AI application in Cancer Diagnostics

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President of the European Society of Radiology

Member of the 2019-2021 EU mission board for Cancer

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Cancer

More screening
Detection of early tumors

minimally invasive treatment

cure
with better QoL

Precision Medicine

more effective targeted- & immunotherapy

prolonged survival

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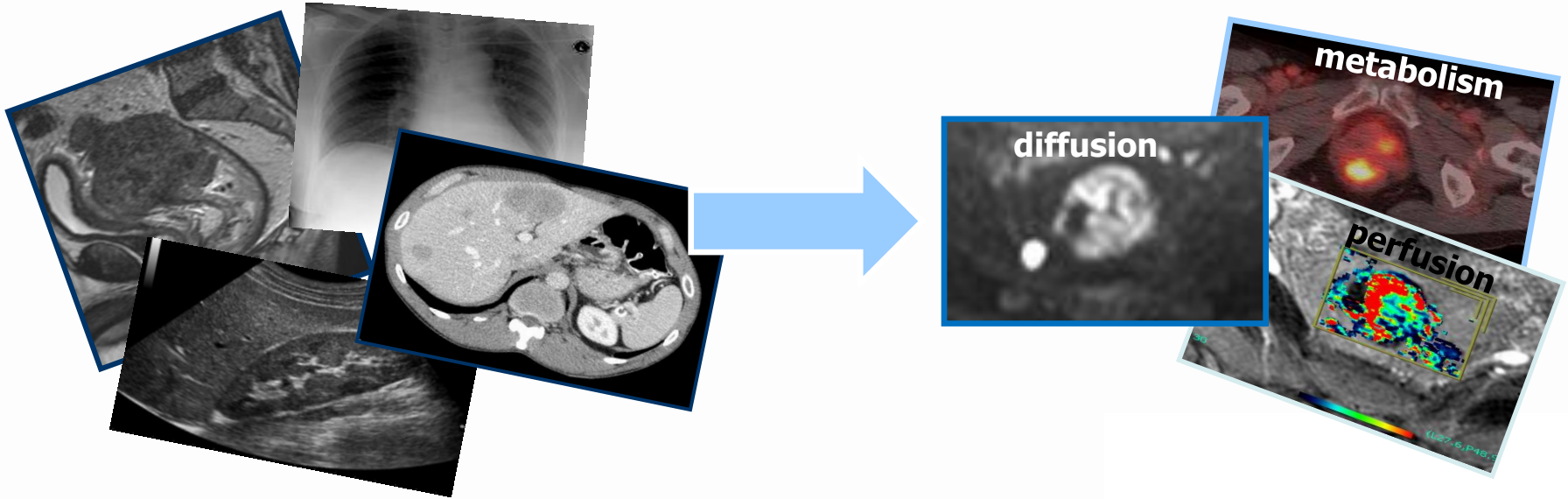
Cancer Imaging



Imaging Morphology & Biology

Trend towards use of imaging in treatment minimally invasive treatment….

- Image guided Radiotherapy
- Image guided Surgery
- Interventional Radiology

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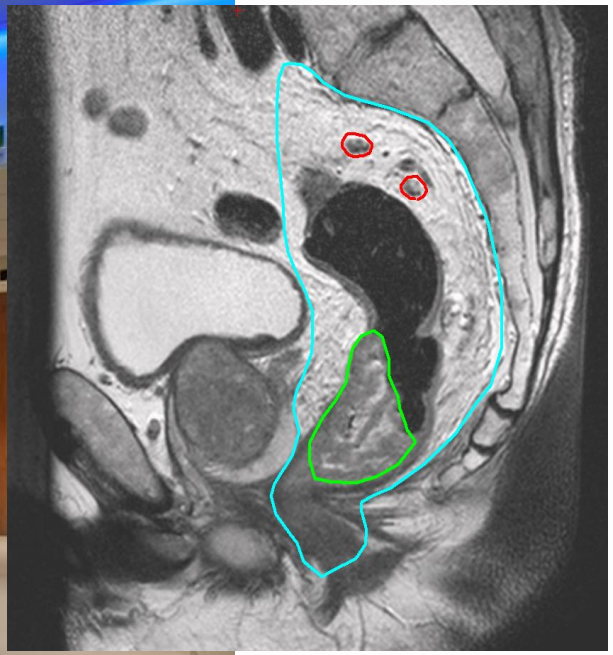
MR guided Radiotherapy



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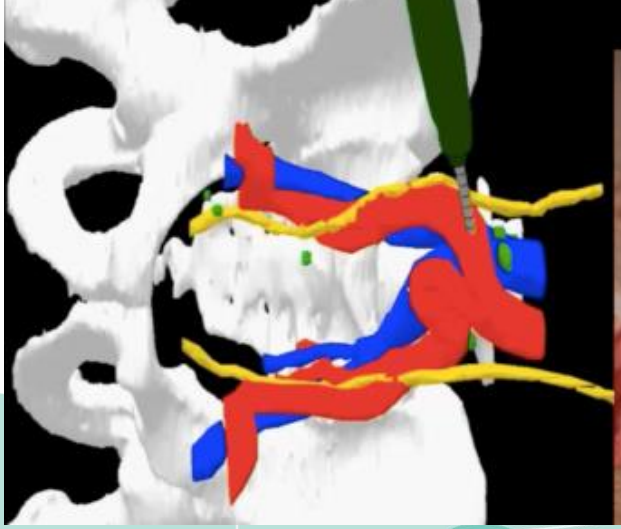
Navigation Surgery



