ACCESS
RADIOTHERAPY
TECHNOLOGIES

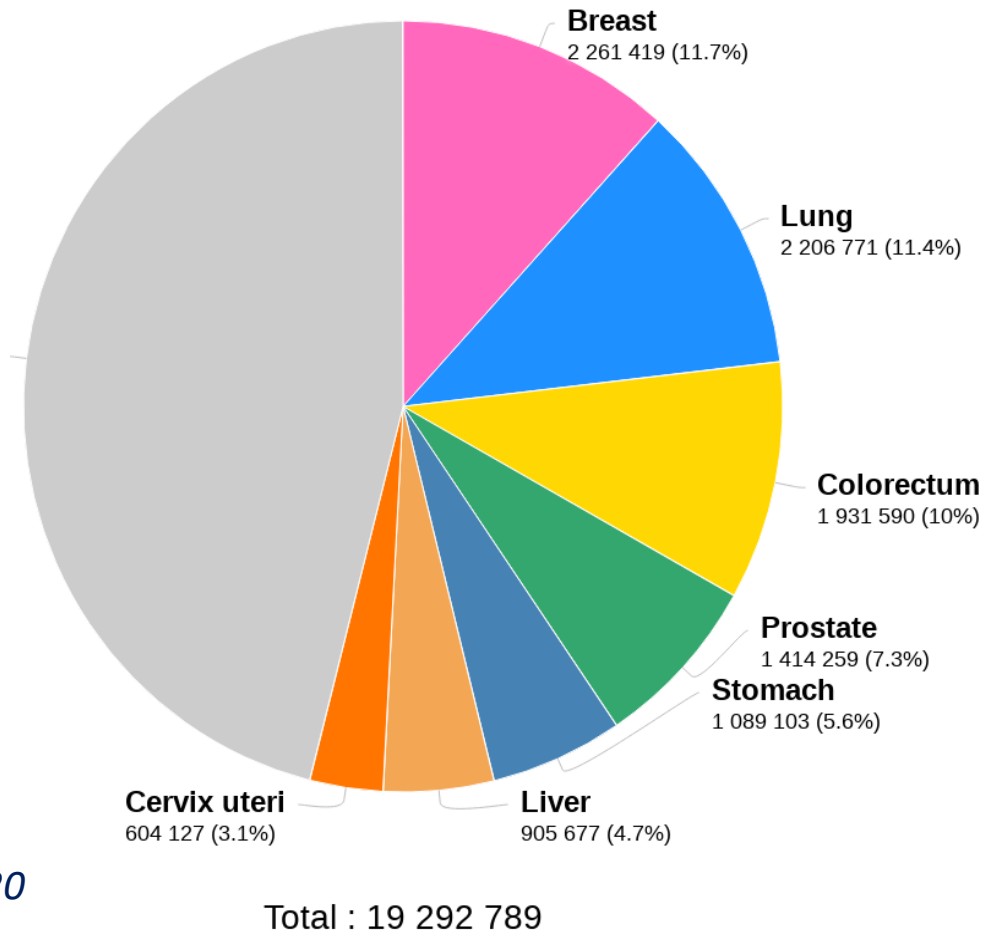
Assessing the cancer patient data and examining the current access to radiation therapy technology and expertise available with a focus on the Baltics

Manjit Dosanjh (*CERN, University of Oxford*)
Erika Korobeinikova (*Lithuanian Society for Radiation Therapy / Lithuanian University of Health Sciences*)
Kristaps Palskis (*Riga Technical University, CERN*)

Cancer is a growing global challenge

- Globally **19.3** million new cases per year diagnosed and **9.96** million deaths in **2020**
- This will increase to **27.5** million new cases per year and **16.3** million deaths by **2040**

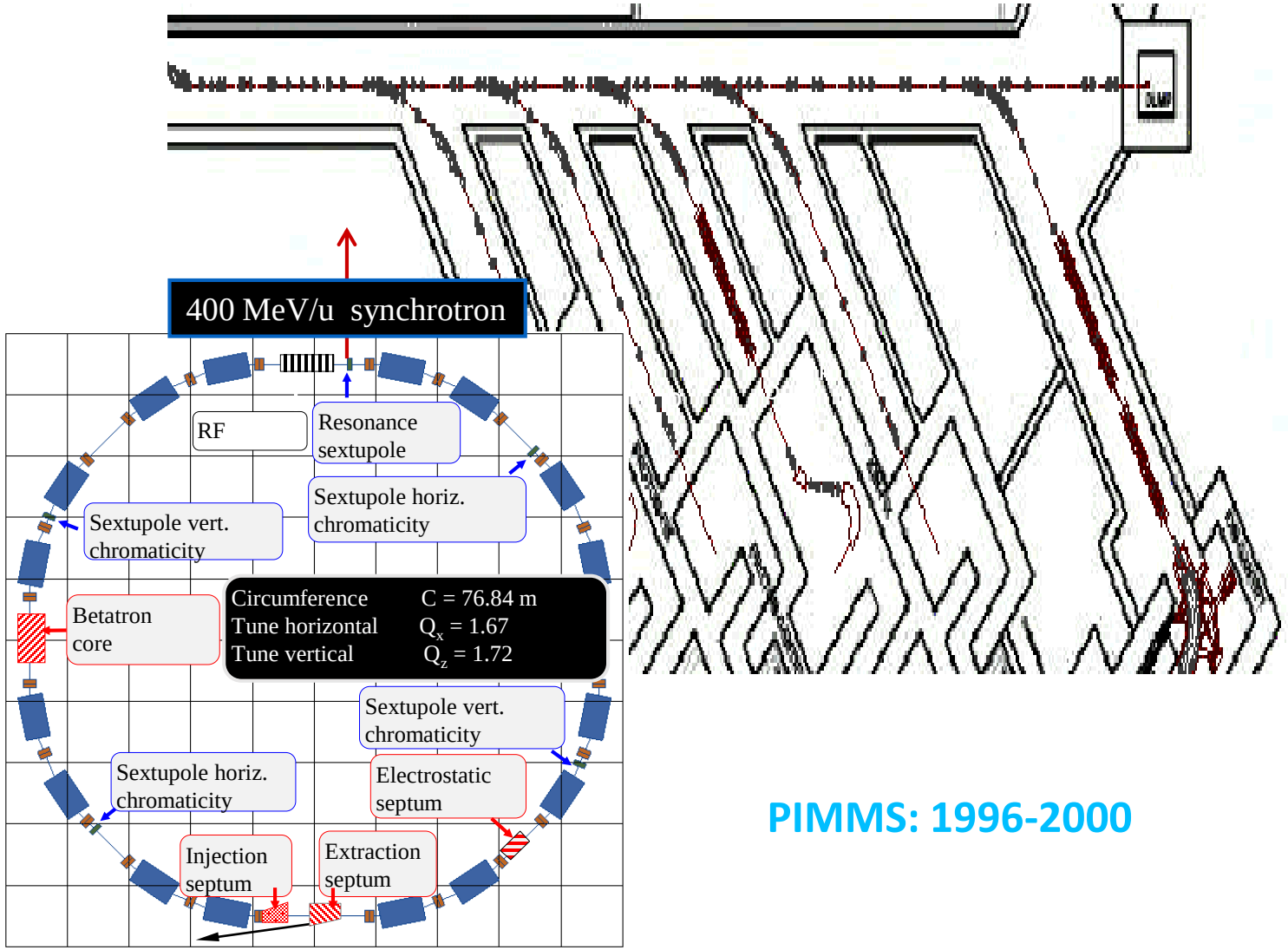
- **70% of these deaths** will occur in low-and-middle-income countries (LMICs)



