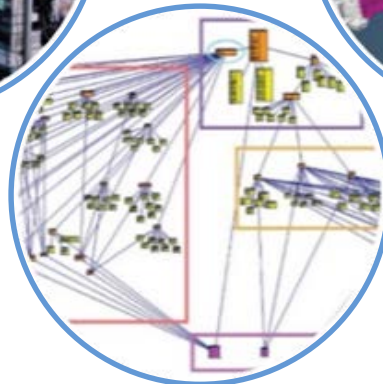
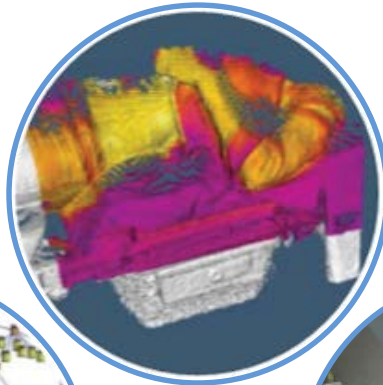
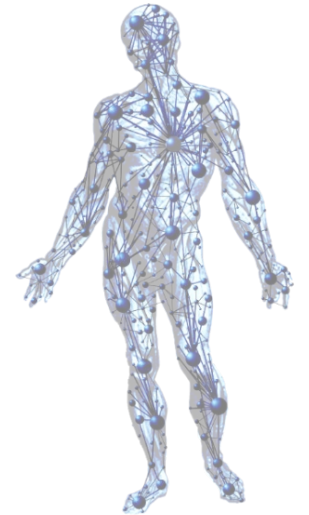


Thomas Neumuth

Artificial intelligence and robots in the OR - Still room for ebM?

Innovation Center Computer Assisted Surgery (ICCAS)

- Affiliated to Medical School of Universität Leipzig
- ~85 engineering and computer science researchers



Technology is integral part of medicine

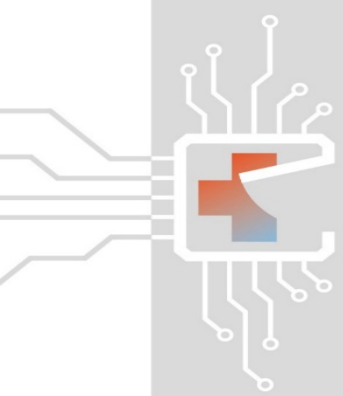
Medicine



Biomedical and information
technology



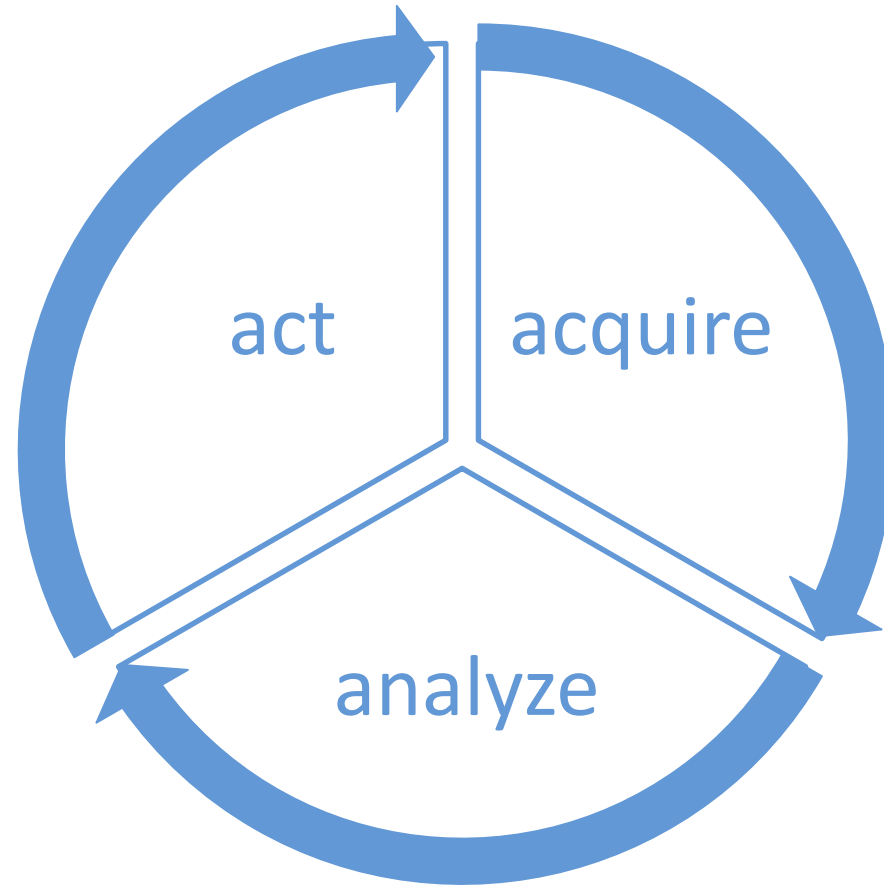
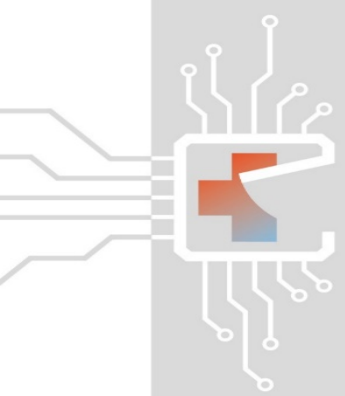
4P medicine
Personalized
Predictive
Preventive
Particatory

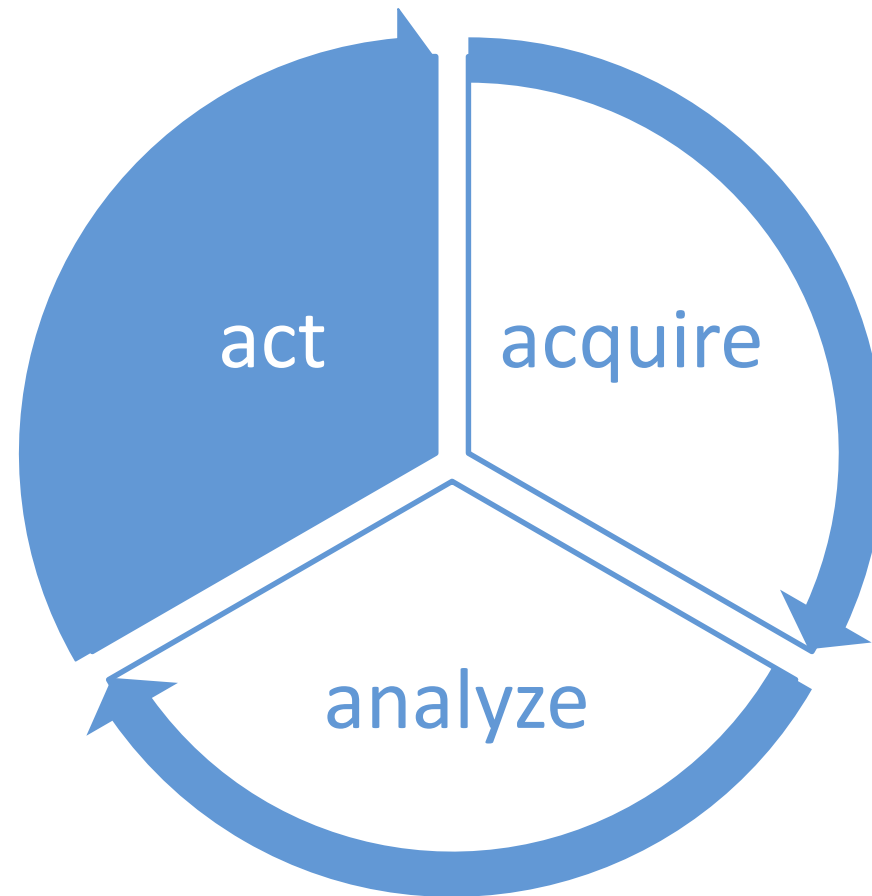
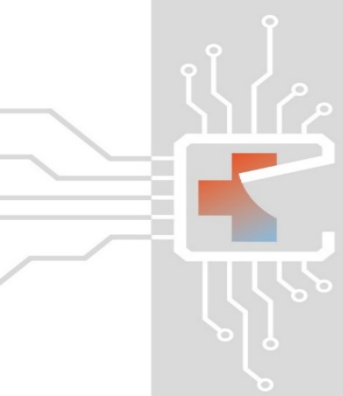


