



## Cancer care for Ukrainian refugees: Strategic impact assessments in the early days of the conflict

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### ABSTRACT

**Background:** The invasion of Ukraine by Russia in February 2022 has resulted in destruction of healthcare infrastructure and triggered the largest wave of internally displaced populations and refugees since World War Two. Conflicts in transitioned countries such as Ukraine create new non-communicable disease (NCD) challenges, especially for cancer care for refugees and humanitarian assistance in host countries. In the early days, rapid attempts were made to model possible impacts.

**Methods:** By evaluating open source intelligence used in the first three months of the conflict through snowball search methods, we aimed to address: (i) burden of cancer in Ukrainian population, specifically considering translating to the refugees population, and its cancer care capacity; (ii) baseline capacity/strengths of cancer systems in initial host countries. Moreover, using a baseline scenario based on crude cancer incidence in Ukraine, and considering data from UNHCR, we estimated how cancer cases would be distributed across host countries. Finally, a surveillance assessment instrument was created, intersecting health system's capacity and influx of internally displaced populations and refugees.

**Findings and conclusions:** The total new cancer patients per month in pre-conflict Ukraine was estimated as 13,106, of which < 1 % are paediatric cases. The estimated cancer cases in the refugee population (combining prevalent and incident), assuming 7.5 million refugees by July 2022 and a female:male ratio of 9:1, was 33,121

**Abbreviations:** ASCO, American Society of Clinical Oncology; CT, Computerised tomography; ECCO, European Cancer Organisation; EU, European Union; GDP, Gross Domestic Product; IARC, International Agency for Research of Cancer; IDP, Internally Displaced Populations; MRI, Magnetic Resonance Imaging; NCD, Non-communicable diseases; NGO, Non-governmental organisation; NHSU, National Health Service of Ukraine; PET, positron emission tomography; OIRM, Oncologic Institute of Republic of Moldova; UN, United Nations; UNHCR, United Nations High Commissioner for Refugees; WHO, World Health Organisation; WoS, Web of Science.

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individuals (Poland: 19284; Hungary: 3484; Moldova: 2651; Slovakia: 2421; Romania: 5281). According to our assessments, Poland is the only neighbouring country classified as green/yellow for cancer capacity, i.e. sufficient ability to absorb additional burden into national health system; Slovakia we graded as yellow, Hungary and Romania as yellow/red and Moldova as red.

## 1. Background

The invasion of Ukraine by the Russian Federation has severely affected healthcare infrastructure and triggered the largest wave of internally displaced populations and refugees since World War Two [1]. One month after the start of the war nearly 3.5 million refugees had fled Ukraine into and beyond neighbouring countries with the majority (>50 %) moving across into Poland. However, in terms of demographic impact, even for countries such as Slovakia who are hosting around 420,000 Ukrainian refugees, this still represents a population increase of almost 8 % in just a month.

Ukraine is a fully transitioned country of just over 44 million, with high pre-conflict levels of non-communicable diseases [2]. A survey of older persons (>60 years) conducted in eastern Ukraine in 2016 found that approximately 70 % of individuals suffered from at least one chronic disease, with a high prevalence of serious psychological distress as measured by Kessler K6 Psychological Distress Scale ranging from 33 % to 42 % [3]. Cancer was already the second most common cause of death by 2012. The rapid escalation of the war has degraded delivery of and access to cancer and palliative care services in many of Ukraine's frontline Oblasts (in particular the Donbas region, in Luhansk and Donetsk oblasts), home still to some 13 million citizens, though the current population cannot be determined with precision. The internal therapeutic geographies of cancer care in the conflict are rapidly changing and adapting with, as of October 2022, some 9–11 million internally displaced persons. How patients are continuing their care, which cancer centres remain operational and at what level, changes day to day.

The rapid mobilisation of the UN, WHO, professional societies, patient groups and cancer centres through WHO/St.Judes for Childhood Cancers and the ECO/ASCO Special Network: Impact of the War in Ukraine on Cancer has meant many cancer patients, especially children with cancer, are actively being moved and moving into host country cancer centres.

