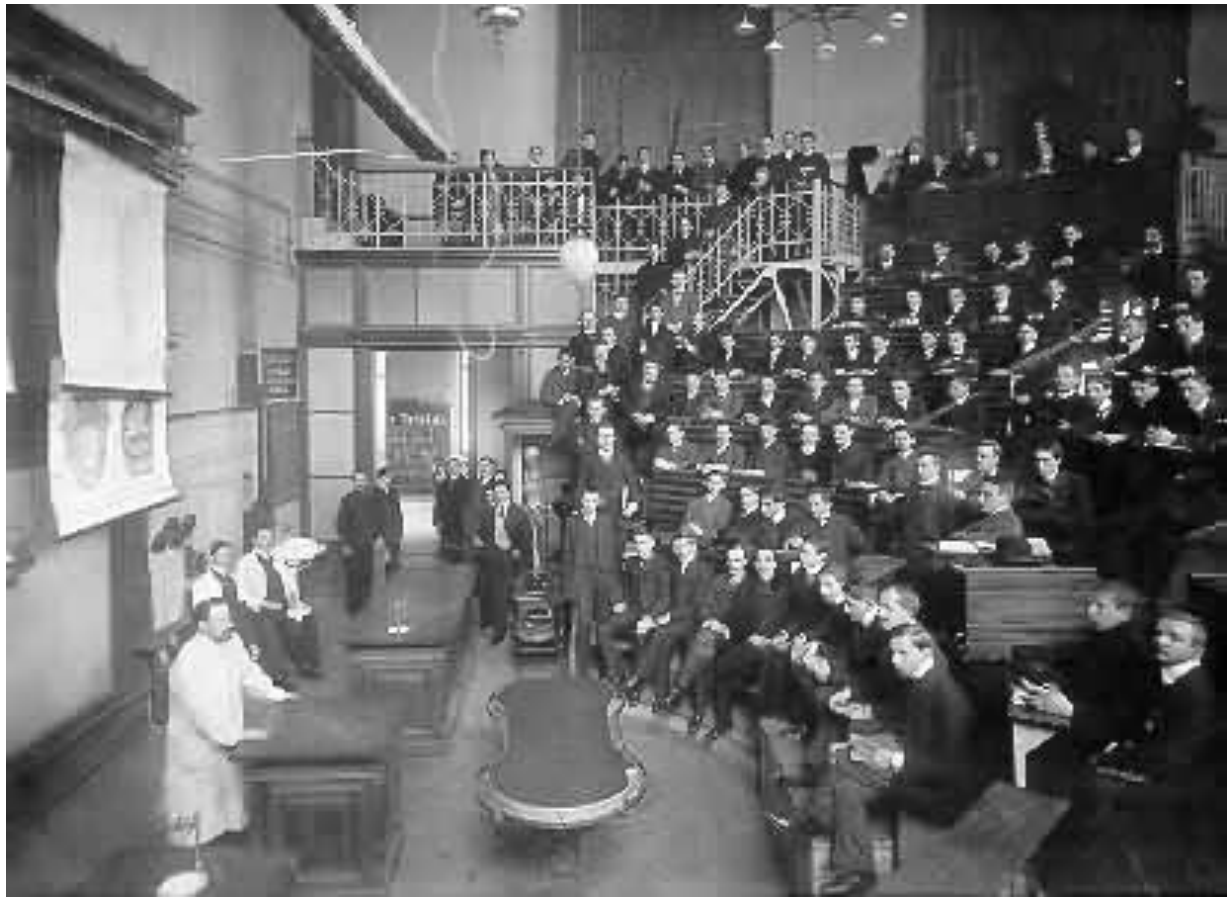
How innovation in radiation oncology changes educational models

Jesper Grau Eriksen
Professor, Dept. Experimental Clinical Oncology, Aarhus University Hospital
Director, ESTRO School

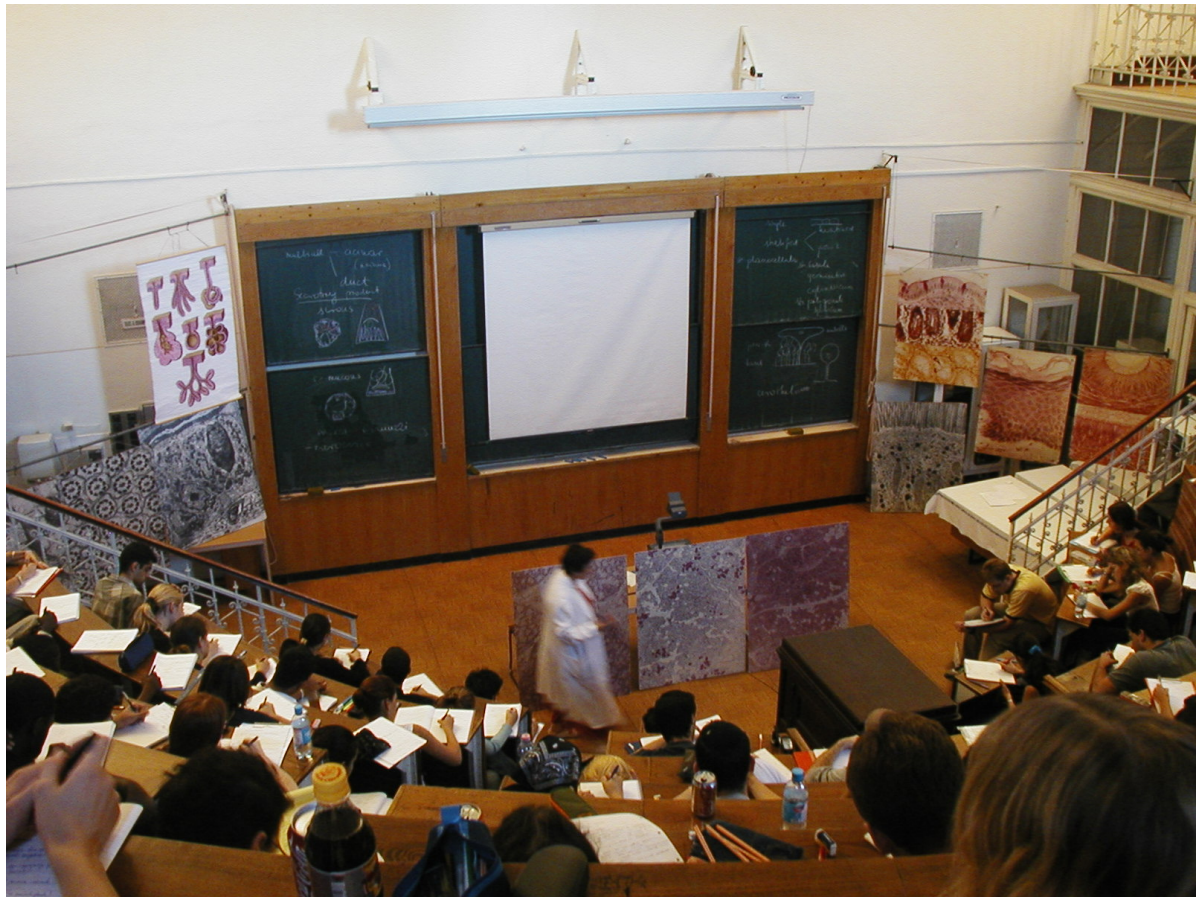
“There has always been and will always be too much to know.
Medical knowledge is theoretically and practically limitless”

Prof. Christakis
Harvard, **1910**

How do we learn?