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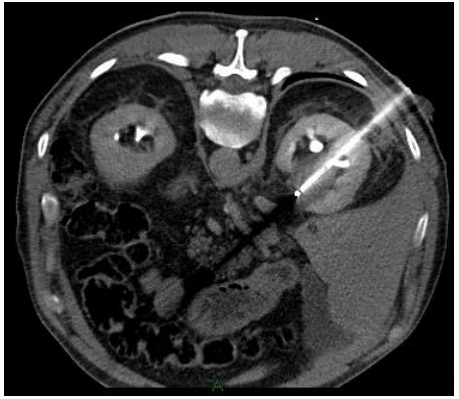
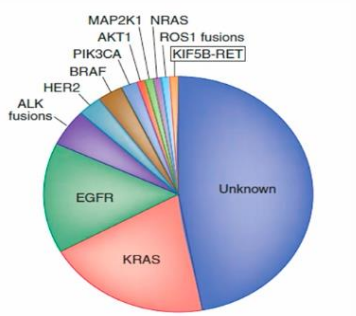
Courtesy T. Ruers

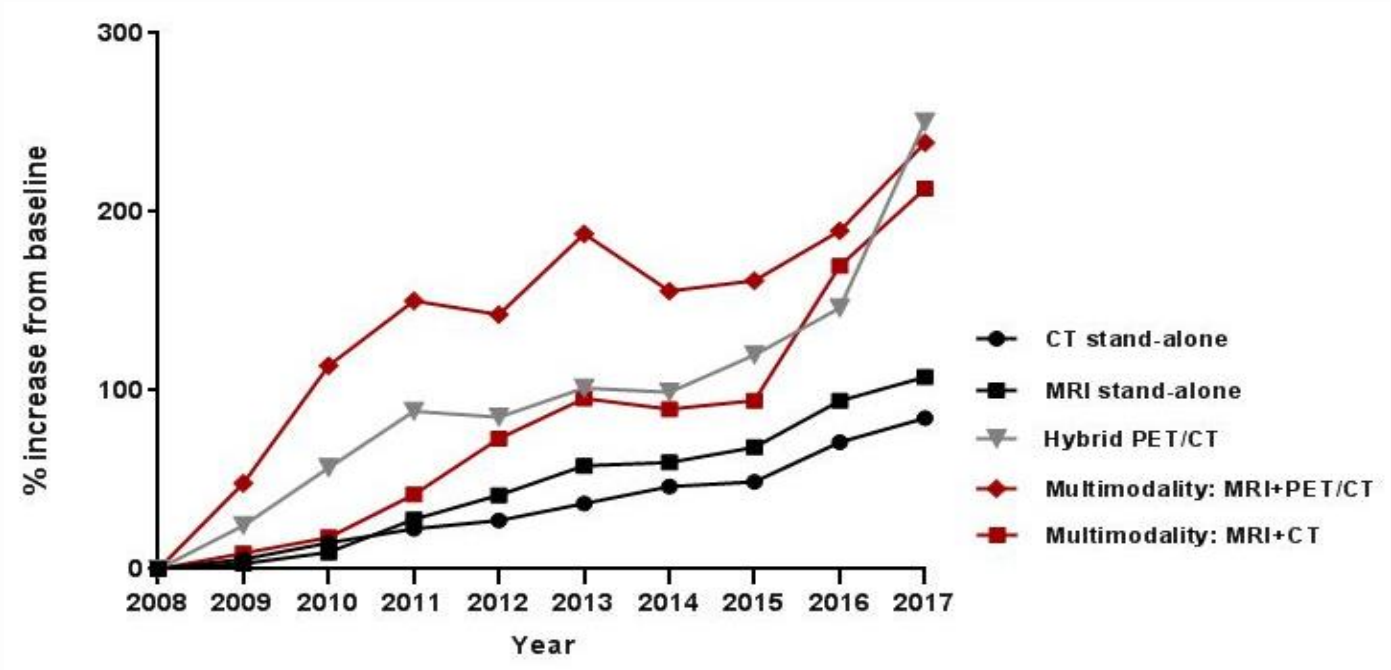
Interventional Oncology – Biopsy & Treat tumors





Hybrid Interventional CT- Angiography Suite at the OR

Increasing use of imaging in Cancer Care



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Min at al. Br J of Rad 2021

increasing use of imaging

does it impact treatment outcome?

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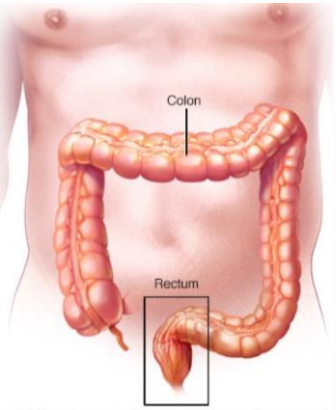
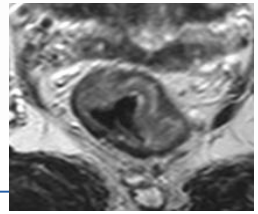


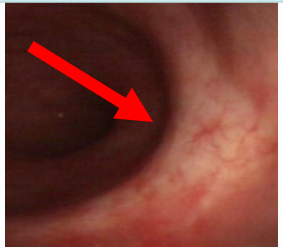
Organ preservation
Watch & Wait

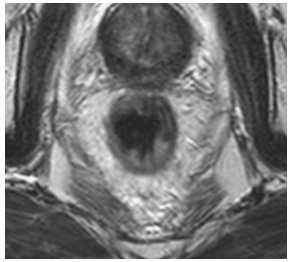
Loc Advanced Rectal cancer

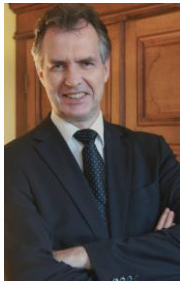


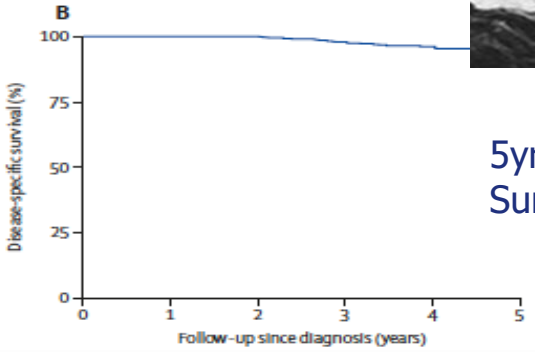
Chemoradiotherapy

Complete response









5yr Disease spec
Survival 94%

Beets et al
The Lancet 2018

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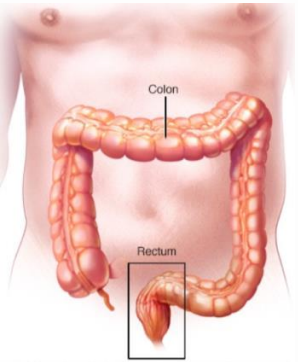

