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Pioneering Perspectives:

Sensing and Imaging as Key Enabling Technologies

Danny Ruijters, Phillips

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Trends and opportunities in image guided therapy

Danny Ruijters - Philips

DISCLOSURE SLIDE

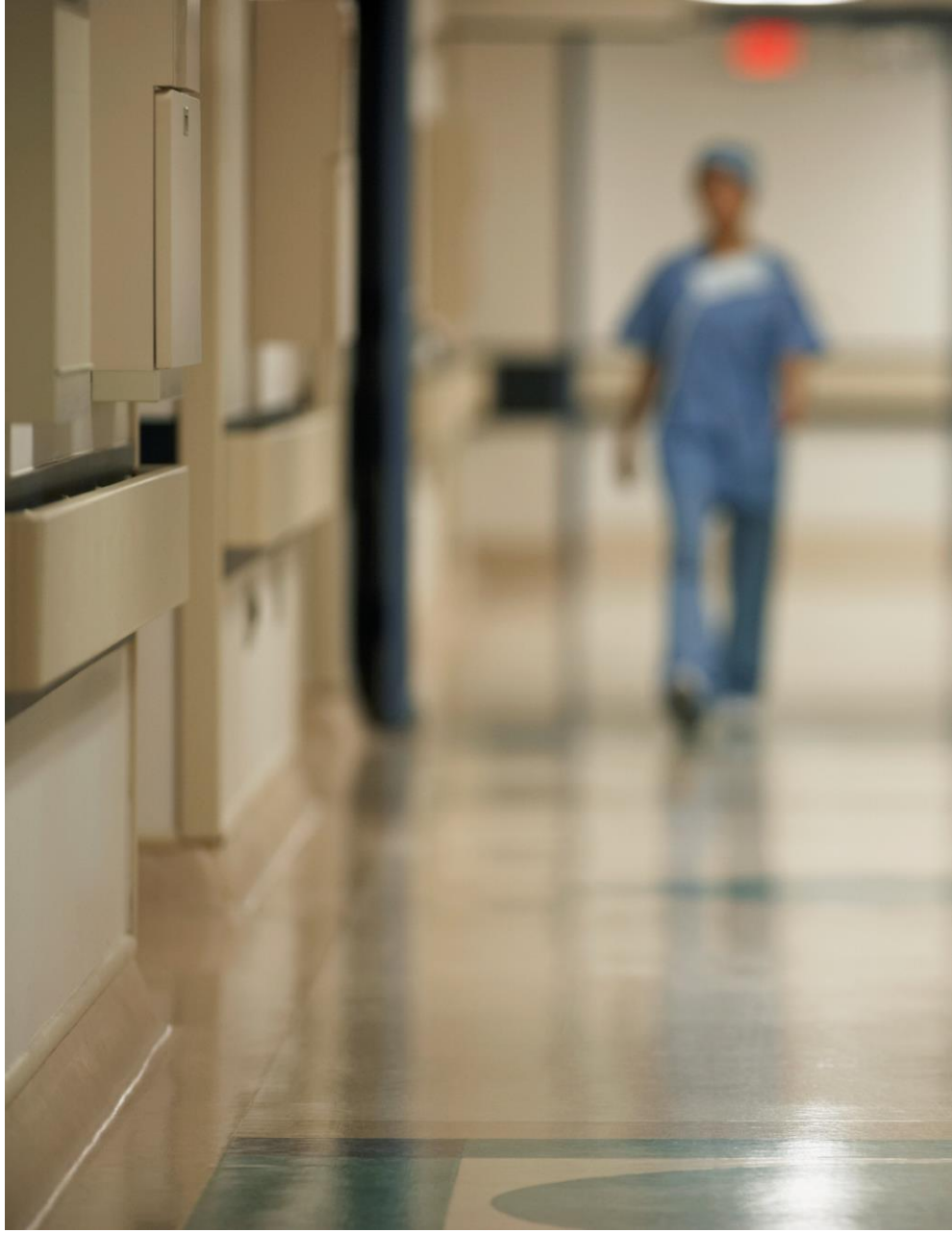
- Philips employee: principal scientist at Philips Image Guided Therapy Innovation
- Part-time professor at Technische Universiteit Eindhoven