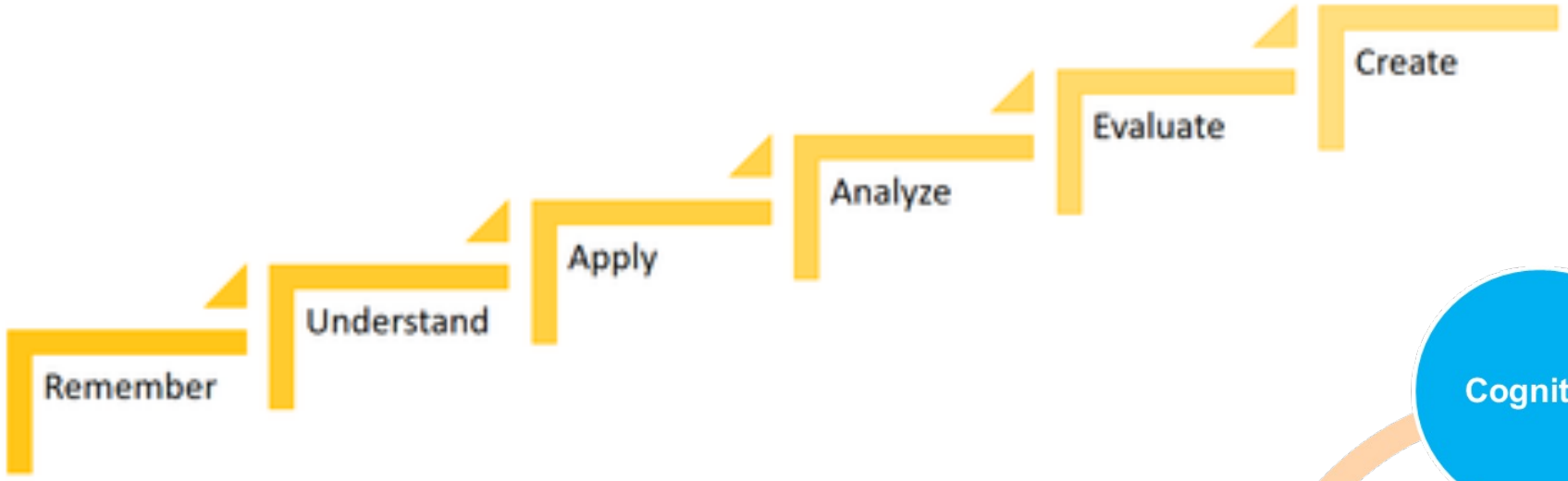


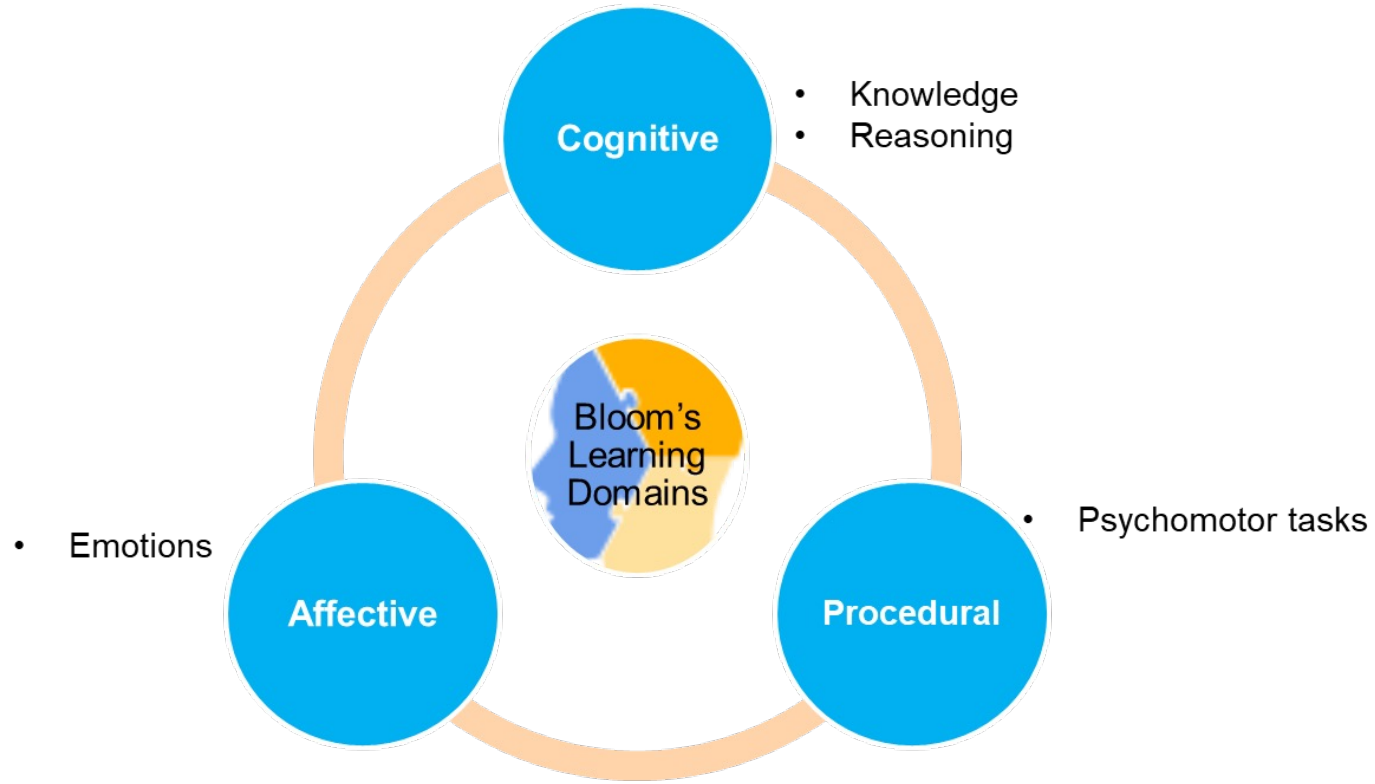
Medical School lecture hall – Budapest 1909



Medical School lecture hall – Budapest 2012

The way we learn

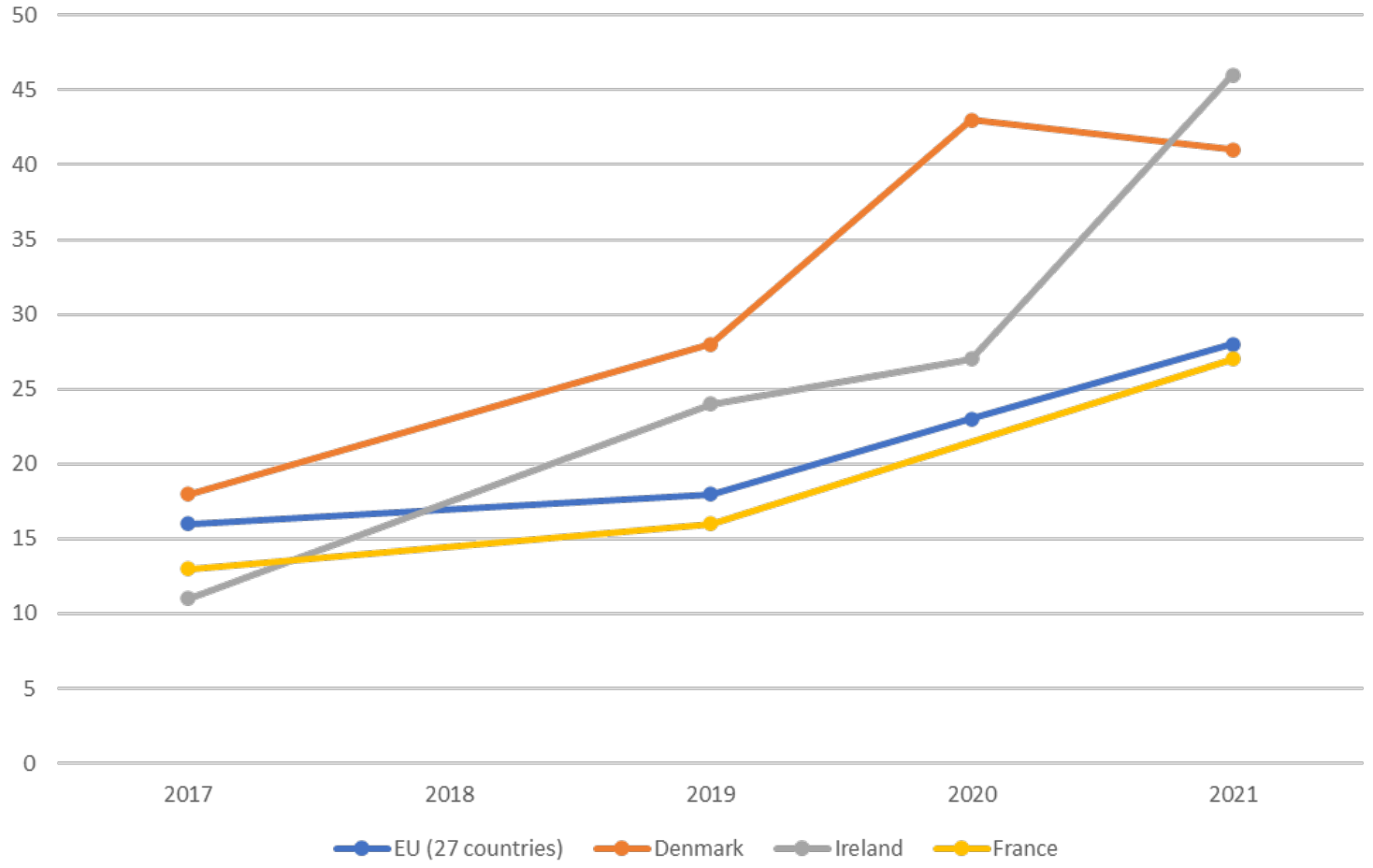




Anderson and Krathwol's (2001) revision to Bloom's cognitive hierarchy (1950'ies)

Online education on the rise

% of individuals who are doing an online course or using online learning material (2017-2021)

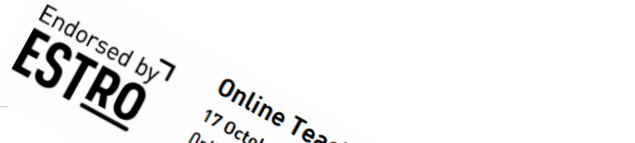


EUROSTAT, Official EU online database. 2022

Is on-demand learning the new black in the 21st century?

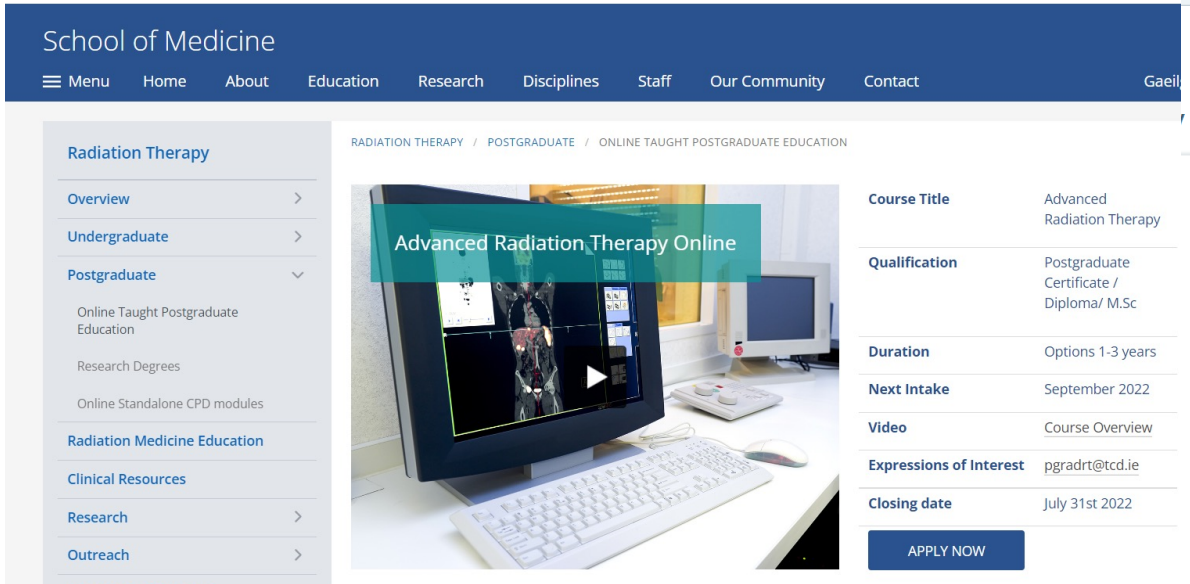
Rooted in strong disciplines, researchers and students have been generating new knowledge here for over 90 years. Aarhus University is Denmark's second-largest university, with 38,000 students, five faculties, research activities all over the country and campuses in Aarhus, Herning and Emdrup.