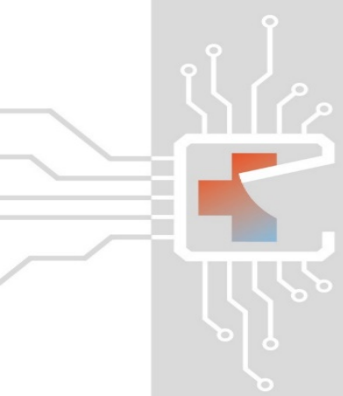
Technology has a different evolution speed

- Information retrieval from distant monitors and devices
- Vendor dependent device operation
- Technical obstacles for advanced workflow management
- Limited flexibility in the selection and combination of systems









Robotic systems for surgery

- Master-slave systems

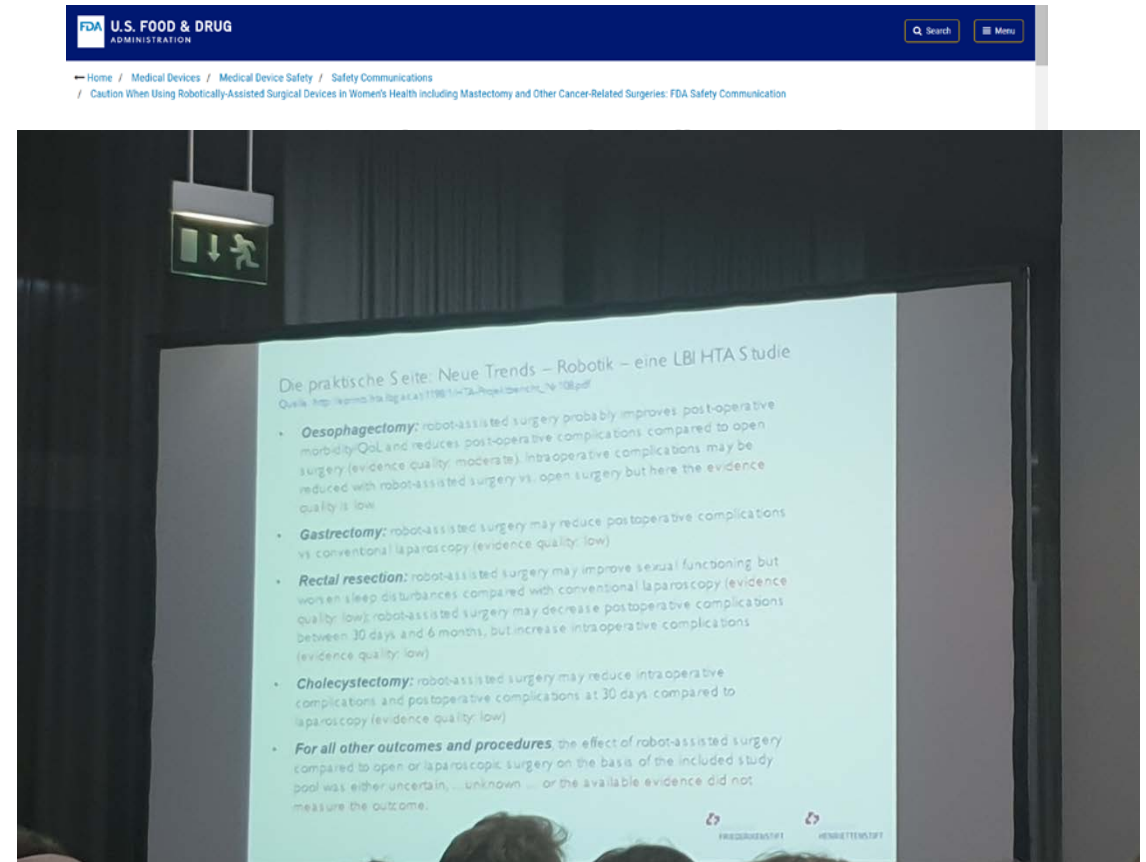


- (Semi-) autonomous systems

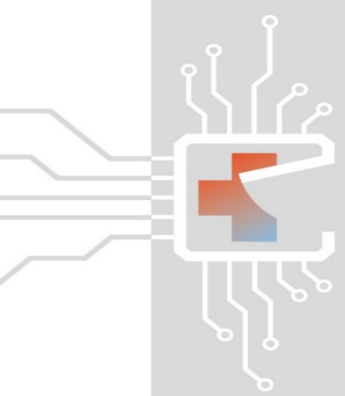


Current evidence for robotic systems

- Operation times
- Operative costs
- Blood loss
- Complication rates
- Hospital stay length
- Transfusion rate



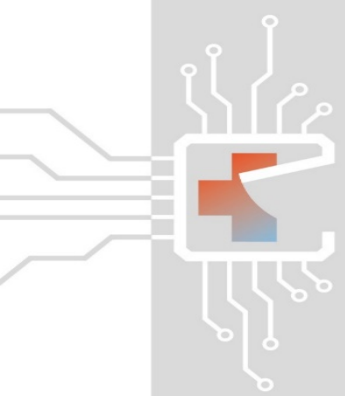
- Be aware that that the safety and effectiveness of using robotically-assisted surgical devices in mastectomy procedures or in the prevention or treatment of cancer has not been established.



Imaging and cooperative robots

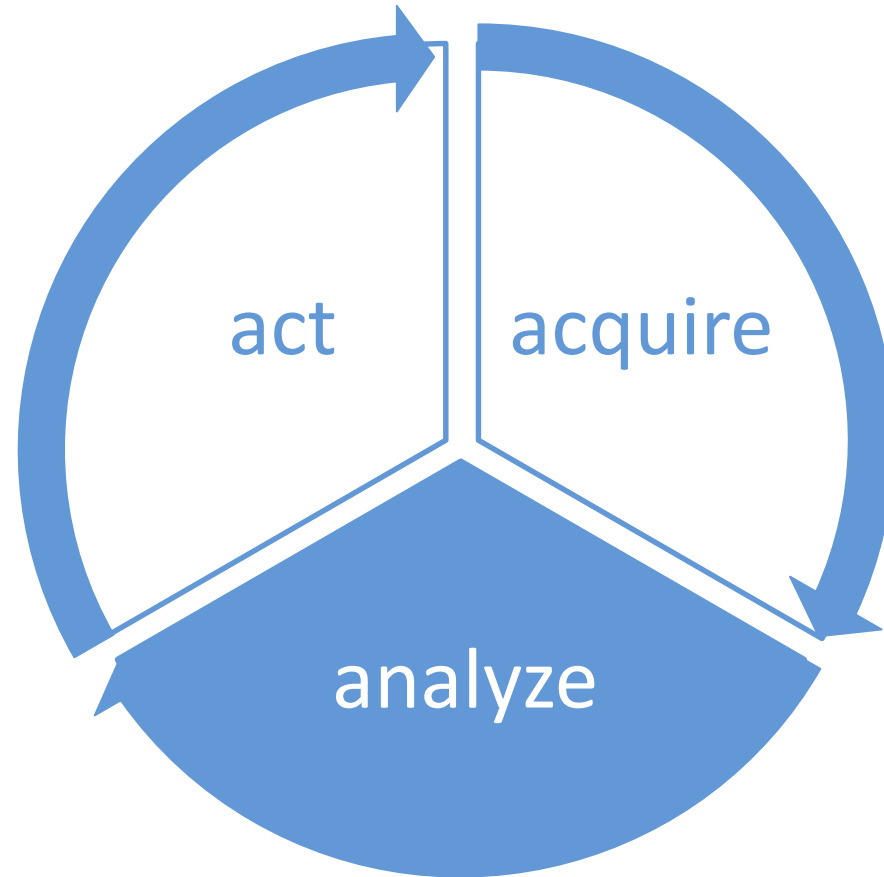
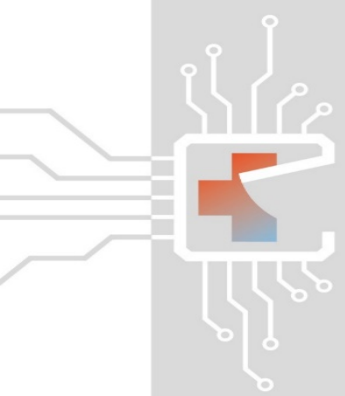


