Integrated Diagnostics: From Patient Twinning to Precision Therapy

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Siemens Healthineers

We focus on clinical conditions to address the medical needs

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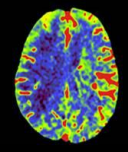
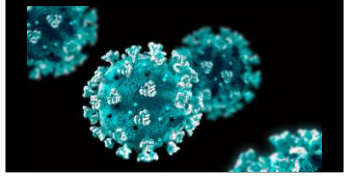
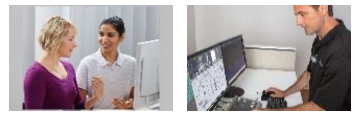
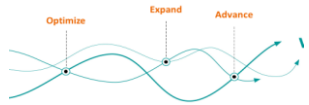
Prevention & Early Detection — **Diagnosis** — **Therapy & Monitoring** — **Follow-up**

Clinical Specialties	Radiology	Interven-tional Radiology	Radiation Oncology	Medical Oncology	Nuclear Medicine	Cardiology	Neurology	Lab medicine	Surgery
Clinical Conditions	Cancer 		Stroke 		Cardiovascular 		Infectious diseases 		Ortho/Trauma 
Devices, Software, Services	Medical Technology 						Service & Training 		Value Partnerships & Oncology Service 
Data, Digitalization and AI									

- **700,000 devices worldwide**

8 Billion

World population is estimated to have hit 8 Billion people on November 15, 2022

Source: UN Population Fund, https://www.unfpa.org/press/worlds-population-hits-8-billion-people-un-calls-solidarity-advancing-sustainable-development

Fundamental demographic and technology trends will result in continuously increased levels of automation in healthcare

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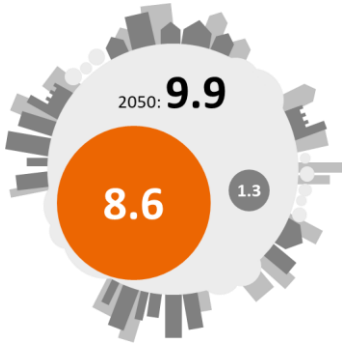
Population growth by 2050
(in billions of people)[1]

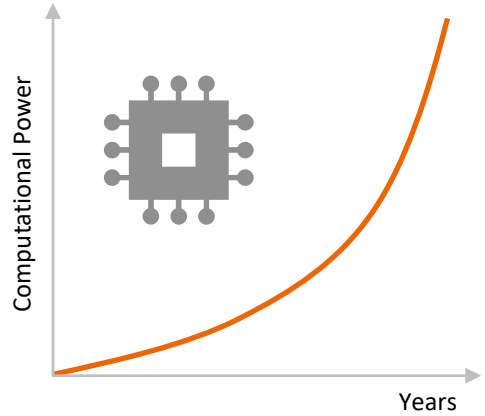


Increased number of **individuals demand access to** high quality **healthcare**.

Global medical staff shortage

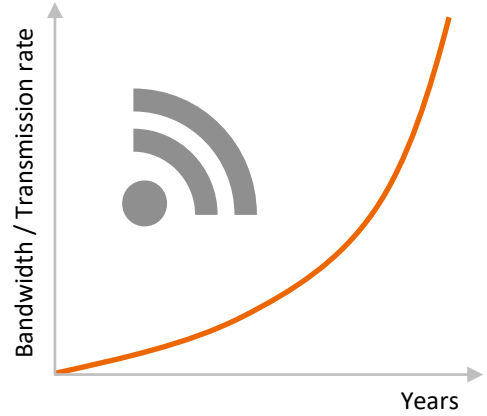
The world will be short of **18 million healthcare workers** by 2030.[2]

Computational Power



Computing power continues to **develop exponentially** (Moore's law).

