

Introduction: Providing oncological care in conflict conditions is a difficult test for the country's health care system, especially if aggression is carried out in violation of the main international rules of conduct of war, the treaties of the Geneva Convention, when the aggressor attacks the civilian population.

Material and methods: Having conducted an analysis of the style of military operations conducted by the aggressor and the peculiarities of the territories of Ukraine, the quality of providing oncological care before the conflict, the digital transformation of the state, the use of the application Diya by the population, and the functioning of the eHealth electronic medical telecommunication information system, we identified four zones of providing oncological care during martial law.

Results: Each zone is defined and the amount of consultation and diagnostics with subsequent treatment assistance to the population is presented.

Conclusions: Thanks to the practical implementation of the above characteristics, with a constantly functioning Internet network throughout Ukraine with a sufficiently high level of computer literacy of the population and available online means of communication, and in addition to the high level of organization of the Ukrainian and international volunteer service, it was possible to provide a qualified level of oncological care to the population during martial law.

Key words: conflict, organization of cancer care, martial law, humanitarian conflict zones, state and medical telecommunication systems.

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A view on the problem of providing oncological aid during the war in Ukraine

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Introduction

Unprovoked external aggression against sovereign Ukraine led to serious changes in the organization of medical care processes. The issues of diagnosis and treatment of cancer patients with high potential for progression of the disease, the risk of complications, and septic conditions were particularly problematic. The global experience of war conflicts, including Somalia, Sudan, Afghanistan, Syria, Iraq, Pakistan, Chechnya, Gaza, and the Democratic Republic of Congo [1–6], has a number of defining characteristics that are fundamentally different from the situation in Ukraine.

The war demanded radical changes in the diagnosis and treatment of patients with oncological pathology, depending on the changes in the situation, which were difficult to predict.

Ukrainian society encountered the cruelty and cynicism of the Russian aggressor, namely: the violation of the international rules of war and the treaties of the Geneva Convention. Killing of civilians in cities and villages by troops, missile and bomb attacks; shooting, torture, and violence against women and children; targeted destruction of the civil infrastructure – these are the signs of this war of the 21st century.

Material and methods

Ukraine has been in this war since 2014; therefore, a lot has been done in the organization of medical aid. To understand the scale, the following data should be provided. The territory of Ukraine is 603,628 km², that is, 5.7% of the territory of Europe and 0.44% of the territory of the world. According to this indicator, Ukraine is the largest country in Europe, with a population of 43,733 million people (35th place in the world). Oncological care in terms of diagnostic, therapeutic (radiological, surgical, medical), and rehabilitation care was in accordance with National Comprehensive Cancer Network and European Society for Medical Oncology recommendations, which have been recommended by the Ministry of Health of Ukraine for basic use since 2017 [7]. Since 2018, the concept of the development of the digital economy and society has been operating in Ukraine at the state level [8], which provided for: increasing the level of digital literacy of the population; access to high-speed Internet in all communities, and social institutions; the possibility of receiving electronic services using a smartphone, etc. [9]. In 2017, the regulation on the National Health Service of Ukraine was approved at the state level, and the eHealth electronic medical telecommunication information system is functioning, which ensured the automated work of business entities in the field of health care and made it possible to review and exchange information in electronic form with the central database for doctors, medical workers, and heads of medical institutions [10].

The main tasks of oncological care during the war were determined as follows: protection of the patient and medical personnel during the treatment; acting in accordance with the key requirements of oncological protocols as much as possible; preventing the occurrence of additional man-made disasters when using high-tech diagnostic and treatment equipment; forecasting the possibility of completion of diagnostic and treatment measures in a specific zone of military operations; optimization of the volume of oncological care according to the combat zone; use of medical and surgical treatment with minimal and manageable complications; implementation of consultation online and on call.

An attempt was made to substantiate and determine the combat zones, and the possibility of providing oncological care in each of them, which, in our opinion, was based on the following: available tactical and operational information for the protection of the population (orders of the Ministry of Health of Ukraine, resolutions of the Cabinet of Ministers); the existing level of air defense; existing protective structures with the possibility of organizing a diagnostic and treatment process in them; available military or public infrastructure facilities within the territorial boundaries of the community, which may be subject to missile and bomb attacks by terrorist-military groups; the presence of high-tech equipment in the area, which is used in the diagnostic or treatment process when providing oncological care according to protocols.