Data source: GLOBOSCAN 2020

Radiation therapy is a key tool for treatment for over <u>50% patients</u>

PIMMS Study - trigger for ENLIGHT



PIMMS: 1996-2000

2001

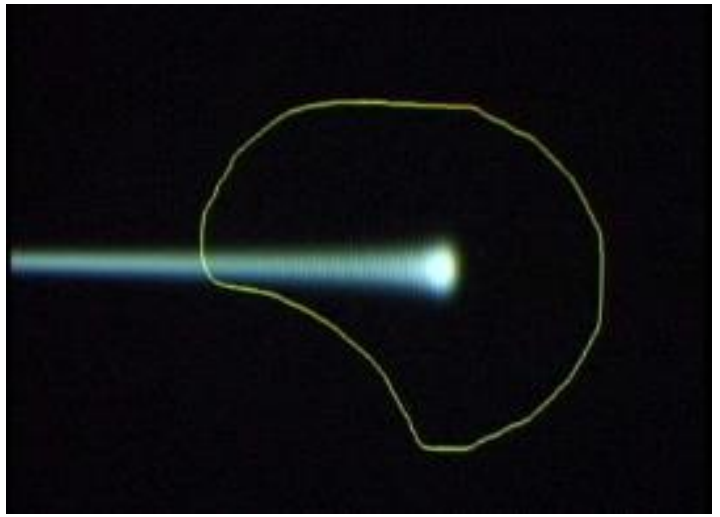
The beginnings of ENLIGHT

- **The idea germinated in 2001 after ESTRO- Med-AUSTRON meeting**
- **In October 2001 the proposal for a Thematic Network was submitted to EC**
- **ENLIGHT was launched In February 2002 at CERN**
- **Funded: 1 million Euros in 2002**

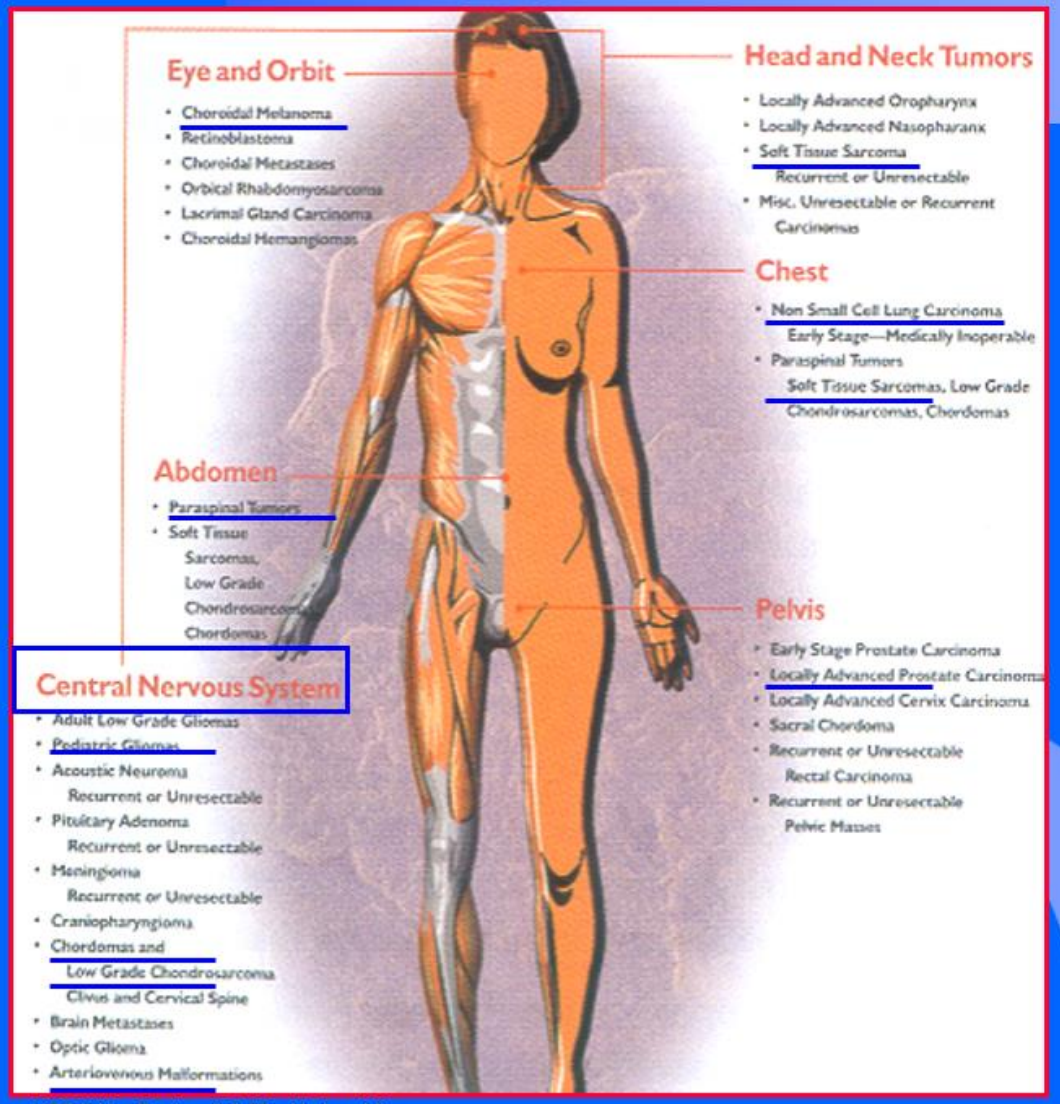
Organisers: Manjit Dosanjh & Hans Hoffmann

ENLIGHT was established to ……..

- Create common multidisciplinary platform
- Cancer treatment
- Identify challenges
- Share knowledge
- Share best practices
- Harmonise data
- Provide training, education
- Innovate to improve
- Lobbying for funding



The sites of protontherapy



40'000 patients

Cost about 20'000 Euro

2-3 x X-rays

If accelerators would be 'small' and 'cheap' as lincs for X-rays

90% of the treatments would be with protons !

	Heidelberg 1998	Milan 2002	Lyon 2002	Vienna 2002	Innsbruck 2002	Mean value
	%	%	%	%	%	%
Chordoma	100	100	100	100	100	**100**
Chondrosarcoma	100	100	100	100	100	**100**
Uveal Melanoma	~	100	~	100	100	**100**
Pankreatic+bile duct	~	20	25	22	20	**22**
Gastric cancer	50	~	50	40	30	**43**
Rectal cancer	15	30	15	19	15	**19**
Bladder cancer	15	10	15	15	20	**15**
Lung cancer (NSCLC)	~	10	15	31	30	**22**
Pediatric malignancies	10	10	20	15	15	**14**
Liver cancer	~	10	100	40	30	**47**
Salivary gland tumors	50	50	30	ENT	50	**45**
Soft tissue sarcoma	30	50	60	10	40	**38**
Head and neck tumors	25	15	20	30	25	**23**
Prostate cancer	15	30	20	28	25	**24**
Brain tumours	30	30	15	17	35	**25**
Anaplast. thyroid cancer	~	50	50	20	50	**43**
Cervix cancer	15	50	~	11	12	**22**
Non-Hodgkin-Lymphoma	~		~	20	20	**20**
Hodgkin-Lymphoma	~		~	20	20	**20**
Recurrence after conv.. RT	~	50	30	30	30	**37**

Numbers of potential patients

From studies in Austria, France, Germany and Italy

(ENLIGHT framework – discussed later)

X-ray therapy

every 10 million inhabitants: 20'000 pts/year

Protontherapy

12% of X-ray patients 2'400 pts/year

Therapy with Carbon ions for radio-resistant tumour

3% of X-ray patients 600 pts/year

TOTAL every 10 M **about 3'000 pts/year**

ENLIGHT and the European projects

European Network for LIGht-ion Hadron Therapy (2002-2005)

