# RER 6039
# Cancer scene in the SEE region (statistics for SEEIIST)


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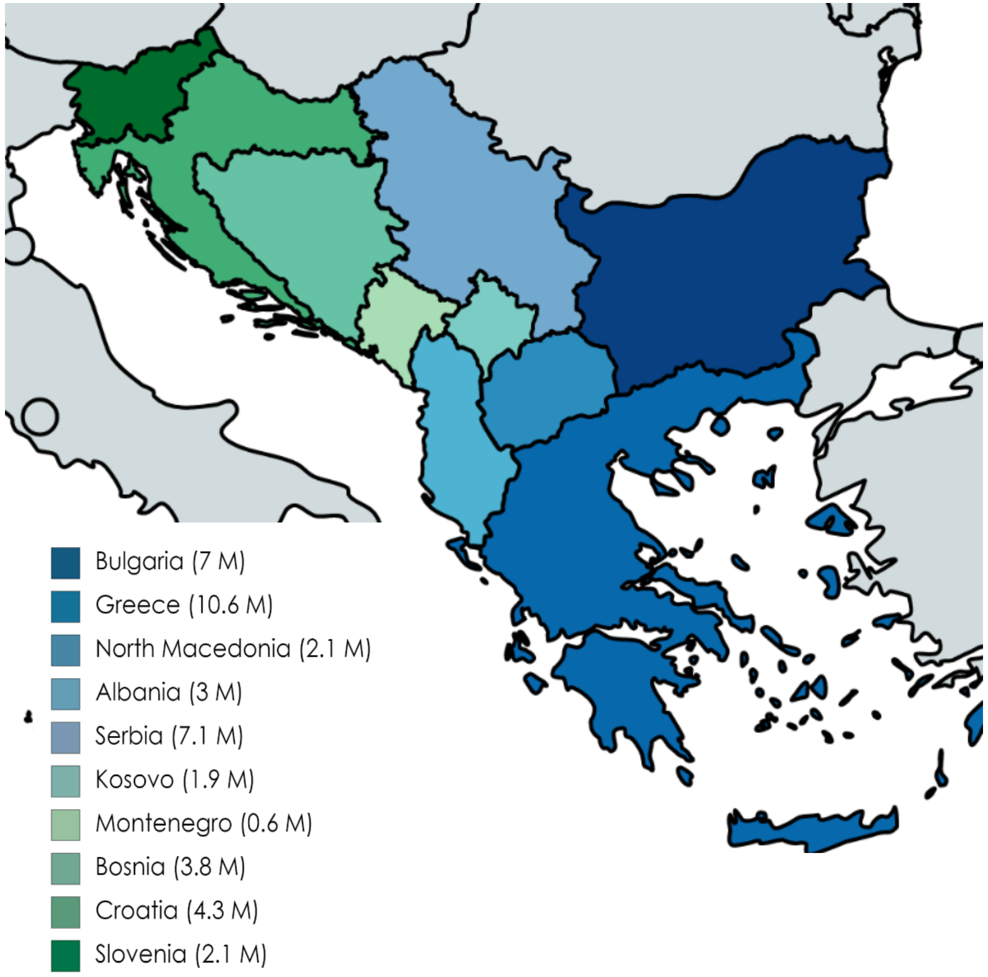
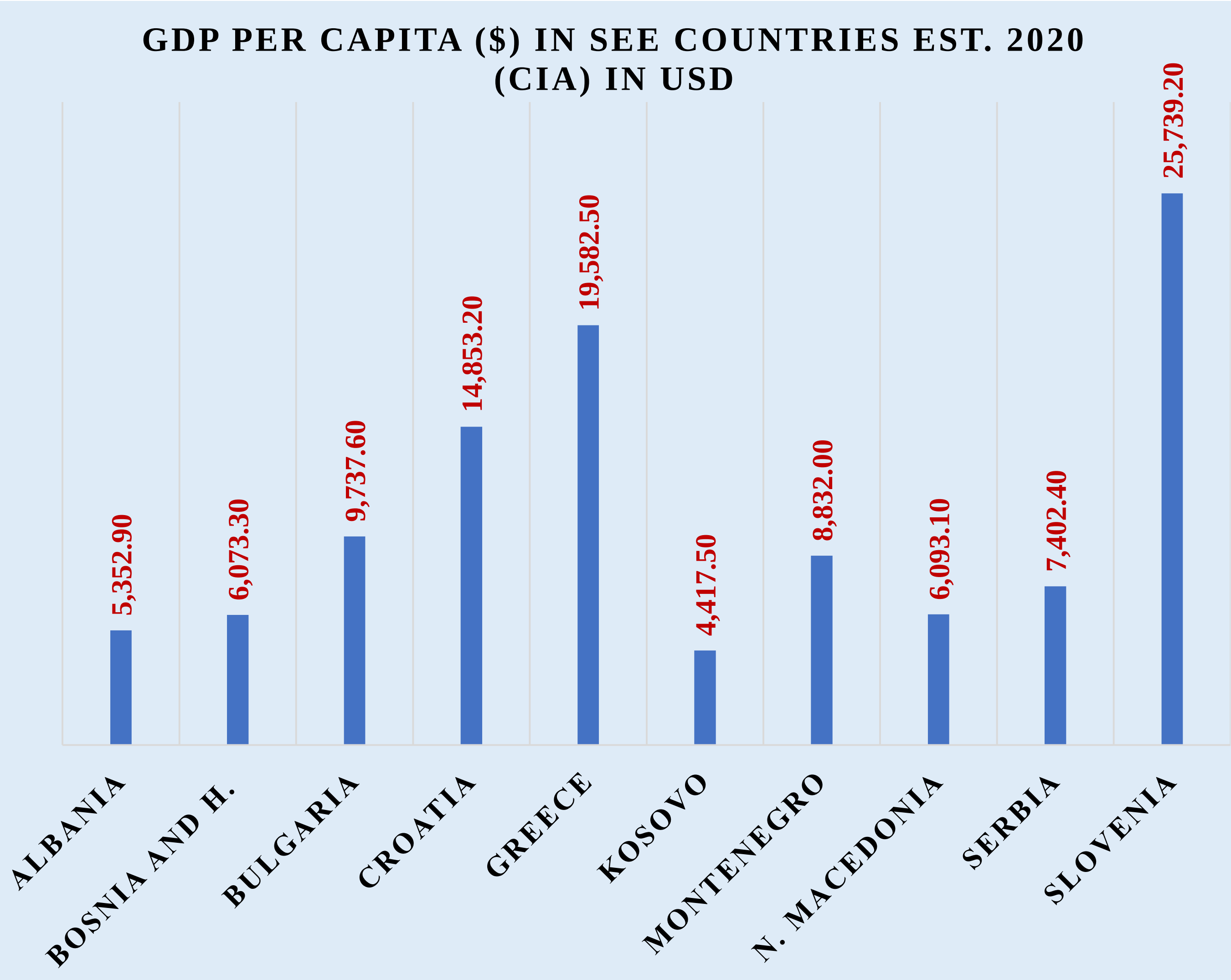
# Challenges in the SEE region

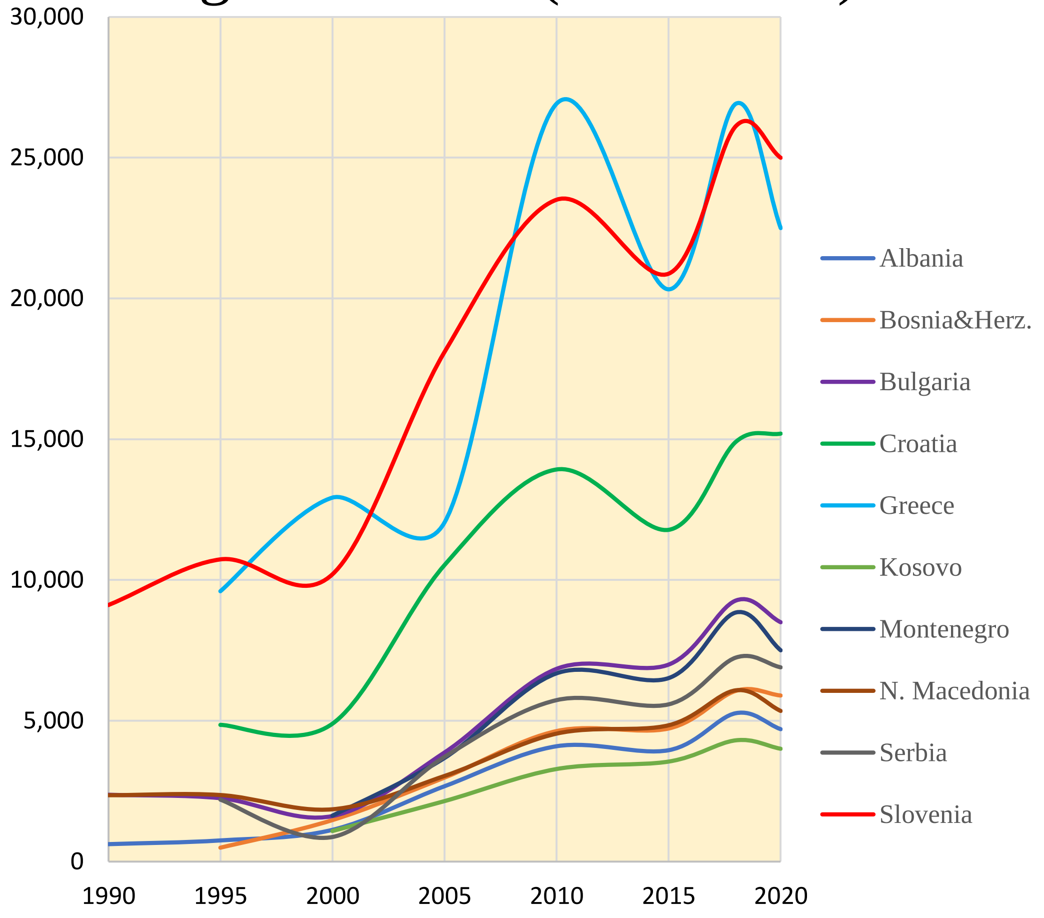
# SEE Region (43 M) – geography and population an PT