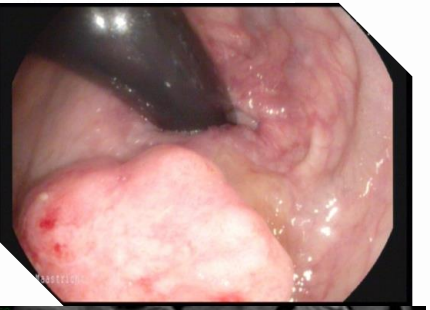

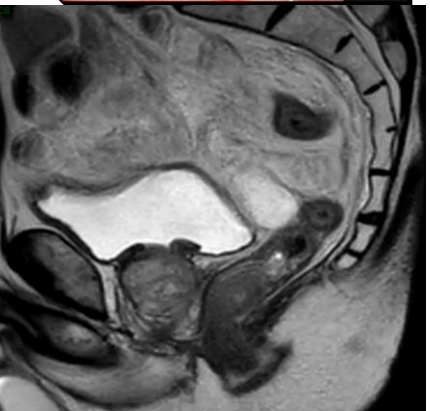

Organ preservation
Cure with better Quality of Life

High demand from patients

Predict response

70% chance complete response -> CRT → cCR -> W&W

15% chance complete response -> Surgery

no single reliable predictive factor !

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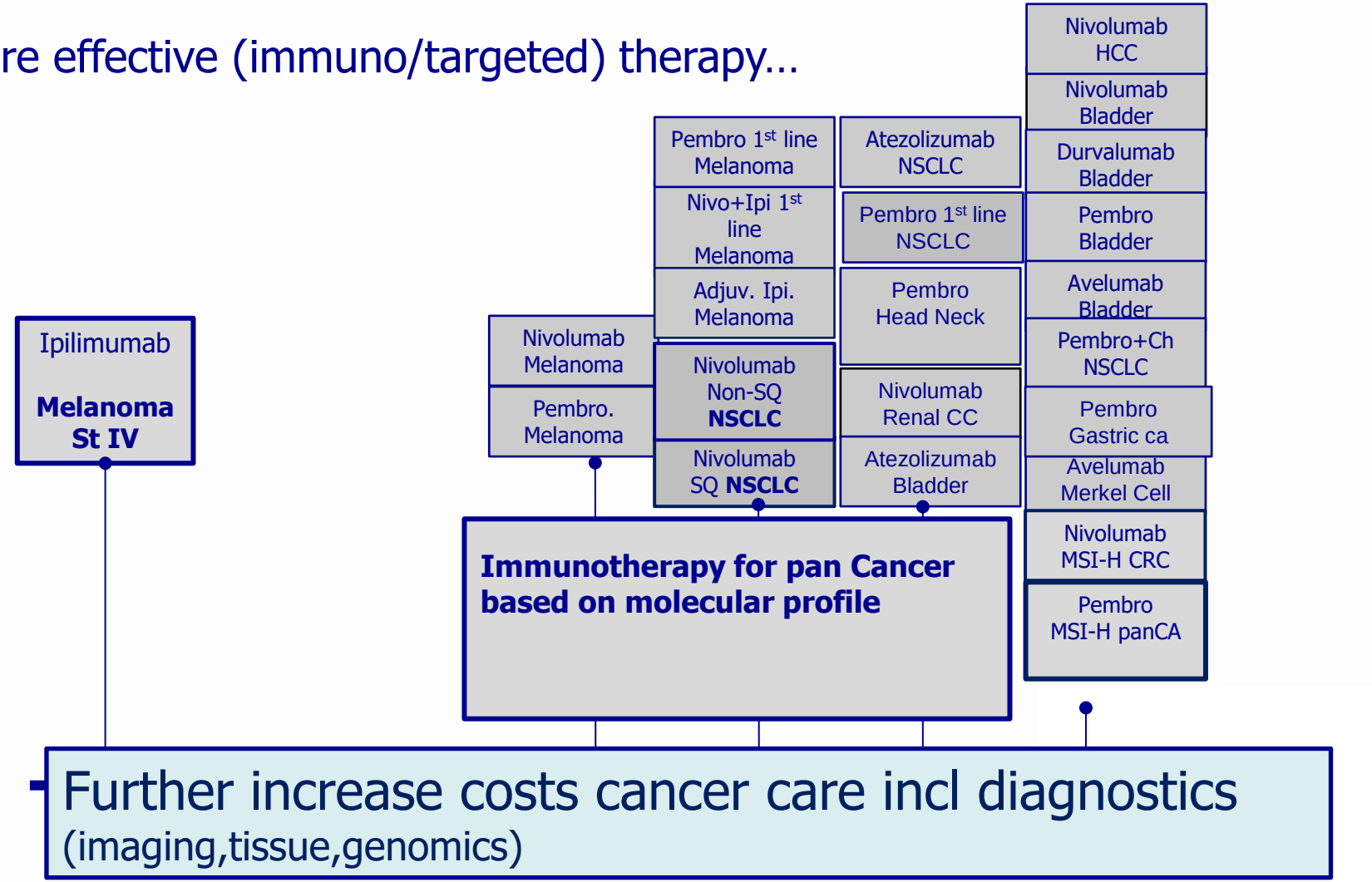
More effective (immuno/targeted) therapy…



AI…..?