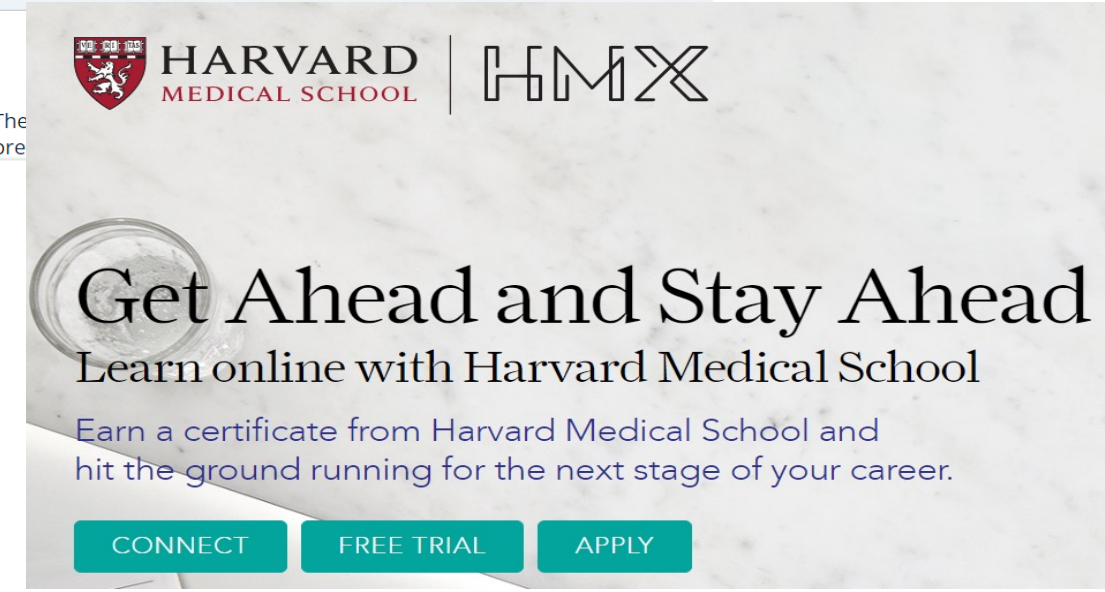
#69 Ranking | 2 Courses | Public Institution Type



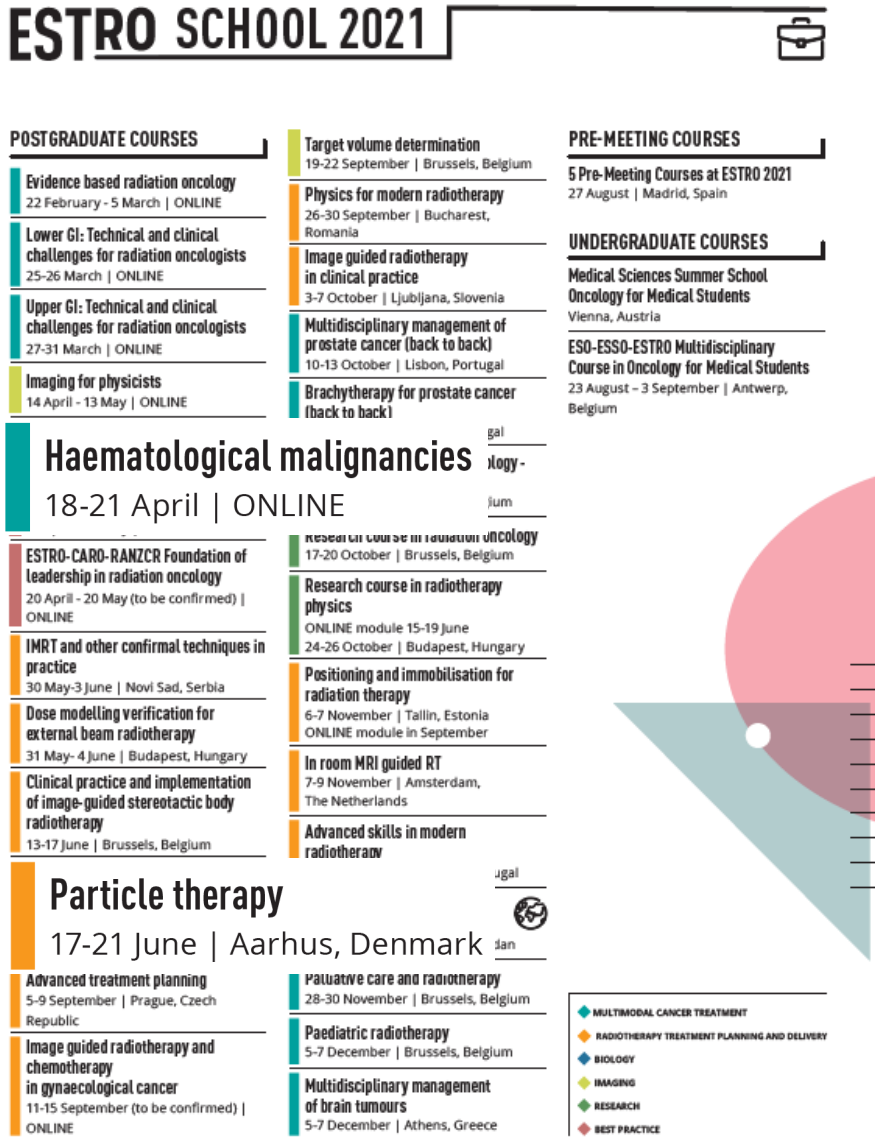
8 weeks, online (e: | **8-10 hours per week,** | **Flexible learning** through

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

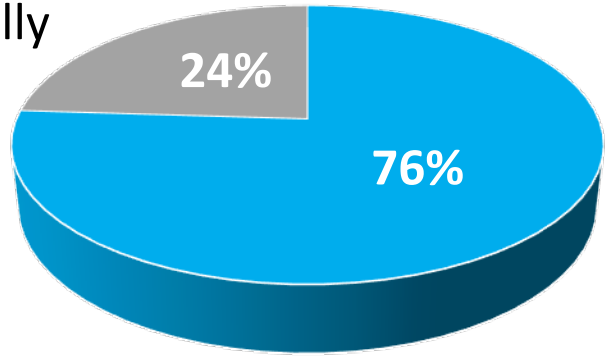




The education in ESTRO School



Keep a reduced number of fully live courses



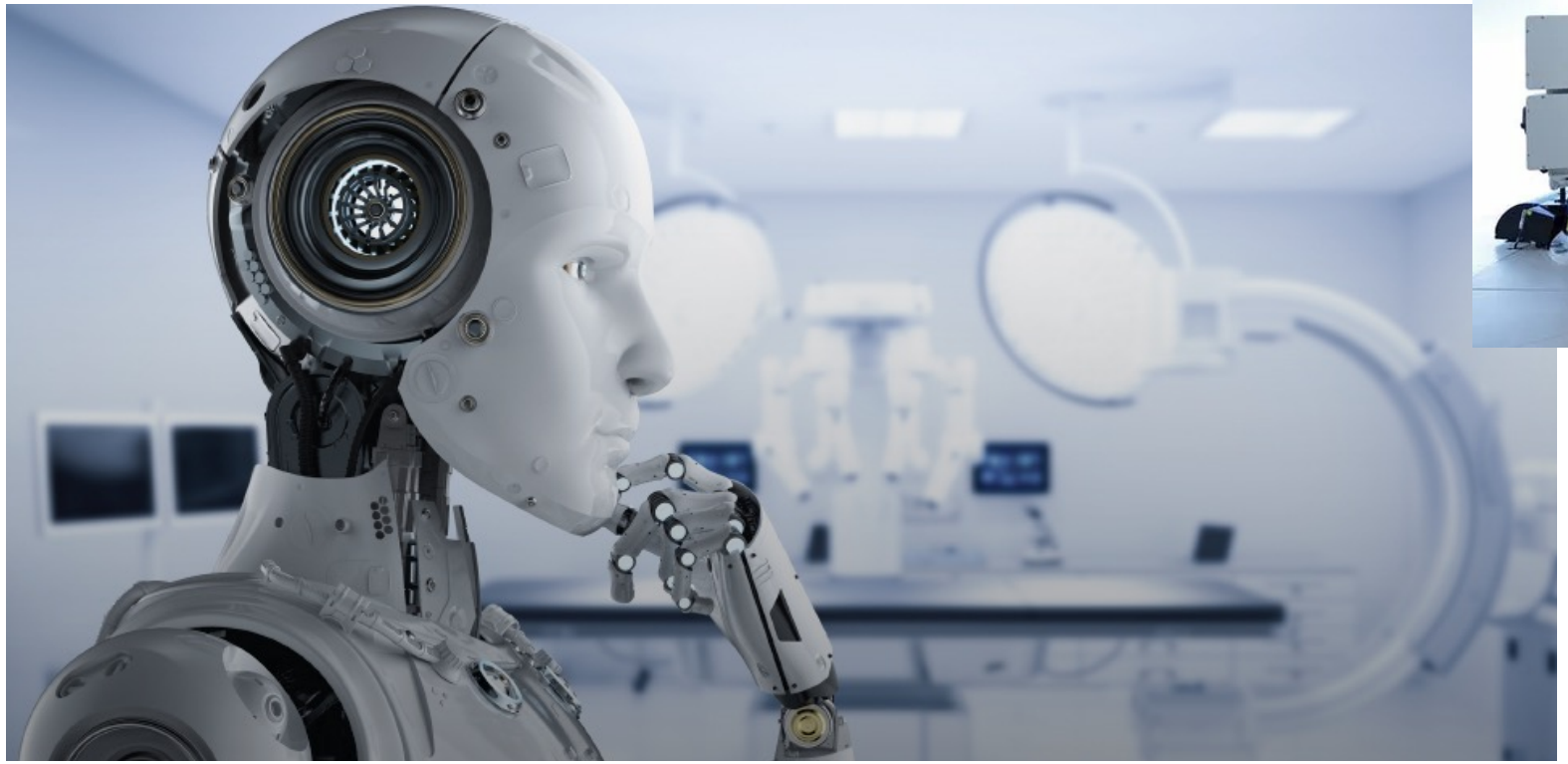
Keep a large curriculum and include both live and online courses

Question	Available Responders/ all participants	Not useful/ fairly useful	Useful/ extremely useful
How useful for your professional activity did you find this event?	481/853 (56% responded)	39/481 (8%)	442/481 (92%)
Question	Available Responders/ all participants	Poor/sufficient/ average	Good/ excellent
How would you rate the quality of the education/program of this event?	479/853 (56% responded)	83/479 (17%)	396/479 (83%)
How would you rate the online course?	477/853 (56% responded)	22/477 (5%)	455/477 (95%)
Question	Available Responders/ all participants	Not at all/not much	Somewhat/ very much
Did the event fulfil your educational goals and expected learning outcomes?	479/853 (56% responded)	14/479 (7%)	465/479 (93%)
Question	Available Responders/ all participants	Never/ only rarely	Sometimes/ almost aways
Did the program allow adequate time for discussion & questions?	485/853 (57% responded)	60/485 (12%)	425/485 (88%)

But are we really ready to educate health care professionals how to implement and use AI-augmented technologies?