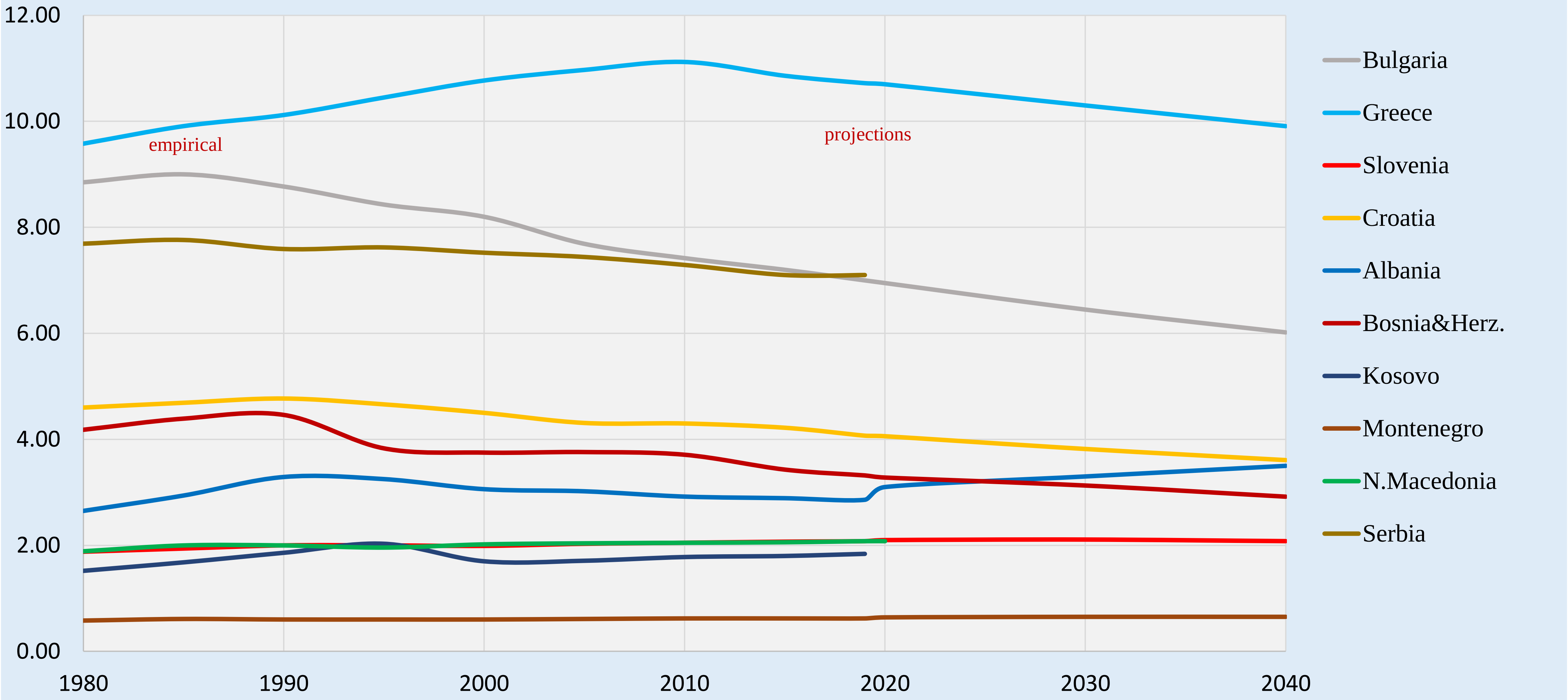
# SEE Region –GDP per Capita 2020 (USD)




## GDP per capita in the SEE region in USD (1990-2020)



# Population in Millions in the SEE countries
# (empirical data till 2018, projected for later than 2018 )



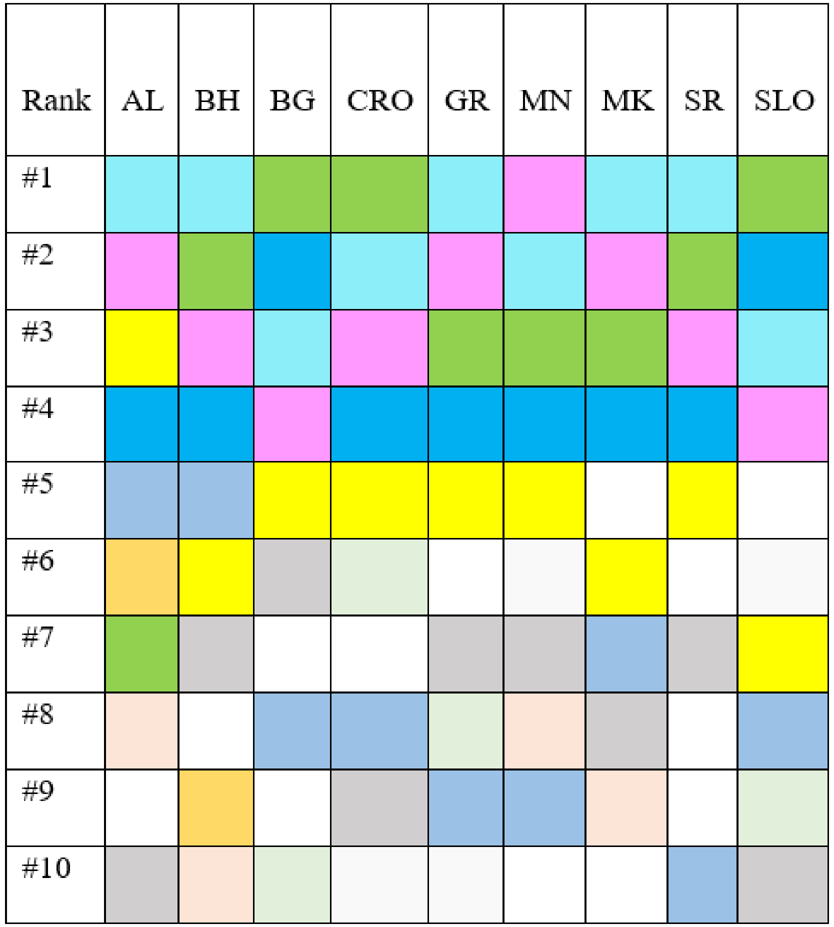
# BRAIN DRAIN INDICATOR: Global Talent Competitiveness Index 2021 Country Ranking

| # | Country |
|---|---|
| 1 | Switzerland |
| 2 | Singapore |
| 3 | USA |
| | |
| 26 | Slovenia |
| | |
| 43 | Greece |
| 45 | Russian Federation |
| 47 | Bulgaria |
| 49 | Montenegro |
| 52 | Croatia |
| 53 | Georgia |
| 58 | Serbia |
| 61 | Ukraine |

| # | Country |
|---|---|
| | |
| 72 | Albania |
| 79 | North Macedonia |
| 91 | Bosnia and Herzegovina |
| 94 | Kenya |
| | |
| 132 | Kongo |
| 133 | Yemen |
| 134 | Chad |
| | |