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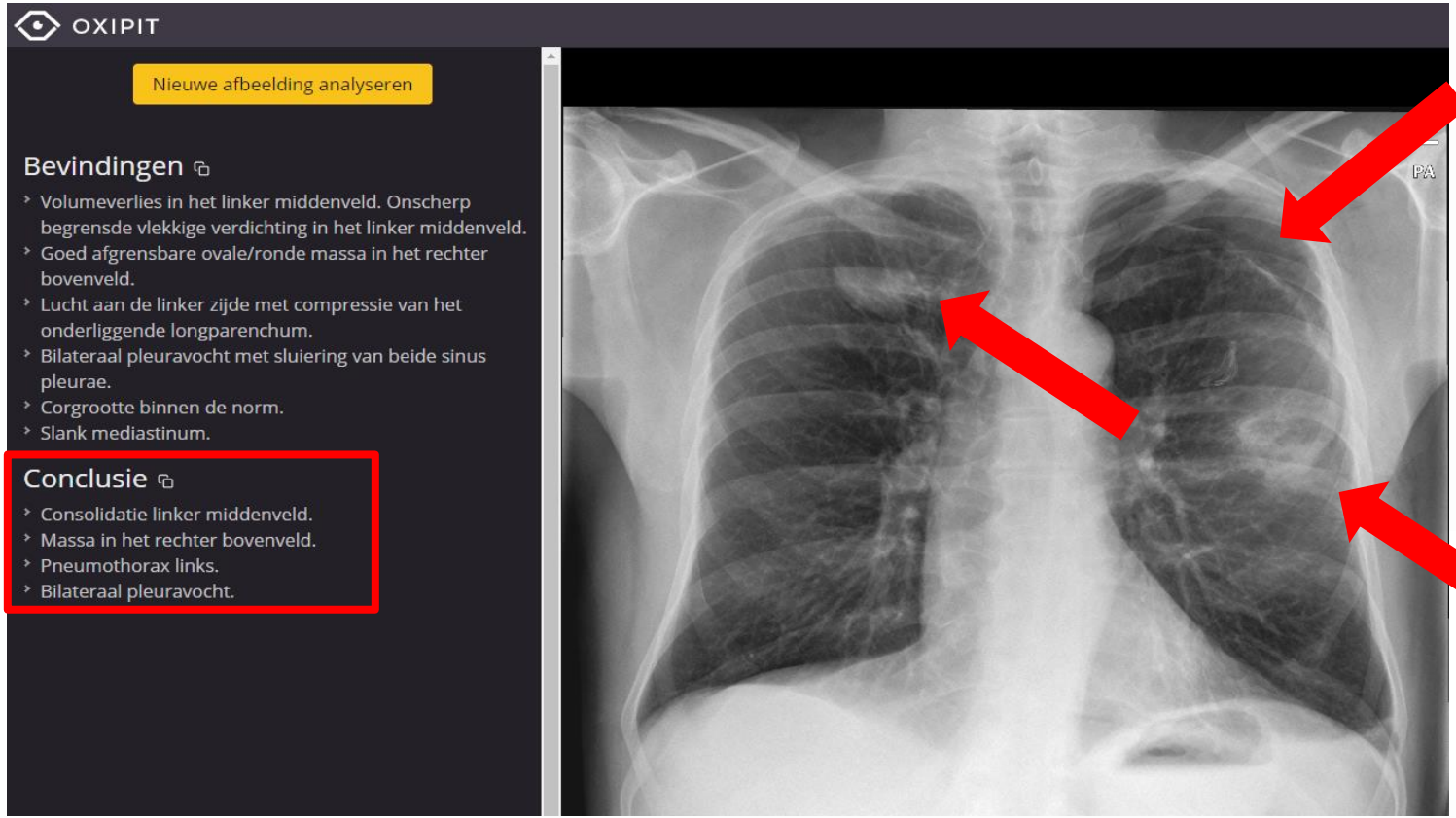
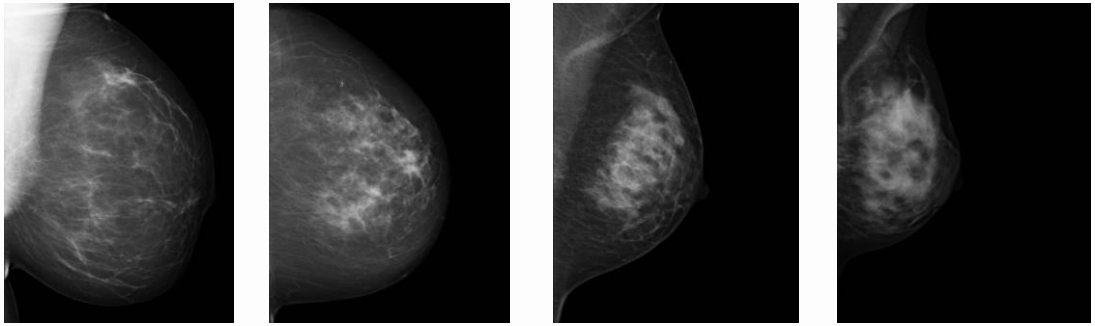
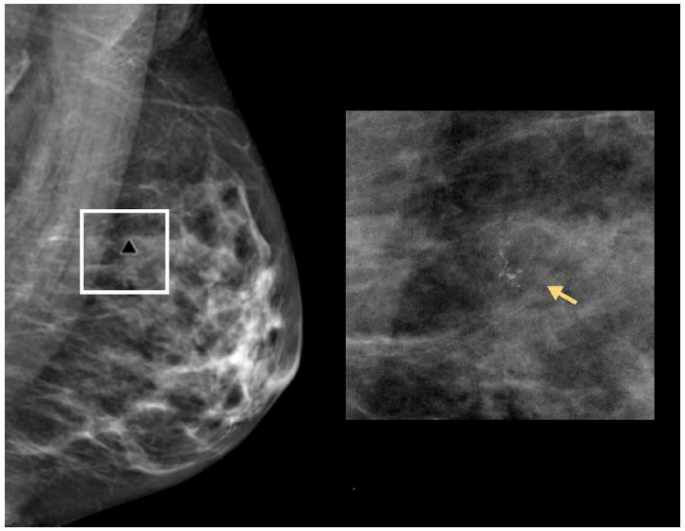
AI reads Chest X-ray