Challenges in healthcare

- Costs
  - WHO: 10% of GDP in 2016
  - USA: $4.3 trillion (4.3 · 1012) in 2021, 18.3% of GDP

- Factors contributing:
  - Advances in medical technology
  - Aging population
  - Increase in chronic diseases
  - Rising cost of prescription drugs

- EU: Up to 20% of health spending is wasteful
- US: $20 billion:
  - Medical errors
  - Unnecessary treatments or procedures
  - Preventable hospital readmissions



Public spending on health: a closer look at global trends WHO/HIS/HGF/HFWorkingPaper/18.3
Centers for Medicare & Medicaid Services (2020). National Health Expenditure Data.
Health at a Glance: Europe 2020: State of Health in the EU Cycle (2020).
Thomson et al.: “Financing health care in the EU: challenges and policy responses”, WHO 2009
Rodziewicz et al.: “Medical error reduction and prevention.” NIH National Library of Medicine (2023).

Evidence-based medicine

- Approach to clinical practice:
  - The best available evidence from well-designed and well-conducted research
  - To inform clinical decision-making

Institute of Medicine. (2001). Crossing the Quality Chasm: A New Health System for the 21st Century
Evidence-Based Medicine Working Group. Evidence-based medicine. A new approach to teaching the practice of medicine. Journal of the American Medical Association JAMA 1992;268(17):2420-5