- GSI project for the University of Heidelberg Clinics
- CNAO in Pavia

} in construction

- Med-Austron for Wiener Neustadt (approved in Novembre 2004)
  partner of PIMMS since 1996
- ETOILE in Lyon (approved in June 2005)
  preliminary design by IN2P3 and CEA based on PIMMS/TERA

[ASCLEPIOS in Caen postponed]

- Baltic Centre in Stockholm
  preliminary design by TERA: NIM B184 (2001) 569

Facilities in Europe: why Baltics project

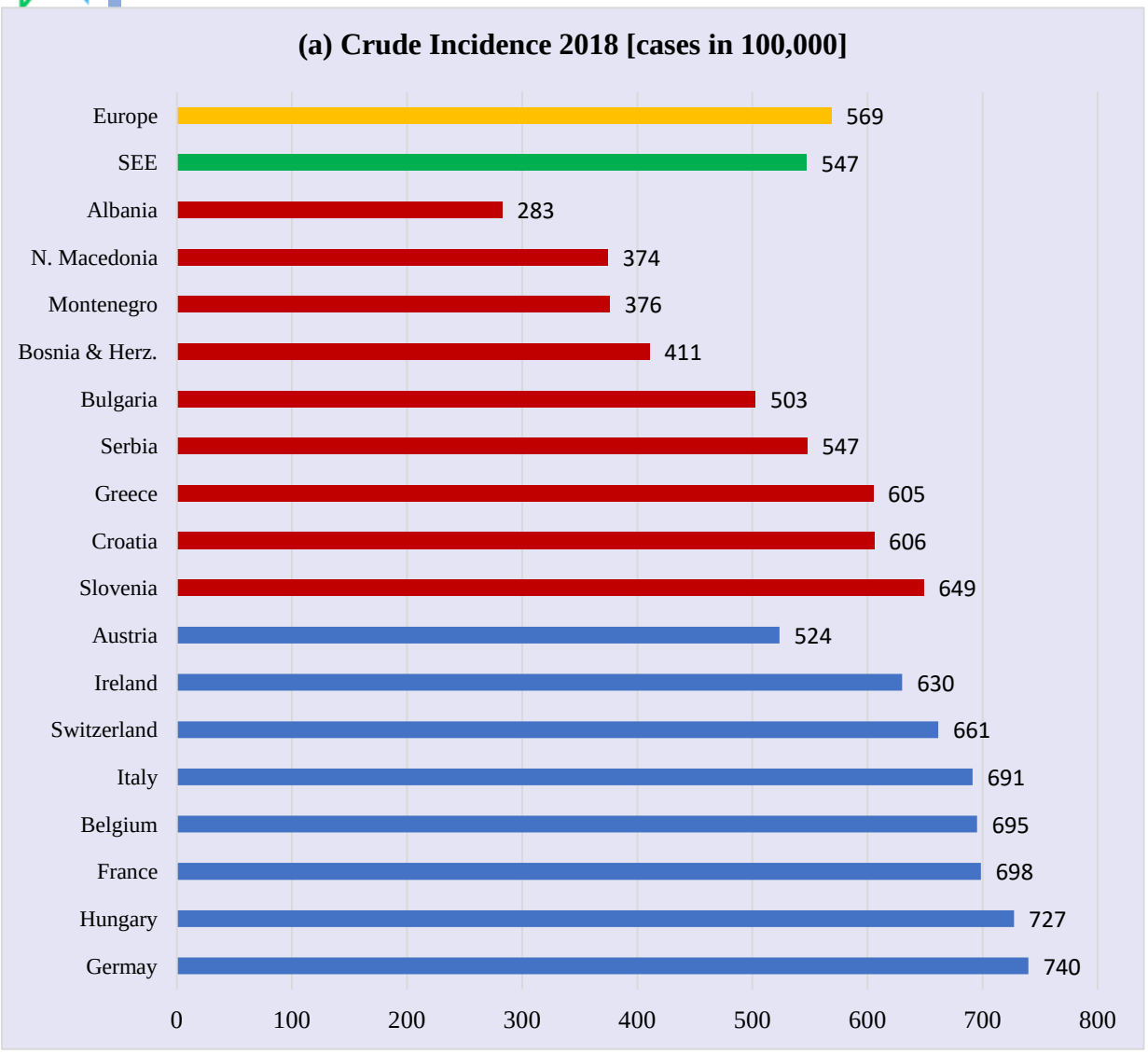
Data gathering on expertise, cancer incidence, access to diagnostic and RT treatment in the South Eastern European (Balkan) countries

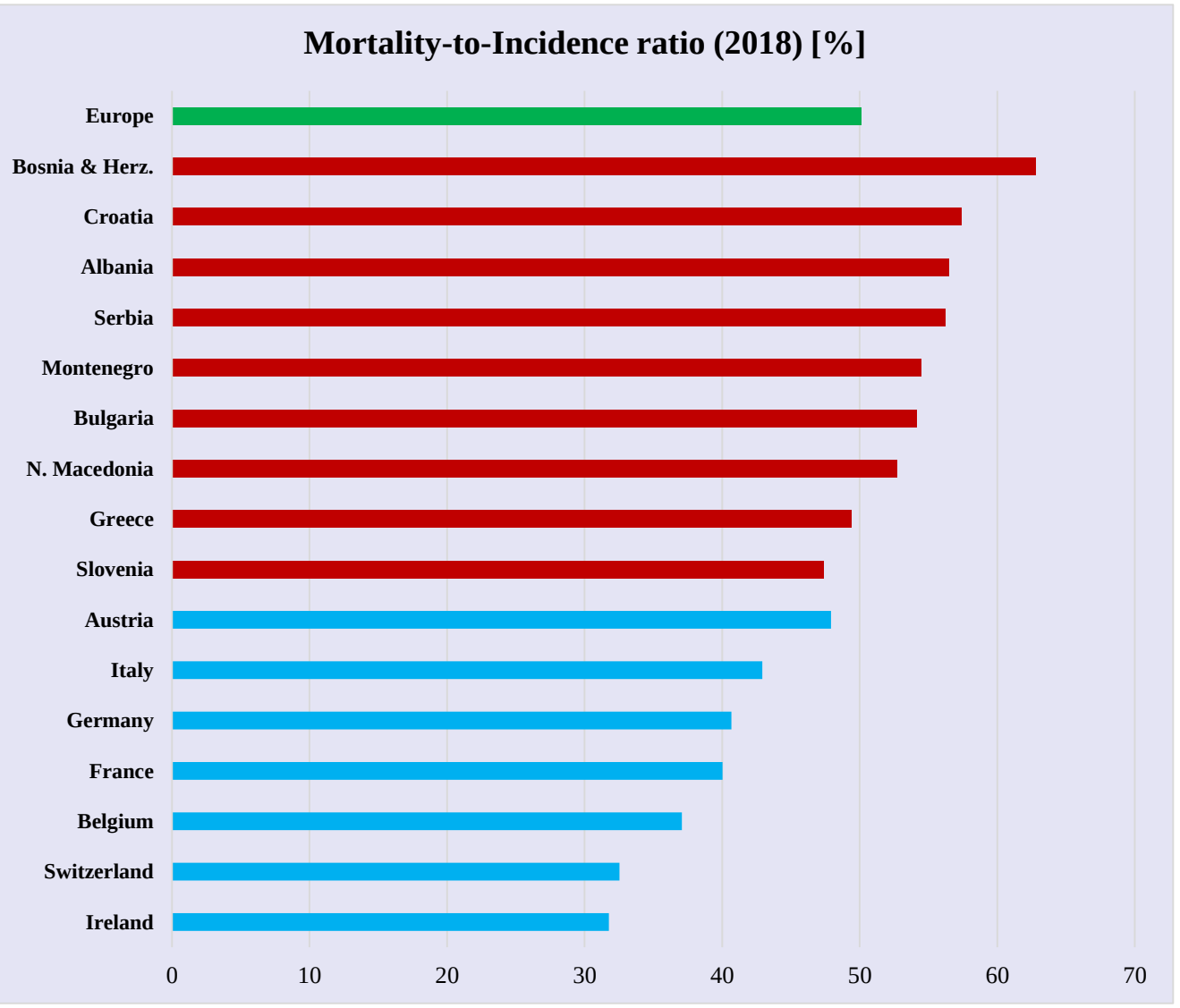
Manjit Dosanjh, Mimoza Ristova, Vesna Gershan, Petya Georgieva