However, it is now clear from the extent of the displacement and refugee crisis that both the Ukrainian government and host countries will need to be able to provide significant additional capacity and capability over the coming months and, potentially, years. Capacity and capability development should begin with an assessment of resources to manage the refugee and IDP return and reintegration process. Enhancing the capacity of local authorities to prevent and resolve any intercommunal conflicts through peaceful means, whilst encouraging development enhances the capacity of all relevant central, regional and local authorities to carry out their long-term responsibility to support the re-integration of IDPs. In many cases, building capability can actually help expand capacity. Previous experience of refugees with cancer from other conflicts in transitioned countries, particularly Syria, has highlighted a range of issues from understanding patient pathways to new models of care, that if not well managed may result in barriers in access to care and economic constraints for host countries cancer centres [4]. Previous emergency responses have been hampered by initial intelligence failures, which did not provide baseline estimates for policy-makers (e.g., UN, WHO) and operational groups (e.g., host country cancer centres).

This paper describes a baseline strategic analysis in the first 3–4 months of the conflict on the situation for cancer and palliative care for Ukrainian refugees, focusing on the primary receiving countries. Such assessments can then be retrospectively assessed as the conflict progresses for ground validity.

## 2. Methods

We utilised a biblio-narrative open source intelligence approach to scientific and non-scientific data through snowball search (databases: PubMed, WoS, Bing, Google, AskJeeves and secondary grey literature searches) in all languages over the last ten years.

The algorithms were designed to interrogate two themes and extract data to inform open source intelligence estimates of:

1. Burden of cancer in Ukrainian population, specifically considering translating to the refugee population, and its cancer care capacity.
2. Baseline capacity / strengths of cancer systems in initial host countries.

We also aimed to assess the status of cancer epidemiology for Ukraine pre-2022 conflict, put into context with neighbouring countries. Cancer epidemiology in Ukraine pre-conflict was obtained from IARC-Global Cancer Observatory, and the National Cancer Registry of Ukraine [5]. The main indicators considered were age standardised incidence, prevalence, and mortality (rates) used to compare the burden of cancer across countries, and crude incidence, prevalence, and mortality (rates) for Ukraine, used to derive estimates for the internally displaced populations (IDPs) and refugees.

More specifically, we have modelled a baseline scenario for Ukrainian refugees based on crude cancer incidence, prevalence, and mortality (rates) in Ukraine [6] and estimated how they might be distributed across host countries based on data from UNHCR over the coming months [1]. As men aged 18–60 are not allowed to leave the country, we estimated, based on UNHCR data, that the proportion of women amongst the refugees was 90 %. No assumptions regarding age were taken into account as the data publically available does not allow for this detailed level of breakdown in our calculations. We applied the crude incidence and prevalence rates to the number of refugees in each host country (estimated based on their distribution on May 16, 2022 as reported by UNHCR and the assumption that there would be a total of 7.5 million refugees by July 2022). As above, we applied a female:male ration of 9:1.

In addition, we evaluated host countries cancer care carrying capacity using Murray and Frenk's framework for assessing the health system's performance [7]. For this evaluation, we have considered the system's responsiveness to the expectations of the population and system's fairness of financial contribution. Using this framework as a basis, host countries were classified in terms of their capacity/capability to receive the refugee population in need of cancer care. We considered the current mapping of healthcare resources for cancer and future estimates of additional burden. For both these moments, a live surveillance instrument was created, intersecting health system's capacity and influx of refugees. The instrument includes three main dimensions: i) Hospital specific and Health care system capacity and functionality, ii) Medicine stock monitoring, iii) Cancer specific assessment capacity. The latter constitutes a 3-tier colour coding system matrix, ranging from green (cancer services judged to have capacity/capability to manage significant increases in cancer burden) to red (cancer care system already at or over its capacity/capability). The 3-tier colour coding system was applied by taking the criteria from the literature review, establishing a 6 point Likert scale with 1–2 = red; 3–4 = yellow; 5–6 = green with 3 independent valuations (RS, JJ, AA) using previously described frameworks [8]. It needs to be noted that this method only provides a first indication of the capacity/capability of the host countries. More multidimensional input data will be required in future (e.g. at 12 months), but it provides a first visualisation reflecting the current intelligence status.