Innovation in radiation oncology changes our lives

Fully AI-based in 2030?

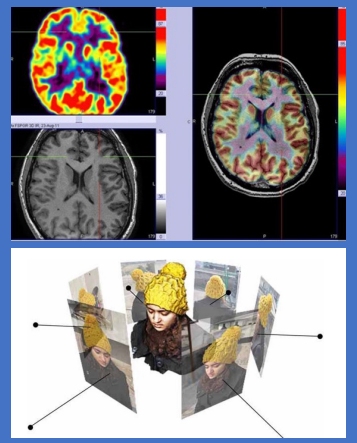


Innovation in radiation oncology changes our lives

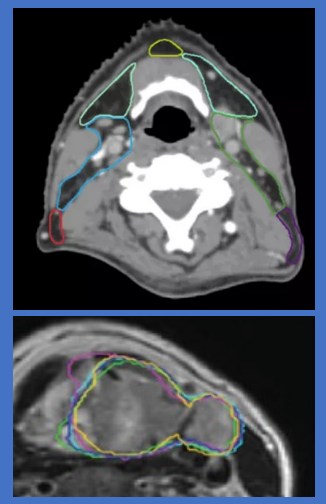
Automation
(to meet increased demand)

Risk modelling
(for personal treatment adaption)

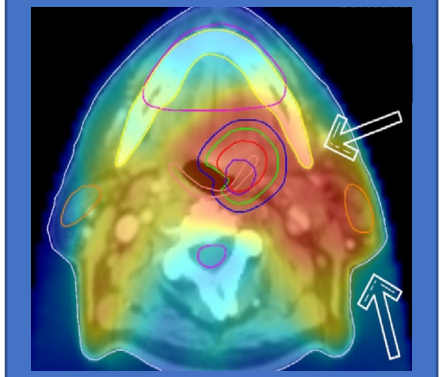
Pretreatment imaging – image reconstruction and co-registration



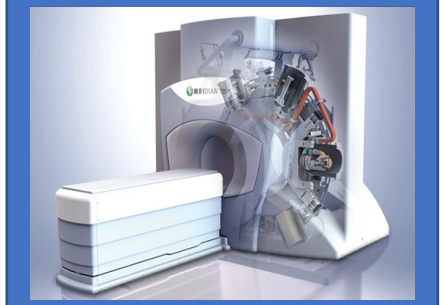
Segmentation of OAR and tumor ID



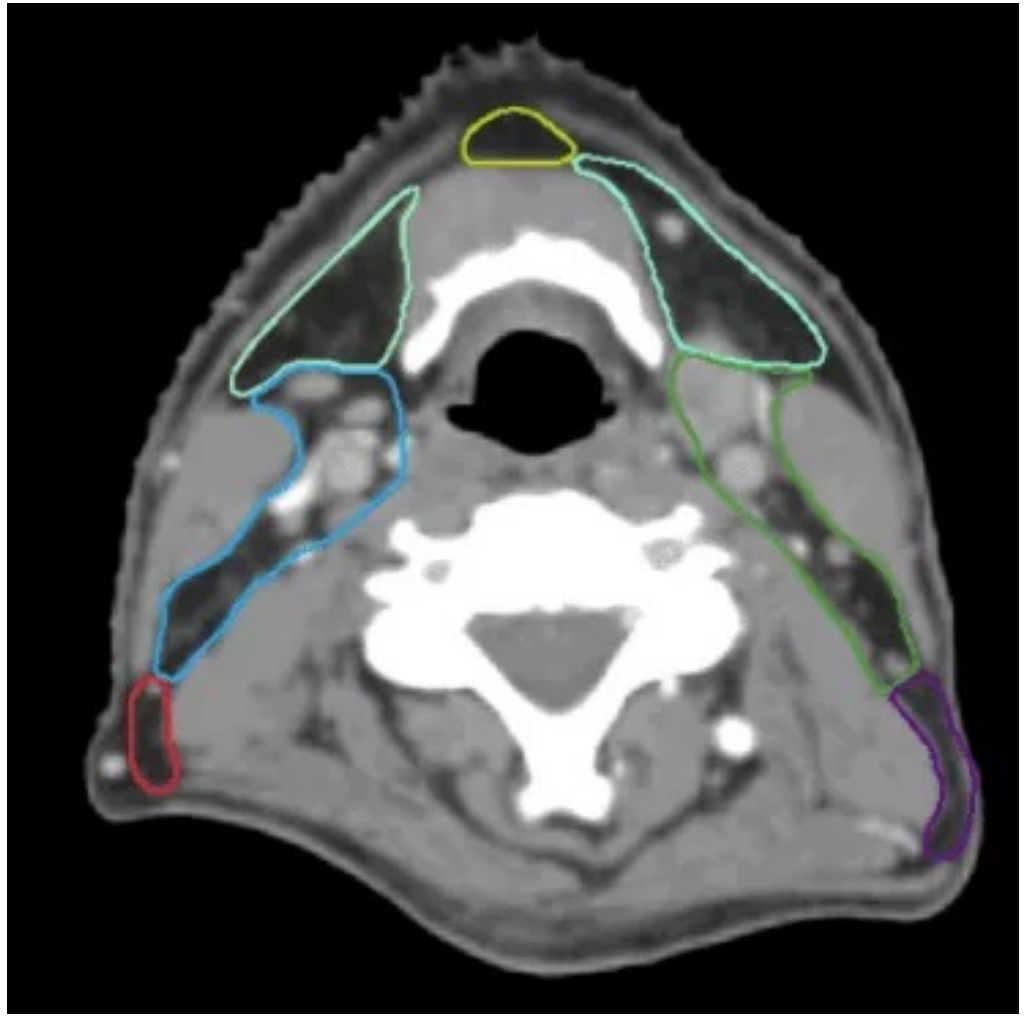
Optimisation of radiation dose



Daily verification and beam-on treatment



Delineation of organs at risk



mim SOFTWARE.

