

Data, AI and cyberspace in image-guided interventions and therapy

Danny Ruijters

Principal Scientist – Image Guided Therapy

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Agenda

- What is image guided therapy?
- Philips in image guided therapy
- Cyberspace in image-guided therapy:
 - Opportunities and challenges
- The long game in cyberspace:
 - Hyper-personalized treatment
- Conclusions

What is image guided therapy?



Minimally Invasive Treatment

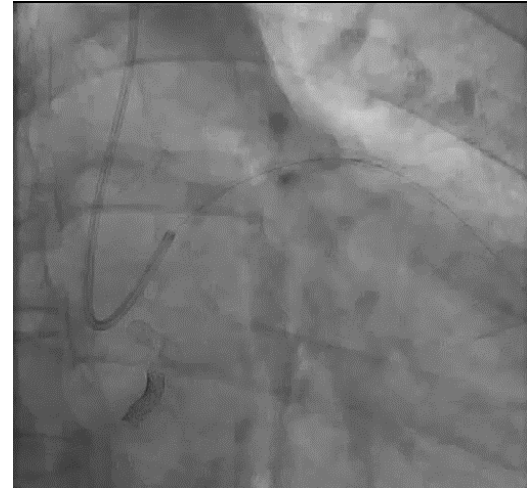
- **Effective therapeutic effect**
 - with less trauma
 - less scarring
 - a quicker recovery time

- **Examples include:**
 - Catheterization
 - Endoscopy
 - Laparoscopy
 - Arthroscopy
 - ...

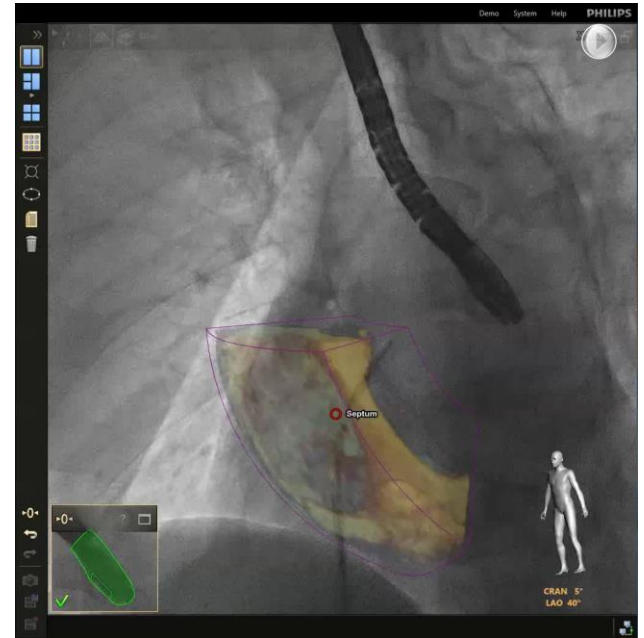
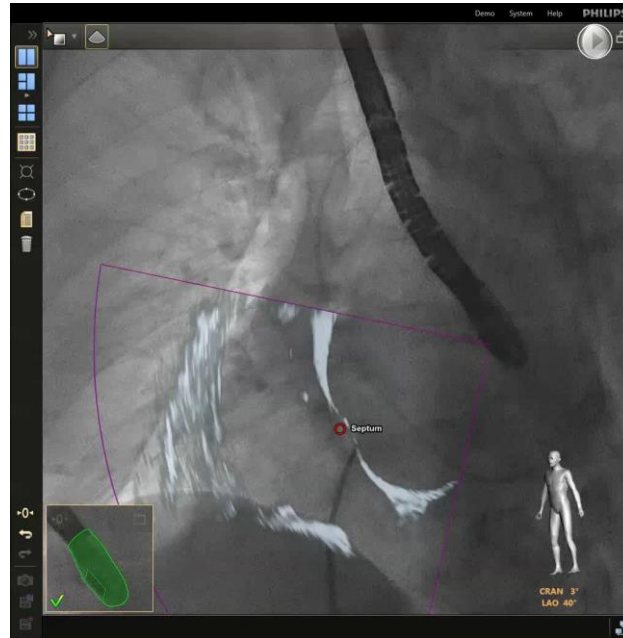


Image Guidance

- No direct sight inside the patient
- Key enabler: real-time imaging
 - X-ray guided therapy
 - Ultrasound
- Other real-time information sources
 - ECG
 - blood pressure
 - respiratory data
 - oxygen levels
 - ...
- => Fully data driven