### 3. Results

#### 3.1. Estimating the conflict cancer burden for refugees

Our estimate is that the National Cancer Registry of Ukraine provides moderate quality data for projecting cancer burden in host countries [9]. The total number of new cancer patients per month in pre-conflict Ukraine was estimated to be 13,106 (male and female combined) (Table 1) [9]. This 'at risk' cancer population for whom there are delays in diagnosis and treatment combined with the prevalent cases of cancer amongst the refugee population (see below) will lead to major excess morbidity and mortality. For every month of the war, there is cumulative compounding of these figures (as of publication this is eight months). At present, there is insufficient data on baseline and current delays in diagnosis and treatment from within Ukraine to derive accurate estimates of excess mortality. The projections for delays in diagnosis and treatment previously made apply equally to Ukrainian cancer patients [10–12].

In addition to the new cases (Ukrainians that become refugees in the next four months and have their initial presentation in host country, i.e. incidence) (Tables 2a and 2b), we also need to consider the prevalent cases of cancer amongst the refugees (those crossing border with a diagnosis of cancer or already undergoing treatment, i.e. prevalence). Table 3 shows how there will be an estimated 33,121 cancer cases in the refugee population over the next 12 months. As Poland has the largest influx of refugees, this would translate into almost 20,000 extra cancer cases (Table 3). It needs to be noted that our estimates for Moldova are likely to be an overestimation as the UNHCR portal indicates that about 92 % of refugees in Moldova transition to Romania and hence may be double counted. As such the numbers in Table 3 for Moldova should be updated to 25 cases (23 males and 192 females).

Furthermore, it needs to be added that we would also expect approximately 5964 Ukrainian female refugees and approximately 803 Ukrainian male refugees to die of cancer within 12 months and hence unburden their respective health systems (based on similar calculations as above, cancer mortality rates applied to on an influx of 7.5 million refugees with a 9:1 female:male ratio). However, given the limited information available to date we did not incorporate these estimates in our overall calculations.

#### 3.2. Cancer care at origin: Ukraine before the war

A critical understanding of cancer care pre-conflict is essential to understand the prevalent health of population and refugees. Such understanding also guides not only planning around humanitarian pathways for cancer care (e.g., health literacy), but also sets expectations for the level of breadth of cancer care in refugee host countries. The Ukrainian health care system was originally based on the integrated Semashko model. There is a transitional system now from old Soviet Semashko model to government-sponsored universal healthcare system; the National Health Service of Ukraine (NHSU). Citizens are entitled to healthcare under this system, but have the option to buy private health insurance as well. The NHSU was introduced in 2017 by the Cabinets of the Ministry of Ukraine as a mandatory part of the reform project of Ukrainian medicine. Since then, the NHSU has been functioning in 2/3 of the hospitals and clinics in Ukraine. NHSU is the central executive body that implements the state policy in the field of state financial

**Table 1**

Total number of new cancers (excluding non-melanoma skin-cancer) for 2020 and per month in pre-war Ukraine data drawn from [1].

	All ages	<18 yrs	18+ yrs
Females (per annum)	79,402	634	78,768
Males (per annum)	77,873	704	77,169
<b>Estimated number per month</b>	<b>13,106</b>	<b>112</b>	<b>12,995</b>

guarantees for healthcare servicing of the population. Activities of the NHSU are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Health.