# Cancer in the SEE region

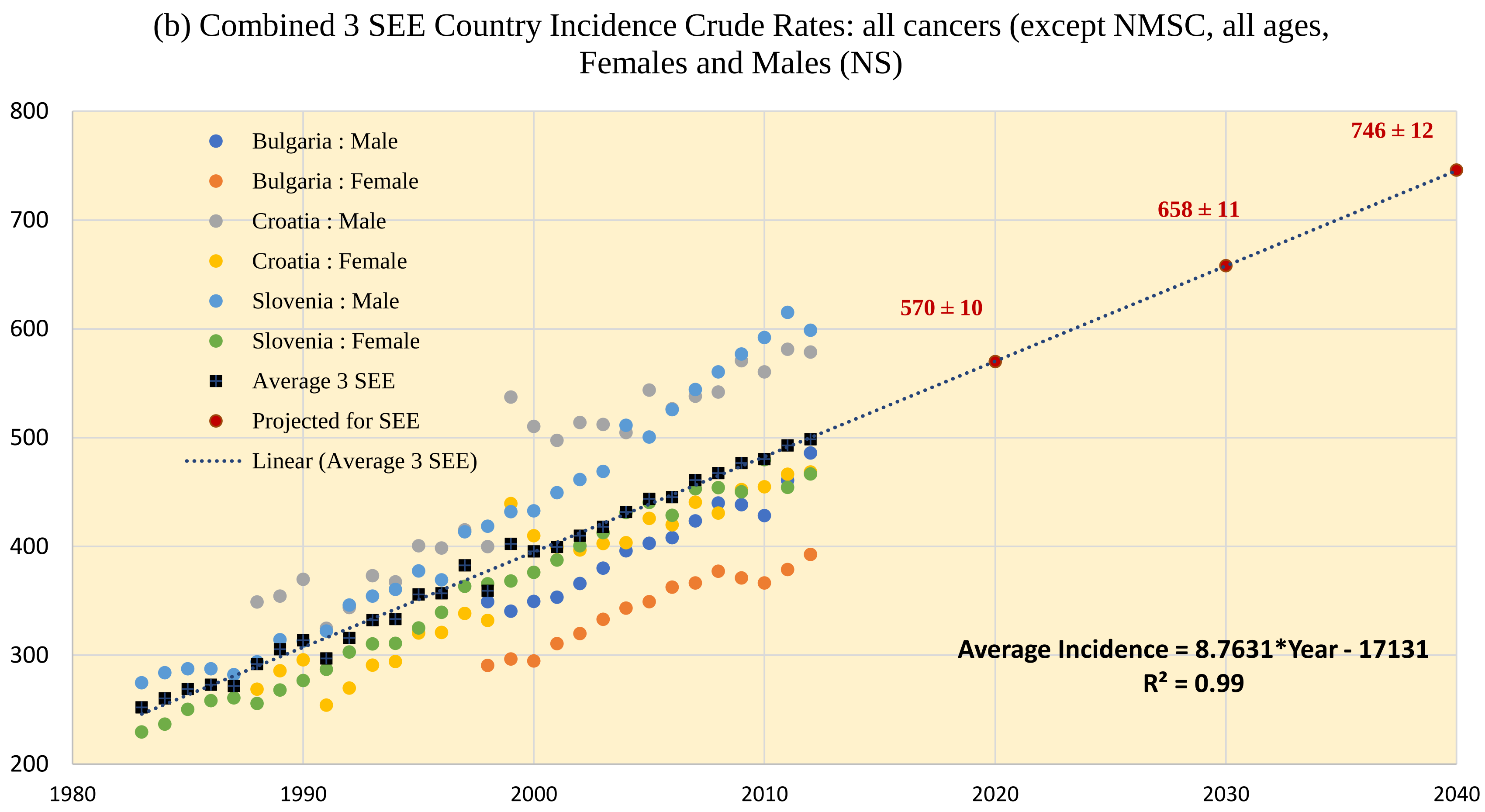
# Cancer patients rank list



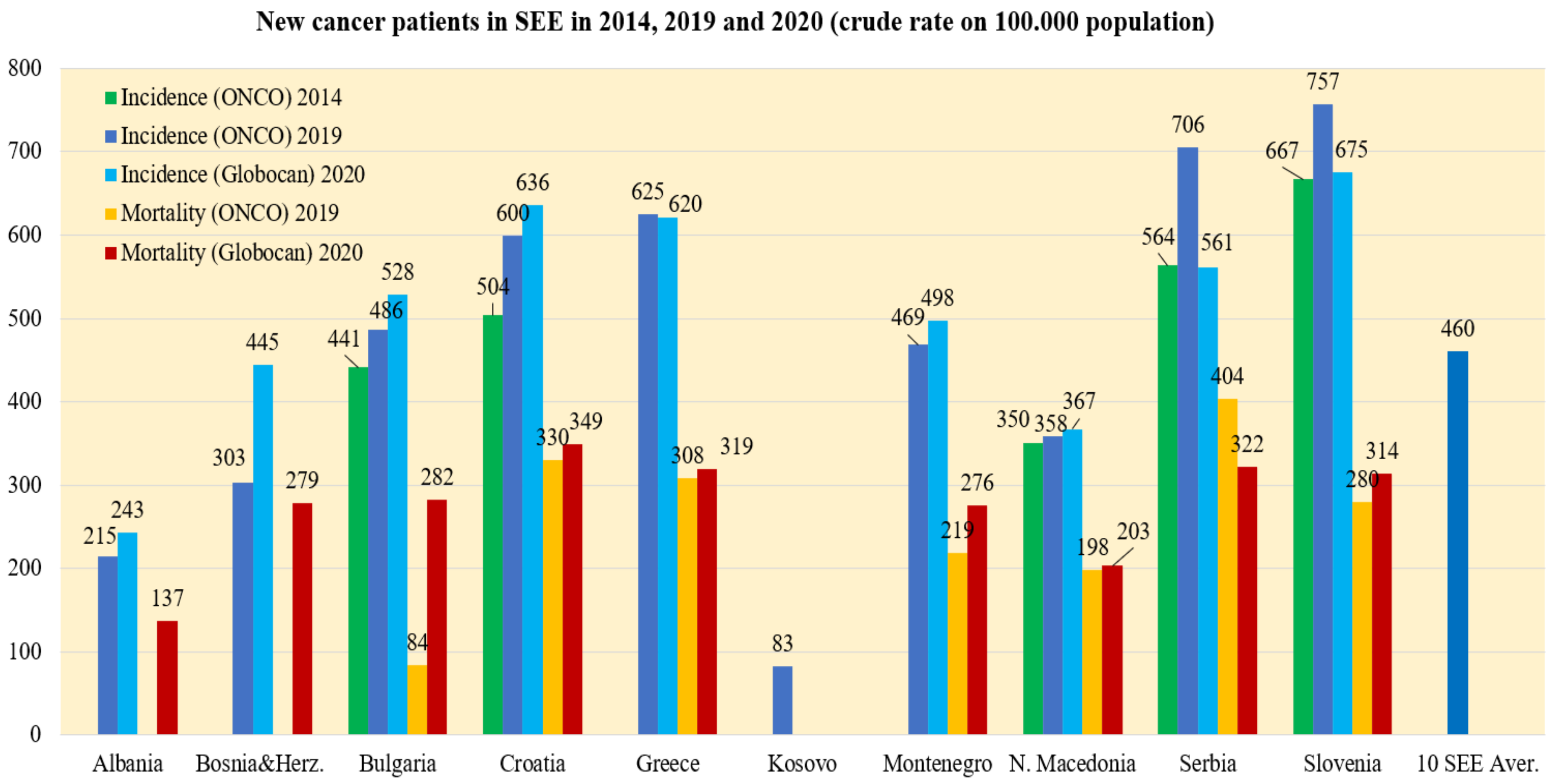

| Cancer site | # in SEE |
|---|---|
| Lung | 31.783 |
| Coloretum | 26.872 |
| Breast | 25.571 |
| Prostate | 20.498 |
| Bladder | 14.091 |
| Stomach | 7.552 |
| Pancreas | 7.406 |
| Kidney | 6.213 |
| Liver | 5.128 |
| Brain, CNS | 4.979 |
| Other sites | 72,222 |
| Top10 | 150.093 |
| All Cancers | **222.315** |

AL- Albania, BH – Bosnia-Herzegovina, BG-Bulgaria, CRO-Croatia, GR-Greece, MN-Montenegro, MK-North Macedonia, SR- Serbia, SLO- Slovenia

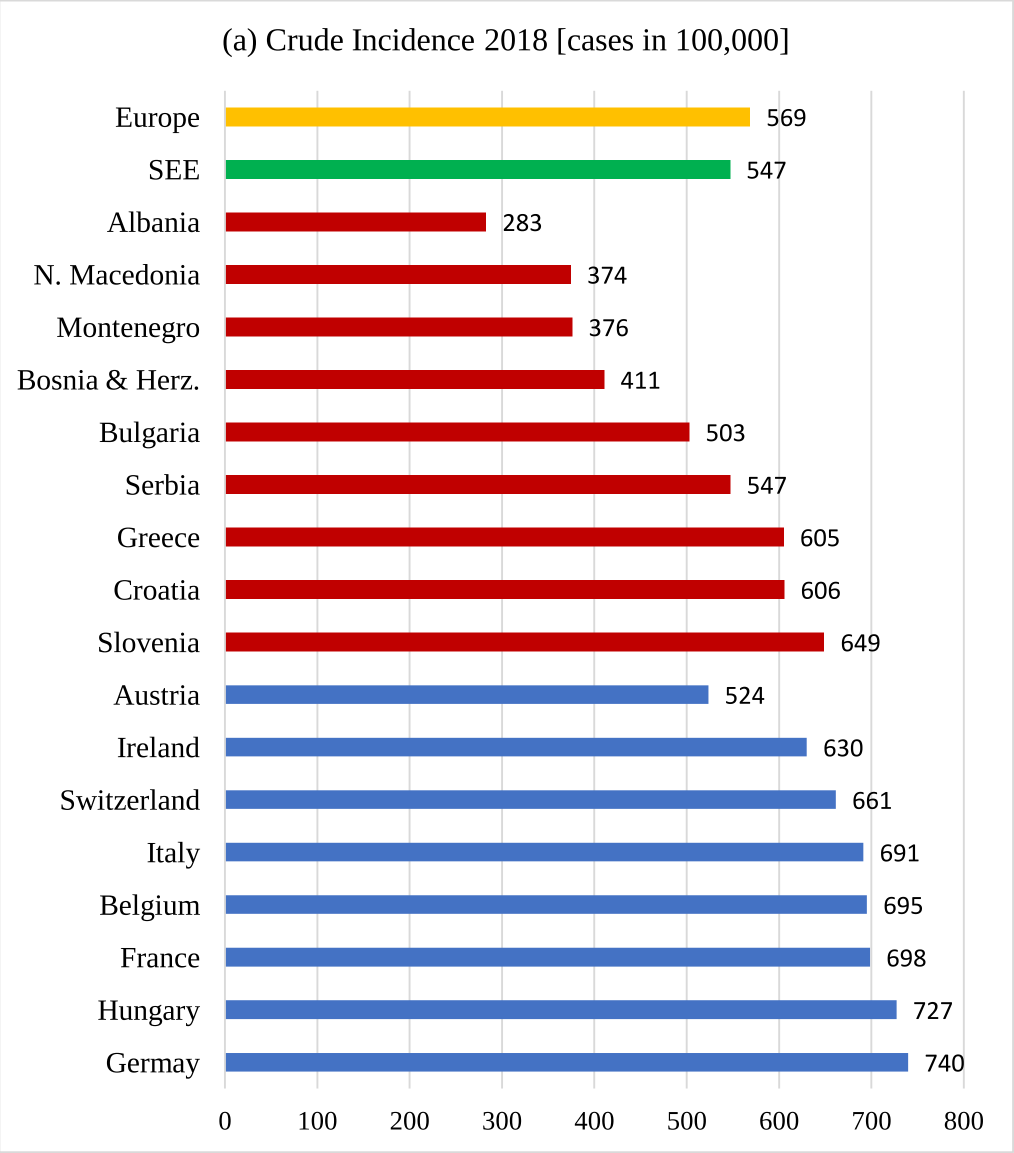
# Growing trend of cancer incidence in 100.000 pop