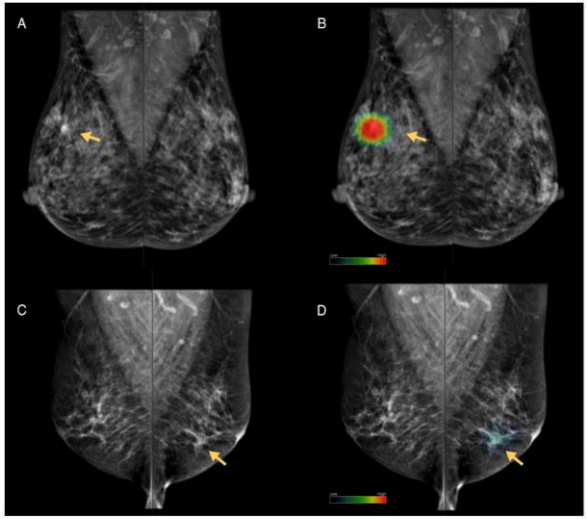
Breast Cancer Screening

2 breast specialised radiologists
hundreds of images per day
repetitive tasks

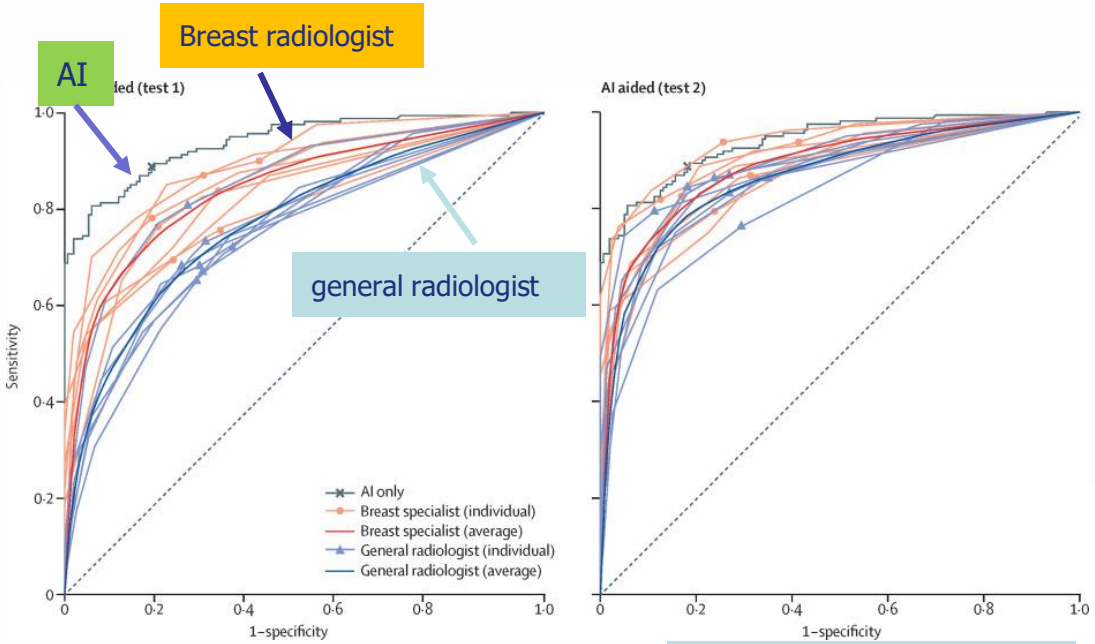




AI improves performance of non-expert radiologists

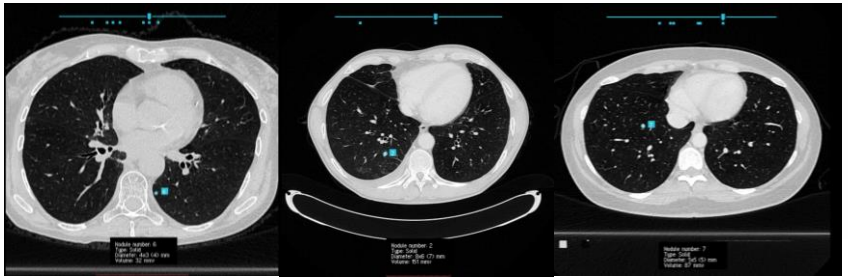


Kim et al 2020, Lancet Dig. Health



radiologists without AI

radiologists with AI



nature medicine

Letter | Published: 20 May 2019

End-to-end lung cancer screening with three-dimensional deep learning on low-dose chest computed tomography

A team of researchers at Google is planning to use deep learning to look for signs of lung cancer in people. So far, the AI has detected malignancies in CT scans of patients, with an accuracy of 94.4 percent. (Gerd Altmann | Pixabay)

In a study featured in the journal *Nature Medicine*, researchers trained a deep learning program to detect the malignancy with a success rate of 94.4 percent.

While Google AI is still considered a work in progress, it offers a brief glimpse of what the technology holds for the future of medicine.

Diagnosing Illnesses Using Deep Learning

By feeding AI programs with large amounts of data, the technology can be trained to identify different medical conditions that would otherwise be too difficult or too time-consuming for human doctors to detect.