The system is financed by general taxation and declaratively provides universal access to unlimited care that is free at the point of use in publicly owned health care facilities. However, in practice patients often need to pay out-of-pocket to access services and medication. For domestic cancer patients, care is provided for free, although, novel systemic therapies, such as targeted therapies and immune-oncology, are still paid for out-of-pocket. The private sector in the Ukrainian health system is small. There is a unified electronic health information system for specific reporting from the regional level upwards, but at the municipal and community levels reporting is done on paper using standardised forms. There are other localised information systems, but these are not necessarily compatible and are for the management of individual facilities rather than national-level planning and coordination. In the pre-conflict era, Ukraine had lower age-standardised incidence and mortality cancer rates (Table 4), higher health expenditure (% of GDP) (Table 5), and a higher number of doctors and nurses/midwives per population (Table 6) compared to most of its neighbouring countries. Our estimate is that as a country, Ukraine pre-war capacity/capability is graded yellow/green.

#### 3.3. Estimate of host countries' capacity (age-standardised incidence and mortality rates reported by country in Table 4)

##### 3.3.1. Poland

Poland's health system is based on social health insurance. In 2019, Poland devoted 6.45 % of its GDP to health (Table 5). Private financing (mainly out-of-pocket spending) accounts for 30 % of current spending on health, which is much larger than in most EU Member States. Eight percent of spending is on ambulatory (outpatient) care and 39 % of admissions are day cases [13,14]. Our assessment is that the cancer care system modelled on a centralised hospital sector, has modest headroom for expanding outpatient care, diagnostics, and long-term care as Poland also has a shortage of doctors and nurses (Table 6). For cancer specifically, this translates into 2.5 radiation oncologists, 32.1 surgeons and 13.6 radiologists per 1000 patients [15]. More specifically, Poland has 1025 surgical oncologists, 588 haemato-oncologists, 246 paediatric oncologists, 1128 medical oncologists, and 904 radiation oncologists [16].

Whilst there are shortfalls in the healthcare workforce, physical infrastructure appears to be sufficient. There are 16 cancer centres across the country (2.2 public cancer centres per 10,000 patients), with the following equipment [17,18]: 8 external beam RT per 10,000 cancer patients (compared to EU average of 7.8); 43.5 CT scanners per 10,000 cancer patients; 24.8 MRI scanners per 10,000 cancer patients (to compare 21.6 in UK, 8.9 in Ukraine); 1.4 PET/PET CT scanner per 10,000 cancer patients (to compare 0.7 in UK, 0.2 in Ukraine). Our estimate is that as a country Poland's capacity is graded yellow/green (Fig. 1).

##### 3.3.2. Hungary

Our assessment is that Hungary has significant issues with cancer capacity. Less than 50 % of domestic patients start cancer treatment within 21 days of the therapeutic decision [19]. The distribution of cancer care is unequally distributed across Hungary. Its capital Budapest has one of the highest density of hospital beds across the EU, as well as numbers of doctors per population size, but some areas in Hungary have the lowest number of healthcare professionals across the EU [20].

Hungary has a relatively low number of CT and MRI scanners per capita compared to the rest of the EU [21]. With respect to radiotherapy, a national assessment in 2019 identified 13 centres, covering 84 radiation oncologists, 19 residents, 66 physicists and 231 radiotherapy technologists, and 40 megavoltage units (38 linear accelerators, 2 cobalt units) in use [22]. This assessment concluded that this infrastructure was insufficient for the needs of the Hungarian population. Our estimate is

**Table 2a**

Estimated incident number of male cancer cases in the refugee population based on their distribution by host countries (on 16th May 2022) and an estimated total number of refugees of 7.5 million by July 2022, with 10 % of them being male.

