, Baloch ZW, Bellevicine C, et al. Global impact of the COVID-19 pandemic on cytopathology practice: Results from an international survey of laboratories in 23 countries. Cancer Cytopathol. 2020;128(12):885-94.
7. Kolesnyk P, Frese T, Vinker S, Shushman I, Zharkova A, Messaadi N, et al. Steps towards implementing evidence-based screening in family medicine in Ukraine: SWOT-analysis of an approach of multidimensional empowerment. BMC Fam Pract. 2021;22(1):20.
8. Roborgh S, Coutts AP, Chellew P, Novykov V, Sullivan R. Conflict in Ukraine undermines an already challenged health system. Lancet. 2022;399(10333):1365–7.
9. Kizub D, Melnitchouk N, Beznosenko A, Shabat G, Semeniv S, Nogueira L, et al. Resilience and perseverance under siege: providing cancer care during the invasion of Ukraine. Lancet Oncol. 2022;23(5):579-83.

10. Puskulluoglu M, Grela-Wojewoda A, Szczubialka G, Zemelka T, Lompart J, Salek-Zan A, et al. Cancer care for Ukrainian refugees during the first 6 weeks of 2022 Russian invasion - an experience of a cancer reference centre in Poland. Eur J Cancer. 2023;178:234–42.

11. Kovalchuk N, Beznosenko A, Kowalchuk R, Ryzhkova J, Iakovenko V, Kacharian A. While Ukrainian Soldiers Are Fearlessly Defending Their Country, Ukrainian Oncologists Are Bravely Battling Cancer. Adv Radiat Oncol. 2022;7(6):100965.

12. Vigliar E, Pisapia P, Dello Iacovo F, Alcaraz-Mateos E, Ali G, Ali SZ, et al. COVID-19 pandemic impact on cytopathology practice in the post-lockdown period: An international, multicenter study. Cancer Cytopathol. 2022;130(5):344–51.

13. Volodko N. A modern view on the cervical cancer screening: Ukrainian and global experience. Proc Shevchenko Sci Soc Med Sci. 2018;54(2):94–107.