© Siemens Artis Zeego

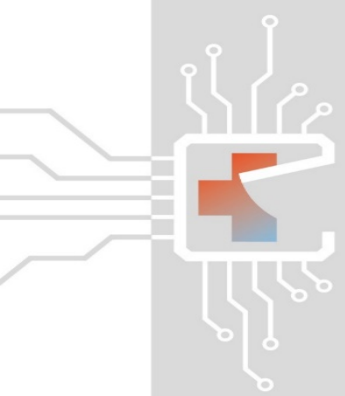


Imaging and cooperative robots



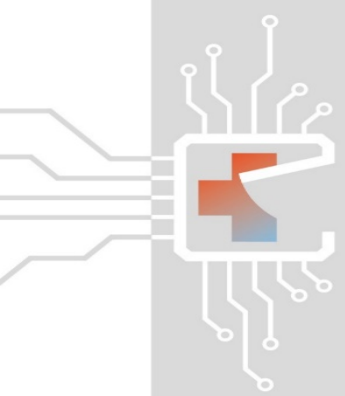






Current research areas

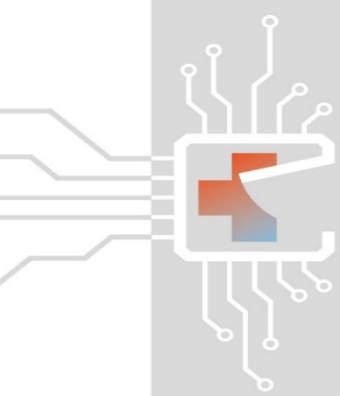
- **Anaesthesia management**
 - Risk for postoperative pain, nausea, and respiratory depression
 - Predict hypotension, hypoxemia
- **Surgery**
 - Prediction of procedure times and anticipation of risk situations
 - Decrease human-technology interaction, Automatic documentation
- **Administration**
 - Decrease non-value-adding activities
 - Provide KPIs