Dosanjh M et al, **Availability of technology for managing cancer patients in the SEE region.** *Clinical and Translational Radiation Oncology* 2022, Vol 34, 57-66. https://doi.org/10.1016/j.ctro.2022.03.004

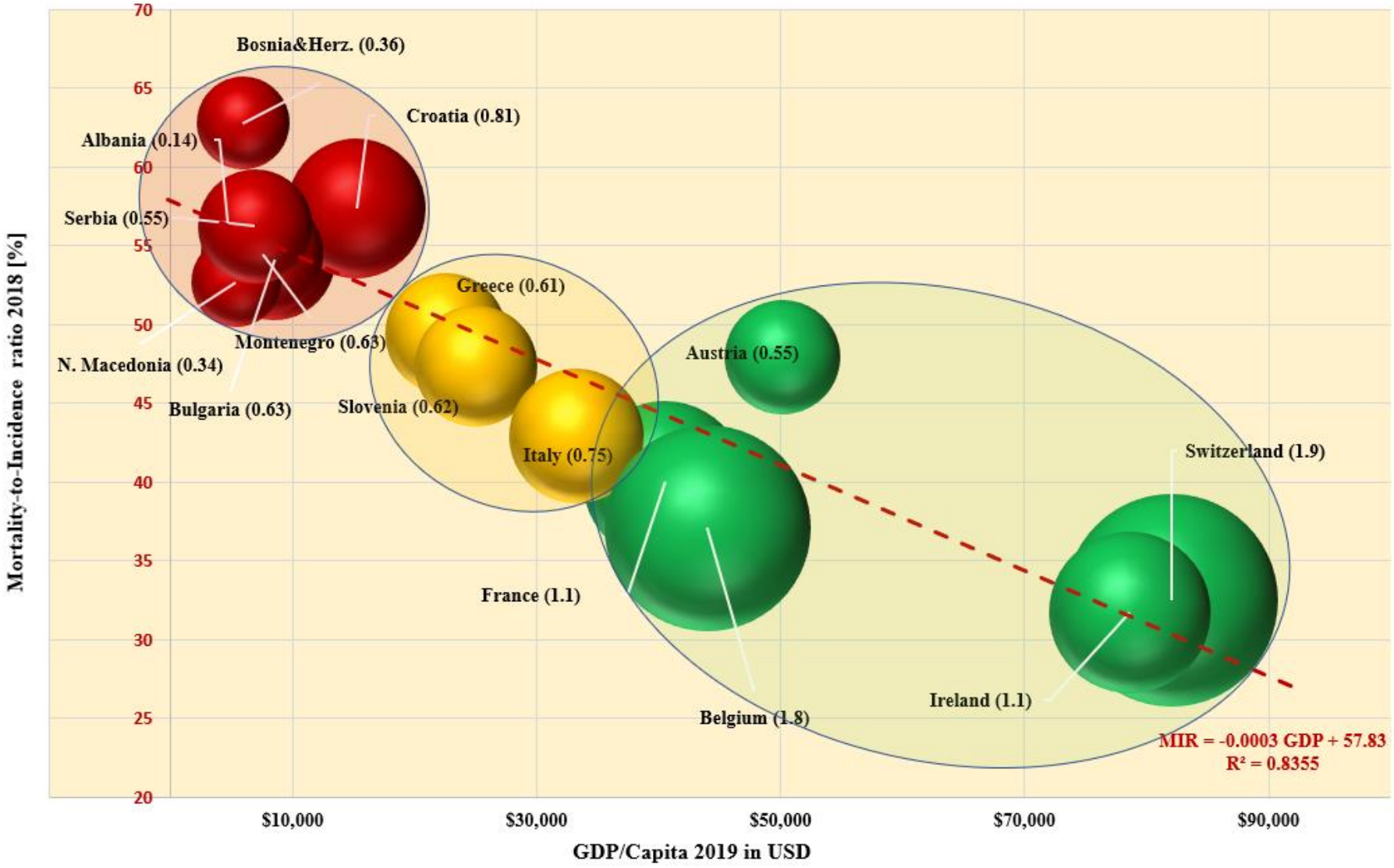
Ristova M, Gershan V, Amaldi U, Schopper H, Dosanjh M. **Cancer patients in the countries of SEE (the Balkans) region and prospective of the Particle Therapy Center – SEEIIST**. *Advances in Radiation Oncology*, 2021, Vol 6. https://doi.org/10.1016/j.adro.2021.100772

Cancer Incidence and Mortality-to Incidence ratio (MIT)

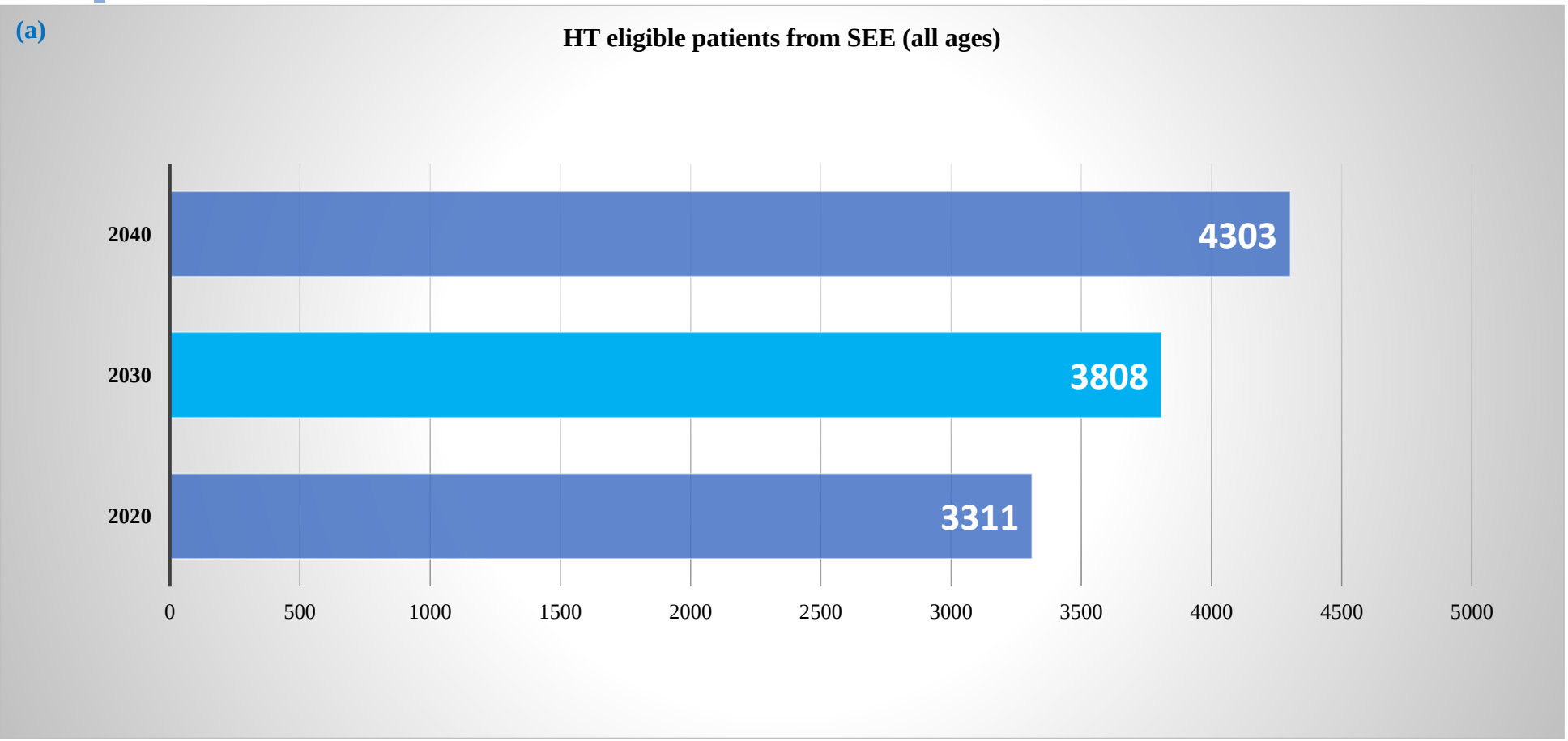




How successfully one country tackles with cancer?