Internet connectivity

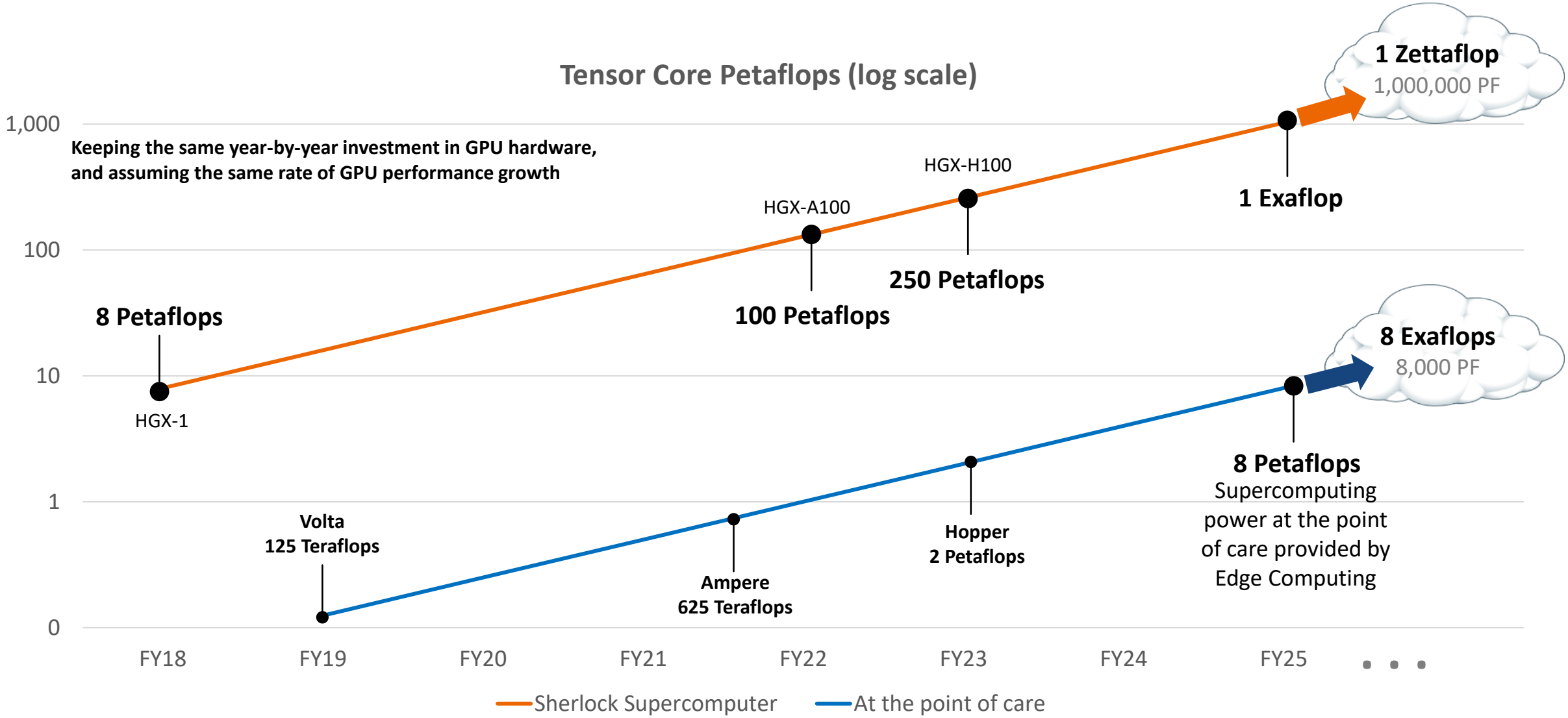


Information exchange **bandwidth increases exponentially** (Nielsen's Law).

The level of automation will continuously increase by means of AI-powered virtual and physical robots
to support healthcare professionals and ultimately patients and healthy individuals.

1 United Nations: https://www.prb.org/2020-world-population-data-sheet/#:~:text=The%202020%20Data%20Sheet%20identifies,2020%20population%20of%207.8%20billion, viewed April 19, 2021; https://population.un.org/wpp/Publications/Files/WPP2019-Wallchart.pdf, viewed April 19, 2021
2 WHO: https://www.who.int/health-topics/health-workforce#tab=tab_1 viewed April 23, 2021

Trends: Projected growth of processing power



Sources: https://www.zdnet.com/article/nvidia-makes-the-case-for-gpu-accelerators/
https://www.nvidia.com/content/dam/en-zz/Solutions/Data-Center/nvidia-ampere-architecture-whitepaper.pdf

Self Supervised Learning from 100 million medical images

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Improved Accuracy

+2.2 - 8% AUC: on various CAD applications (abnormalities in chest radiography, CT brain hemorrhage, MR brain metastases)

Higher Robustness

To variations in image intensity

To geometric variations: rotation, scaling, etc.

Accelerated Training

60 - 83% faster training rounds – allowing for more experiments and hyper-parameter optimization

Scalability

To large amounts of data

To various applications

Contrastive self-supervised learning from 100 million medical images with optional supervision, FC Ghesu et al, ...Journal of Medical Imaging 9 (6), 2022

The concepts and information presented in this slide are based on research results that are not commercially available.