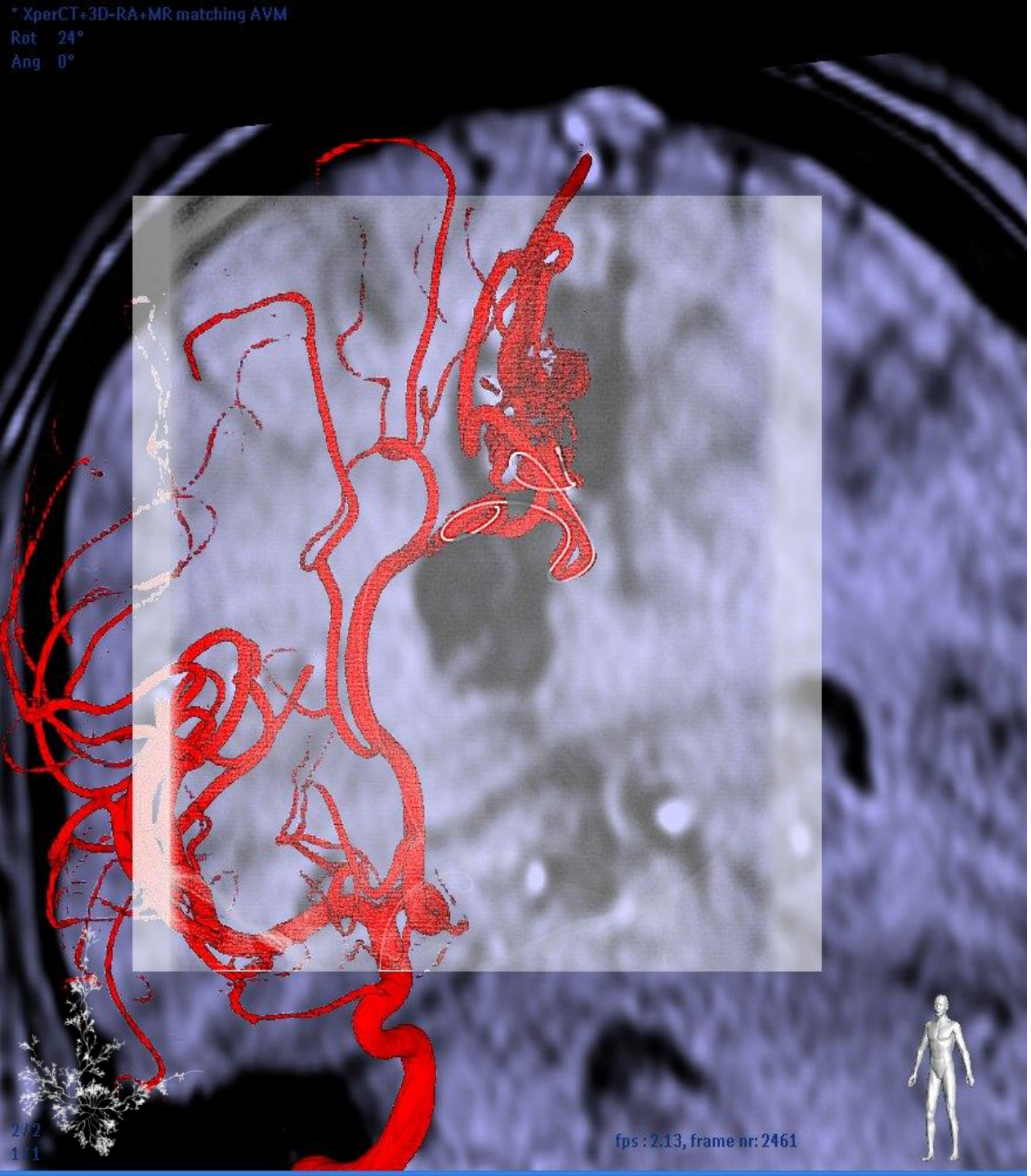
Value-based healthcare

- Emphasizes achieving the best possible outcomes for patients at the lowest possible cost.
- Focuses on measuring outcomes that matter to patients and using this information to drive improvement in care delivery.

M. E. Porter, T. H. Lee: (2013). The strategy that will fix health care. Harvard Business Review, 91(10), https://hbr.org/2013/10/the-strategy-that-will-fix-health-care

Minimally invasive surgery

- Without any major incisions
  - No direct sight inside the patient
  - Key enabler: real-time imaging
    - X-ray guided therapy
    - Ultrasound
- Effective therapeutic effect
  - with less trauma
  - less scarring
  - a quicker recovery time
- Examples include
  - Catheterization
  - Endoscopy
  - Laparoscopy
  - Arthroscopy