SEE region cancer patients that would benefit from PT *(projections)*



Population of SEEIIST countries **~ 40 million**

Mimoza Ristova – ART Project Conference - Almaty - SEEIIST

ART study participation

Last year the 3 Baltic States took part in the ***Access to Radiotherapy Technologies Study***

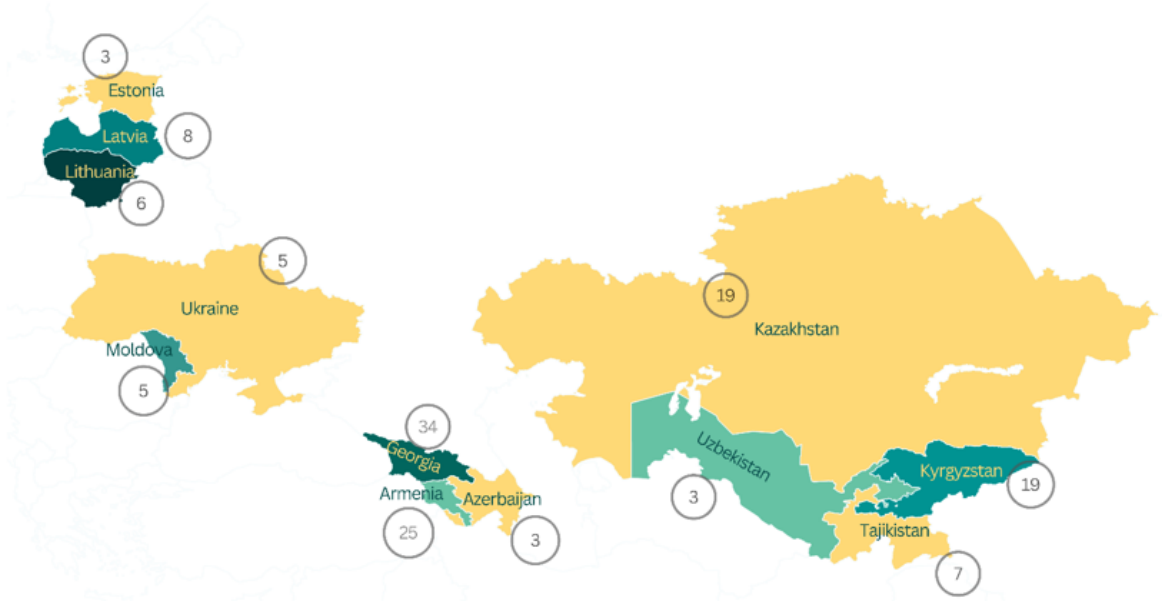
The questionnaire looked at the **key aspects regarding conventional radiation therapy:** number of treated patients, number of RT equipment, human capacity etc.

Participation and/or data from ALL of the radiotherapy facilities in the Baltic States

These were first initial data set for starting the current study

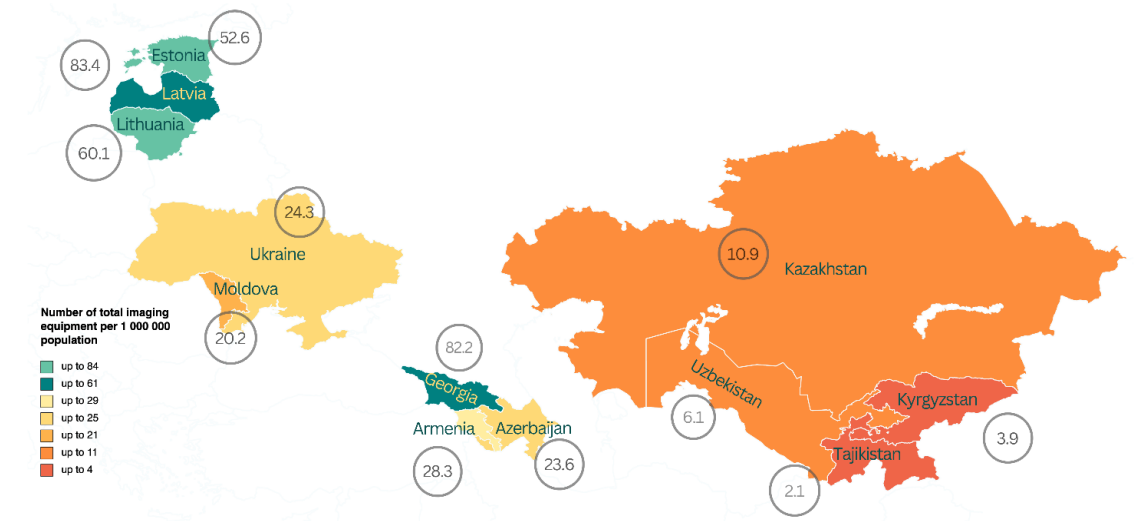
ART (Access to Radiotherapy Technology) Study

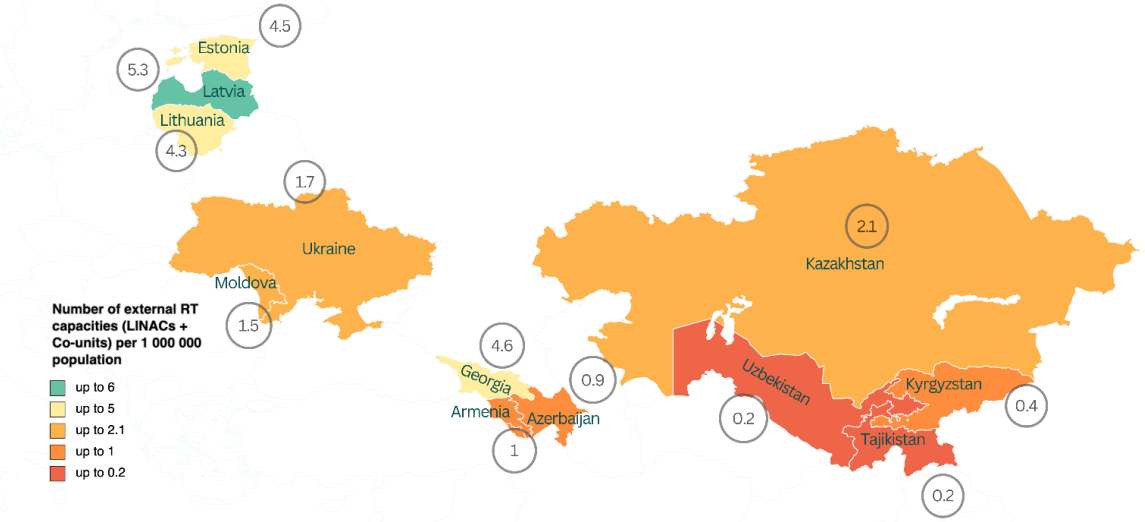
gathering data and number of surveys



Population of Baltic countries – **6 million**

Technology availability:
Diagnostics and RT equipment





	Lithuania	Latvia	Estonia
CT	70	71	28
Mammography	42	51	18
MRI	46	30	18
SPECT	8	2	3
PET	2	3	3