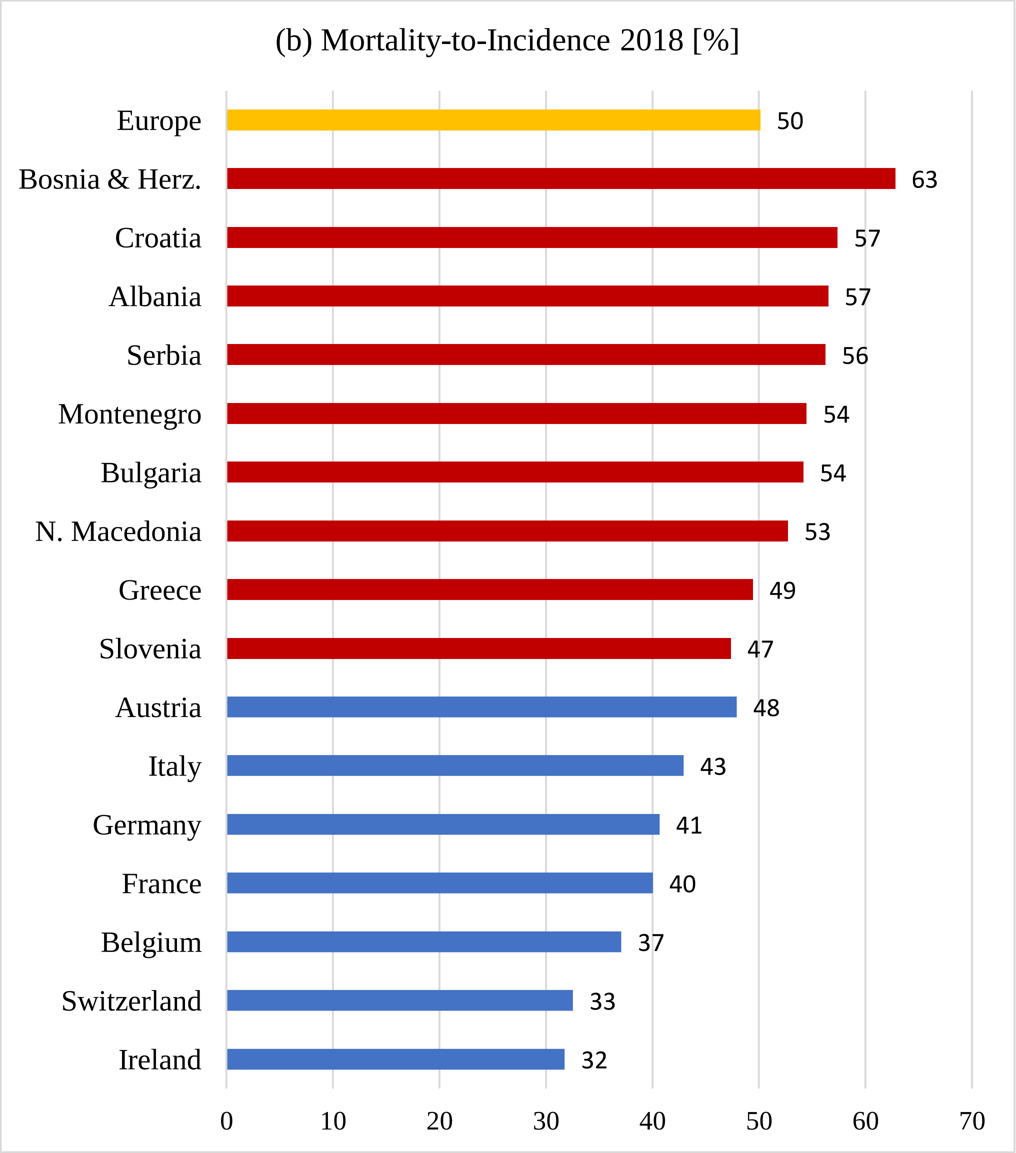


# Cancer Incidence and Mortality



# Cancer Patients



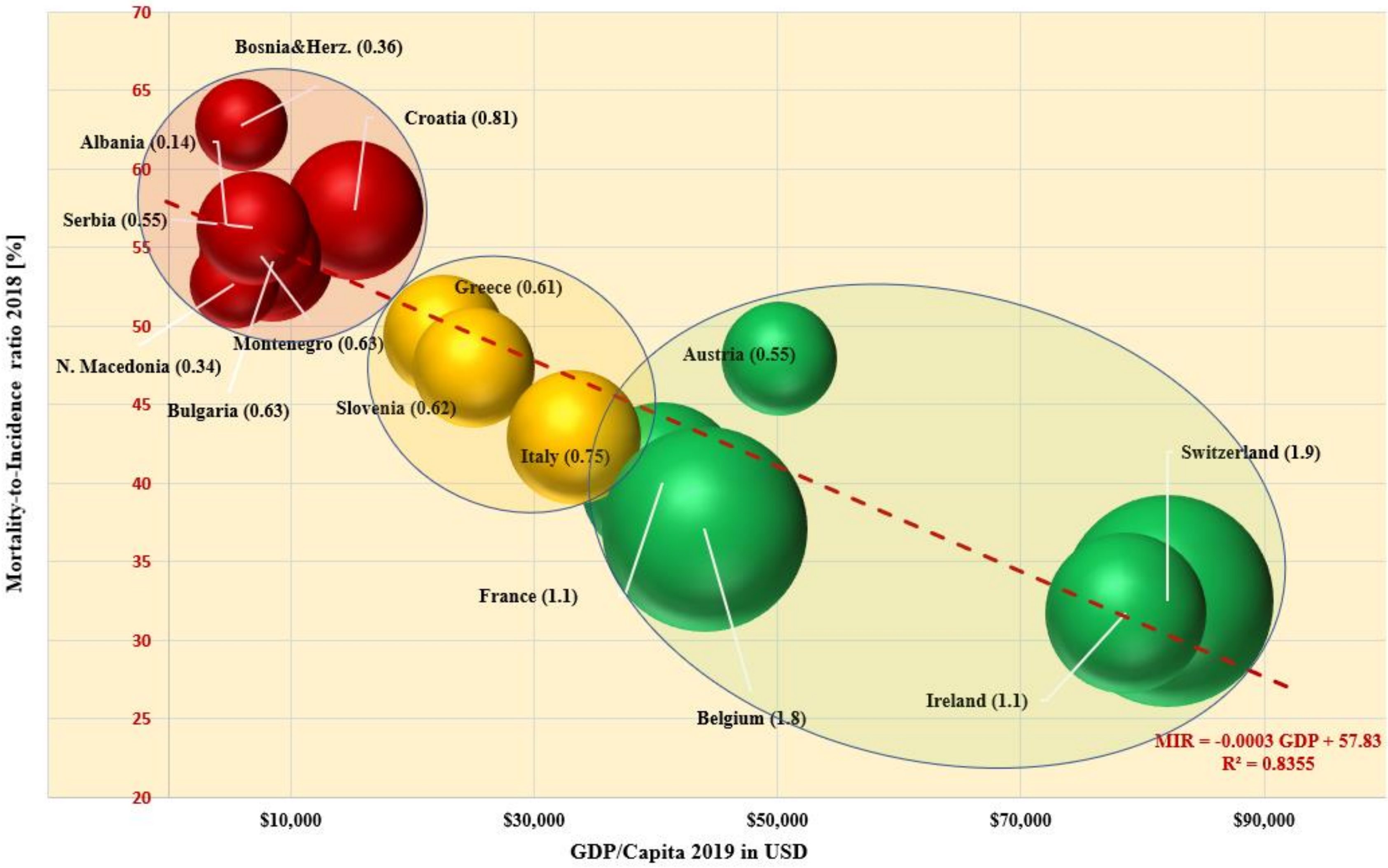



# How successfully a country detects cancer?

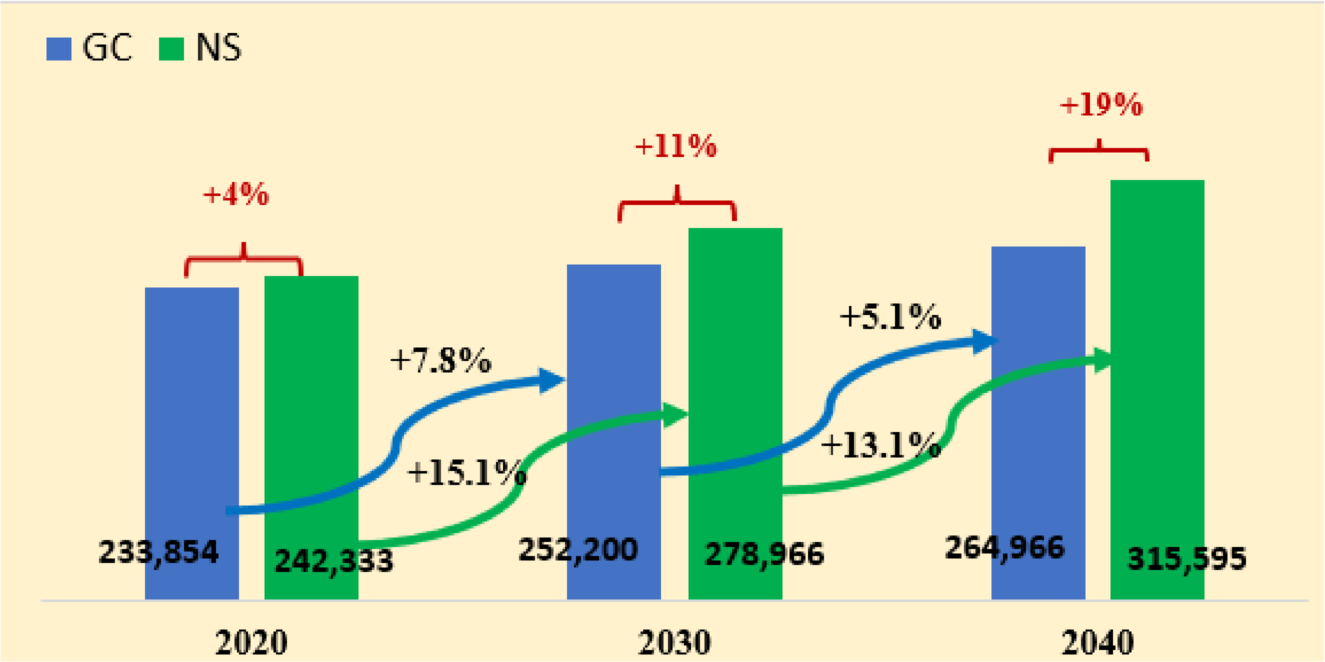
# Incidence

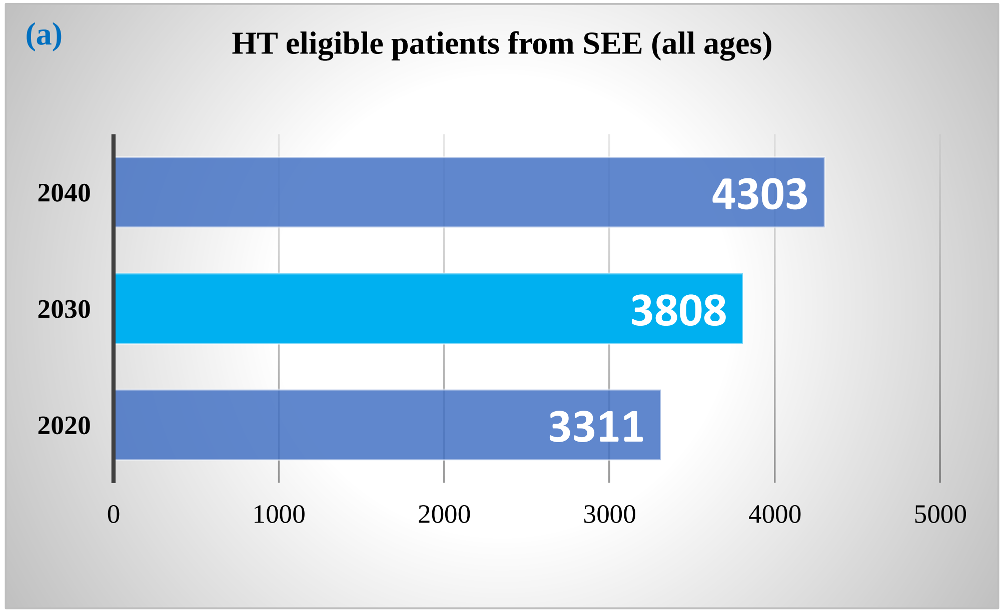
# How successfully a country deals with cancer?