Situation aware biomedical technologies

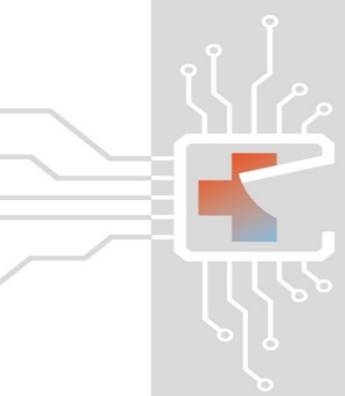


Intelligent operating room
Context-aware medical technology



Situation aware biomedical technologies

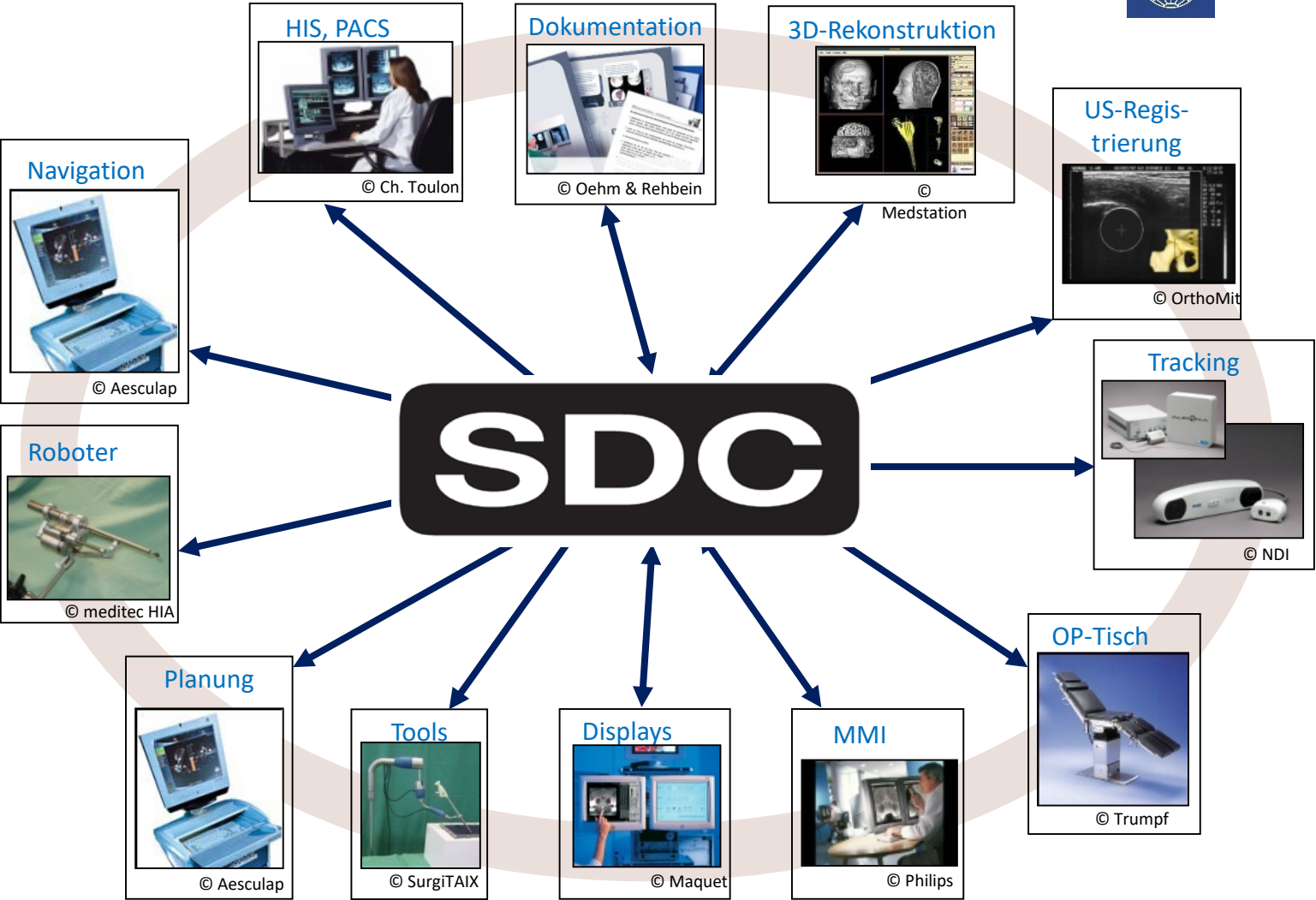


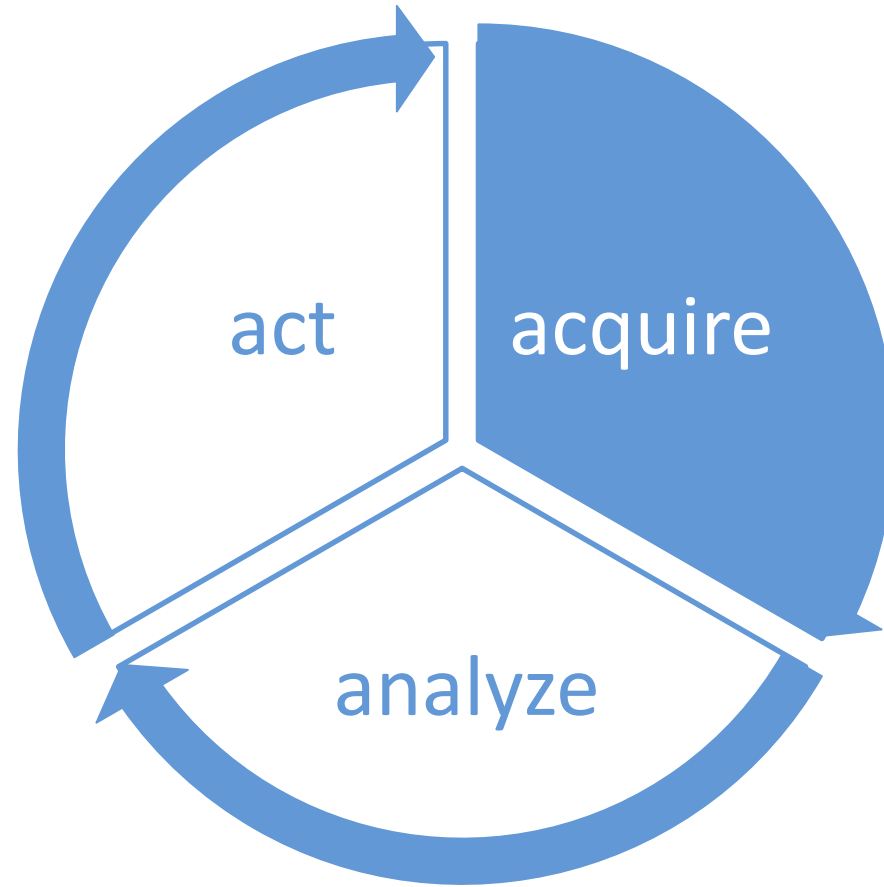
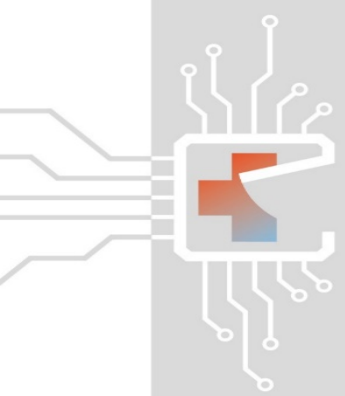


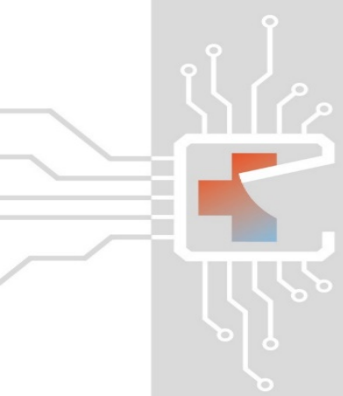
Medical device interoperability



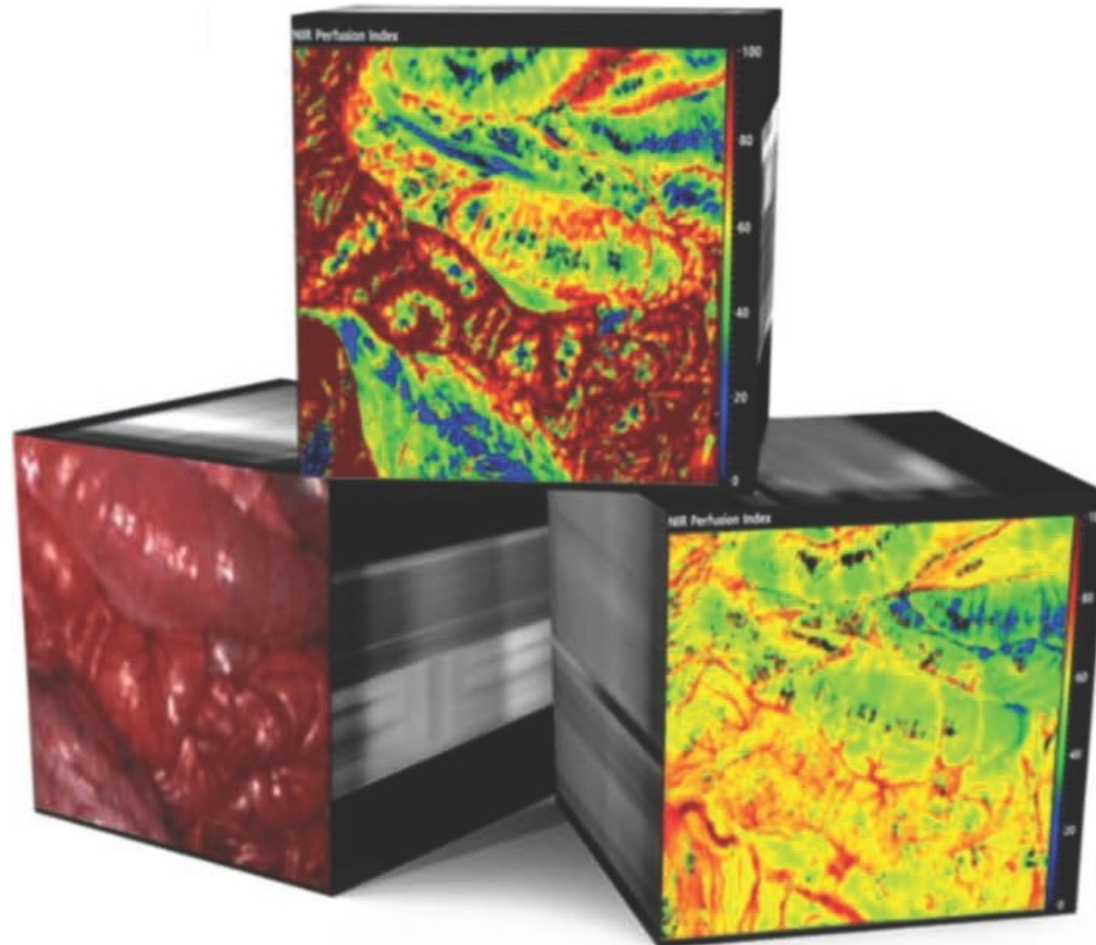
ISO/IEEE 11073-10207
IEEE 11073-20701
ISO/IEEE 11073-20702