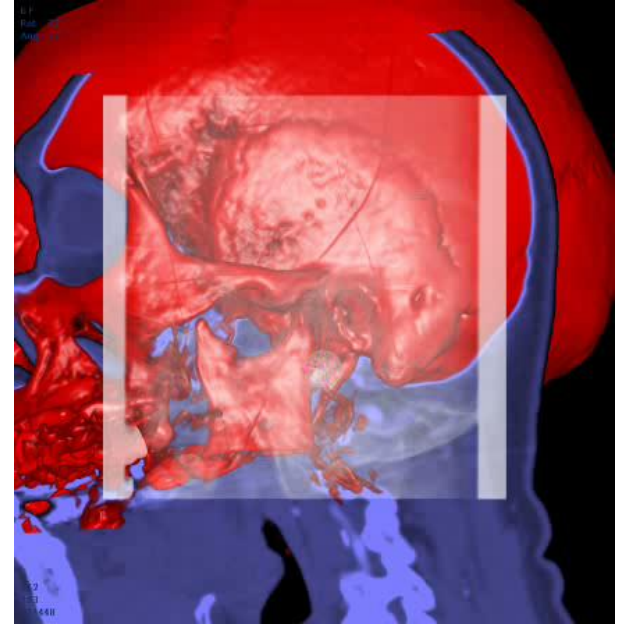
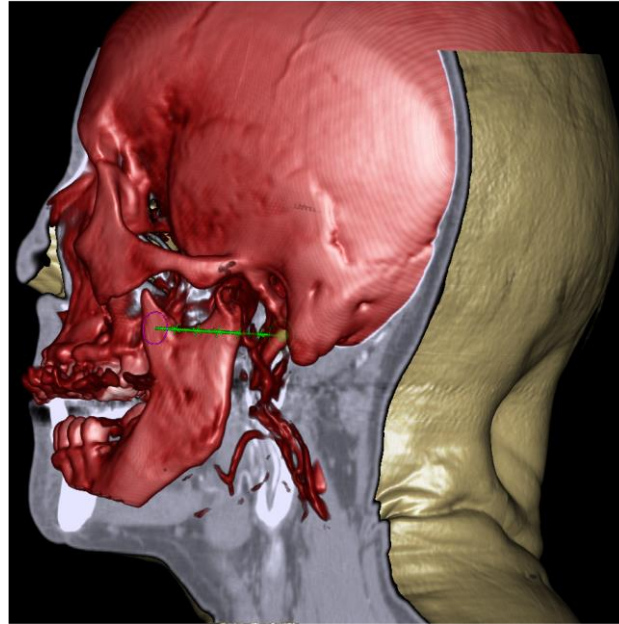
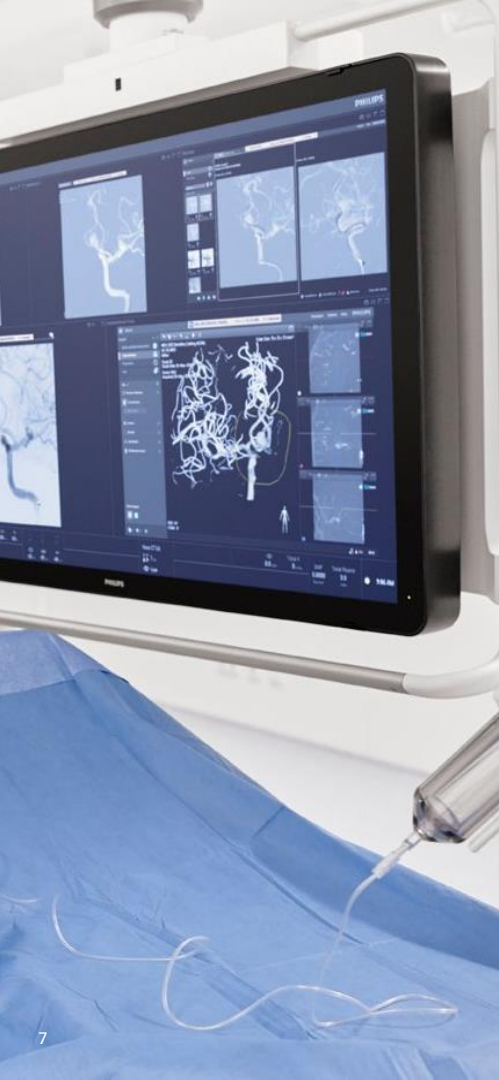