# Mortality-to-Incidence ratio

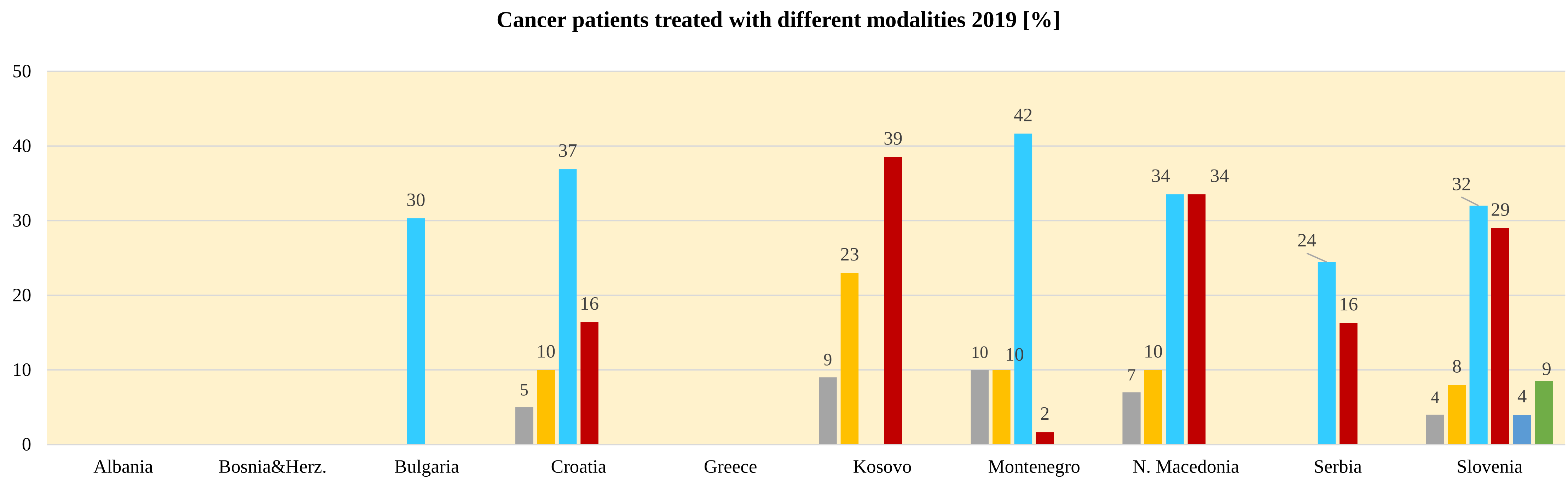


# Cancer Projections for the future in SEE



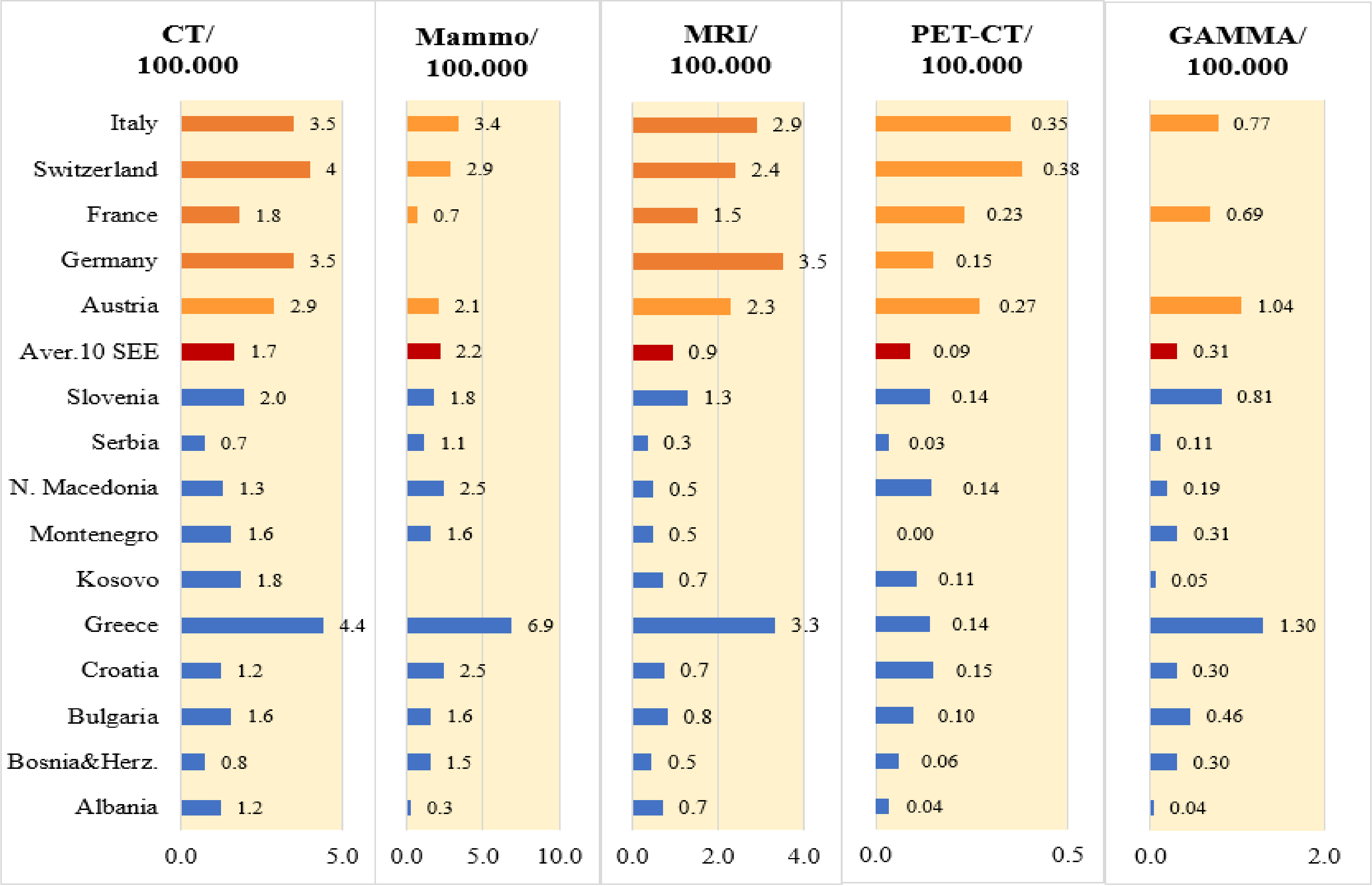



# Availability of Diagnostic Modalities

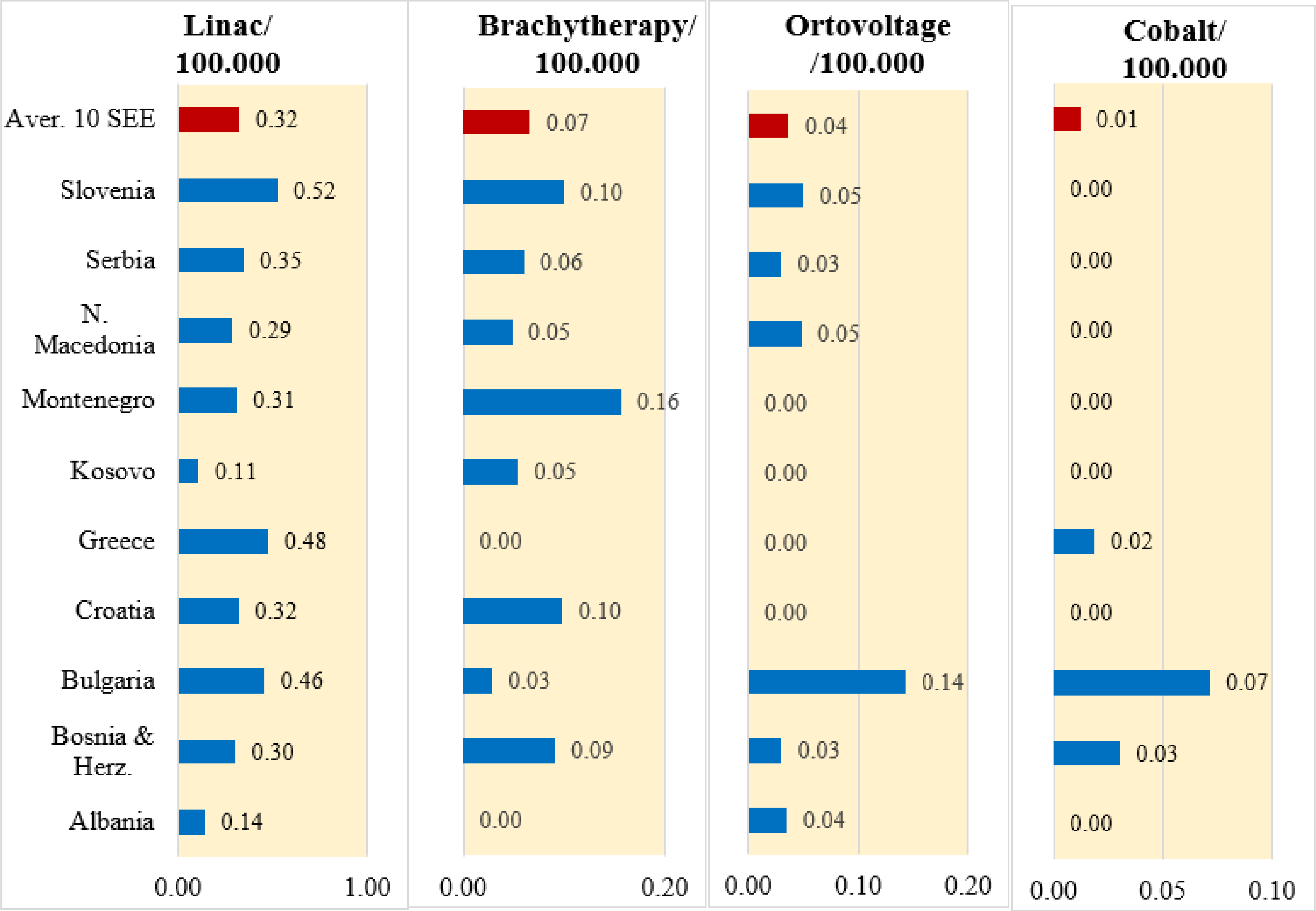



- A. Newly diagnosed cancer patients in 2019 who received ONLY RT by the end 2019 [%]
- B. Newly diagnosed cancer patients with cancer in 2019 who received ONLY Chemo by the end 2019 [%]