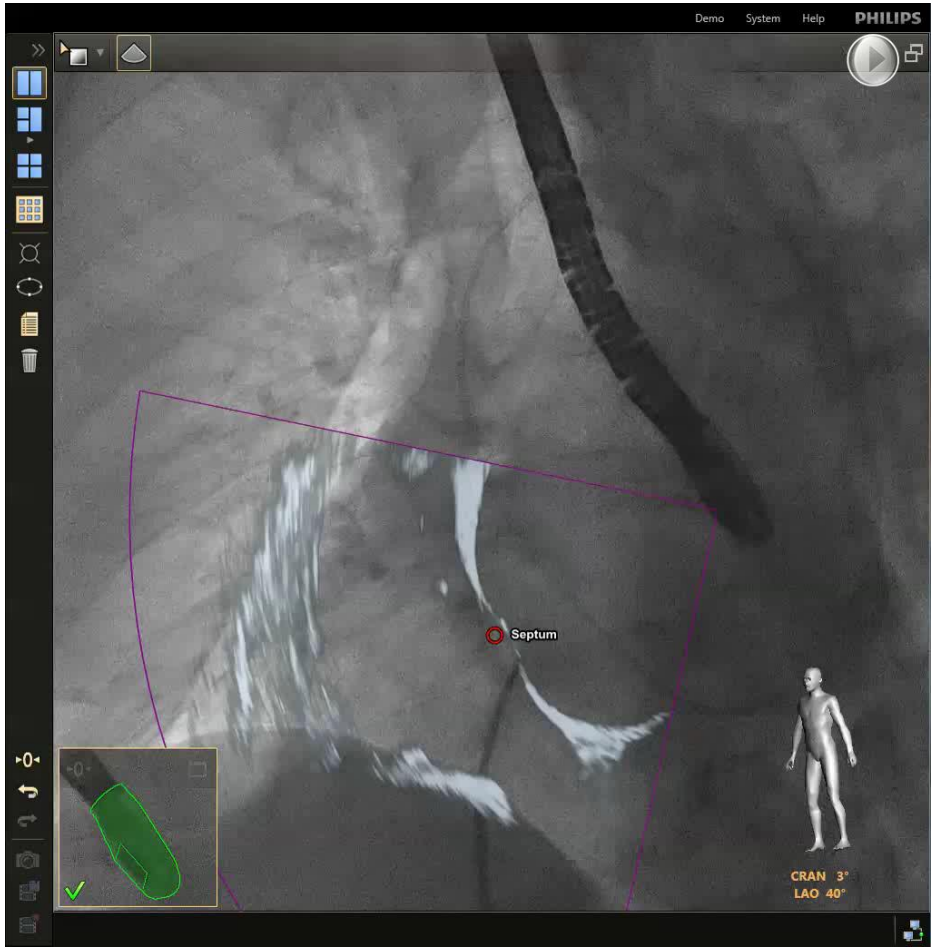


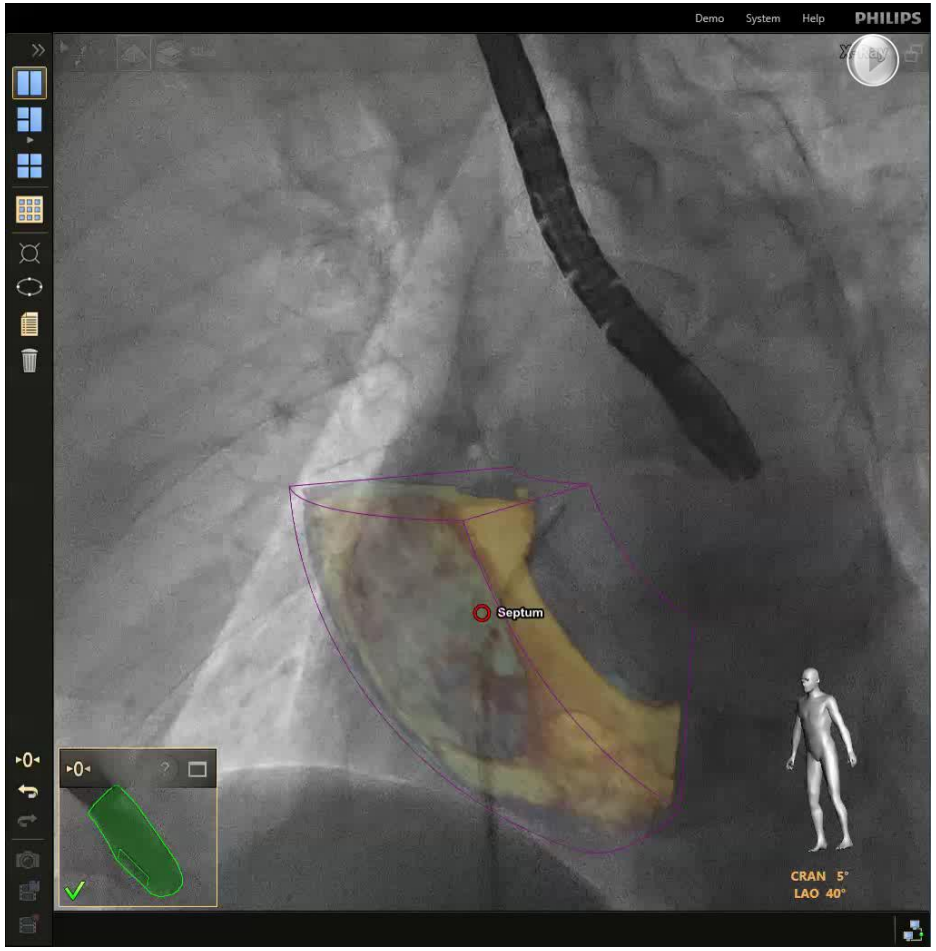
Advanced image fusion during interventional treatment

- Example:
  - Endovascular catheterization to treat an arterio-venous malformation (AVM)
  - Live 2D x-ray is combined with interventional 3D x-ray reconstruction and pre-interventional MR
  - The catheter is navigated over a guidewire, which is visible in the live x-ray overlay

Gupta, Ruijters, Flexman: “Augmented Reality for Interventional Procedures”, 2021
Ruijters et al.: “Validation of 3D multimodality roadmapping in interventional neuroradiology”, Physics in Medicine and Biology 2011