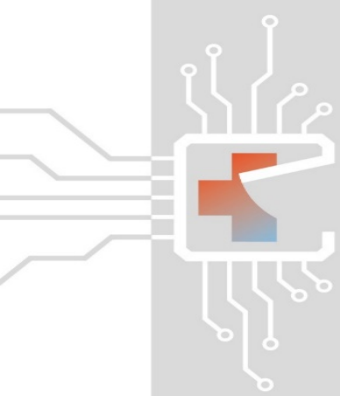




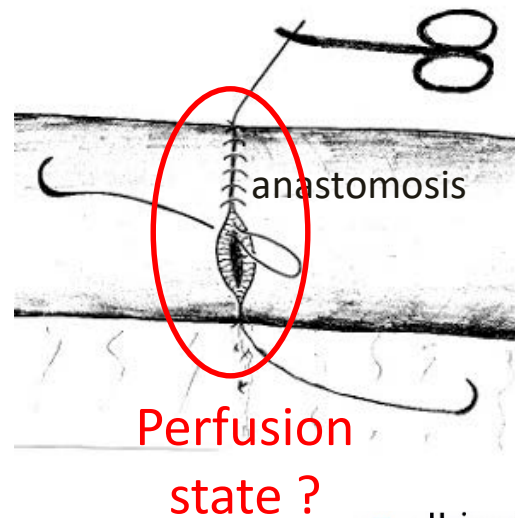
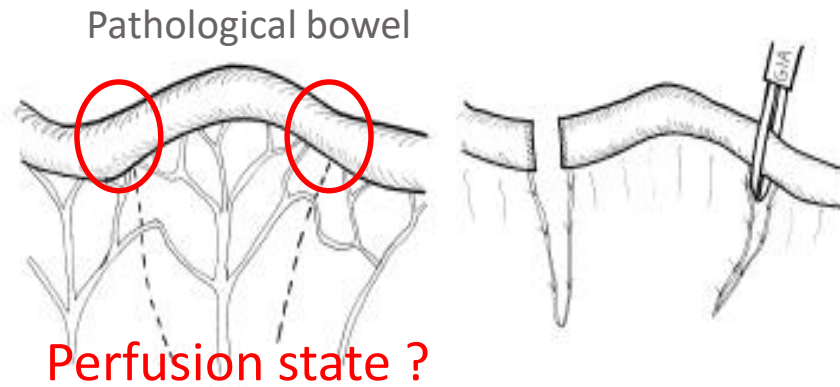