	Lithuania	Latvia	Estonia
LINACs	11	9	6
Brachytherapy	4	1	2

Anatomical and functional imaging units - sufficient
Cobalt-60 – **long out of clinical practice**
***27 state-of-art* LINACs**, practicing IMRT and VMAT, as well stereotactic techniques
GammaKnife, CyberKnife and MR-LINAC (*installation*)

Cancer incidence and mortality rate
Patients receiving conventional RT

Data as of 2020 or 2021

	Lithuania	Latvia	Estonia
Registered cancer cases	17073	12051	8907
Registered cancer deaths	8168	5892	3840
Cancer incidence rate	611	637	669
Cancer mortality	292	311	288

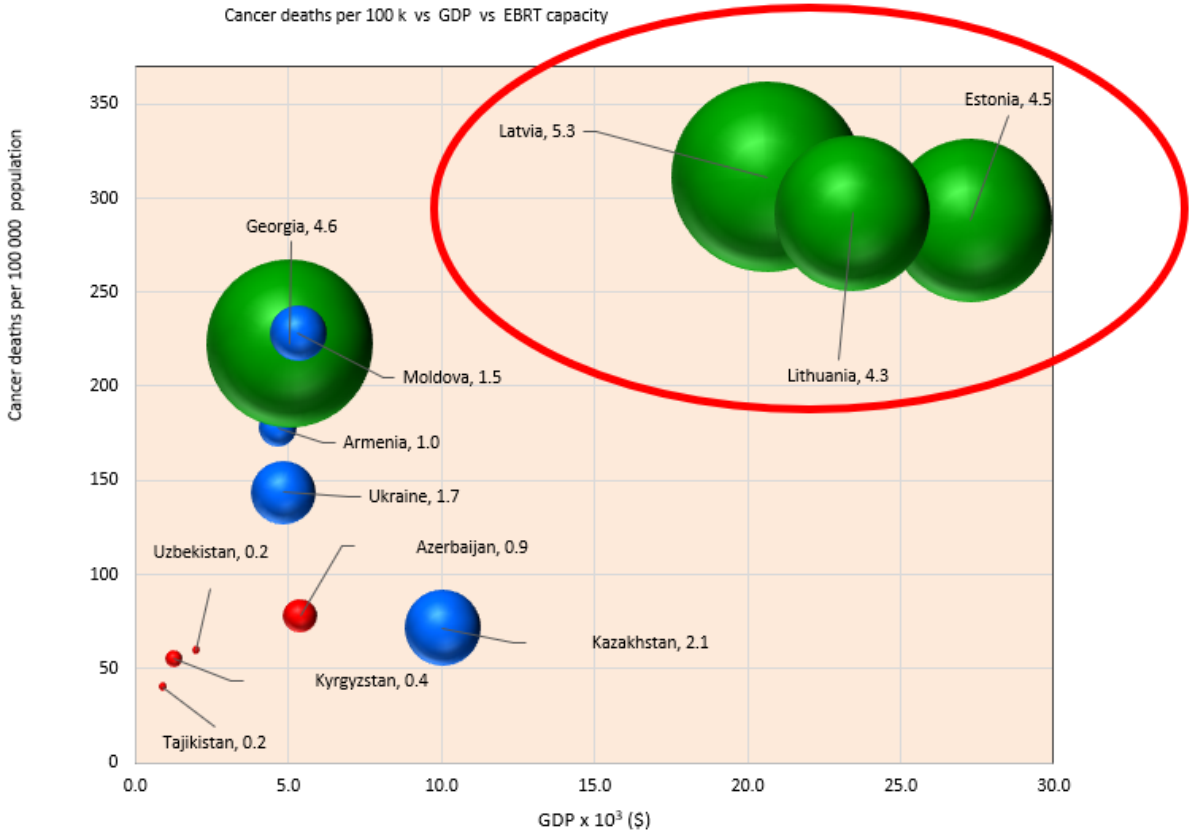
With the total number of inhabitants of **6.02 million** –
the average incidence rate of **632 per 100 000**
the average mortality of **297 per 100 000**

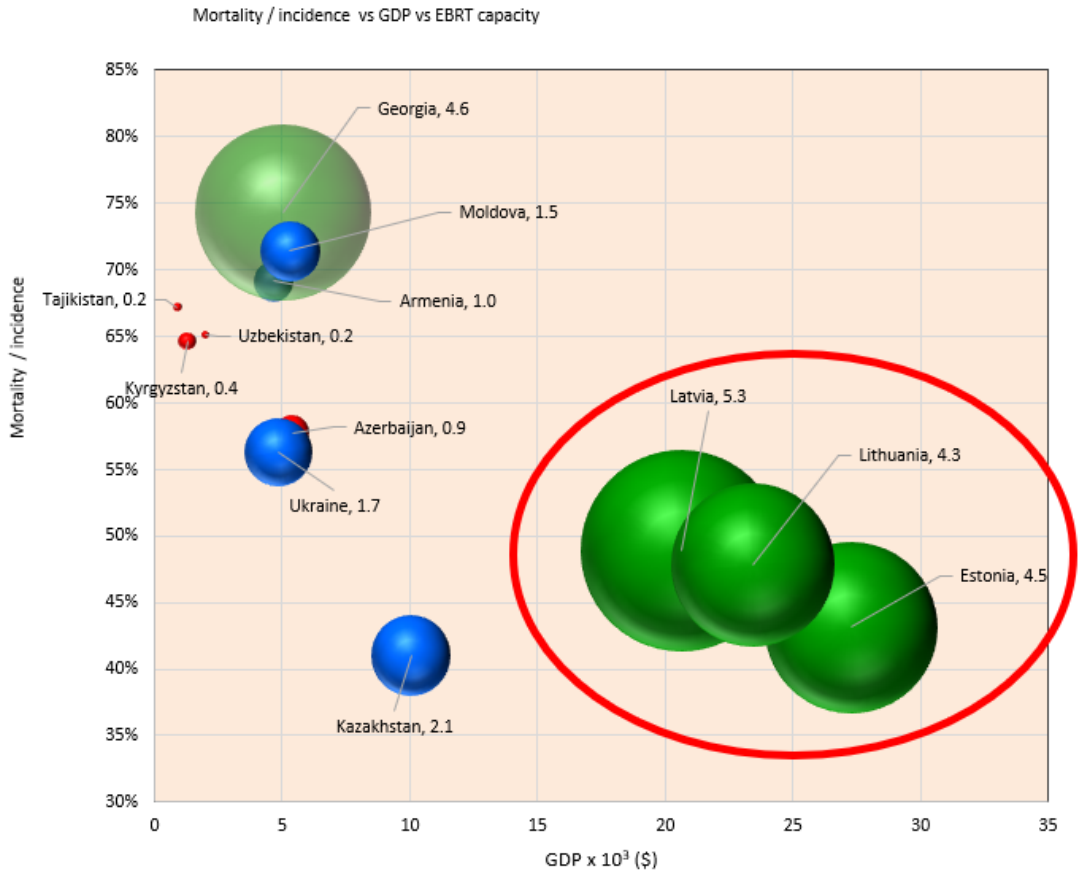
	Lithuania	Latvia	Estonia
Number of patients receiving RT	6343	4146	2556
Percentage	**37.2 %**	**34.4 %**	**28.7 %**

As of 2020, **13045 patients** have received radiation therapy treatment (*external beam or brachytherapy*) – accounting to
34.3 % of all registered cancer cases

Reminder – 50 % recommended

Cancer mortality and mortality /incidence ratio and in correlation with GDP and available EBRT equipment per 1 million inhabitants.