MVISION
- Artificial Intelligence in Medical Imaging -

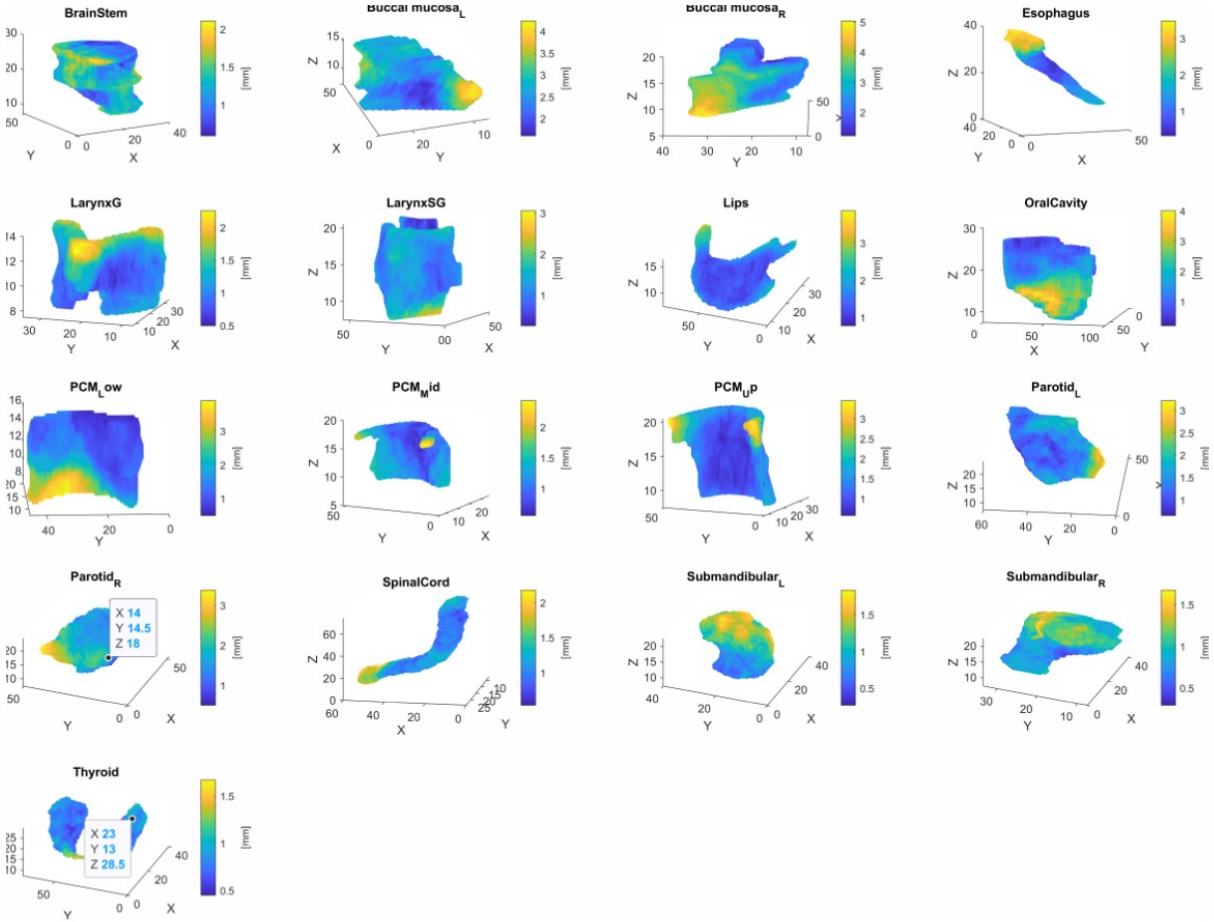
SYNOPSYS®

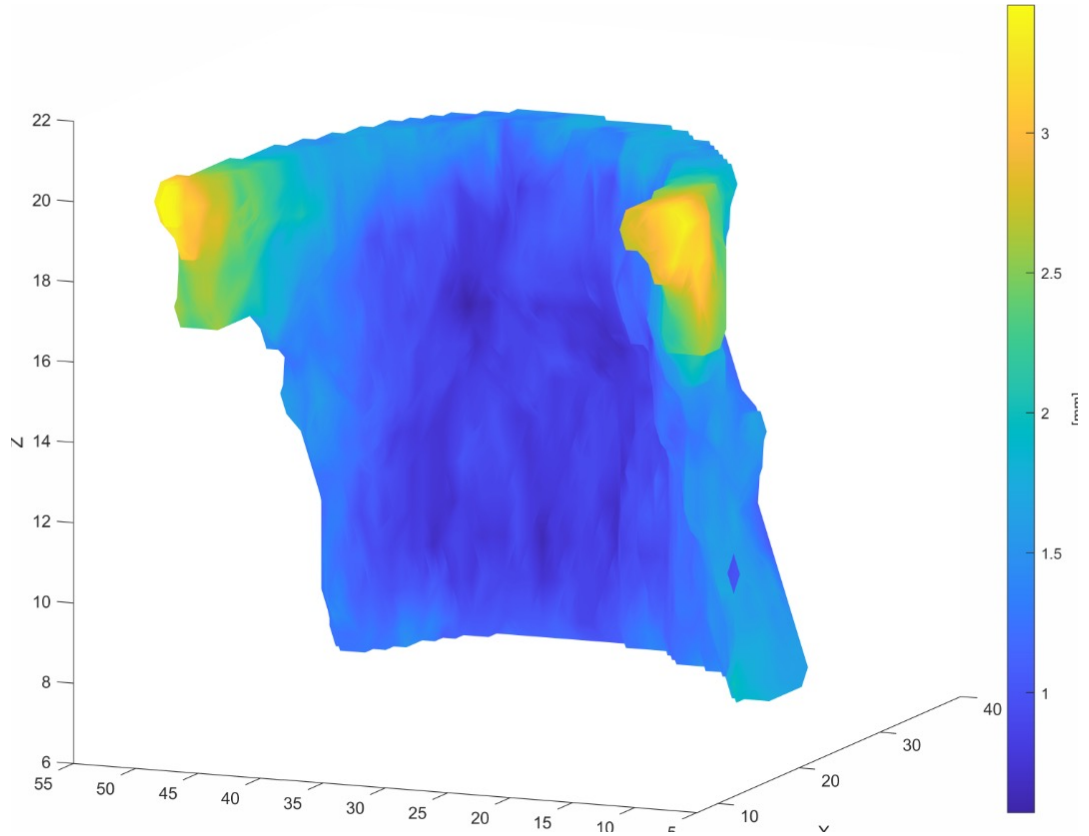
Limbus AI

varian
A Siemens Healthineers Company

Elekta

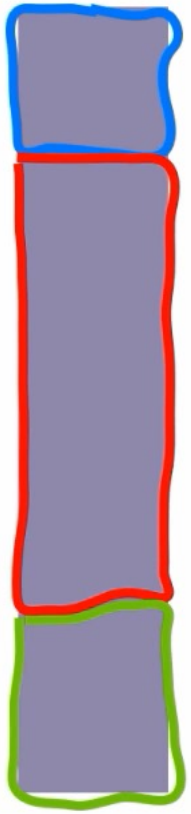
Delineation of organs at risk with a little help

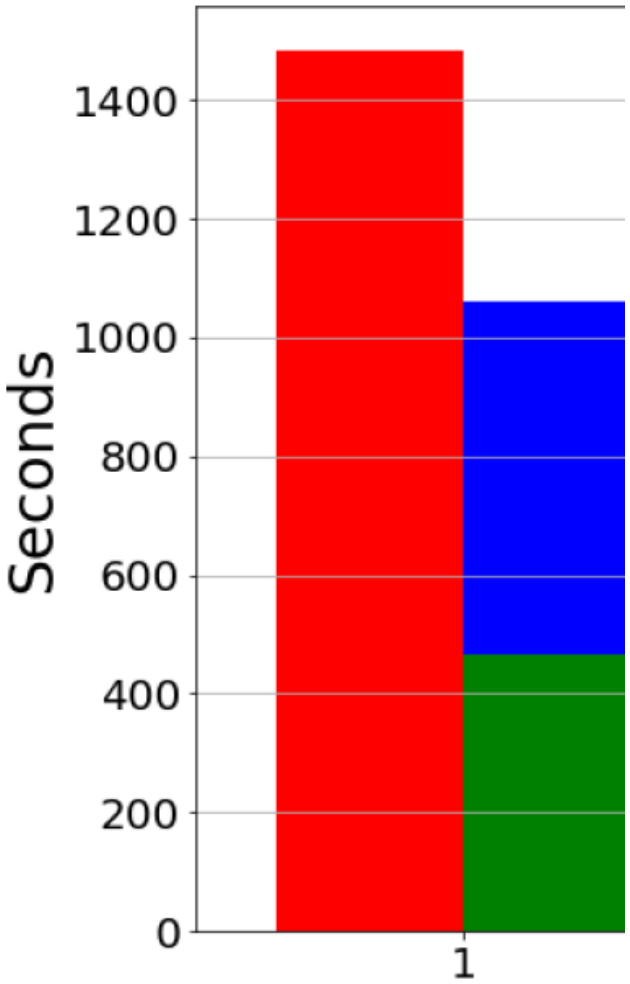




DAHANCA consensus project on OAR delineation – courtesy Christian Rønn Hansen

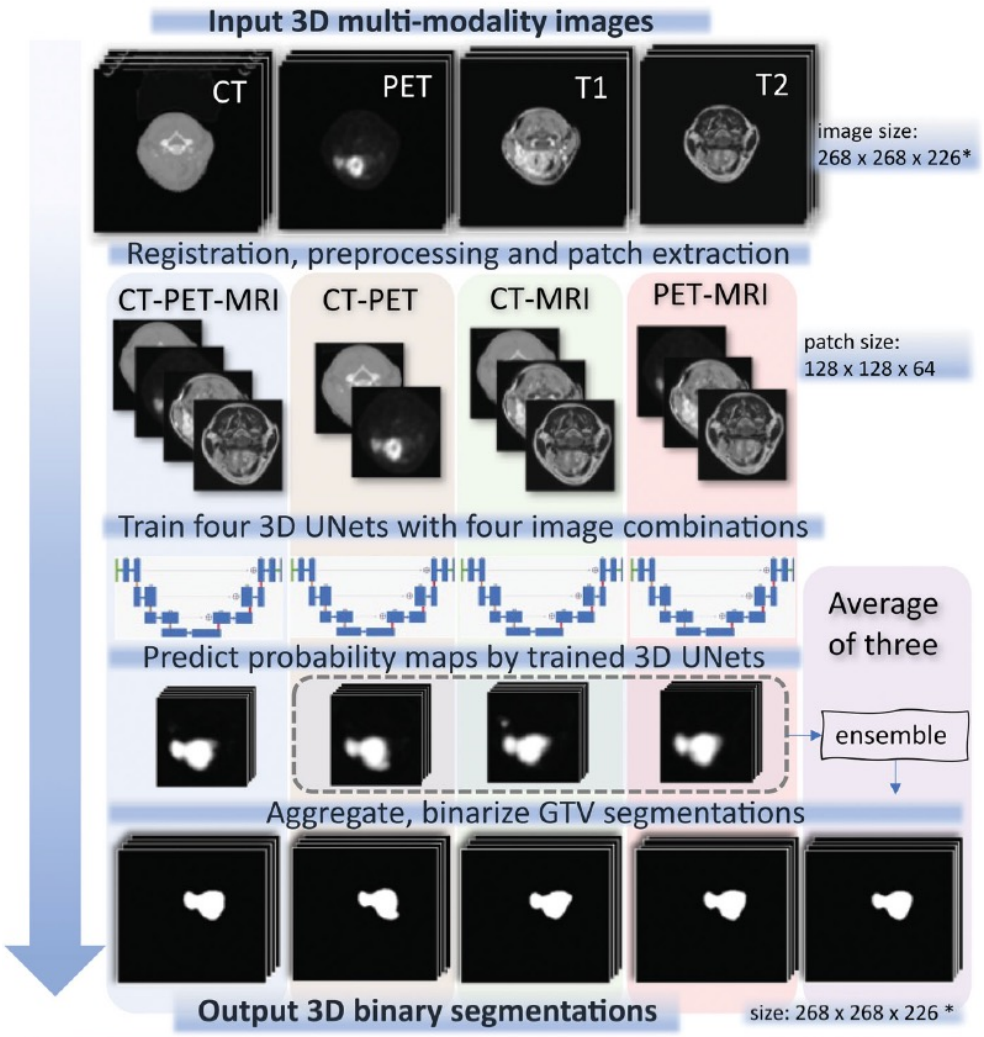
Delineation of organs at risk with a little help