- C. Total number of cancer patients who received RT as a part of their treatment in 2019 [%] (including those under A)
- D. Total number of cancer patients who received Chemo as a part of their treatment in 2019 [%] (including those under B)
- E. Newly diagnosed cancer patients who received RT+Chemo by the end 2019 [%]
- F. Newly diagnosed cancer patients who received Surgery+RT+Chemo by the end 2019 [%]

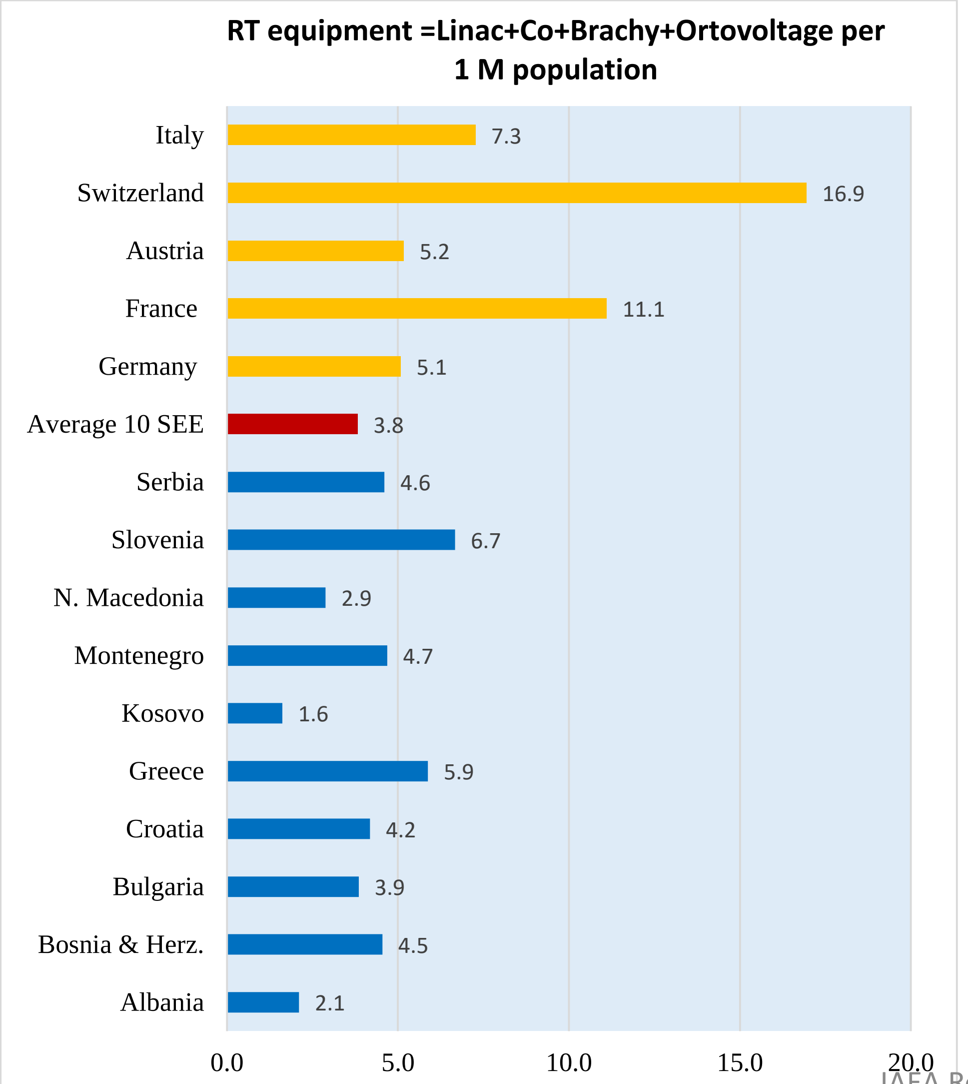
# Availability of Radiation Treatment Modalities