Advanced Image Guidance



Thaden et al.: "Echocardiographic and Fluoroscopic Fusion Imaging for Procedural Guidance: An Overview and Early Clinical Experience", 2016
Arujuna et al.: "Novel System for Real-Time Integration of 3-D Echocardiography and Fluoroscopy for Image-Guided Cardiac Interventions:" 2014

Advanced Image Guidance



Spelle et al.: "First clinical experience in applying XperGuide in embolization of jugular paragangliomas by direct intratumoral puncture", IJCARS 2009

Philips in image guided therapy

How big is image guided therapy?

EUR 12 billion

addressable market in 2025

~7% CAGR
(2025-2028)

Aging population and rise of chronic disease

Driving demand for minimally invasive interventions

Staff shortages and productivity pressures

Demand for efficient workflows

Large eligible patient pools remain untreated

Demand for access to care

Innovation enables more complex and new procedures

Clinical evidence drives guidelines and reimbursement

Generating strong revenue growth for hospitals

Shift towards data-driven, and AI-supported interventions

How big is Philips in image guided therapy?

Systems

EUR 2.4 billion

Global #1 for over a decade

20,000+ systems in **80+** countries

EUR
3.5 billion

Sales in 2025

Devices

EUR 1.1 billion

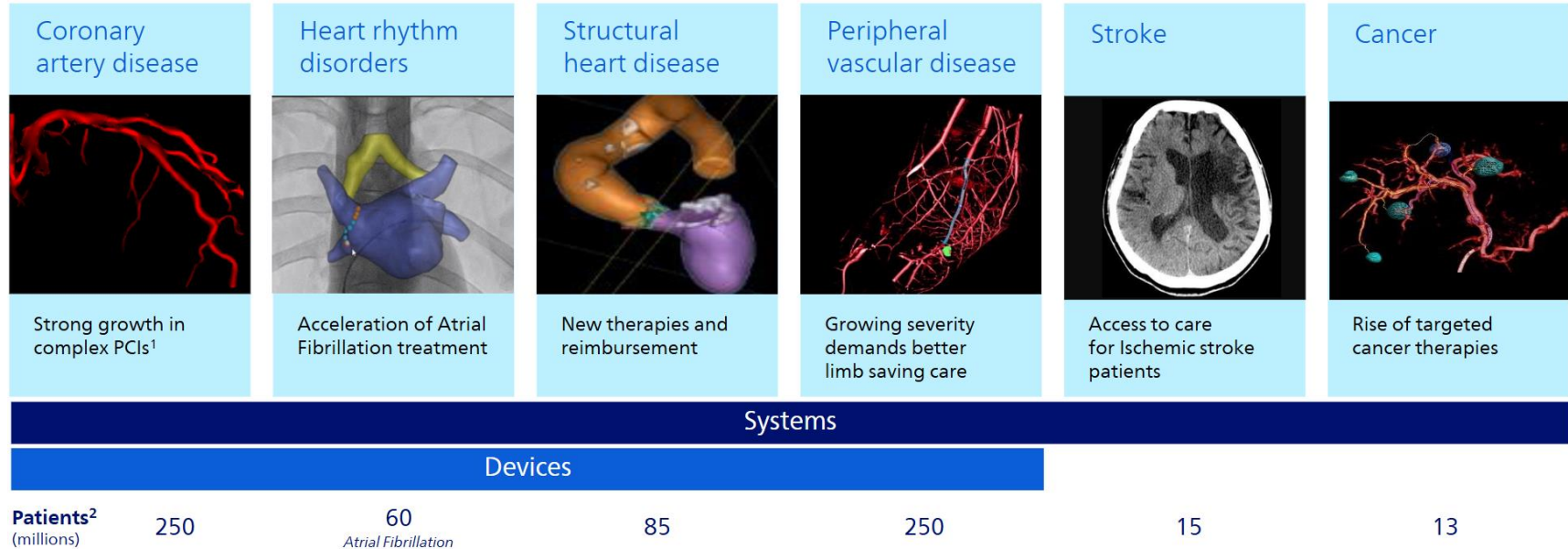
Global #1 across different segments

>50% of labs are device-ready¹




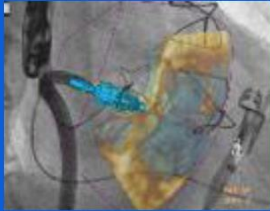




One Integrated Interventional Platform

Which clinical segments does Philips serve?