Rasmussen, submitted to PHIRO 2022

Delineation of target volumes



Ren, Acta Oncol 2021

Delineation according to risk modelling

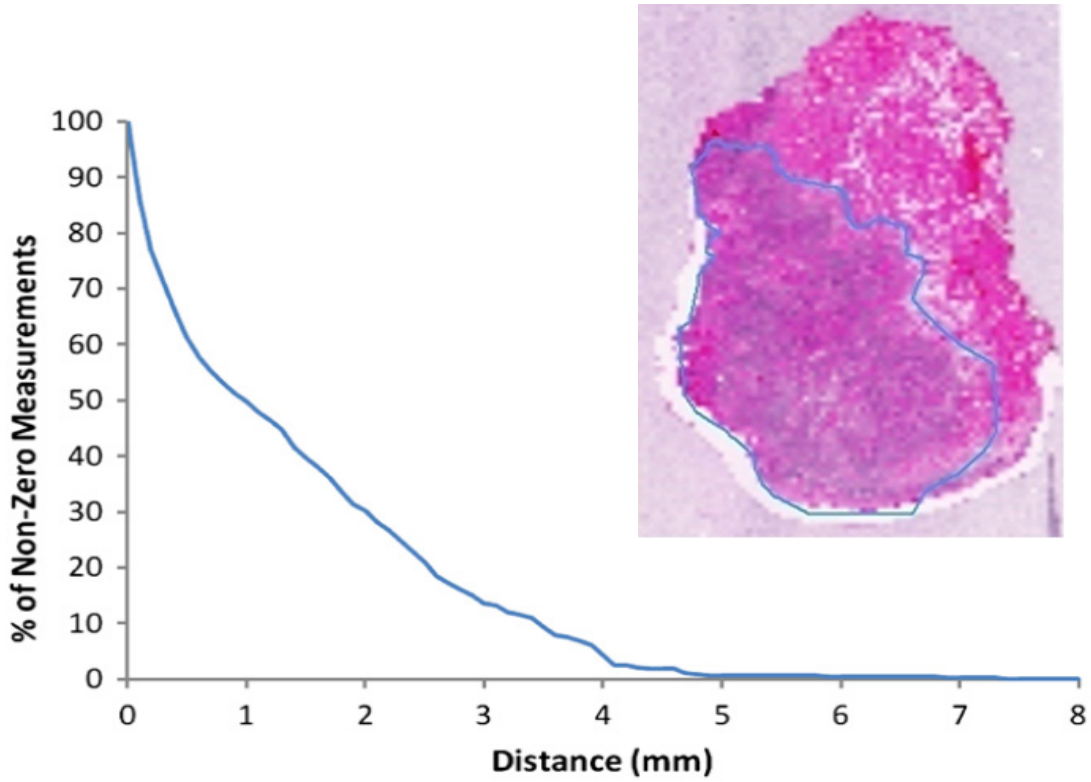
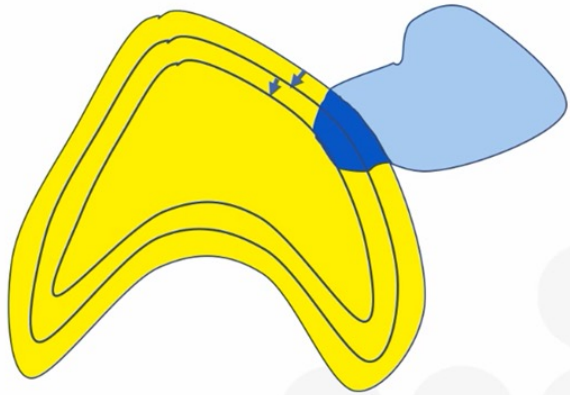


Fig. 8. Graph showing the percentage of nonzero measurements against distance from the gross tumor volume.



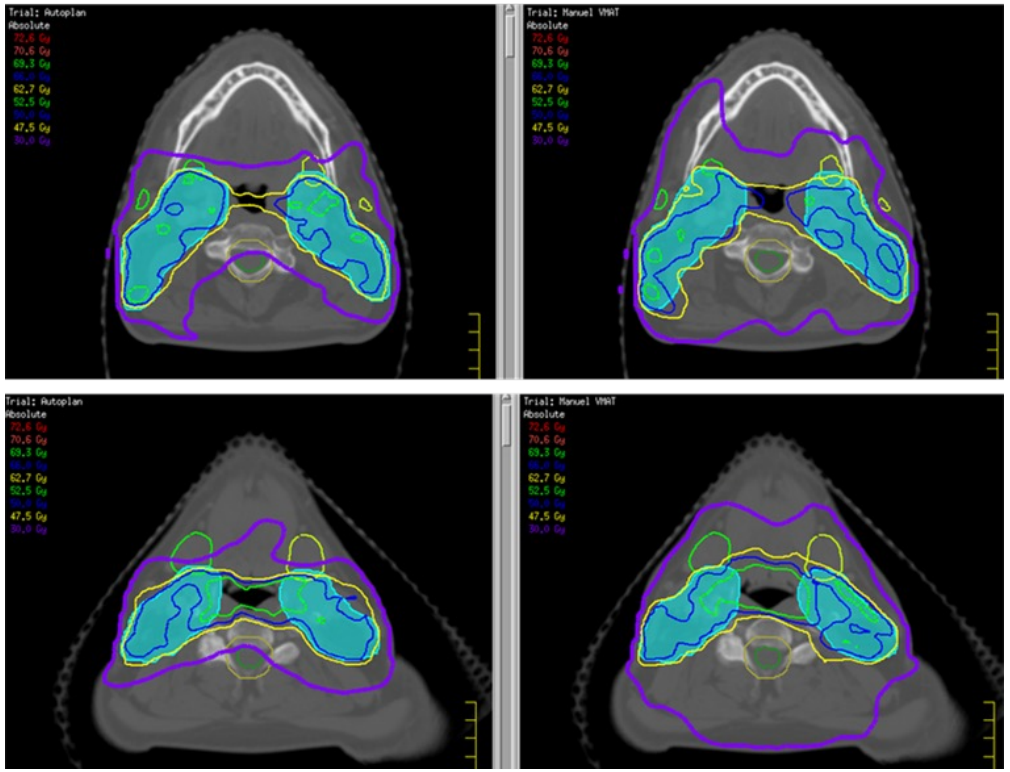
Percentage of voxels below 95% by distance from outer contour – median over all patients

	0-1 mm	1-2 mm	2-3 mm	3-4 mm	4-5 mm	5-6 mm	6-7 mm
TO_{90}	46.3%	24.9%	10.9%	6.4%	3.5%	2.4%	1.9%
TO_{85}	32.5%	24.1%	14.6%	10.2%	6.5%	4.1%	2.8%

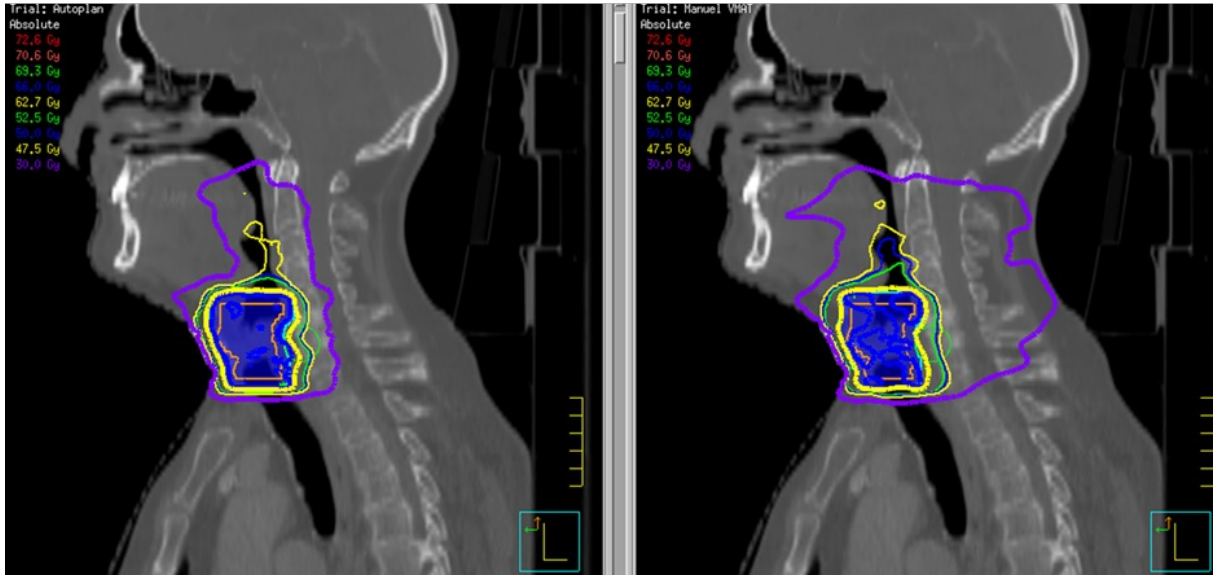
Campbell IJROBP 2012; Kaplan, submitted to Radiother Oncol 2022

AI for treatment planning

Autoplan | Manual plan

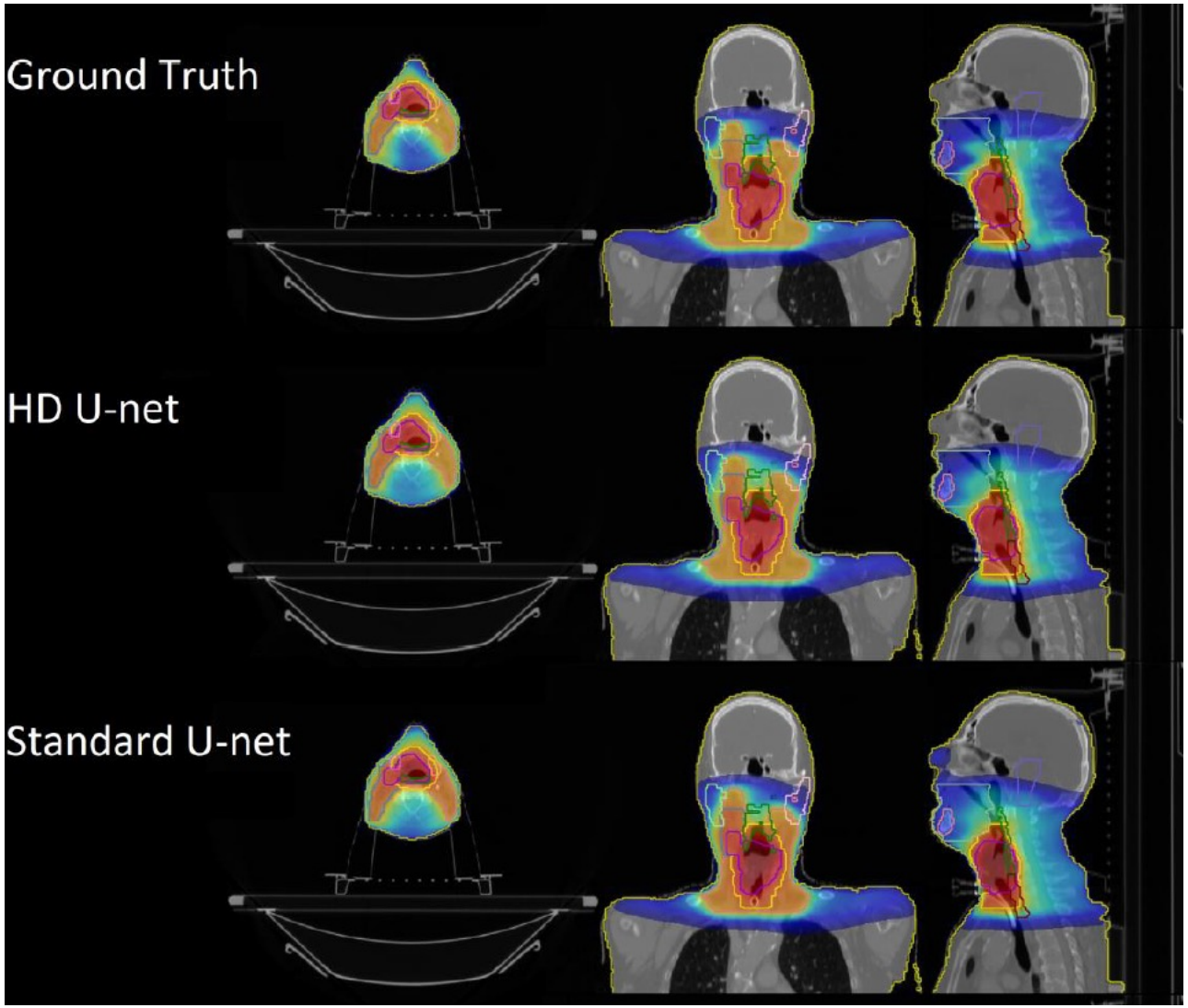


Autoplan | Manual plan



Hansen CTRO 2016

AI for treatment planning



Nguyen et al, arXiv:1805.10397

How do we teach the use of AI-based tools?