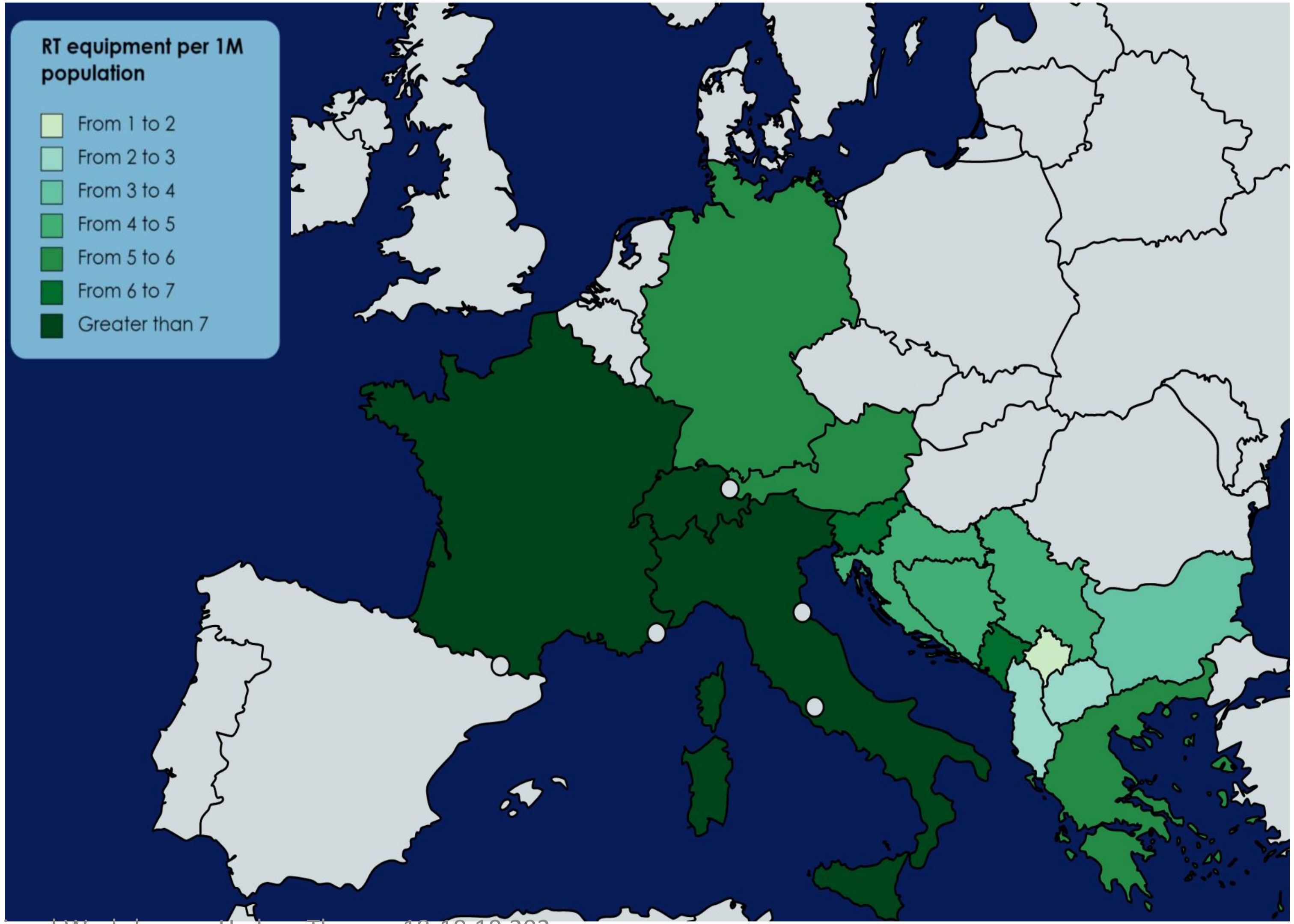


# RT versus other treatments



# Radiation Therapy in SEE region and some reference European countries



# Publications

ELSEVIER
Advances in Radiation Oncology
Volume 6, Issue 6, November–December 2021, 100772

Scientific Article

## Patients With Cancer in the Countries of South-East Europe (the Balkans) Region and

frontiers | Physics    Sections    Articles    Research Topics    Editorial board    Abo

REVIEW article

Front. Phys., 29 January 2021
Sec. Medical Physics and Imaging
Volume 8 - 2020 | https://doi.org/10.3389/fphy.2020.567466

This article is part of the Research Topic
Applied Nuclear Physics at Accelerators
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## South East European International Institute for Sustainable Technologies (SEEIIST)

Ugo Amaldi[1] Elena Benedetto[1] Sanja Damjanovic[2*] Manjit Dosanjh[3,4]
Marco Durante[5,6] Petya Georgieva[1] Thomas Haberer[7] Mark Plesko[8]
Mimoza Ristova[2,3,9] Sandro Rossi[10] Nicholas Sammut[11]
Mariusz Sapinski[5] Herwig Schopper[3] Hans Specht[12] Rudiger Voss[3]

Get citation

ELSEVIER
Clinical and Translational Radiation Oncology
Volume 34, May 2022, Pages 57-66

## Availability of technology for managing cancer patients in the Southeast European (SEE) region

Manjit Dosanjh [a b], Mimoza Ristova [a c d], Vesna Gershan [c], Petya Georgieva [a d], Marijana Balin Kovacevic [e], Ledio Bregu [f], Irma Coralic [g], Tamara Djurovic [h], Deyana Dosieva [i], Yiota Foka [a j], Ana Fröbe [k], Konstantinos Hatziioannou [l], Costas J. Hourdakis [m], Yllka Kabashi [n],
Di
Sv

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NINTH INTERNATIONAL CONFERENCE ON RADIATION IN VARIOUS FIELDS OF RESEARCH
June 14-18, 2021 | Herceg Novi | Montenegro
rad-conference.org | Book of Abstracts

## Cancer in the countries of the SEE (Balkans) region and the prospective of the Particle Therapy Center – SEEIIST

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https://doi.org/10.21175/rad.abstr.book.2021.29.2

**Purpose.** A recent initiative was launched for establishing the South East European

# Besides for Cancer Cure, SEE needs what is SEEIIST project is about

- Building mutual trust
- Overcoming historical tensions
- Revert Brain Drain
- Boost the collaborative science in SEE

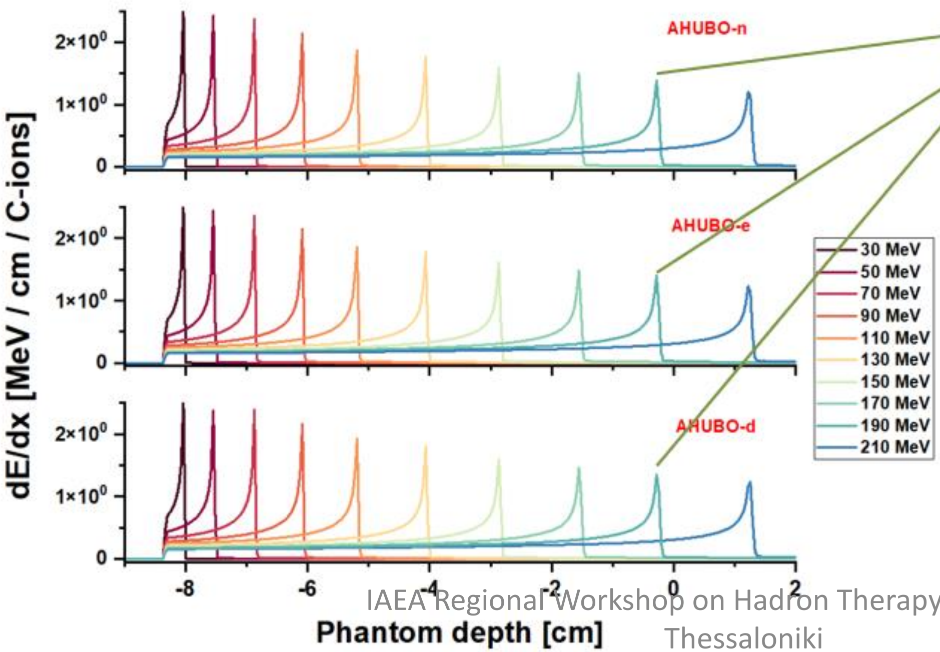
.... **Thank you for your attention…**

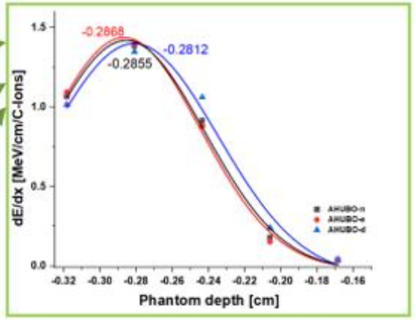
# Scientific contribution of Nort Macedonia to SEEIIST technical development

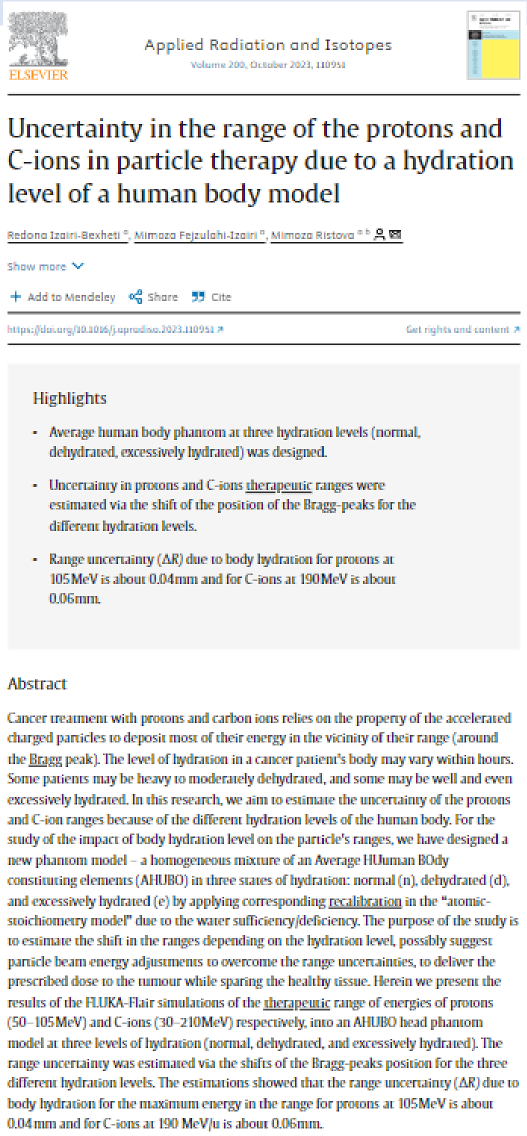
# 2023-Uncertainty in the range of the protons and C-ions in particle therapy due to a hydration level of a human body model

**Table 3. Stoichiometry of average human body at different hydration levels**

| | Hydration status | Water ($H_2O$) deficiency/sufficiency | Stoichiometry |
|---|---|---|---|
| 1 | Heavily dehydrated body | -5% (-2.25 kg for 60 kg body) | $O_{61.1}C_{18}H_{1.63}N_{3.2}Ca_{1.5}P_{1.2}$ |
| 2 | Dehydrated body | -2% (-0.9 kg for 60 kg body) | $O_{63.45}C_{18}H_{6.35}N_{3.2}Ca_{1.5}P_{1.2}$ |
| 3 | Body with the normal hydration | 0% (0 kg) (average stoichiometry) | $O_{65}C_{18}H_{9.5}N_{3.2}Ca_{1.5}P_{1.2}$ |
| 4 | Excessive hydration | +2% (+0.9 kg for 60 kg body) | $O_{66.55}C_{18}H_{12.65}N_{3.2}Ca_{1.5}P_{1.2}$ |