Cancer	Crude Rate Ukraine *	Poland	Hungary	Moldova	Slovakia	Romania
<b>Allcancersexcl.non-melanomaskincancer</b>	<b>384.3</b>	1553	281	214	195	425
Lung	63.7	257	47	35	32	71
Prostate	56.1	227	41	31	28	62
Colorectum	54.6	221	40	30	28	60
Stomach	27	109	20	15	14	30
Bladder	21.2	86	15	12	11	23
Kidney	18.5	75	14	10	9	20
Pancreas	14.2	57	10	8	7	16
Lip,oralcavity	13.7	55	10	8	7	15
Larynx	12	48	9	7	6	13
Leukaemia	9.7	39	7	5	5	11
Oesophagus	8.7	35	6	5	4	10
Non-Hodgkinlymphoma	8	32	6	4	4	9
Melanomaofskin	7.5	30	5	4	4	8
Hypopharynx	7.3	30	5	4	4	8
Oropharynx	7	28	5	4	4	8
Liver	6.6	27	5	4	3	7
Brain,centralnervoussystem	6	24	4	3	3	7
Thyroid	4.8	19	4	3	2	5
Testis	3.1	13	2	2	2	3
Hodgkinlymphoma	2.5	10	2	1	1	3
Multiplemyeloma	2.4	10	2	1	1	3
Penis	1.5	6	1	1	1	2
Salivaryglands	1.5	6	1	1	1	2
Nasopharynx	0.88	4	1	0	0	1
Gallbladder	0.6	2	0	0	0	1
Mesothelioma	0.59	2	0	0	0	1
Kaposisarcoma	0.13	1	0	0	0	0

\* Crude Incidence rate in 2020 as reported by IARC.

**Table 2b**

Estimated incident number of female cancer cases in the refugee population based on their distribution by host countries (May 16th 2022) and an estimated total number of refugees of 7.5 million by July 2022, with 90 % of them being female.

Cancer	Crude Rate Ukraine *	Poland	Hungary	Moldova	Slovakia	Romania
<b>Allcancersexcl.non-melanomaskincancer</b>	<b>338.3</b>	12,469	2253	1714	1545	3370
Breast	77.8	2868	518	394	355	775
Colorectum	46.2	1703	308	234	211	460
Corpusuteri	41.3	1522	275	209	189	411
Cervixuteri	20.3	748	135	103	93	202
Ovary	17.6	649	117	89	80	175
Thyroid	17.6	649	117	89	80	175
Stomach	14.1	520	94	71	64	140
Lung	12.8	472	85	65	58	128
Pancreas	10	369	67	51	46	100
Melanomaofskin	10	369	67	51	46	100
Kidney	9.6	354	64	49	44	96
Leukaemia	7.1	262	47	36	32	71
Non-Hodgkinlymphoma	6	221	40	30	27	60
Brain,centralnervoussystem	5	184	33	25	23	50
Bladder	4.8	177	32	24	22	48
Liver	3.5	129	23	18	16	35
Lip,oralcavity	2.8	103	19	14	13	28
Vulva	2.8	103	19	14	13	28
Hodgkinlymphoma	2.6	96	17	13	12	26
Multiplemyeloma	2.3	85	15	12	11	23
Gallbladder	1.7	63	11	9	8	17
Salivaryglands	1.1	41	7	6	5	11
Oesophagus	0.93	34	6	5	4	9
Oropharynx	0.73	27	5	4	3	7
Vagina	0.63	23	4	3	3	6
Larynx	0.53	20	4	3	2	5
Mesothelioma	0.41	15	3	2	2	4
Nasopharynx	0.33	12	2	2	2	3
Hypopharynx	0.21	8	1	1	1	2
Kaposisarcoma	0.03	1	0	0	0	0

\* Crude Incidence rate in 2020 as reported by IARC.

that as a country Hungary's capacity is graded red/yellow (Fig. 1).

### 3.3.3. Moldova

Healthcare and cancer care capacity in Moldova is very limited (Table 5); it is one of the lowest GDP countries Europe. As such, Moldova

**Table 3**

Estimated number of prevalent and incident male and female cancer cases in the refugee population based on their distribution by host countries (May 16th 2022) and an estimated total number of refugees of 7.5 million by July 2022, with 90 % of them being female. [6].

	Poland	Hungary	Moldova	Slovakia	Romania	Total
<b>Incident and prevalent cancer cases in the refugee population</b>						
Males	2045	369	281	257	560	3512
Females	17239	3114	2370	2165	4721	29609
<b>Prevalence cancer population in host country (% of increase refugee population would bring)</b>						
Males	73 905 (2.8 %)	22 945 (1.6 %)	4482 (6.3 %)	11 739 (2.2 %)	35 862 (1.6 %)	148 933 (2.4 %)
Females	76 561 (22.5 %)	23 339 (13.3 %)	3979 (59.6 %)	10 502 (20.6 %)	32 242 (14.6 %)	146.623 (20.2 %)

**Table 4**

Age-standardised incidence and mortality rates for Ukraine and its refugee host countries as reported by IARC in 2020 (pre Feb 2022, pre-war) [6].