First step is to decode what people are doing

ELAISA study (E-Learning interventions for AI-assisted contouring Skills in rAdiotherapy)

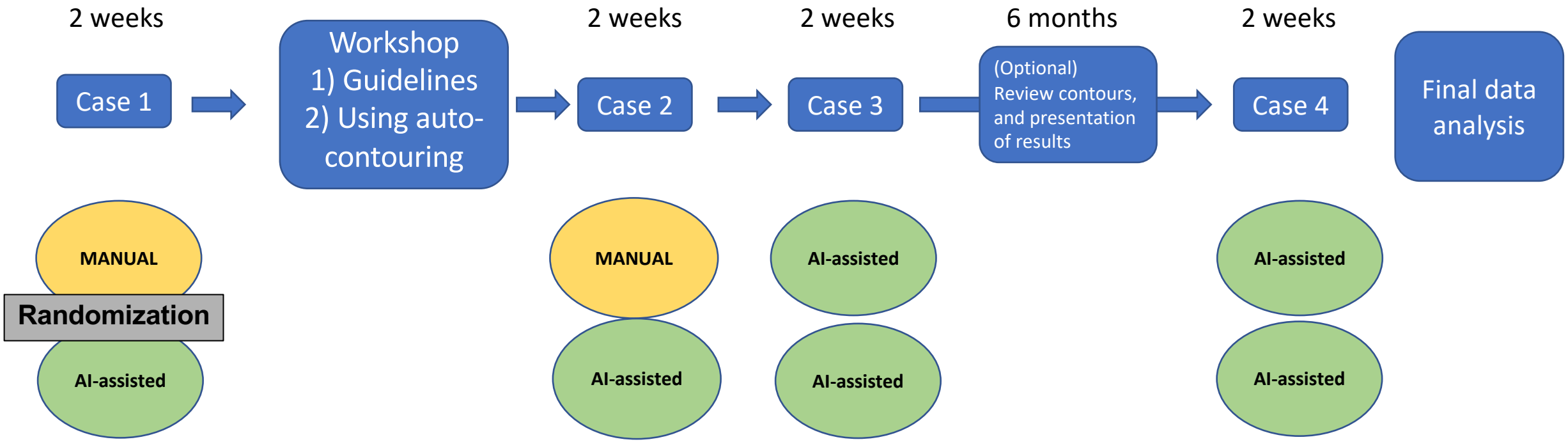
AIM:

1. What are the consequences of introducing AI assisted contouring without prior training and education?
2. How does training and education affect AI assisted contouring skills?
3. Are the effects of AI assistance on contouring skills retained on the long term?

ELAISA: Study design

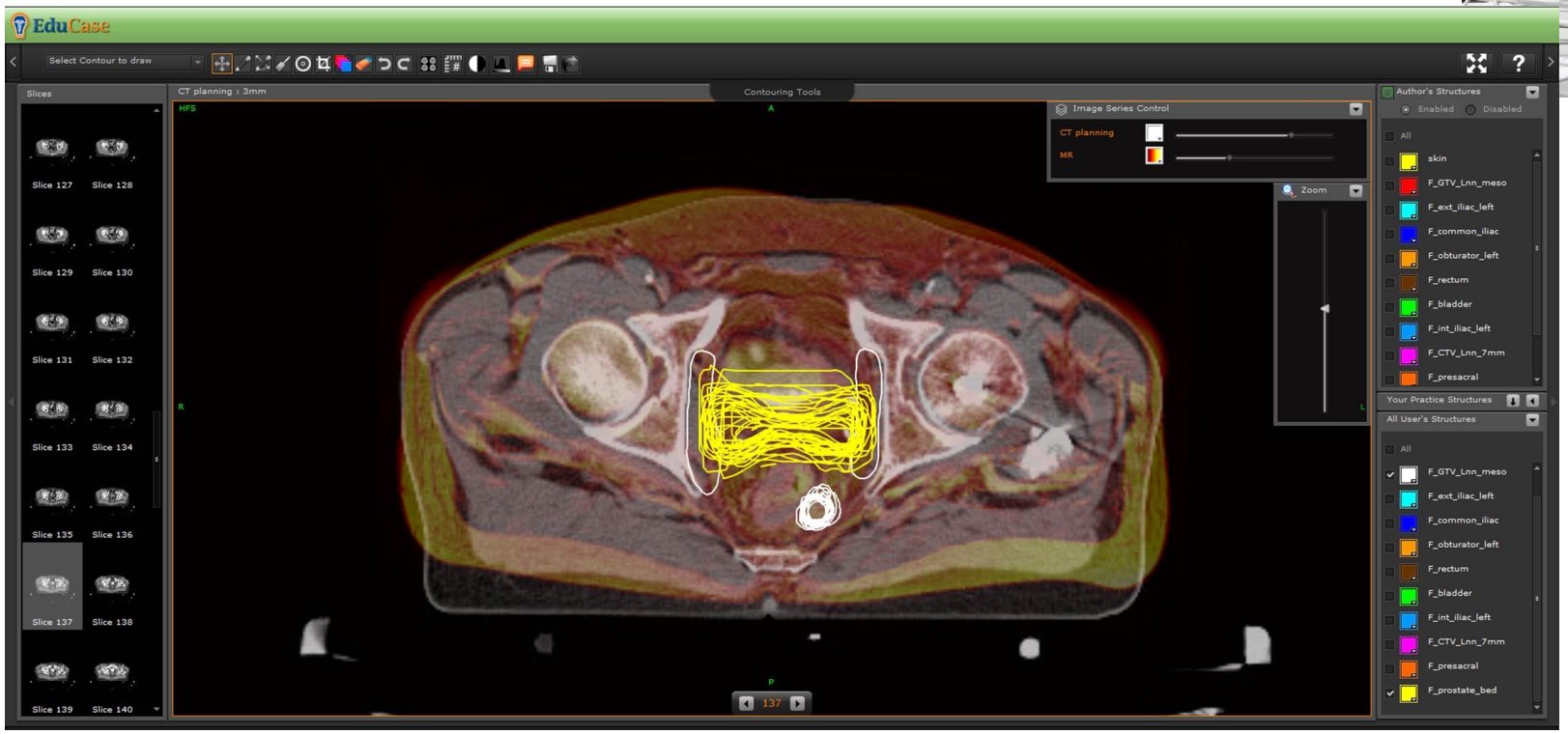
Organs-at-risk

- Parotid (one side)
- Submandibular gland
- Oral cavity
- Mandible
- Brainstem
- Optic nerve
- Thyroid
- Spinal cord

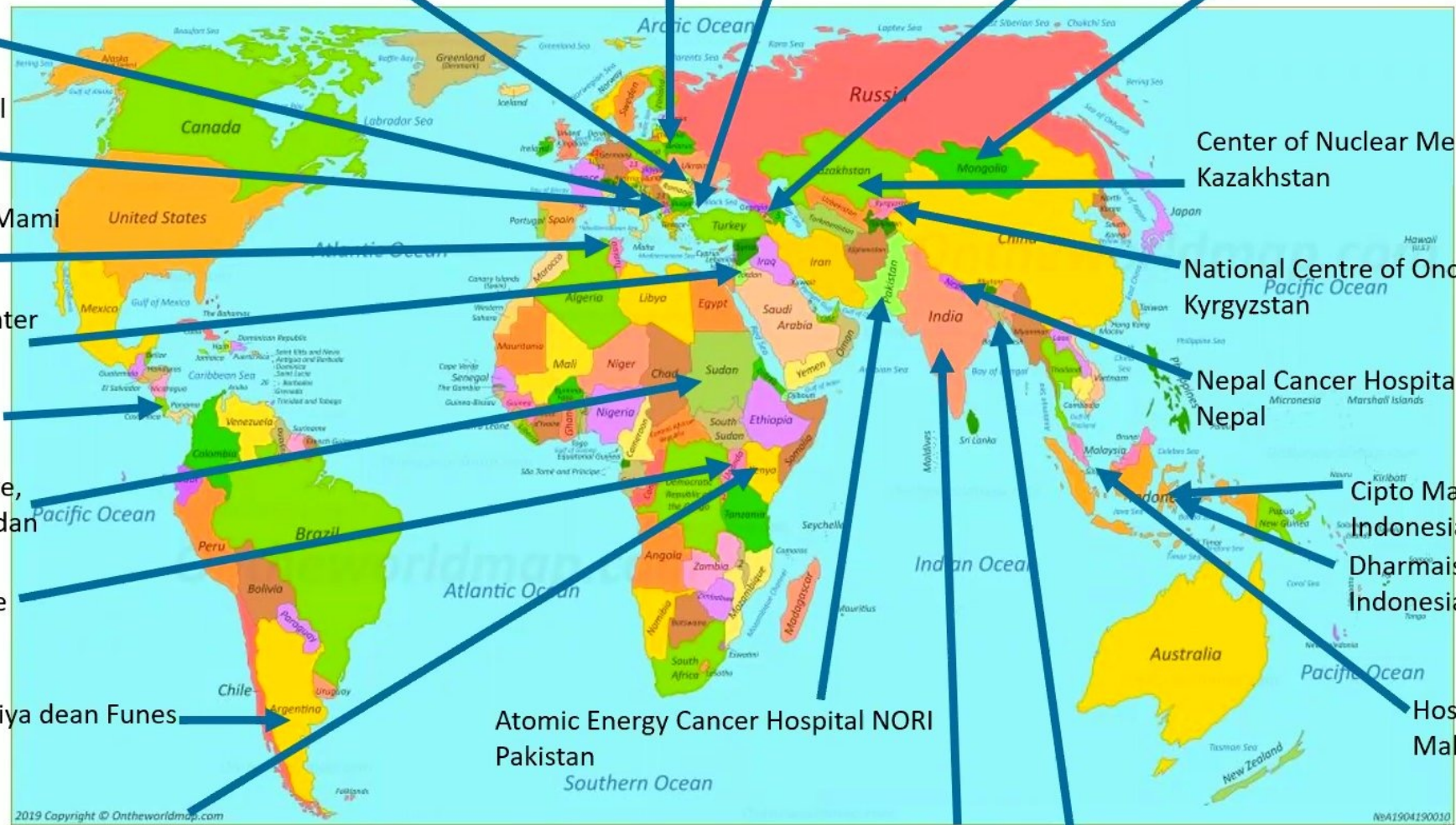


FALCON-EduCase

Build-in Big Brother tool



Participating centers



Moldavian Oncology Institute
Moldova

N. N. Alexandrov
National Cancer Centre of Belarus

Tbilisi State Medical University and
Ingorokva High Medical Technology University Clinic
Georgia