Hyperspectral Imaging



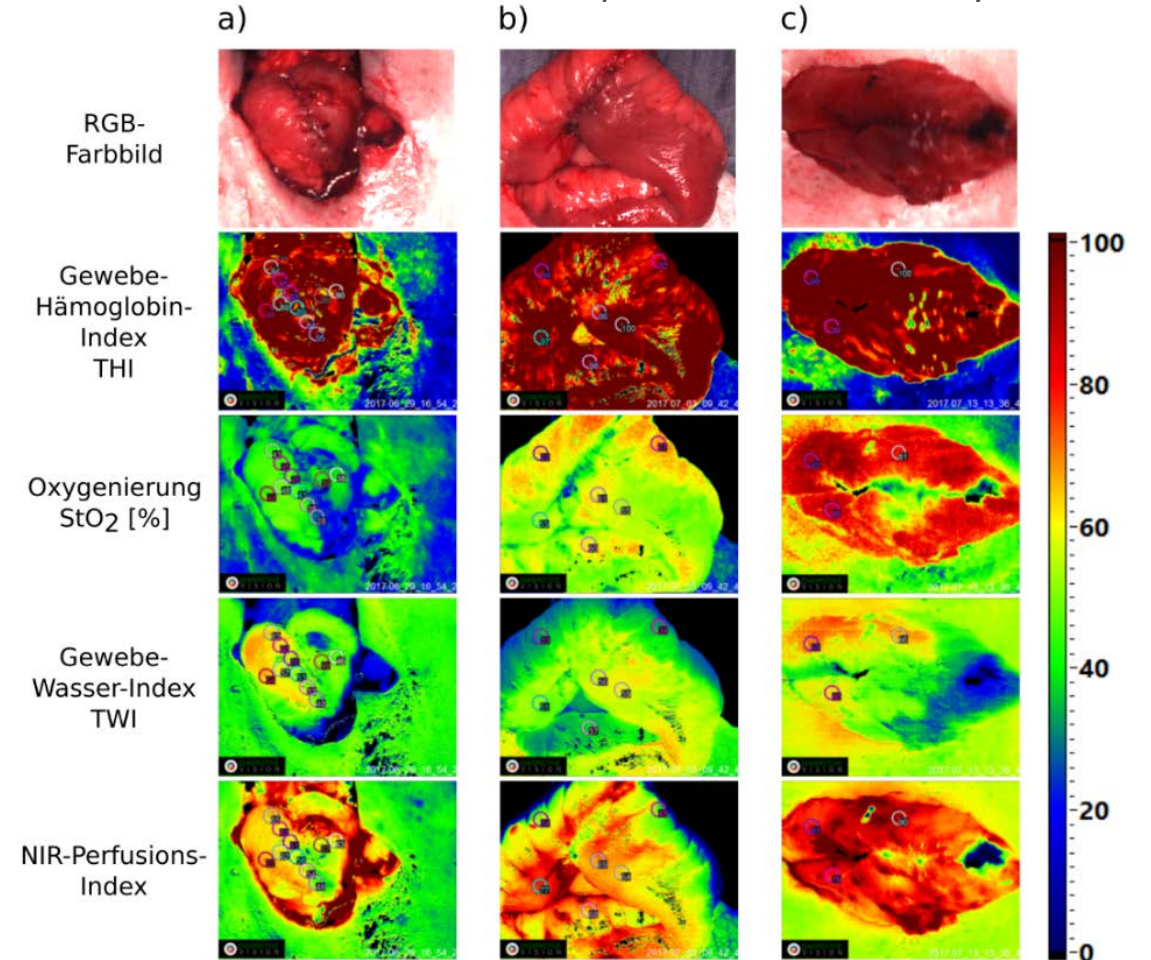


Hyperspectral imaging for tissue perfusion

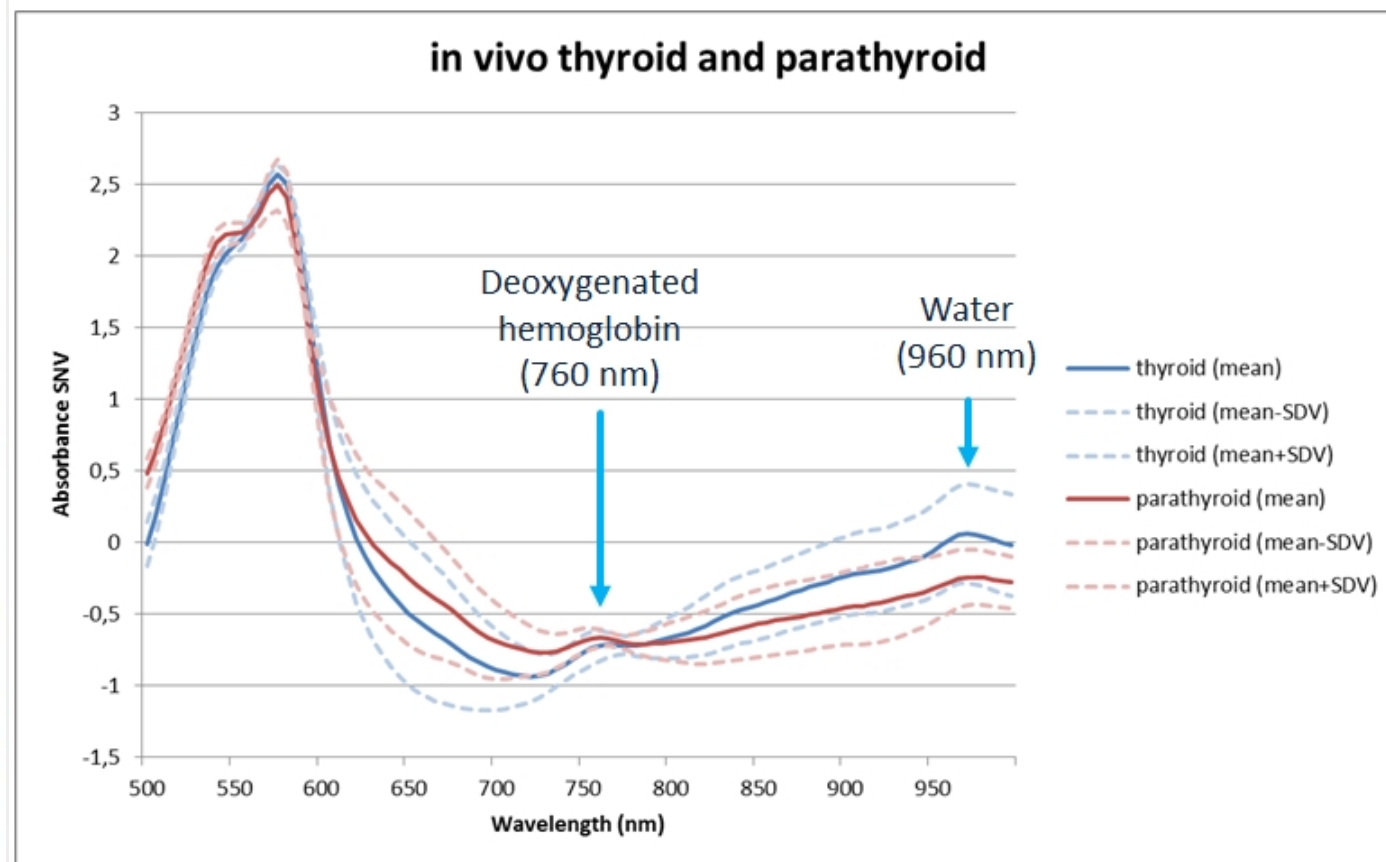
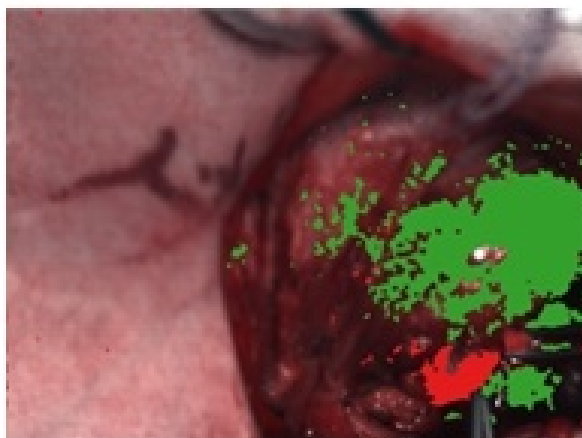
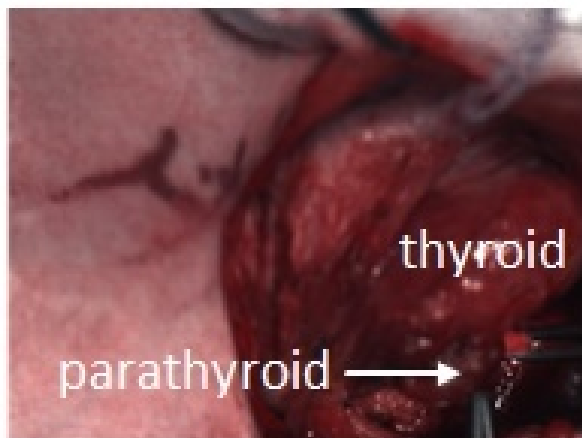


a) Patient **with** postop. perfusion insufficiency

b) and c) Patients **without** postop. perfusion insufficiency



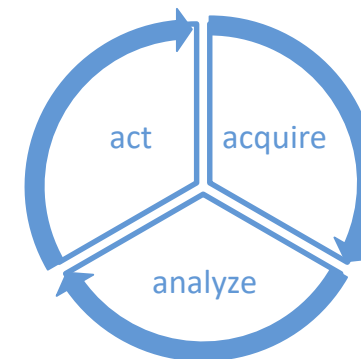
HSI-based discrimination of thyroid and parathyroid

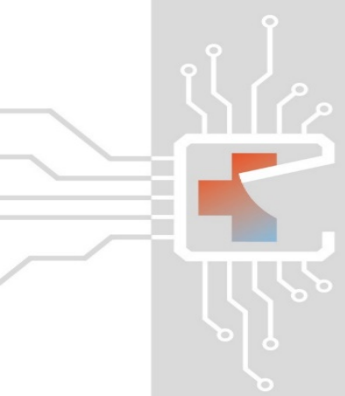


Total number of spectra:

$n_{\text{thyroid}} = 3128,$ $n_{\text{parathyroid}} = 383$

But surgery is just one option ...






Digital patient models for decision-making



Prediction and clinical decision support



Patient

Max Mustermann

Alter

56 Jahre

Geschlecht

Männlich

Hauptdiagnose

Larynxkarzinom

Histologie

Plattenepithelkarzinom

Übersicht
Behandlungspfad
Labor
Therapieentscheidung

Modellentscheidung

Primäre Therapieempfehlung

Kehlkopfteilresektion

Empfehlungssicherheit: 80%

Sekundäre Therapieentscheidung

Radiotherapie

Empfehlungssicherheit: 72%

Entscheidungsmodell

Chemotherapie	Therapietolerabilität	Nierenfunktion Knochenmarksfunktion Lungenfunktion Herzfunktion Leberfunktion Immundefekt
Nein	Nein	
	UICC Stadium	T Stadium N Stadium M Stadium
	IV A	
	Patientencompliance	
	Psychiatrische Nebenerkrankung	
	Andere Bosartige Neubildung	
Larynx Surgery	Resektabilität	Infiltration Präventiv Infiltration Zung Infiltration Mediastinal Infiltration Arterien Infiltration Ösophagus Infiltration Trachea
Transorale Endoskopische Laryngektomie	Resektabel	
	UICC Stadium	T Stadium N Stadium M Stadium
	IV A	
	Anästhesietauglichkeit	
Radiotherapie	UICC Stadium	T Stadium N Stadium M Stadium
Ja	IV A	
	Patientencompliance	
	Psychiatrische Nebenerkrankung	
	Andere Bosartige Neubildung	
Halbschirurgie	UICC Stadium	T Stadium N Stadium M Stadium
Bilaterale Neck Dissection	IV A	
	Anästhesietauglichkeit	

Zugehörige Referenz

Close

Head Neck 2017

Transoral laser microsurgery or total laryngectomy for recurrent squamous cell carcinoma of the larynx: Retrospective analysis of 199 cases.

Weiss BG, Bertlich M, Canis M, Ihler F.

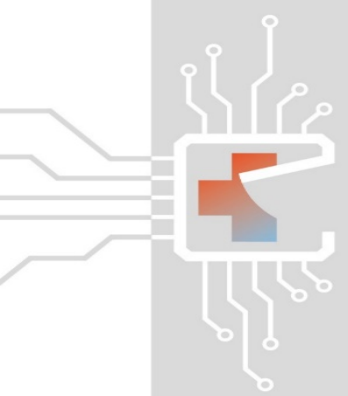
BACKGROUND: Surgical treatment options for local recurrences of laryngeal cancer can be either organ-preserving surgery or total laryngectomy. The purpose of this study was to present our evaluation of the treatment with transoral laser microsurgery (TLM) in comparison to laryngectomy.

METHODS: We conducted a retrospective review of 199 consecutive patients with recurrent laryngeal cancer at a tertiary referral center.

RESULTS: The 5-year overall survival, disease-specific survival, and local control rates were 64.8%, 79.6%, and 57.5%, respectively, for 93 patients with early tumors treated by TLM, 28.9%, 41.7%, and 43.7%, respectively, for 52 patients with advanced tumors treated by TLM as well as 39.4%, 44.6%, and 68.8%, respectively, for 54 patients with advanced tumors treated by total laryngectomy. Five-year larynx-preservation rate was 77.7% for early as well as 68.4% for advanced tumors treated by TLM.

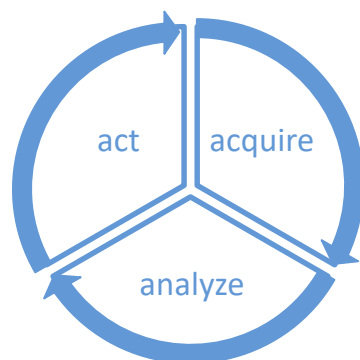
CONCLUSION: TLM is an option in early and in selected cases of advanced locally recurrent laryngeal cancer. © 2017 Wiley Periodicals, Inc. Head Neck 39: 1166-1176, 2017.