Applied Radiation and Isotopes
Volume 200, October 2023, 110951

Uncertainty in the range of the protons and C-ions in particle therapy due to a hydration level of a human body model

Redona Izairi-Bexheti [a], Mimoza Fejzulahi-Izairi [a], Mimoza Ristova [a b]

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https://doi.org/10.1016/j.apradiso.2023.110951

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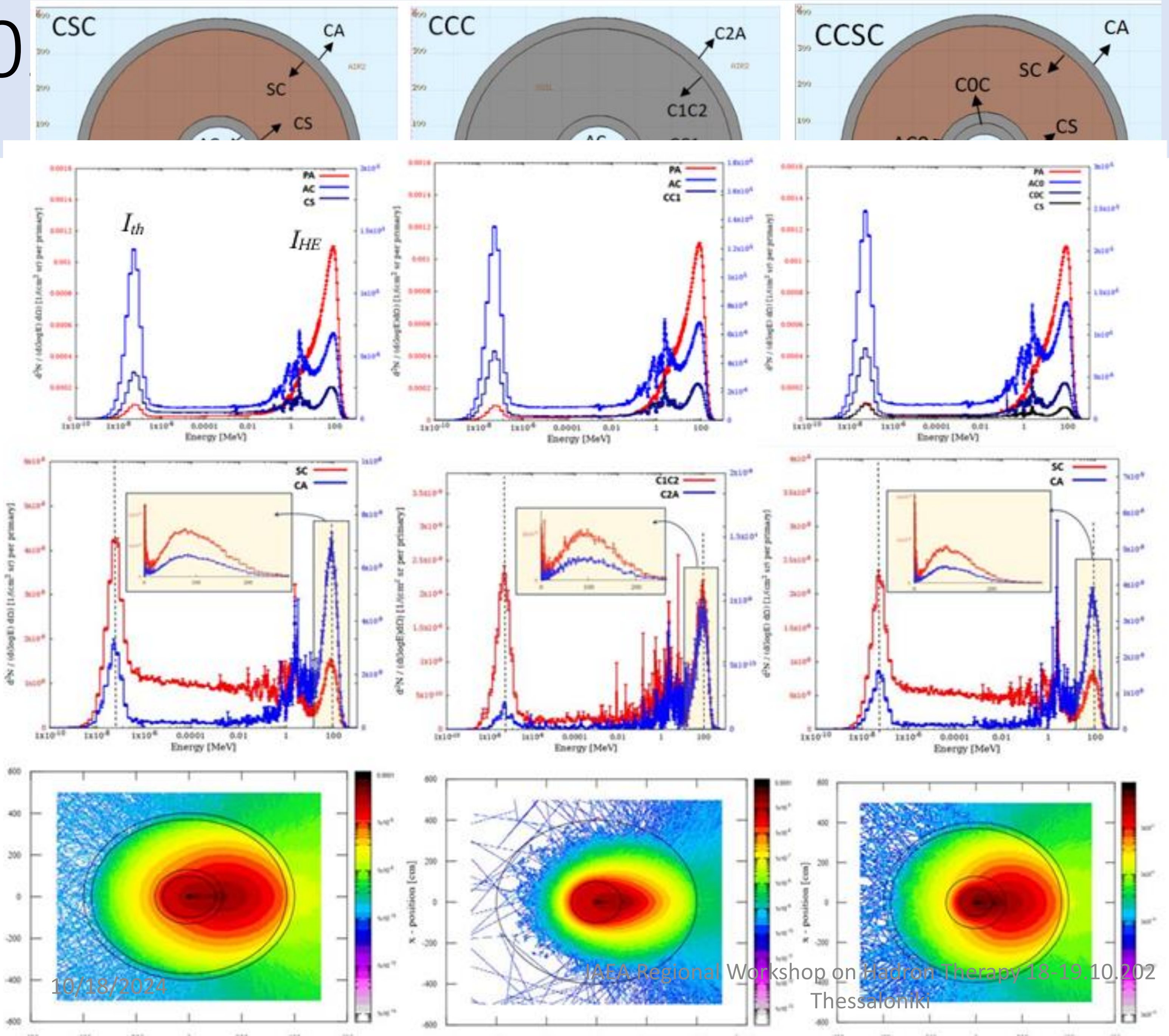
Highlights

- Average human body phantom at three hydration levels (normal, dehydrated, excessively hydrated) was designed.
- Uncertainty in protons and C-ions therapeutic ranges were estimated via the shift of the position of the Bragg-peaks for the different hydration levels.
- Range uncertainty ($\Delta R$) due to body hydration for protons at 105MeV is about 0.04mm and for C-ions at 190MeV is about 0.06mm.

Abstract

Cancer treatment with protons and carbon ions relies on the property of the accelerated charged particles to deposit most of their energy in the vicinity of their range (around the Bragg peak). The level of hydration in a cancer patient's body may vary within hours. Some patients may be heavy to moderately dehydrated, and some may be well and even excessively hydrated. In this research, we aim to estimate the uncertainty of the protons and C-ion ranges because of the different hydration levels of the human body. For the study of the impact of body hydration level on the particle's ranges, we have designed a new phantom model – a homogeneous mixture of an Average HUuman BOdy constituting elements (AHUBO) in three states of hydration: normal (n), dehydrated (d), and excessively hydrated (e) by applying corresponding recalibration in the "atomic-stoichiometry model" due to the water sufficiency/deficiency. The purpose of the study is to estimate the shift in the ranges depending on the hydration level, possibly suggest particle beam energy adjustments to overcome the range uncertainties, to deliver the prescribed dose to the tumour while sparing the healthy tissue. Herein we present the results of the FLUKA-Flair simulations of the therapeutic range of energies of protons (50–105MeV) and C-ions (30–210MeV) respectively, into an AHUBO head phantom model at three levels of hydration (normal, dehydrated, and excessively hydrated). The range uncertainty was estimated via the shifts of the Bragg-peaks position for the three different hydration levels. The estimations showed that the range uncertainty ($\Delta R$) due to body hydration for the maximum energy in the range for protons at 105MeV is about 0.04mm and for C-ions at 190 MeV/u is about 0.06mm.

# 20





Applied Radiation and Isotopes
Volume 214, December 2024, 111525


## Conceptual design of sandwich walls for shielding against secondary neutrons using MC simulations with FLUKA


Redona Bexheti [a], Mimoza Ristova [a b]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https://doi.org/10.1016/j.apradiso.2024.111525


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### Highlights

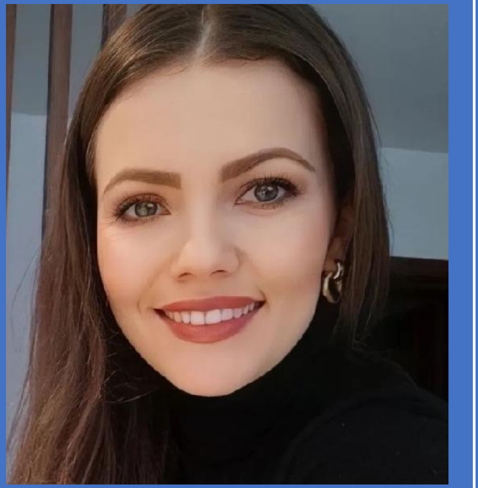
- Sandwich of concrete-soil was compared to full concrete shielding for secondary neutrons from particle therapy using FLUKA.
- Neutron spectra and 2D-fluence were used to evaluate shielding configurations in spherical geometry.
- Adding a supplementary concrete layer improves the RP against neutrons.


### Abstract

FLUKA Monte-Carlo transport code was employed to evaluate the secondary neutron spectra emerging from spherical sandwich shielding configurations composed of concrete and soil, similar to that used at the particle therapy facility MedAustron. This study provides a comparative analysis of neutron spectra attenuated by a concrete-soil-concrete (CSC) sandwich wall shielding configuration versus a full concrete wall design (CCC). Furthermore, we enhanced the shielding performance of the CSC configuration by adding an additional concrete layer (CCSC) to achieve results comparable to the CCC shielding. Two scenarios were tested for shielding performance: (1) primary protons at 100MeV, and (2) primary carbon ions (C-ions) at 190 MeV/u. Our simulations with primary protons of 100MeV showed that adding additional internal concrete wall to the CSC configuration, therefore designing the CCSC configuration, the RP performance becomes slightly improved – the HE-peak drops from $(1.43\pm0.11)10^{-11}$ to $(5.62\pm0.3)10^{-12}$, about 2.5 times. Still, the HE-peak of the exiting neutron spectrum from CCC -$(6.29\pm1.87)10^{-13}$ is about 9 times lower than that exiting CCSC - $(5.62\pm0.3)\ 10^{-12}$.

Our simulations with primary C-ions showed that by placing an additional internal concrete wall to the CSC configuration (CCSC) the RP performance becomes slightly improved – the exiting HE peak can be further attenuated from $(6.92\pm0.40)10^{-9}$ for CSC to $(3.79\pm0.15)10^{-9}$, becoming comparable to the one exiting the CCC configuration, $(0.92\pm0.04)10^{-9}$, only 4 times higher. Future research should be focused on improvements of the RP performance of the CCSC, by increasing the soil layer thickness and taking into consideration the humidity (water content) in the soil and concrete and also improve the number of primaries to $10^9$ or even $10^{10}$ for better statistical outcome.

# PhD candidates working on SEEIIST topics

| | | | |
|---|---|---|---|
|  |  | |  |
| **Dr Redona Bexeti** | **Mimoza Fejzulahi Izairi** | **Mirjeta Mediji Arifi** | **Yllka Kabashi** |

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