The overall data do show that we are “well-shaped” in conventional radiotherapy, **yet there are improvements to be made in terms of Mortality/Incidence compared to higher income countries.**
Number of diagnostic equipment – seems sufficient, question for the root cause . . .

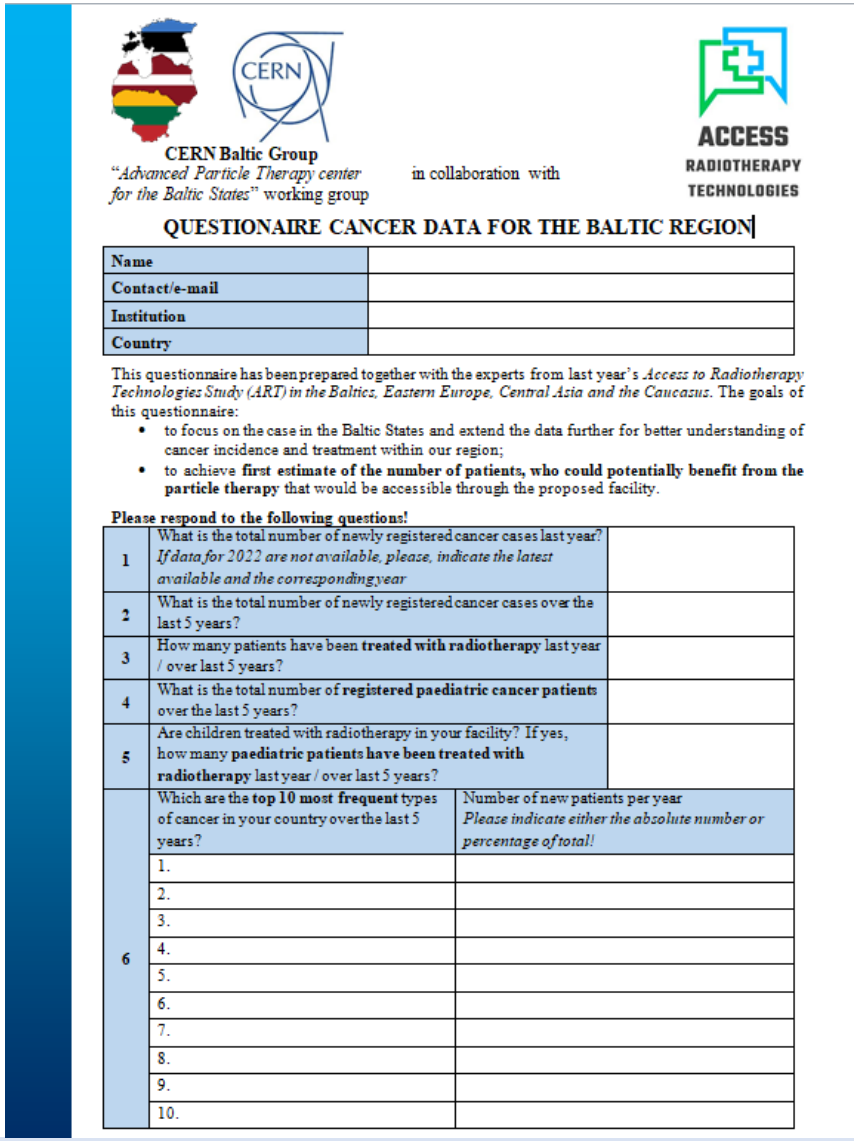
Need of data stratification. Development of questionnaire.

Dataset of *Access to Radiotherapy Technologies Study* did not explicitly look into the profile of cancer types most prevalent and general stratification of different cancer types – **crucial for proton and particle therapy**

Based on previous, similar studies and general consensus statements and guidelines – an addititional questionnaire has been developed with the focus also on localizations indicative of proton therapy

Preliminary data to be extended in near future!

We welcome additional ideas and welcome collaborations for expanding the study even further!



CERN Baltic Group
"*Advanced Particle Therapy center for the Baltic States*" working group
in collaboration with
ACCESS RADIOTHERAPY TECHNOLOGIES

QUESTIONAIRE CANCER DATA FOR THE BALTIC REGION

Name	
Contact/e-mail	
Institution	
Country	

This questionnaire has been prepared together with the experts from last year's *Access to Radiotherapy Technologies Study (ART) in the Baltics, Eastern Europe, Central Asia and the Caucasus*. The goals of this questionnaire:

- to focus on the case in the Baltic States and extend the data further for better understanding of cancer incidence and treatment within our region;
- to achieve **first estimate of the number of patients, who could potentially benefit from the particle therapy** that would be accessible through the proposed facility.

Please respond to the following questions!

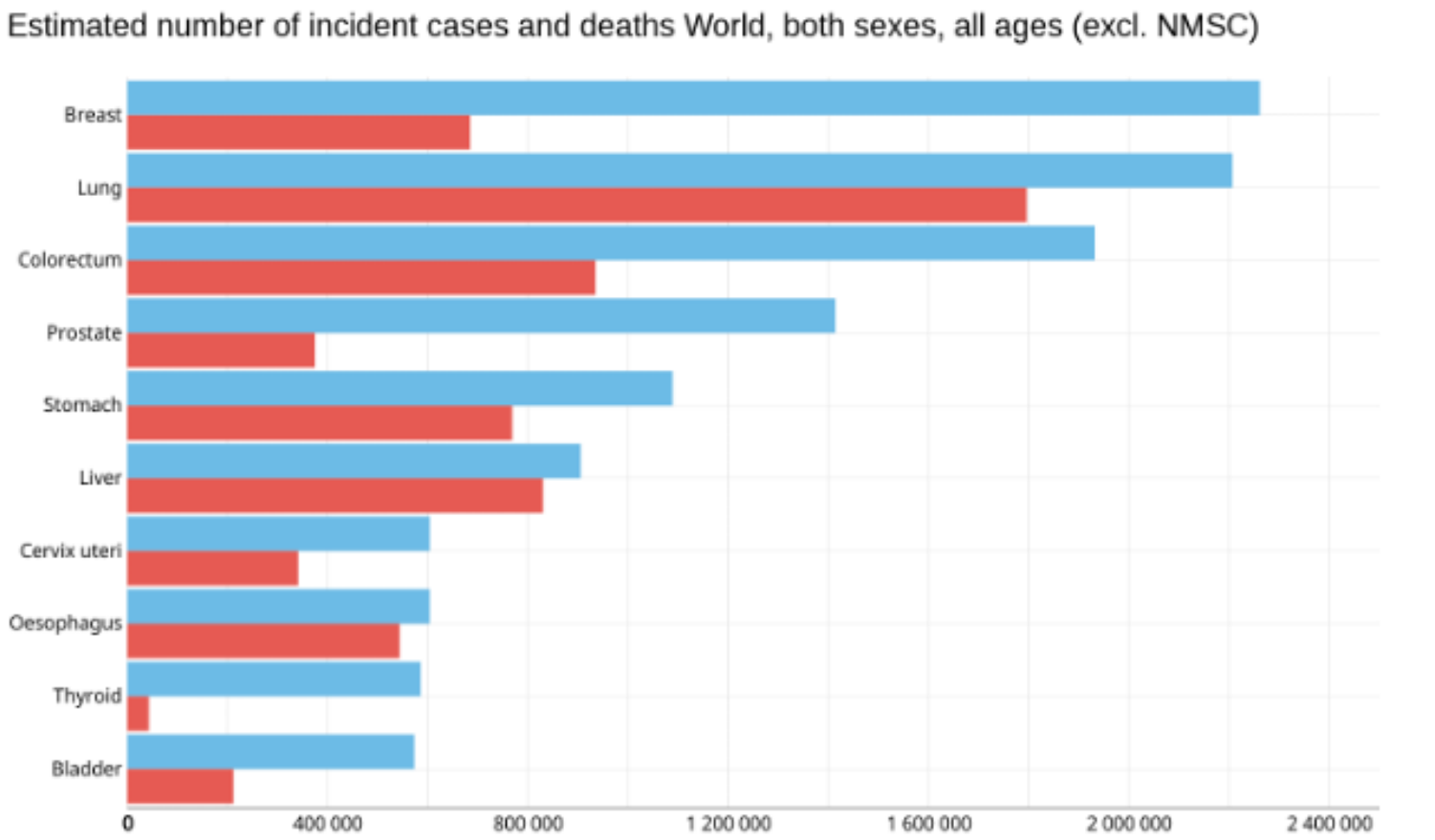
1	What is the total number of newly registered cancer cases last year? *If data for 2022 are not available, please, indicate the latest available and the corresponding year*	
2	What is the total number of newly registered cancer cases over the last 5 years?	
3	How many patients have been **treated with radiotherapy** last year / over last 5 years?	
4	What is the total number of **registered paediatric cancer patients** over the last 5 years?	
5	Are children treated with radiotherapy in your facility? If yes, how many **paediatric patients have been treated with radiotherapy** last year / over last 5 years?	
6	Which are the **top 10 most frequent** types of cancer in your country over the last 5 years?	Number of new patients per year *Please indicate either the absolute number or percentage of total!*
	1.	
	2.	
	3.	
	4.	
	5.	
	6.	
	7.	
	8.	
	9.	
	10.	