Delivering procedure innovation in complex clinical areas

Philips interventional platform

Azurion				+	EPIQ	+	IntelliVue
Interventional imaging systems	Image fusion software and AI	Integrated device console, with co-registration	Diagnostic and therapeutic devices		Cardiovascular ultrasound		Hemodynamic patient monitoring
							
Global market share ¹ : ~46%					~47%		~54%
Largest installed base ready for Philips and partners devices	Integrated workflow 17% reduction ² in procedure time and 65% dose reduction ³	Procedure innovation unlocks new procedures and revenue growth for hospitals	One commercial team with clinical procedural support to drive adoption, customer intimacy				

Philips capital markets day, https://www.philips.com/c-dam/corporate/about-philips/investors/calendar/2026/CMD_2026_Transcript.pdf

Cyberspace in image-guided therapy: Opportunities and challenges

AI in image guided therapy

- Advanced Image Guidance require advanced algorithms
 - Image segmentation
 - Multi-modal image registration
- Agentic AI enable new applications
 - Workflow automation
 - AI assistant for intra-procedural Q&A
 - Decision support systems
- Digital twin concepts



AI requires data...

- AI requires data...
- Lots of data...
- Multimodal data streams: pre-operative imaging, intraoperative sensors, patient records, device telemetry
- Data volumes are exploding as procedures generate richer, higher-resolution imaging and continuous monitoring
- Interoperability remains a core challenge across DICOM, HL7 FHIR, and proprietary device protocols
- Data quality and curation are essential for training reliable AI models
- Balancing data accessibility for innovation with strict privacy requirements (GDPR, HIPAA)



Building the Cath Lab of the future with Azurion Eye

✦ Azurion Eye

World's first AI-powered interventional platform

Ambient co-pilot, seamlessly integrated into the Azurion platform to drive procedural and operational efficiency and optimize patient outcomes

Unlocking new opportunities

Adjacent high growth software

Deployable on existing and future Installed Base

Accelerating AI and data leadership
From 160 million multi-modality images collected to date, to >1 Million images per day in 2027



Release modules progressively over 2026–2028

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Going cloud...

- AI is exponentially accelerating the digitalization of the entire society
 - On premise hardware will be less powerful than cloud computing and outdated quickly
 - Cloud allows to roll out and update algorithms
- Data is foundational for developing AI technology
 - Data needs for developing AI technology are orders of magnitude larger than for traditional algorithms
 - To collect data at scale a cloud platform, cloud tooling and cloud data hosting is needed
- Cloud enables a single platform
 - A single platform for the surgery suite, with multiple vendors of validated tools
 - Centralizes security and privacy handling



Regulatory landscape

- FDA Section 524B (2023): mandatory cybersecurity plans, SBOM, and secure update mechanisms for all cyber devices
- EU Cyber Resilience Act: 21 mandatory requirements; reporting obligations from September 2026
- NIS2 Directive: supply chain security obligations for essential healthcare entities across the EU
- Revised EU MDR/IVDR (2025): cybersecurity integrated into general safety requirements; 30-day incident reporting
- 83% of healthcare organizations now integrate cybersecurity standards directly into device procurement

U.S. Food and Drug Administration, [“Cybersecurity of Medical Devices,”](#) FDA, 2023.

European Commission, [“Cyber Resilience Act \(Regulation \(EU\) 2024/2847\) – Reporting Obligations,”](#) 2026.