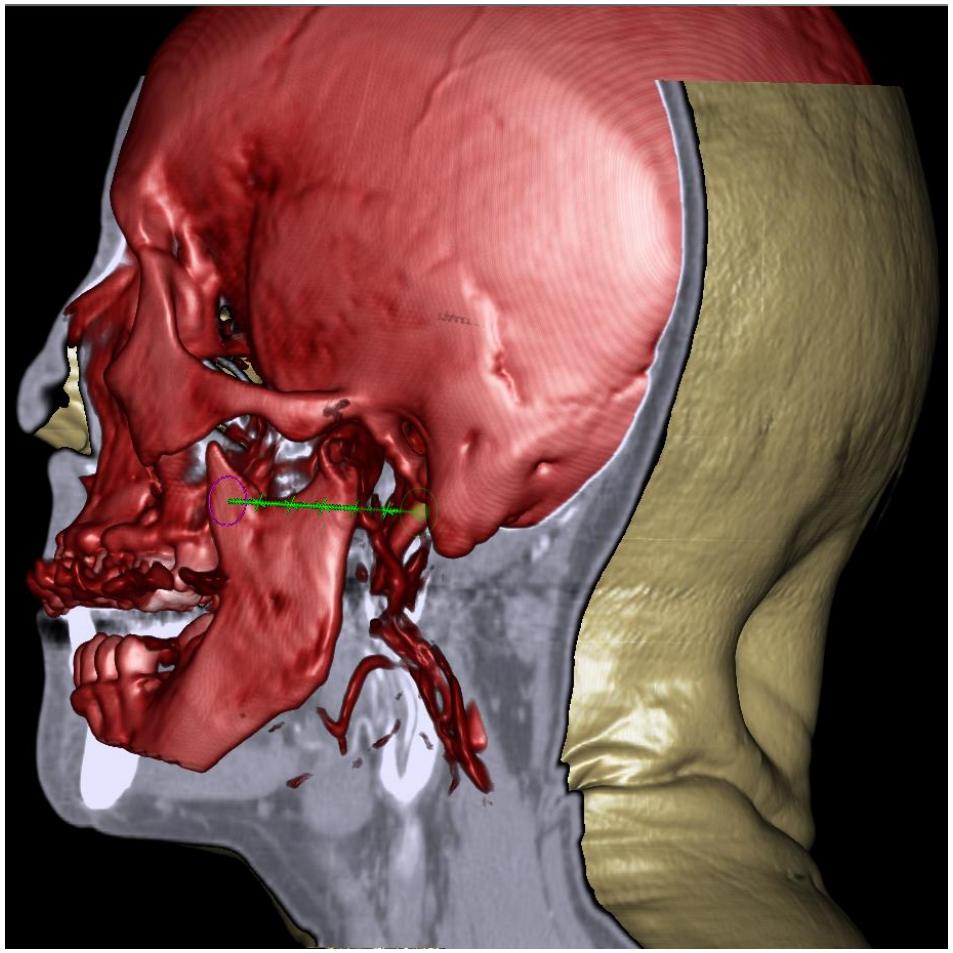
Fusion of two live imaging sources in real-time