Integrated diagnostics: One workspace

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Harmonized UI

Case summarization

Longitudinal patient view

Ai-supported reading

Visualization / cinematic rendering

Reporting

Virtual assistant

Research

1 Access clinical information

2 Artificial Intelligence

3 Advanced visualization

4 Actionable reporting

5 Research and innovation

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Access clinical information
Large language models for radiology

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Patient information

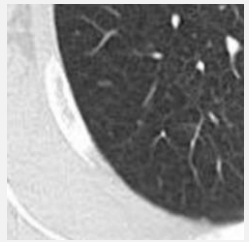
EMR

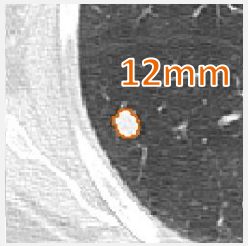
Indication for exam

Radiology Information System

Reports

PACS





Imaging

Connectivity/Access

Scalable standardization of multiple data streams

- Imaging
- Reports
- Reason/Indication for exam
- Additional patient information (prior treatments, …)

Interpretation support

Scalable structuring of all prior patient information

Synthesize

Putting all relevant information together

Contribution of Large Language Models

One workspace

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Large language models for radiology

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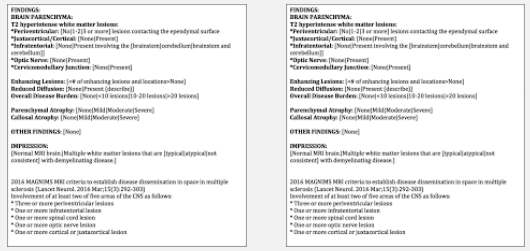
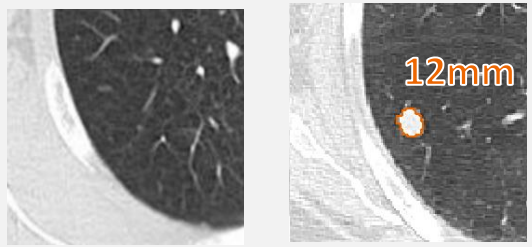


Reports

PACS



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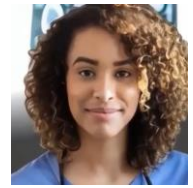

Q&A: Radiologist Assistant

One workspace

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Radiologist Assistant

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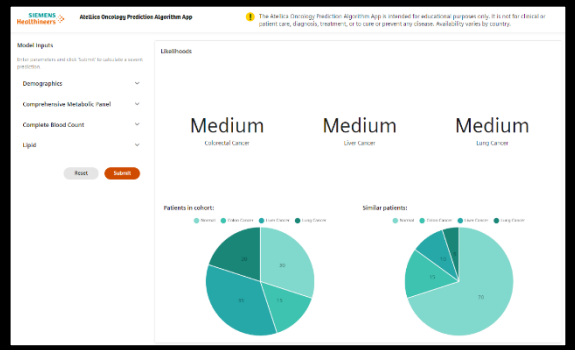
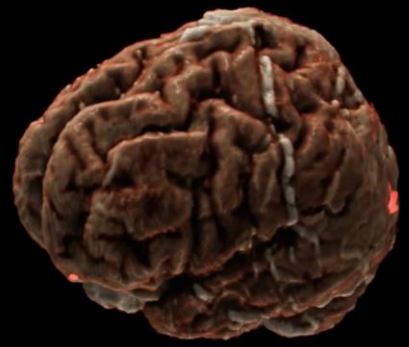
The concepts and information presented in this application are based on research results that are not commercially available. Future commercial availability cannot be guaranteed. The AI avatar is an animated photograph, and all the information disclosed in this application describes fictional patients and exams for purposes of demonstrating the capabilities of the software. No actual patients participated in the creation of this demonstration.