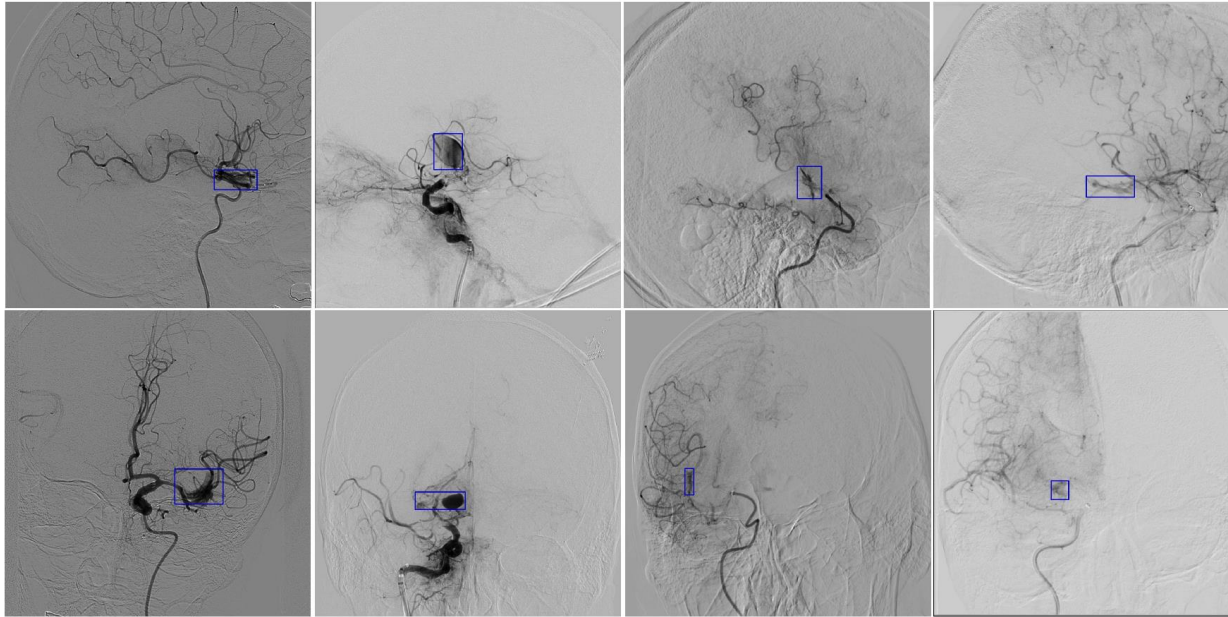
European Union, [“Directive \(EU\) 2022/2555 on measures for a high common level of cybersecurity across the Union \(NIS2\),”](#) Official Journal of the European Union, 2022.

Moody’s, [“Healthcare Providers – Global Cyber Survey,”](#) 2024.



The long game in cyberspace:
Hyper-personalized treatment

Example 1: Automatic hemorrhage detection in brain X-ray angiograms through machine-learning



Su, van der Sluijs, et al.: "Spatio-temporal deep learning for automatic detection of intracranial vessel perforation in digital subtraction angiography during endovascular thrombectomy", *Medical Image Analysis* 77, 2022. <https://doi.org/10.1016/j.media.2022.102377>

Example 2: German Heart Center Munich

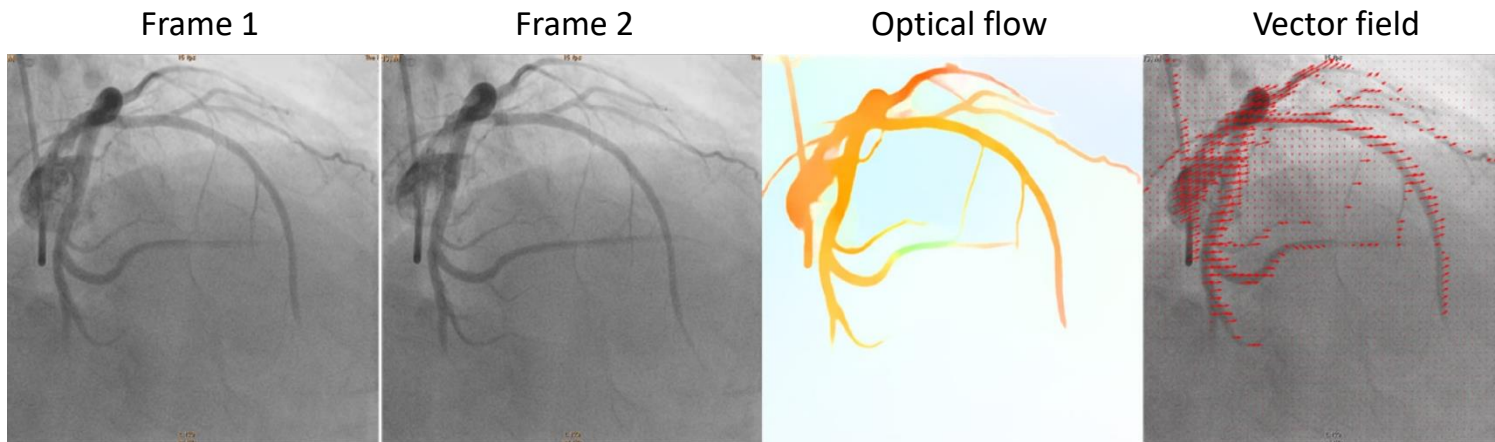
- > 300 000 heart patients treated for coronary artery disease
- Database:
 - > 180 000 individual cath lab cine clips + structured reports
 - 5 500 coronary CTs (completely annotated), including 3a clinical follow-up
 - 1 500 heart MRIs
 - 65 000 structured ultrasound reports
 - 11 000 genotyped individuals
 - ICD10 codes, lab results, clinical measures, study information, ECG, etc.