Depending on the available information, the following zones were formed for the oncological treatment:

- 1st zone – active hostilities (humanitarian disaster),
- 2nd zone – high probability of missile/bomb damage (humanitarian problems),
- 3rd zone – average probability of missile/bomb damage (humanitarian alertness),
- 4th zone – low probability of missile/bomb damage (humanitarian stability).

In accordance with the defined zones, the oncological treatment was divided into two components: consultation, diagnostics, evacuation; and medical treatment. In the first zone of active hostilities (humanitarian disaster), treatment of cancer was not provided; the priority was the evacuation of children with cancer by specialized or volunteer transport to the fourth zone or outside the state. Adult cancer patients with complicated oncological pathology (bleeding, peritonitis) were evacuated to the second zone by a volunteer or territorial defense transport, in the absence of functioning in the zone of a multidisciplinary medical facility and the impossibility of providing it with emergency surgical treatment.

In the first 3–4 weeks of the military aggression, the oncological institutions of Kyiv were on the border of the first and second zones, as active combat operations were conducted on the outskirts of the city and enemy subversive groups in the city were eliminated. Since March 9, 2022, according to our analysis, the oncological treatment provided in Kyiv has been in the second zone – a high probability of rocket/bomb damage (humanitarian problems). Therefore, oncological treatment was provided in bomb shelters: consultative and diagnostic assistance to patients

with suspected or oncological pathology was provided both face-to-face and remotely with the help of messengers and a hotline of the medical facility that makes it possible to control the time of receiving care for a specific patient. The following were carried out: general clinical, laboratory, and biochemical examinations; X-ray (scopic, graphic, contrast) studies; sonographic examinations were more widely used; endoscopic examinations (gastroduodenoscopy, esophagogastroduodenoscopy, oesophagogastroduodenoscopy, and others); pathomorphological studies, limited performance of immunohistochemical and molecular genetic studies; spiral computed tomography if there was a safe place to conduct it. Medication-assisted treatment was carried out in bomb shelters in accordance with the following principles: refusal of weekly regimes in order to minimize the number of visits to a medical institution and intensified chemotherapy regimes for high-risk cases of developing febrile neutropenia, thrombocytopenia; limited use of drugs for high-risk cases of developing infusion reactions.

If possible, replacement of long-term infusions with tableted drugs, reduction of the number of cycles of adjuvant chemotherapy and targeted treatment, early transition to hormone-therapeutic adjuvant treatment; mandatory accompaniment of chemotherapeutic regimens capable of causing neutropenia with granulocyte colony-stimulating factors. Outpatient radiation therapy using intensive treatment regimens. Surgical treatment – providing emergency oncological care and performing surgery of the first to second category of complexity. We continued the treatment of patients who participated in international multicenter studies but could not be transferred to other centers for various reasons. Palliative treatment was provided in full using the resources of the institution and the informational and technical support of the volunteer service.

Employees of the Kyiv City Clinical Oncology Center during their service in the second zone (high probability of missile/bomb damage (humanitarian problems) provided patients consultation and diagnostic services, which are presented in Table 1.

Starting from April 3, 2022, in the sixth week of the war, the oncological treatment in Kyiv entered the third zone – the medium probability of a missile/bomb impact (humanitarian alertness), which made it possible to provide the following volumes of consultative, diagnostic and therapeutic oncological treatment. Consultative and diagnostic assistance was provided to evacuees from the first and second zones, the volume of diagnostic examinations corresponded to oncological protocols taking into account possible resources, and it became possible to use laparoscopic diagnostic methods. Medical oncological treatment:

- it was possible to carry out chemotherapy in full in hospital conditions in compliance with international recommendations, including algorithms with a high risk of developing febrile neutropenia, multi-day cycles, and long continuous infusions,
- remote radiation therapy, brachytherapy, and X-ray therapy were carried out,
- surgery using techniques with a low level of postoperative complications.