AI-powered diagnostics for oncology

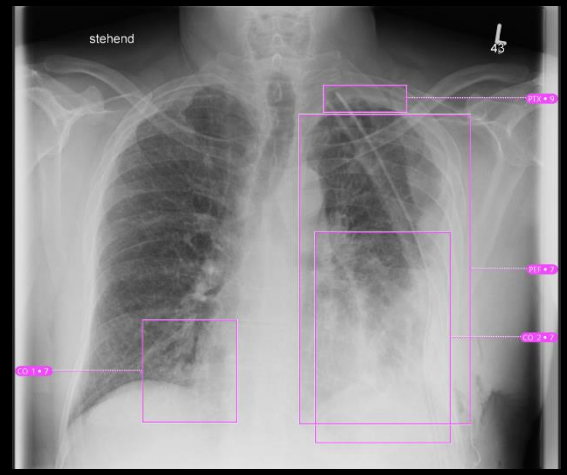


Oncology risk prediction

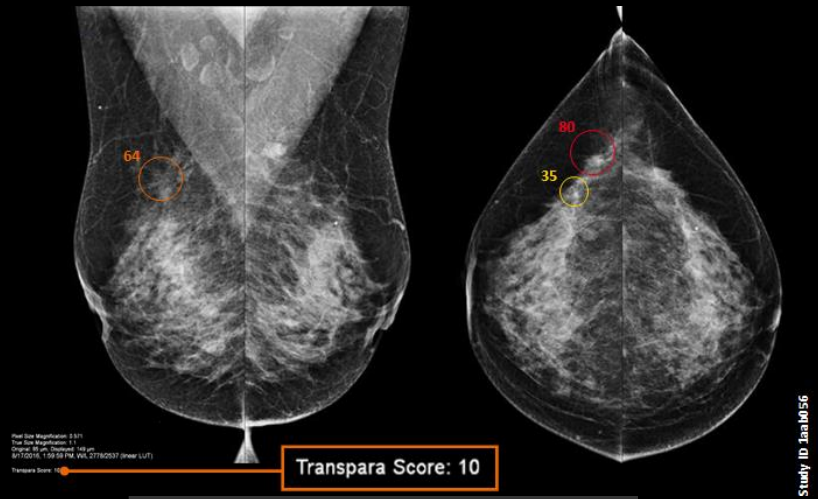


Brain tumor and mets

Lung cancer screening Chest CT



Pulmonary lesions – Chest X-Ray



Breast cancer screening

Prostate MR

Cardiotoxicity

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Research: Integration of pathology, proteomics, and genomics
Tumor fingerprinting

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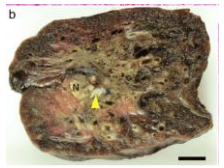
Data generation	Data analysis & integration

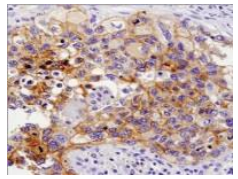
Tumor Biopsy



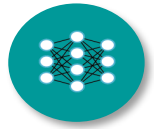
Digital Pathology

Digitalization of available slides

Digital image



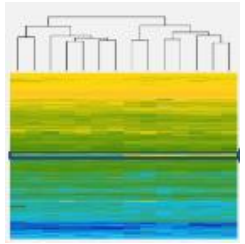
Artificial intelligence on image analysis



Proteomic/Metabolomic Profile

Sample preparation for Mass Spec

Mass Spec data analysis



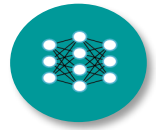
Genomic Profile

Sample preparation and NGS panels

NGS raw data

NGS data analysis

AI - Tumor Fingerprint



Digital Biopsy of molecular changes in tumors

Cancer Scout project, BMBF. Courtesy of University Hospital Göttingen

The system is currently under development and is not for sale. Its future availability cannot be guaranteed.

Radiation Therapy outcome optimized with Deep Profiler
Outcome-based prediction of radiation therapy (SBRT)

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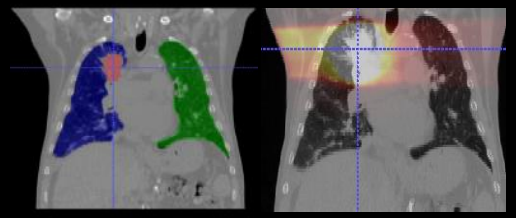
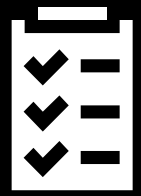
Diagnosis and Planning

Imaging

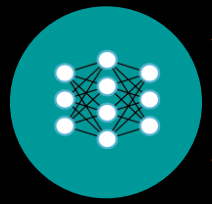


Treatment Parameters

EHR (Tumor Sub-Type)

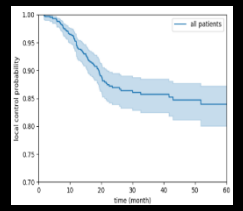


Deep Profiler

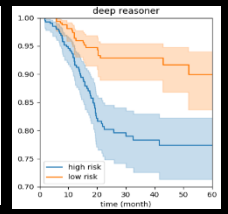


Patient Stratification

Probability of local control after SBRT



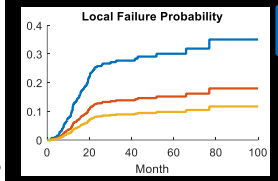
No stratification



Deep Profiler stratification

Dose Prescription

Can AI-based risk score help modulate therapy?