Example 2: German Heart Center Munich

Extract cardiac motion patterns in angiograms

- Two consecutive angiographic X-ray frames showing moving coronary arteries filled with iodine contrast medium
- Through the optical flow algorithm, the motion is established
- Delivering a vector field describing the motion per pixel between the two frames.



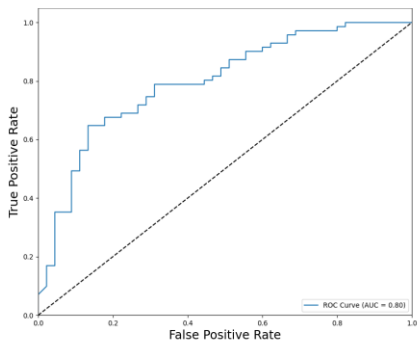
Yin, et al.: Optical flow estimation of coronary angiography sequences based on semi-supervised learning, Computers in Biology and Medicine 146, 2022, <https://doi.org/10.1016/j.combiomed.2022.105663>

Example 2: German Heart Center Munich

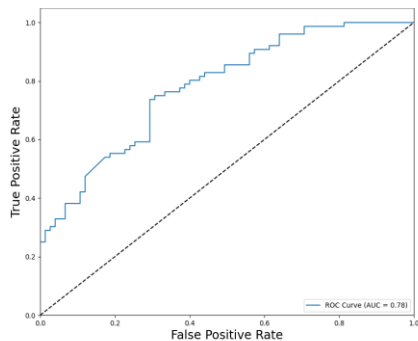
Motion pattern classification in angiograms

- A receiver operating characteristic (ROC) curve can be used to examine the performance of a classifier
- The closer the ROC curve is to the 45-degree reference, the poorer the classifier performs
- ROC curves for cardiac ejection fraction, hypertension, and nicotine can be predicted from the coronary motion fields.
- The ROC curve for diabetes is very poor -> not correlated to the coronary motion field