Table 1. The volume of consulting and diagnostic assistance provided in the zone of high probability of missile and bomb damage (from March 24 to April 2, 2022)

Consulting assistance	Quantity	Diagnostic assistance	Quantity
Consultation	8511	Sonographic diagnosis	428
Online	5967	Mammography	283
Offline	2544	Radioscopy	157
Consultations on chemotherapy	3309	Computed tomography	103
Consultations of incurable patients		Gastroscopy	48
Online	242	Colonoscopy	27
Offline	47	Bronchoscopy	8
Physical examination of incurable patients at home	14	Morphological studies	178

National Comprehensive Cancer Network [11] guidelines for the definition of distress thermometry were applied to determine the stress index of patients receiving oncological treatment in different zones during the war and the following results were obtained (Fig. 1, Table 2).

As of this writing, since May 11, 2022, we have associated our work with the fourth zone: low probability of rocket/bomb damage (humanitarian stability), so the possibility of using a positron emission tomography scanner and significantly expanding the facility’s diagnostic capabilities was restored, an immunological laboratory became functional, and surgical assistance was provided in full. Chemotherapy and radiation therapy departments work stably with the possibility of treatment in hospital conditions in full, in accordance with international recommendations.

Therefore, in the institution during the analyzed period of war, depending on the zones, the following medical treatment was provided to patients with oncological pathology, which is presented in Figure 2 and Table 3.

The presented results show that in the transitional situation between the first and second zones, medical care was provided mainly on an outpatient basis. With the improvement of the situation, it became possible to increase the frequency of its provision and to expand the volume with the possibility of inpatient stay of patients. Surgical treatment had a direct correlation with the zone; if in the second zone it was used mainly as an exception with the use of diagnostic methods, then with the transition to the fourth zone, the number of performed surgical interventions of the second to fourth degree of complexity in one and a half months was 886.

Discussion

The institution chose a strategy: observing the war, and curfew, to ensure the protection of patients and employees, to prevent a crisis in the institution, and to continue providing oncological care according to oncology protocols.

Planning and provision of medical aid in conflict conditions is an urgent necessity. Instability, violence, and widespread insecurity have well-documented consequences for the day-to-day operation of the health care system and determining the burden of health care in conflict settings [12]. The importance and necessity of electronic healthcare in the context of conflicts are discussed in the above meta-analysis [13]. In practice, we have evaluated and confirmed the significance of the factors presented above based on the results of their implementation in Ukraine.

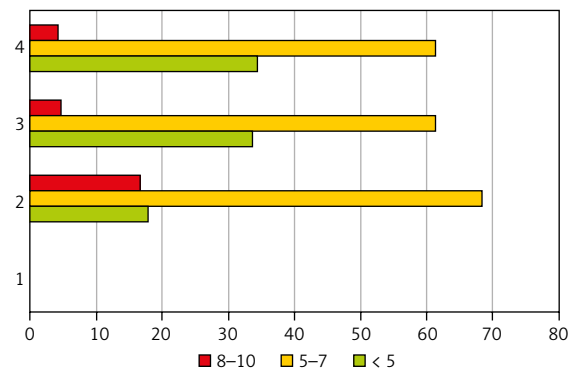


Fig. 1. Distress thermometry indicators (points)

Table 2. Dynamics of distress thermometer indicators of patients depending on the zones of oncological treatment during the war

Zone of oncological treatment	Distress thermometer indicators (%)		
	< 5	5-7	8-10
I	Not determined		
II	17.9	68.4	16.7
III	33.7	61.5	4.8
IV	34.4	61.4	4.2

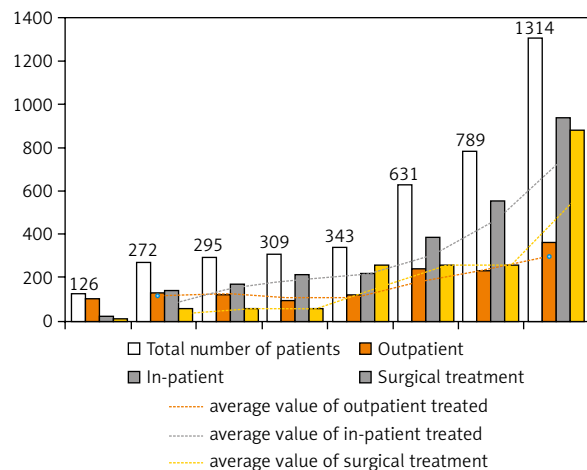


Fig. 2. Dynamics of the provision of medical oncological treatment depending on the zones