Country		Age-standardised Incidence rate	Age-standardised Mortality rate
Ukraine	Females	187.4	74.3
	Males	246.6	146.1
	Both	206.3	101.9
Hungary	Females	292.6	117.6
	Males	371.0	192.2
	Both	321.6	148.1
Poland	Females	244.3	107.7
	Males	290.7	178.0
	Both	260.4	136.8
Republic of Moldova	Females	169.2	87.4
	Males	273.6	184.9
	Both	211.2	127.8
Slovakia	Females	245.4	105.1
	Males	354.7	190.8
	Both	290.4	140.7
Romania	Females	221.8	95.0
	Males	304.5	176.9
	Both	255.9	130.9

**Table 5**

Health expenditure (% of GDP) in 2019, as reported by the world bank [38].

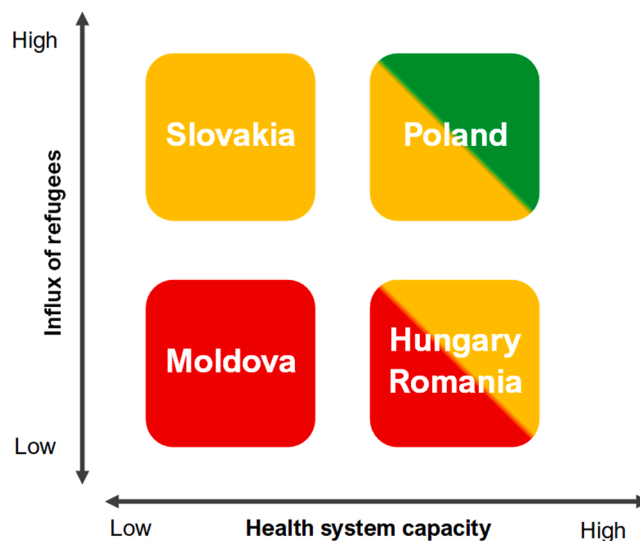
Country	Health expenditure (% of GDP) – Year 2019
Ukraine	7.10
Hungary	6.35
Poland	6.45
Slovakia	6.96
Romania	5.74
Republic of Moldova	6.38

has just one centre specialising in cancer – the Oncologic Institute of Republic of Moldova (OIRM), in Chisinau. The centre has 700 beds according to a WHO short report from 2020. Moldova has only two CT scanners in the whole country (not located at the OIRM); no other data on infrastructure is available [23]. Provision of cancer care is challenging, notably because of shortages of health personnel, including physicians and nurses specialising in oncology (Table 6). There are significant waiting times for chemotherapy and radiotherapy, and access is very limited outside Chisinau [24]. Data on cancer treatment in Moldova is limited, but what is available reflects significant shortages

**Table 6**

Number of doctors, nurses and midwives per population, as reported by the world bank [39].

Country	Doctors (per 1000 people)	Year	Nurses/midwives (per 1000 people)
Ukraine	3.0	2014	6.7
Hungary	3.4	2018	5.3
Poland	2.4	2017	6.9
Slovakia	3.5	2018	6.0
Romania	3.0	2017	6.1
Republic of Moldova	2.6	2019	3.9



**Fig. 1.** Preliminary evaluation of host countries cancer care carrying capacity using Murray and Frenk’s framework for assessing the health system’s performance. This 3-tier colouring coding system matrix ranges from green (cancer services judged to have capacity/capability to manage significant increases in cancer burden) to red (cancer care system already at or over its capacity/capability). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

[25]. An analysis in 2016 found that only 16 of the 31 pathology departments in district hospitals in Moldova had access to appropriate immunohistochemistry for cancer diagnosis [26]. Most palliative care is supported by NGOs [27]. The only state institution in the country specialised in palliative care is the Municipal Hospital number four in Chisinau. The rest are NGOs, which receive most of their funding from donations. Around 25,000 patients need hospice care each year, but it is reported that just 7–8 % of palliative care patients receive any form of support [27]. Our estimate is that as a country Moldova’s capacity is graded red (Fig. 1).