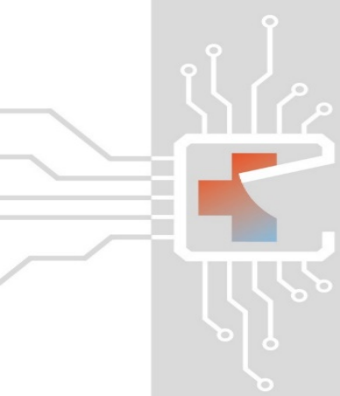
View Full Article



Artificial intelligence and robots in the OR

- Still room for ebM?





The digital footprint

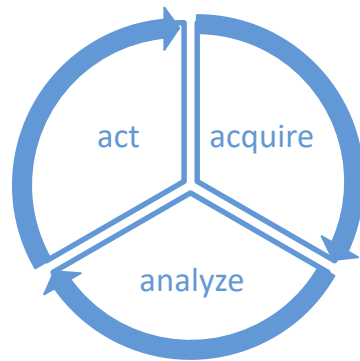
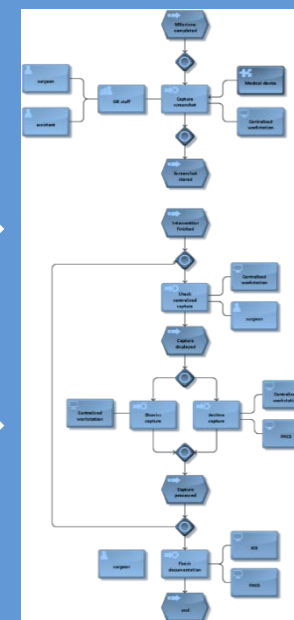




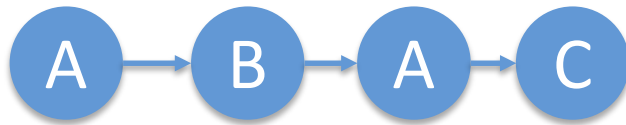
Figure 1 displays five time-series plots showing the evolution of different variables over time. The plots are labeled 'Heave', 'Heading', 'Pitch', 'Roll', and 'Yaw'. Each plot has a y-axis ranging from -5 to 5. The 'Heave' plot shows high-frequency oscillations. The 'Heading' plot shows a single peak around time 10. The 'Pitch' plot shows a sharp peak around time 10. The 'Roll' plot shows a sharp peak around time 10. The 'Yaw' plot shows a sharp peak around time 10.

Symbolic models



Model generalization

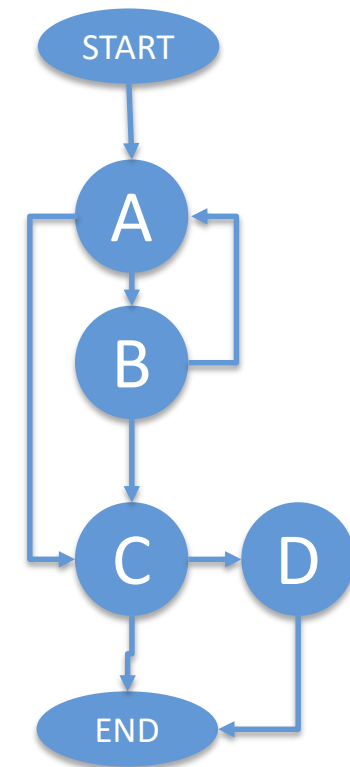
Single cases



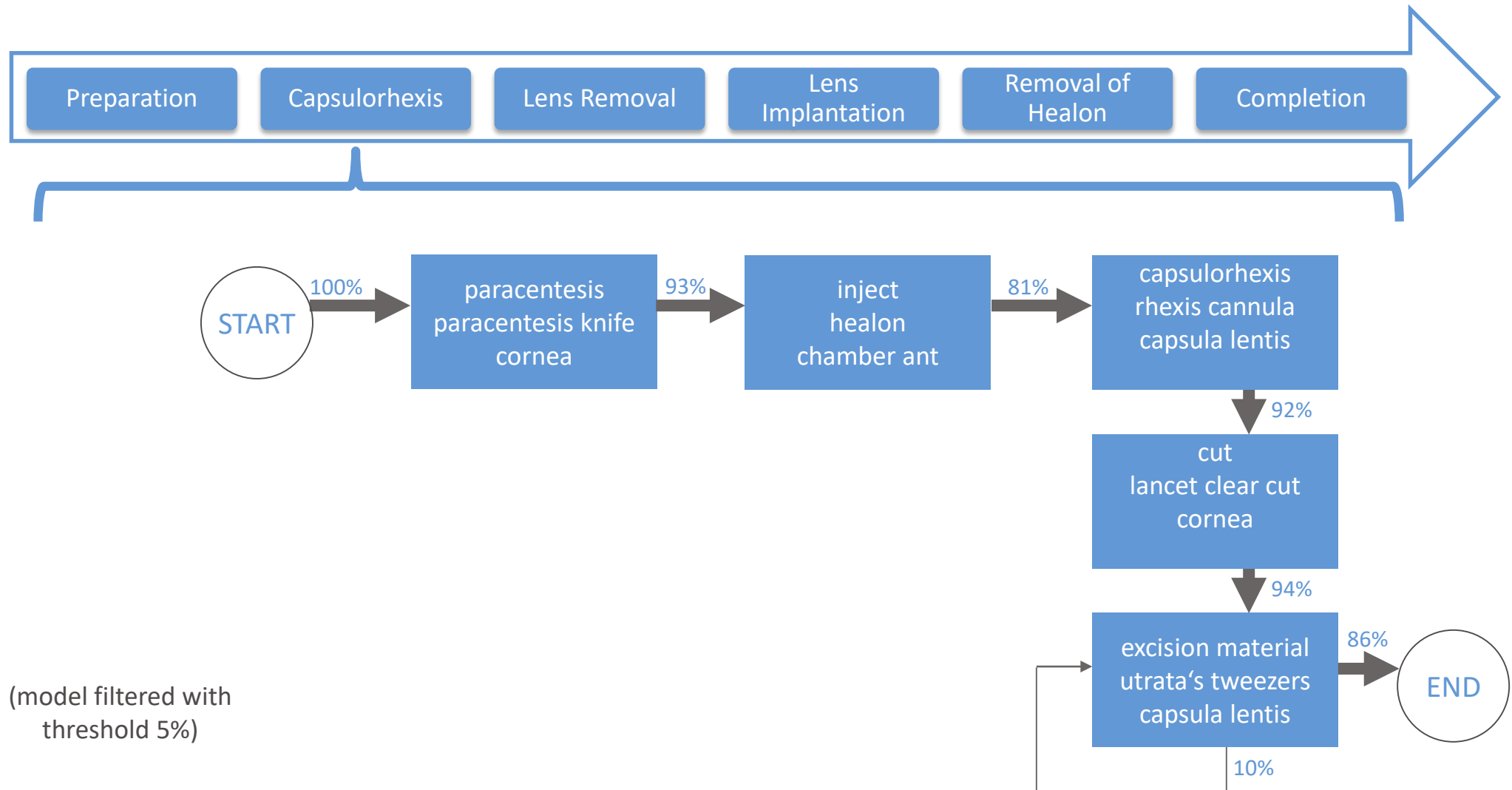
...