National Center of Oncology
Azerbaijan

National Cancer Center of Mongolia
Mongolia

University Clinic of Radiotherapy and Oncology
Macedonia

Mother Tereza Hospital
Albania

Center of Nuclear Medicine and Oncology
Kazakhstan

Hospital Abderrahmen Mami
Tunisia

National Centre of Oncology and Hematology
Kyrgyzstan

King Hussein Cancer Center
Jordan

Nepal Cancer Hospital and Research Center
Nepal

Hospital México,
Costa Rica

National Cancer Institute,
University of Gezira, Sudan

Cipto Mangunkusumo Hospital
Indonesia

Dharmais Cancer Hospital
Indonesia

Uganda Cancer Institute
Uganda

Centro de Radioterapiya dean Funes
Argentina

Atomic Energy Cancer Hospital NORI
Pakistan

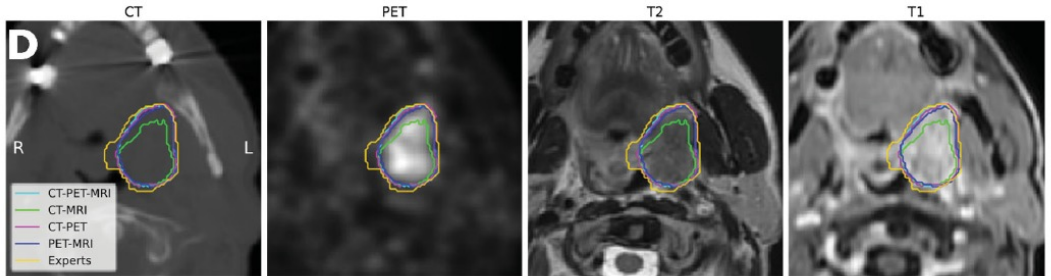
Hospital Kuala Lumpur
Malaysia

Kenyatta National Hospital
Kenya

Christian Institute of Health Science and Research
India

Labaid Cancer Hospital and super speciality centre
Bangladesh

Testing target delineation



Primary curative RT
No surgery
Larynx or pharynx

Randomize

Delineate from scratch

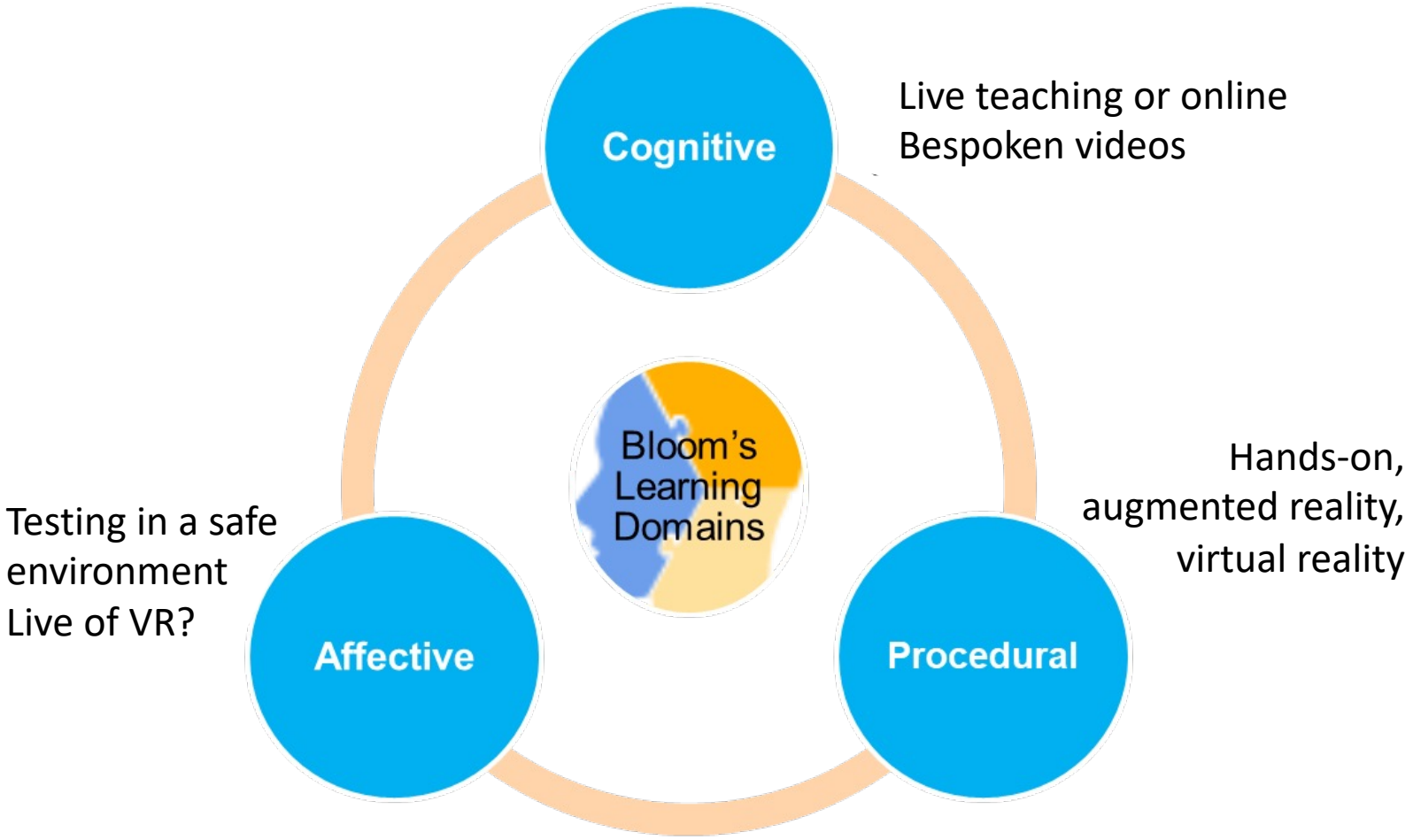
AI-supported delineation

This are just the first scratches in the surface

This knowledge has to be tranformed into teaching

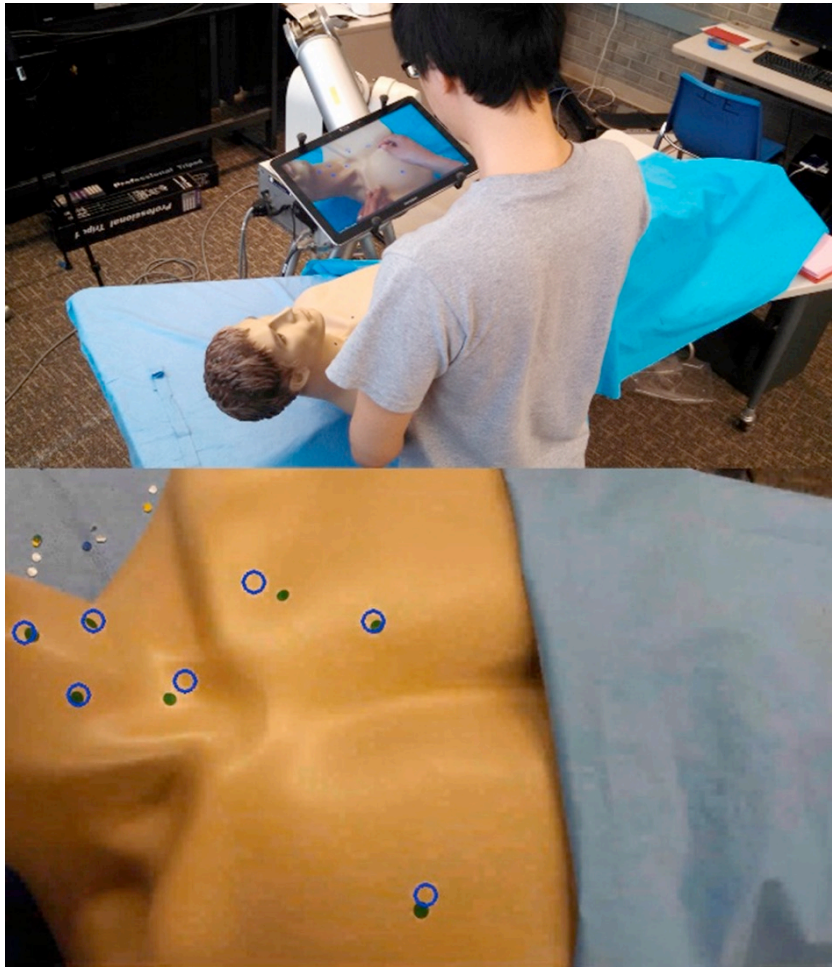
But the same way as we always have done?

Future steps of screen-based learning that fit innovations in radiation oncology



What could the next steps be?

Augmented Reality?



Virtual Reality for RT training?

Maybe not a dream

Courtesy by professor David Kok, Melbourne

Conclusion and perspectives

- AI-augmented radiotherapy is here and will grow in the years to come
- Will revolutionize the way we are working
- The bottle neck is how we will perceive it and use it
- There is a need for research in that field
- If we are ready to embrace new learning technologies - then we have a unique possibility to better teach how to use AI-augmented tools in the future