During the provision of oncological care to the population of Ukraine, different factors played an important role, which are difficult to prioritize, as each of them was important. Ukraine is a fairly large country in terms of territory

Table 3. Dynamics of the provision of medical oncological treatment depending on the zones

	Between zones I-II (February 24 – March 7, 2022)	Zone II (March 9 – April 2, 2022)		Zone III (April 3 – May 10, 2022)			Zone IV (May 11 to present date)	
Total number of patients treated with medication	126	272	295	309	343	631	789	1314
Ambulatory	104	131	121	95	121	243	231	368
Stationary	22	141	174	214	222	388	558	946
Surgically	11		57			261		886

(it ranks first in Europe) and before the war, the provision of oncological care throughout its territory was uniformly organized with material and technical support. There was no difference depending on the location of the patient in the provision of oncological care, and there was no fundamental difference between the metropolitan and peripheral regions. A digital patient registration implemented and working at the state level with information on the scope and results of the performed examinations and treatment was available to a practicing doctor who had access to it from anywhere in Ukraine. These factors played an important role, which cannot be overestimated; since the beginning of the war up to 15 million displaced citizens of Ukraine have been recorded, and for the continuation of treatment and dispensary measures, objective information about the history of the disease and the completed stages, schemes and volumes of already performed medical and diagnostic measures was required. The availability of reliable, legally substantiated data contributed to the timely continuation of diagnostic and treatment measures in accordance with oncological protocols, and on the other hand, relieved the stressful situation of patients, and fears of not providing them with timely diagnostic and therapeutic oncological care.

The problem of the occurrence of distress with the transition to acute stress disorder in cancer patients was explained by the combined effect of two factors, namely the fear of being left without oncological care, and aggressive military actions with the possibility of being subjected to violence, loss of material possessions, or life.

Deep social, archetypal attitudes about the inevitability of death as a result of this disease are activated in the human subconscious, which always has a catastrophic effect on survival. Even the suspicion of cancer and waiting for the results of the examination can cause the patient to experience acute distress [14, 15].

Intense distress can aggravate the course of the disease. This is evidenced by the results of studies by Jar-emka et al. [16] and according to Nakane et al. [17], under the influence of the stress hormone – cortisol – the concentration of cytokines IL-1 α and IL-1 β increases, due to which inflammation increases in the tumor and its development is stimulated.

As evidenced by the obtained results, the tension of the stressful situation in patients also changed with the change in the area of oncological care. With the transition of patients from the second to the third and fourth humanitarian zones, there was a statistically significant improvement in psychological well-being ($p < 0.05$) with a corresponding

decrease in acute stress disorders. The desire of patients to undergo diagnostic procedures increased, the responsible attitude to the recommended therapy increased, and the number of exacerbations of accompanying neurological and cardiovascular pathology decreased.

The use of the electronic health care system eHealth, the use of telemedicine, online consultations, etc. during the war in Ukraine became possible under the condition of the implementation of the state's digital transformation projects over the past two years and constant access to the Internet during the war. The constant ability to connect to the Internet was also important in reducing the distress syndrome in patients, as there was hope that they would not be abandoned and that they would be provided with oncological care. Using the Internet, the volunteer service, especially in the first zone, was able to evacuate patients and provide them with medicines if needed. Deep gratitude should be expressed to Elon Musk [18, 19] for his promptness in ensuring the proper functioning of the Internet in Ukraine. After the Russian invasion of Ukraine, the Deputy Prime Minister for Digital Transformation Mykhailo Fedorov requested Elon Musk to provide Ukraine with access to Starlink high-speed Internet. Four days after the start of the war, Elon Musk's Starlink Internet terminals were delivered to Ukraine. Everyone was able to legally use it – authorities, enterprises of any form, and ordinary Ukrainians. All legal grounds for using Starlink were provided by the State Special Forces of Ukraine.

Conclusions

Thanks to the current projects of the UN, WHO, the practical implementation by the Cabinet of Ministers and the Ministry of Health of Ukraine of the digital transformation of the state, the implementation of Diya, the electronic health care system eHealth, organized and logistical support of the oncology service throughout the territory of Ukraine, constantly operating Internet with a sufficiently high level of computer literacy of the population of Ukraine in the presence of mobile devices made it possible to provide a decent level of oncological care to the population during the war.

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