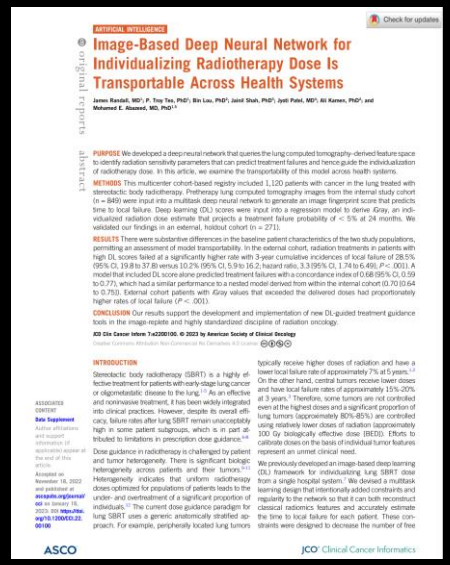
Patient with BED=100Gy

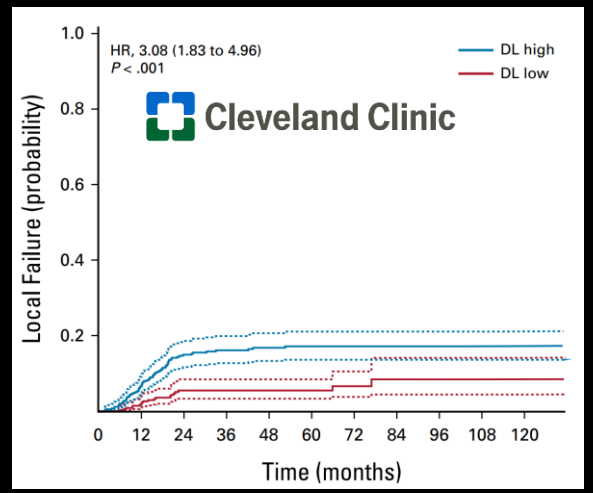
Patient with BED=150Gy

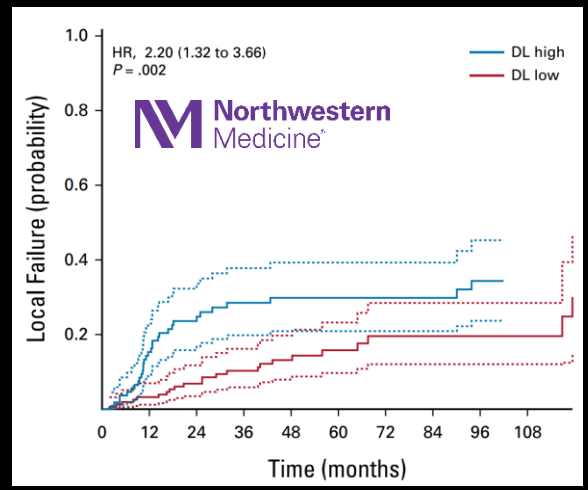
Patient with BED=180Gy

Help radiation oncologist on the dose escalation studies.

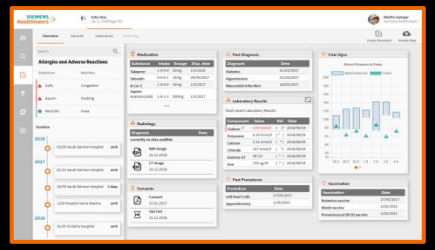
Deep profiler reduces the local failure rate by 45% in favorable sub-group (compare with Radiomics 32% only).

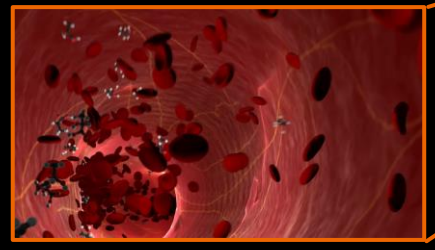






Lou B et al., An image-based deep learning framework for individualizing radiotherapy dose: retrospective analysis of outcome prediction, Lancet Digital Health. 2019; 1: e136-e147
Randall J. et al., Image-Based Deep Neural Network for Individualizing Radiotherapy Dose Is Transportable Across Health Systems, JCO Clinical Cancer Informatics 2023 :7.





Health Digital twin – lifelong, personalized physiological model updated with each scan, exam

Person-centric prevention and holistic treatment

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