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Université de Paris

AI and Radiologists

- AI recognizes patterns and continuously learns to get better
- The Radiologist's value is not defined by pattern recognition but by clinical relevance
- AI will assist Radiologists & free his time to take on a more clinical role

European Society of Radiology (ESR)
Insights into Imaging (2022) 13:100
https://doi.org/10.1186/s13244-022-01241-4

Insights into Imaging

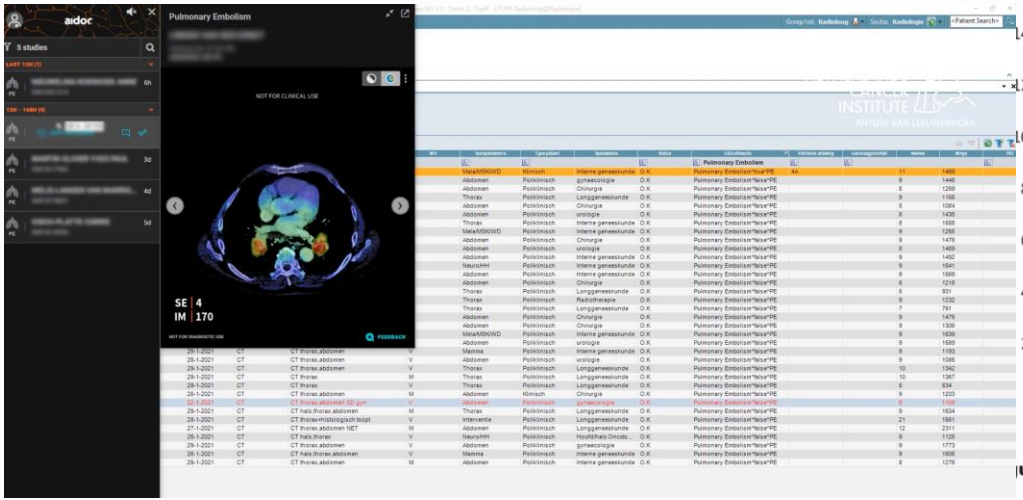
STATEMENT Open Access

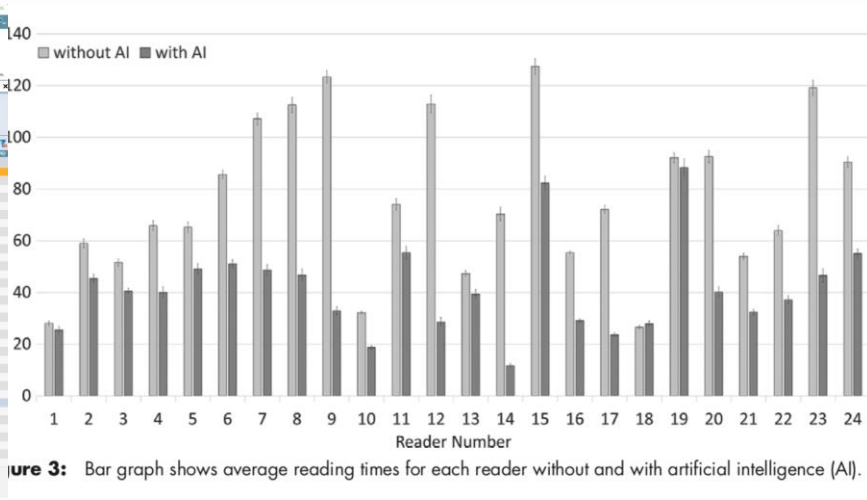
The role of radiologist in the changing world of healthcare: a White Paper of the European Society of Radiology (ESR)

European Society of Radiology (ESR)*

AI as Radiologist’s companion in clinical practice

AI for efficient workflow





ure 3: Bar graph shows average reading times for each reader without and with artificial intelligence (AI).

- ✓ AI prioritise complex cases to be evaluated by radiologists
- ✓ AI will free Radiologist's time
  - ✓ to become a true sparring partner in the multidisciplinary team

The Netherlands Cancer Institute

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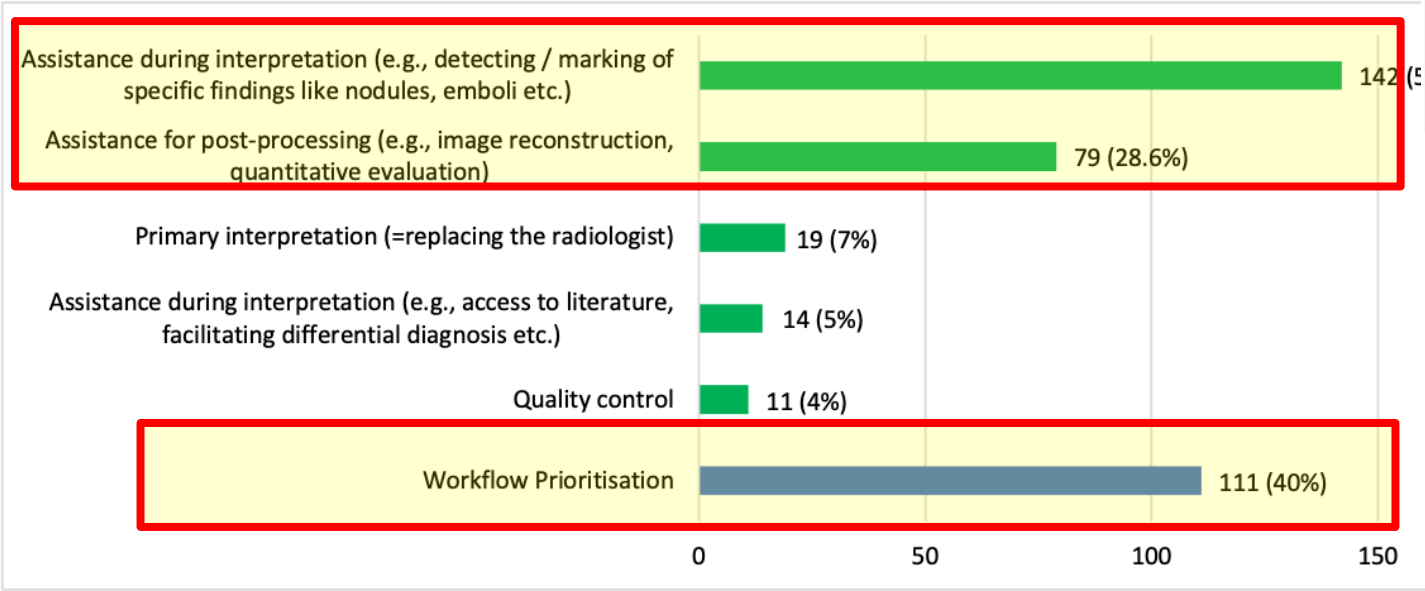
ESR survey - AI in clinical radiology