**3.3.4. Romania**

Health care and cancer care are significantly under-funded in Romania (Table 5). Domestic population diagnosed with cancer have modest levels of access to cancer care (there are currently only 0.4 public cancer centres available per 10,000 cancer patients) [28]. There is a significant deficit in comparable open source information on the state of cancer care in Romania, which makes analyses and estimates for capacity challenging. However, such deficits typically reflect significant access and availability issues in cancer care. Palliative care in Romania is usually provided by charitable organisations, however, it is our assessment that this also falls short of what is required for the domestic population [29]. Our estimate is that as a country Romania’s capacity is graded yellow/red (Fig. 1).



### 3.3.5. Slovakia

Health expenditure and healthcare professional numbers in Slovakia are similar to Ukraine (Tables 5 and 6). Whilst the 2020 report of the National Institute of Oncology in Slovakia reported sufficient capacity for domestic population cancer care [30], issues of access have been previously identified [31]. This 2020 report also found that the domestic population continued to have challenges in terms of access of radiotherapy, and more advanced forms of systemic therapy e.g., immuno-oncology. Data drawn from this report, such as 525 radiation oncology beds available in 2020, are difficult to put into context. However, taking this absolute number at face value, this is only just sufficient to manage needs of the domestic population [30]. Hence, our estimate is that as a country Slovakia's capacity/capability is graded yellow (Fig. 1).

## 4. Cancer care initiatives for Ukraine refugees

### 4.1. Poland

The government of Poland has welcomed refugees as reflected by a tweet from the Minister of Health: "Every citizen of Ukraine who comes to Poland fearing for his health and life can count on access to medical care. We will also help the injured who will not be able to help the Ukrainian side. In these difficult times, Poland will stand by Ukraine and its citizens". The government adopted a law on the 7th of March that allows a person who has crossed the border due to the armed conflict in Ukraine to register with Polish offices and obtain a Polish registration number. Moreover, healthcare benefits provided to Ukrainian citizens will be settled by the National Health Fund [32].

Several Cancer centres and hospitals have specifically offered their support. For example, the National Oncology Institute in Warsaw runs an oncology helpline for Ukrainian-speaking people. The Polish Cancer Society estimates that about 5–10 % of all cancer patients in Poland will be Ukrainian refugees (which is in line with our estimates in Table 2a and 2b). Other Polish foundations are also setting up initiatives to help Ukraine cancer patients. For instance, providing hotlines and websites in Ukrainian, information at the reception points and geolocators to monitor the exact whereabouts of the patient, since Ukrainians often do not know where they are due to lack of understanding of the Polish language.

### 4.2. Hungary

The website of the National Institute of Oncology currently has a message in English, Ukrainian, and Hungarian for Ukrainian citizens with cancer, providing them with a hotline as well as various email addresses to try and refer patients as efficiently as possible [24,33,34]. Hungary has enacted legal provisions that entitle refugees to six months of free treatment pending final status through Hatóság Bizonyítvány documentation managed by social workers from the Menedék Association.

This is not the first major refugee situation Hungary has had to address. In 2015, they experienced a big influx of refugees, asylum seekers and migrants; it was estimated an additional 350,000 people crossed the borders from early to mid-October 2015, most of whom moved onto other countries [35]. The WHO published a report assessing their capacity to manage this sudden influx of refugees, with a specific focus on immediate help needed by refugees rather than long term capacity in hospitals and healthcare. It was noted that Hungary was able to adapt quickly to provide aid where required, however an additional contingency planned would be required for future influxes.