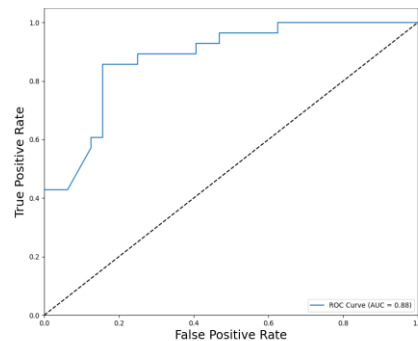
Ejection fraction



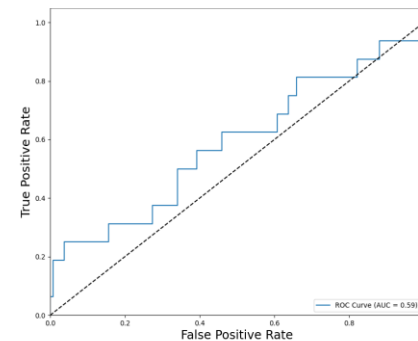
Nicotine



Hypertension



Diabetes

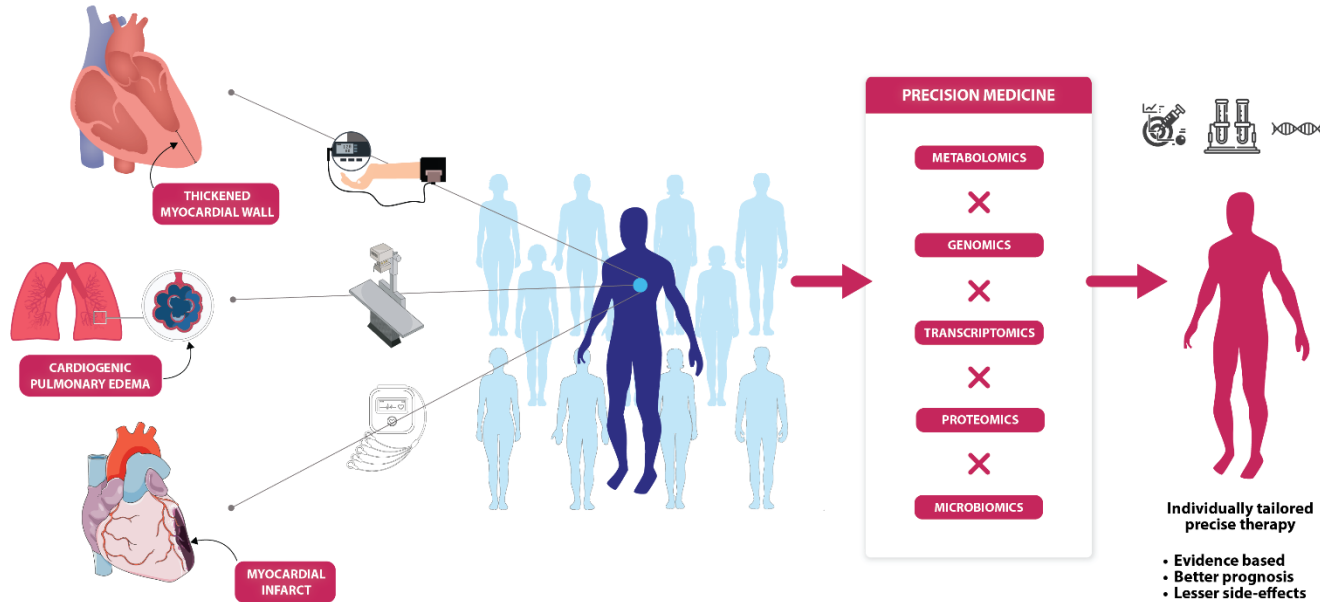


R. Tao: Coronary Artery Motion Clustering based on Optical Flow. Master thesis. TU/e. May 25, 2023.

Precision medicine



PRECISION MEDICINE AND THE FUTURE OF CARDIOVASCULAR DISEASES

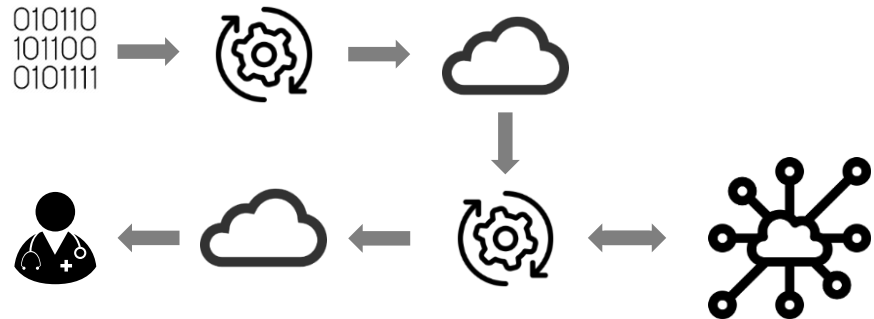


Sethi, et al. Precision Medicine and the future of Cardiovascular Diseases: A Clinically Oriented Comprehensive Review. J. Clin. Med. 2023, 12, 1799. <https://doi.org/10.3390/jcm12051799>



Data cycle

- The full data cycle of gathering data, pre-processing, uploading to the cloud. In the cloud processing and matching with (pre-processed) big data. Consequently, storing the results and feeding them back to the clinical user.



Ruijters, "[Data-driven patient treatment: imagine the future of data-driven minimally invasive patient treatment](#)", Inaugural lecture, Technische Universiteit Eindhoven, 8 September 2023,

Conclusions

Conclusions

- AI will transform image guided therapy
- AI requires lots of data
- Large scale data collection requires connectivity and a cloud platform
- This enables digital twins
- Which unlock hyper personalized treatment
- The long-term goal: precision interventions that are personalized, data-driven, and inherently secure

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