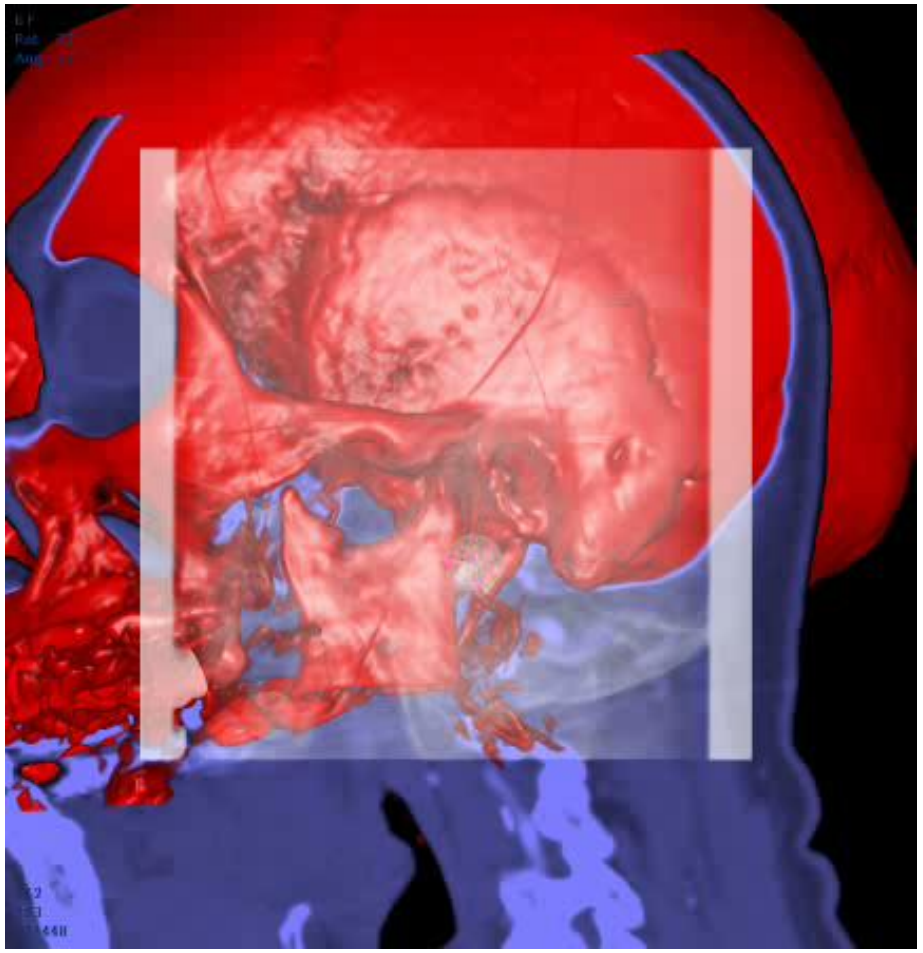




Thaden et al.: “Echocardiographic and Fluoroscopic Fusion Imaging for Procedural Guidance: An Overview and Early Clinical Experience”, 2016
Arujuna et al.: “Novel System for Real-Time Integration of 3-D Echocardiography and Fluoroscopy for Image-Guided Cardiac Interventions:” 2014

Live needle guidance with pre-operative overlay



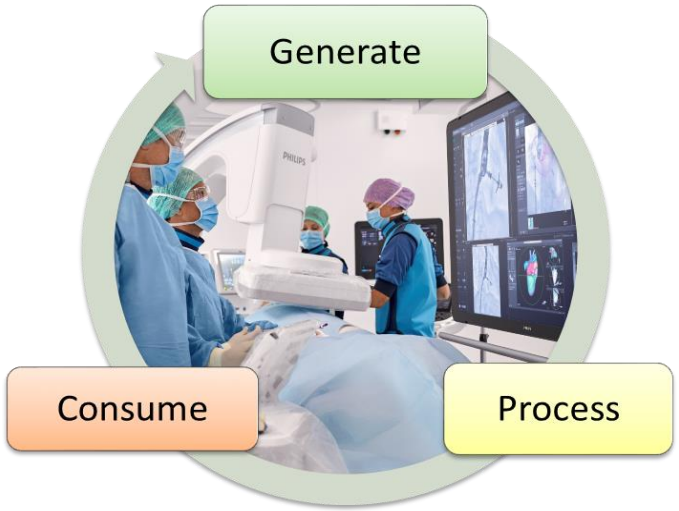


Spelle et al.: “First clinical experience in applying XperGuide in embolization of jugular paragangliomas by direct intratumoral puncture”, IJCARS 2009

The real-time and the long-term data cycles

- The real-time data cycle consists of all the data generated during patient treatment.
- The long-term data cycle is setup to analyze the patient outcomes and identify the most successful therapies, and risk factors.
- These data cycles exist today, and are driving e.g. evidence based medicine
- However, a lot of data is not captured…