690 radiologists **using AI in their practice**

229 institutions, 0.52 academic, 0.37 regional, 0.11 private



Country	Number of respondents per country	Percentage of radiologists with practical clinical experience in AI per country
Italy	71	32%
Spain	64	30%
United Kingdom	60	38%
Germany	50	46%
Netherlands	50	70%
[illegible]	[illegible]	[illegible]
Denmark	27	56%
Turkey	27	11%
Norway	26	46%
Switzerland	27	54%
France	25	48%
Belgium	23	57%
Austria	21	57%
Greece	21	24%
[illegible]	[illegible]	[illegible]
Romania	16	25%
Ukraine	13	23%
Croatia	11	36%
Russian Fed.	11	36%
Bulgaria	10	0%
Poland	10	40%
Finland	7	57%
Hungary	7	43%
Serbia	7	14%
Slovenia	7	43%
Slovakia	6	83%
Ireland	5	40%
Lithuania	5	40%
Bos. & Herzegovina	4	0%
Czech Republic	4	75%
Israel	4	50%
Latvia	4	0%
Armenia	3	0%
Albania	2	0%
Azerbaijan	2	0%
Belarus	2	0%
Estonia	2	100%
Georgia	2	0%
Kazakhstan	2	0%
Luxembourg	2	50%
Cyprus	1	0%
Iceland	1	0%
Kosovo	1	100%
Uzbekistan	1	0%

AI in clinical radiology – ESR survey

- AI software reliable & no problems with technical integration
- Is AI helpful to reduce the workload for medical staff :

Answer	Number of respondents	(%)
Not at all helpful	16	14.4 %
Moderately helpful	69	62.2 %
Very helpful	26	23.4 %
TOTAL	**111**	**100%**

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- Radiology - Digital
- Expo

digital images

each year

Yet no wide adoption in clinical practice → Why?

Challenges

- Need for large scale external validation, using multicenter curated data
- Need for standardization of diagnostic protocols/quality across Europe
- ethico-legal issues
  - cross-border research collaboration still have hurdles
  - laws too complex for researchers
  - GDPR interpretation varies across MS
  - **AI related legislation**

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Challenges

- **AI related legislation**
- Dedicated pathway for AI software licensing

  → AI software still considered as medical device

  FDA 2021: 343 medical devices - 241 relating to AI

  → standards for risk assessments of AI products
- transparency – make AI software publicly available
- code of conduct for public - private partnerships

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Challenges

- **Build trust** and ensure patients that it is safe to share their data
- Medico legal → Who will be **responsible** for the diagnosis?
- Establish **accredited AI training programs** for medical professionals

  If radiologists do not understand how AI led to diagnosis

  how can physicians and patients trust radiologist's diagnosis?
- **Culture change** of medical community
- Research on Human-AI interaction