### 4.3. Moldova

In Moldova refugees are covered by national legislation (No. 1286-XV) that broadly covers entitlements and processes for seeking

asylum. Such legislation only covers social, economic and legal arrangements, with no special sections on healthcare beyond that mandated under UNHCR rules. In terms of cancer patients specifically, the Oncologic Institute of Republic of Moldova are accepting both paediatric and adult cancer patients seeking refuge from Ukraine and are currently dealing with around 10–12 cases from Ukraine per day. Moreover, around 40 % of all Moldova's food is imported from Ukraine. Although not directly relevant to cancer care, the potential implications for public health and Moldova's economy going forward could be substantial and could ultimately affect healthcare availability.

### 4.4. Romania

Ukrainian cancer patients are covered under Romanian law through Article 17[1](m) of the Asylum Act. Access to health care covers the right to receive free primary care and appropriate treatment, emergency hospital care and free health care and treatment in cases of acute or chronic illnesses considered imminently life threatening, through the national emergency health care system. These services through the medical service of the Regional Centres and/or other health care facilities accredited and authorised by law.

Currently many cancer patients simply utilise Romania as a conduit. Around 80–100,000 Ukrainian refugees, mostly centred in Bucharest, remain in Romania with the majority transiting through to other countries. Many pass through the city of Huși, where the Romanian Department for Emergency Situations has organised transit facilities to countries such as Italy or Israel for further treatment [36–38].

### 4.5. Slovakia

The government of Slovakia implemented temporary legislation on the 1st of March 2022 to support Ukrainian refugees. In case of special need and on the basis of an individual assessment of the applicant's health condition, the Ministry of Health pays for the provision of necessary health care including cancer care. However, the refugees who are staying in Slovakia on a visa-free basis are not entitled to state-provided health care, but can purchase a commercial health insurance plan. Emergency and life-saving treatments are provided to everyone in Slovakia free-of-charge, including refugees. Refugees in need of special health care treatment can sign on a list to be assessed by the Slovak government.

## 5. Discussion and conclusions

The data and estimates presented in this paper cover the period 24 Feb to 18 March 2022, with projections to end of July 2022. The accuracy of these projections will be possible at the 12 + month mark and will allow a 'red teaming' of the assumptions used to build these models to inform future planning. Pre-war Ukraine saw some 13,106 new cancer diagnoses per month ( $n = 112$  paediatric oncology). Our estimate is that 60–70 % of cancer care has been disrupted in the first month of fighting, which will increase to 90 % at current trajectories for the 13–14 M million citizens living in conflict impacted regions (even those from which Russian forces have now withdrawn). The impact in terms of delays in diagnosis and treatment is cumulative and substantial.

Whilst we estimated that there would be about 33,000 cancer patients in these host countries, the actual number presenting for treatment is likely to be much lower; many will succumb to their disease (end stage), whilst others will not present until there are acute emergencies. It is not possible at this stage to give reliable estimates. Moreover, it is difficult to predict how having cancer (treatment) impacts on the decision to emigrate and which country to go to. Data on the speed of presentation to cancer centres in the next months will be critical to re-evaluate the model. Although Poland will receive the majority of these, the impact of even the more modest numbers on other host countries will impose a significant burden. Our estimate is that the

carrying capacity for initial host countries to manage projected volumes of cancer patients is moderate to weak. Current sentiment analysis and policy reactions by host countries is estimated as good, with high confidence. However, this needs to be continually evaluated through segmented analysis to understand how cancer care for refugees is being perceived by host countries.

The legal provisions underpinning cancer and palliative care across host nations are not uniform, imposing different limitations to access. It also needs to be noted that palliative care is not necessarily restricted to cancer. Moreover, very different resources for cancer care are available in each host country [40,41]. Our analysis reflects the reality that Ukraine and Europe are now experiencing their first cancer (and NCD) humanitarian crisis. As structures and organisations begin to focus on gathering actionable intelligence, it is essential not to lose sight of the universal declaration of human rights, which guarantees care irrespective of status and ability to pay.

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### Authors' contributions

All listed authors have made a significant contribution to this article.

### Conflicts of interest

None to be declared.

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