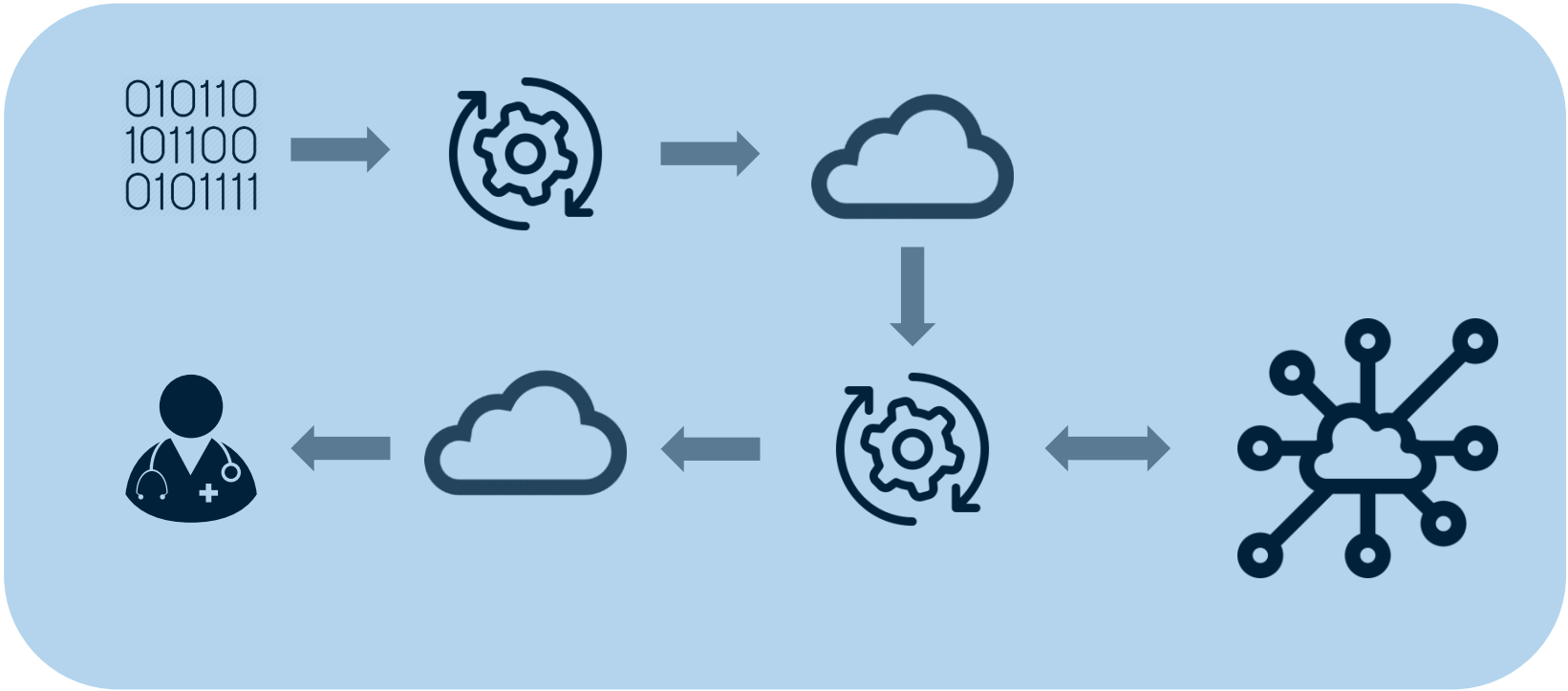
Real-time



Long-term

Automating the data cycles

- By automating the data collection, very large rich databases can be created
- Mining the large rich databases can fuel personalized precision medicine
- Personalized insights can be derived for individual patients by harvesting the preprocessed large rich databases



Conclusions

- Healthcare challenge: costs
- Trends:
  - Evidence-based medicine
  - Value-based healthcare
- Personalized precision medicine:
  - Large scale data collection
  - Automatically determine best treatment options & risk stratification
- Requires data infrastructure
  - Scaling world-wide
  - Real-time performance
  - Cost and load balancing
  - Quality of service

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BRIDGING PAST AND FUTURE: FIVE YEARS OF MEDTECH ADVANCEMENTS AND BEYOND