  Caution for overreliance on machine generated results

  ignoring conflicting human decision

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EU Research Opportunities

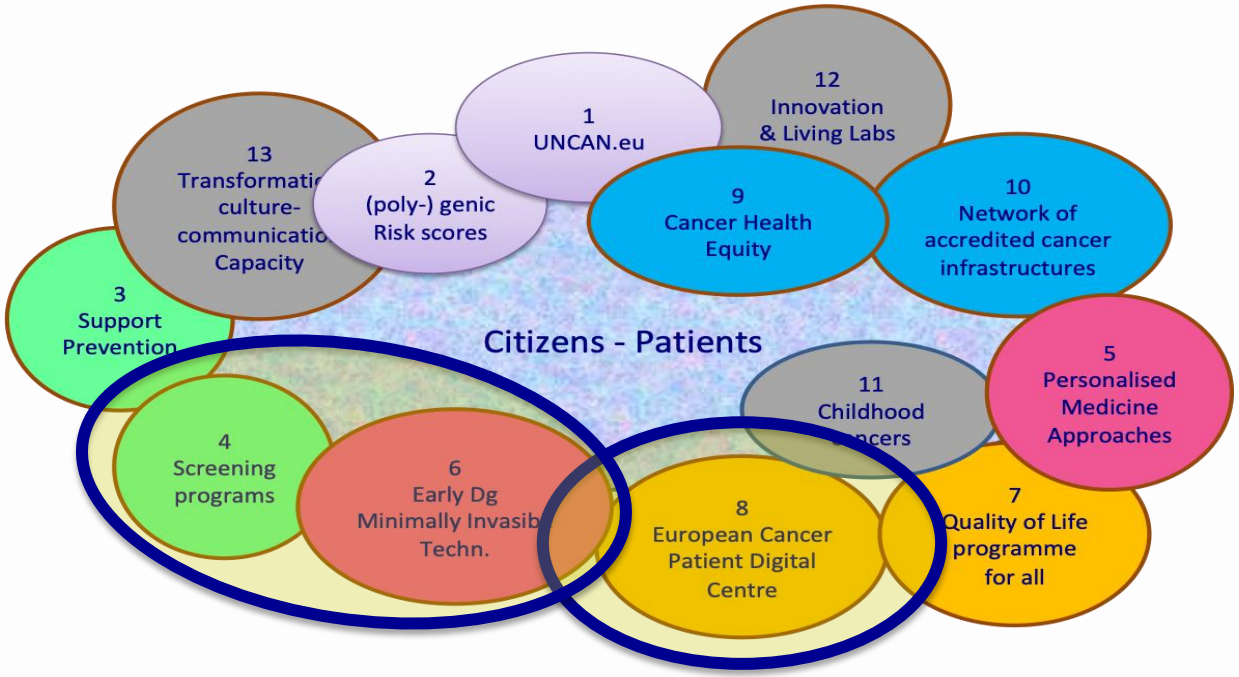
Europe's Beating Cancer Plan

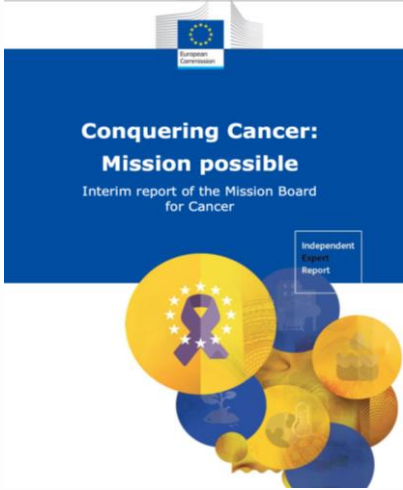
Flagship 2: European Cancer Imaging Initiative to develop an **EU atlas of cancer-related images**…. **accessible to a wide range of stakeholders** ….. …will further improve personalised medicine and support innovative solutions, thanks to greater accuracy and reliability in minimally-invasive diagnostics and follow-up of treatments

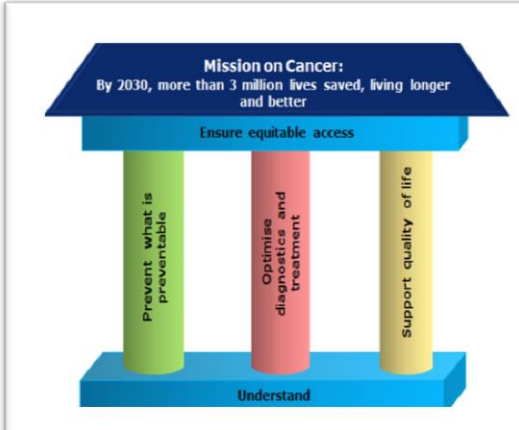
Digital Europe

2022 Call to establish a **pan-European digital infrastructure facilitating access to cancer images & link with other data (genomics, tissue molecular, clinical)**….contributes to the Europe's Beating Cancer Plan and Cancer Missions under Horizon Europe…

EU Cancer Missions







European Commission

Which measures can be taken at EU level ?

4 Optimise existing screening programmes and develop novel approaches for screening and early detection

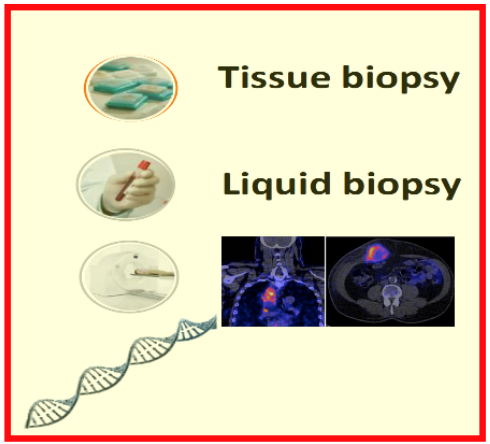
5 Advance and implement personalised medicine approaches for all cancer patients in Europe

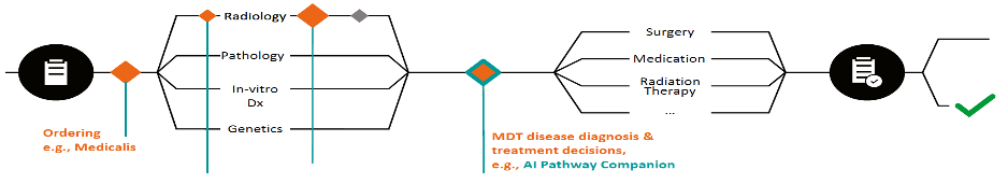
6 Develop an EU-wide research programme on early diagnostic and minimally invasive treatment/ technologies

7 Develop an EU-wide research programme and policy support to improve the quality of life of cancer patients and survivors, family members and carers, and all persons with an increased risk of cancer

Accelerate the implementation of multi-modal diagnostic methods for better guidance and treatments (drugs, surgery, radiotherapy, other) by establishing an ambitious academic clinical trial programme. They should involve clinical trials of existing diagnostic techniques, including imaging and most demonstrated clinical utility. They may also involve trials validating AI powered integrated diagnostic methods (Integrating biomarkers of imaging, tissue, genetic, fluids, clinics).

Multidisciplinary approach





Integration of biomarkers

accurate AI prediction models of outcome

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EUROPEAN SOCIETY OF RADIOLOGY

ECR 2022

JULY 13-17, VIENNA & ONLINE

AIX THEATRE

Shaping the Future

VISIT US AT MYESR.ORG

EU Cancer Missions

8 Create a European Cancer Patient Digital Centre where cancer patients and survivors can deposit and share their data for personalised care

This recommendation involves the creation of a European Cancer Patient Digital Centre (ECPDC), i.e. a virtual network of patient-controlled (national) health data infrastructures, in which cancer patients and survivors can deposit their health data provided by their medical care providers (e.g. imaging, genetics, blood markers, clinical and lifestyle data) in a standardised, ethical and interoperable manner. The repository would include a summary of treatments and integrate patient-reported outcomes useful for the cancer patient own use and everyday life data provided by patients and survivors themselves.

Health passport

"All too many observations lie isolated and forgotten on personal hard drives and CDs, trapped by technical, legal and cultural barriers" — Nature, September 2009

'Creating a data center where patients will have control of their own data, where data will not only be for the use of researchers but for multi stakeholders and patients is actually the next step we need to take to help realise the full potential of Real World Evidence and the step that can make the difference in outcome of cancer treatment'

Regina Beets-Tan

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