Most common cancer localizations

	Lithuania	Estonia
Prostate	13 % (2267)	12.9 % (1132)
Non-melanoma skin	13 % (2209)	15 % (1323)
Lung, trachea, bronchus	9 % (1557)	9.6 % (842)
Breast	9 % (1486)	9.2 % (808)
Colon	6 % (960)	7.2 % (632)
Stomach	5 % (816)	4.3 % (376)
Rectum	4 % (707)	4.2 % (370)
Kidney	4 % (691)	3.8 % (336)
Corpus uteri	4 % (650)	2.7 % (239)
Pancreas	3 % (561)	3.3 % (287)

As there is no cancer registry currently in Latvia, data acquisition is more difficult, though the most common cancer types remain similar

Cancer types with highest mortality



Lung, bronchus
Colorectal
Stomach, Liver
Haematological
Pancreas
Prostate
Breast
Rectum
Oral cavity, pharynx
Kidney

Incidence for main PT indications (over 5 years)

For pediatric cancers			
	Lithuania	**Estonia**	**Latvia**
Incidence (**over 5 years**)	405 (2015-2019)	234 (2016-2020)	~ 384
Receiving RT (**over 5 years**)	48+69	40 (NEMC)	54 (LOC)
Receiving RT (**recent year**)	10+15	7 (NEMC)	9 (LOC)

Most common pediatric indications:

Lithuania: Leukaemia (28%), Brain/CNS (17%), Bone, connective and soft tissue (13%), Non-Hodgkin lymphoma (9%) and retroperitonium (7%)

Estonia: Leukaemia, Hodgkin lymphoma, Colon, Kidney, CNS

Latvia: CNS, Leukaemia, Lymphoma

To our knowledge and current data **– just 1 pediatric patient referred for PT !**

For other cancers			
	Lithuania	**Latvia**	**Estonia**
Brain	1383	217 (RT treat)	559
Head & Neck	3251	1362 (RT treat)	998
Glioblastoma	622	N/A	N/A
Pancreas	2782	26 (RT treat)	1435

Baltic projections for patients eligible for PT

- Opinion of Baltic specialists – **joint consensus under discussion**
- With the data from the ART study of **13045 patients** receiving radiotherapy and projections from publications, what we can estimate:
  - **At 4.3 % - 561 patient**
  - **At 15 % - 1957 patients**

The process of defining clear criteria for patient eligibility for particle therapy is still on-going

Personnel – numbers in the Baltics

Key personnel for conventional radiation therapy: a team of

radiation oncologists + radiotherapy technologists + medical physicists

	Lithuania	Latvia	Estonia
Radiation oncologists	41	33	12
Radiotherapy technologists	55	43	31
Medical physicists (RT)	30	20	17

The core specialist team **~ 100 professionals** in each of the countries + technical support specialists, nuclear medicine clinicians, radiochemists, pharmacists and radiobiologists

As mentioned – specialized for conventional, photon based therapy with the use of commercial LINACs

“What is missing” – **physicist’s point-of-view**

In terms of knowledge:

- The changes and nuances of treatment planning and quality assurance: **doable in exchange visits/further educational courses**
- Role of LET, RBE modelling in planning: **doable in educational courses, incorportation into university curriculum**
- Broader use of Monte Carlo and physics processes specific to particle therapy: **incorporation into university curriculum**

In terms of specialists:

- The addition of **on-site accelerator physicists** and technologists
- More crucial integration of radiation biologists

Development of a novel synchrotron is not the same as buying a commercial cyclotron – local personnel are the ones running and repairing

“What is missing” – **clinician’s point-of-view**

State-of-art cancer registries…

The Clinical Network (radiation oncologists, medical physicists, technologists, nuclear medicine specialists)

Scientific Network (oncologists, medical physicists, technologists, radiobiologists, nuclear medicine specialists, etc.)

As the project is long term, both are needed first of all to recruit the teachers who will form new experts in the field.

“What is missing” – **clinician’s point-of-view**

Basic needs from clinical point of view:

- Incorportation of PT into university (RO residency, RTT)/higher education (RTT) curriculums.
- More RO residency vacancies???
- Teaching the teachers kind of activities, educational activities for vast majority of RO, NMS in Baltic states.
- Hands on (including long term) practices in existing proton centers for RO and RTTs and nuclear medicine centers for NMS.
- A net of close collaboration with outside experts to prepare the indication (PT, various tracer PET/CT) and treatment protocols.
- …Collaboration of scientific societies and involvement of political structures to ensure timely (clear and easy) reimbursement schemes of diagnostic and treatment procedures.
- Spreading the knowledge to patient communities…

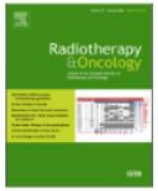
Future considerations for PT in the Baltics

Radiotherapy and Oncology 167 (2022) 7–13

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com



Original Article

Current practice in proton therapy delivery in adult cancer patients across Europe

Makbule Tambas [a,*], Hans Paul van der Laan [a], Roel J.H.M. Steenbakkers [a], Jerome Doyen [b], Beate Timmermann [c,d], Ester Orlandi [e], Morten Hoyer [f], Karin Haustermans [g], Petra Georg [h], Neil G Burnet [i], Vincent Gregoire [j], Valentin Calugaru [k], Esther G.C. Troost [l,m,n,o,p,q,r], Frank Hoebers [s], Felipe A. Calvo [t], Joachim Widder [u], Fabian Eberle [v], Marco van Vulpen [w], Philippe Maingon [x], Tomasz Skóra [y], Damien C. Weber [z], Kjell Bergfeldt [aa], Jiri Kubes [ab], Johannes A. Langendijk [a]

Reasons for not treating certain tumour types with PT are:

- **Lack of evidence (30%)**
- **Reimbursement issues (29%)**
- **Technical limitations (20%)**

Patterns of Proton Beam Therapy Use in Clinical Practice between 2007 and 2019 in Korea

Sung Uk Lee,[1] Kyungmi Yang,[2] Sung Ho Moon,[1] Yang-Gun Suh,[1] and Gyu Sang Yoo[2]

ACCESS
RADIOTHERAPY
TECHNOLOGIES

Thank you for listeninng