Merged model

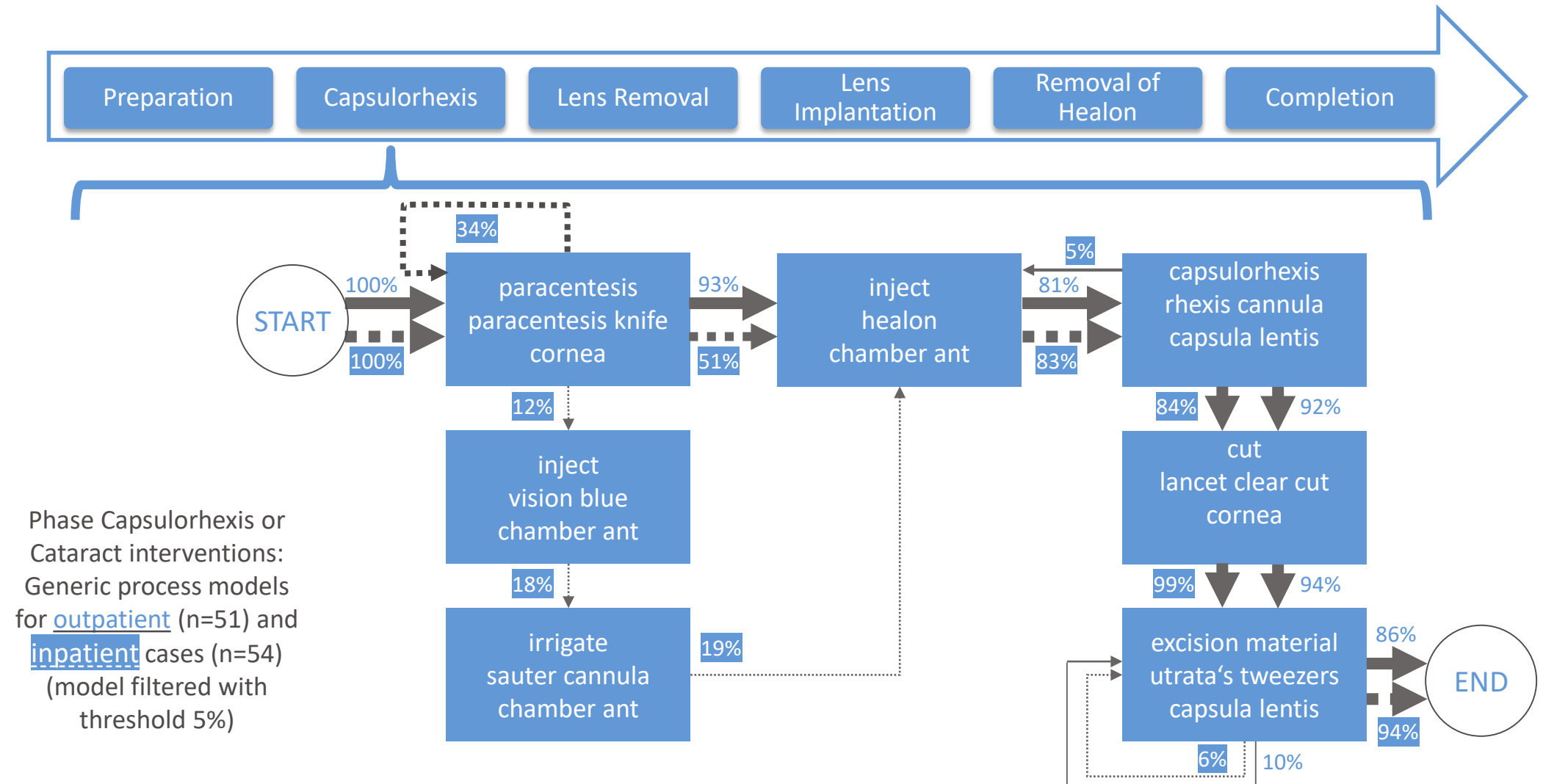


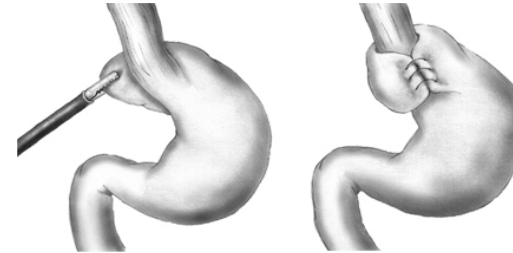
Model analysis: workflow assessment



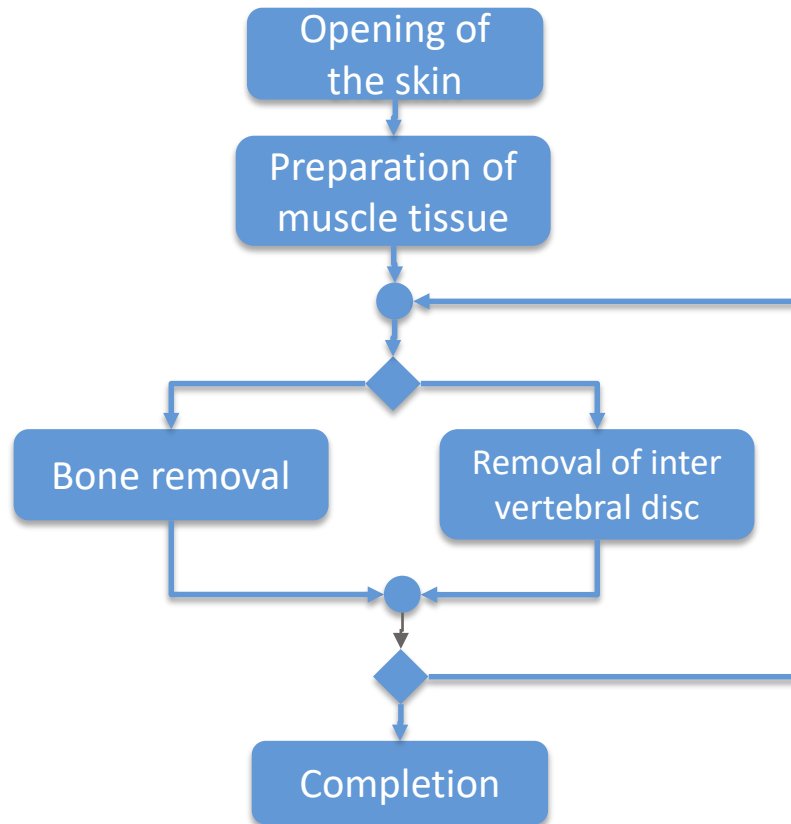
(model filtered with
threshold 5%)

Model analysis: workflow assessment

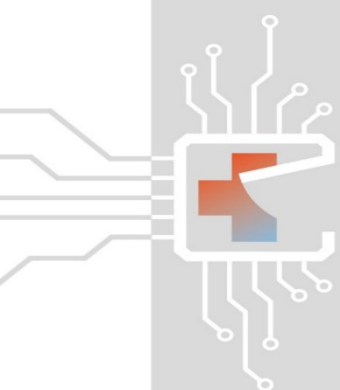




Model analysis: technology requirements



n=14	Unit	AVG	Min	Max	SDEV
Time Frame	hh:mm:ss	00:45:08	00:22:23	01:13:43	00:13:08
Iterations	activity	15.2	7	27	6.3
Cumulated Duration	hh:mm:ss	00:19:55	00:12:40	00:32:11	00:06:52



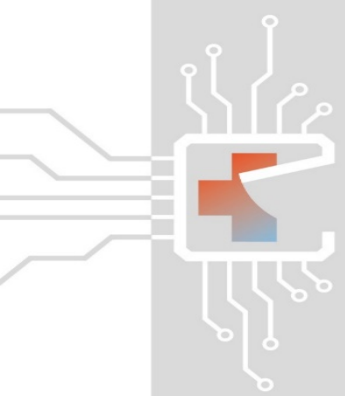
Künstliche Intelligenz für Klinische Studien



Bundesministerium
für Wirtschaft
und Technologie

Objective: Development of an eco system for data acquisition and AI-based analysis for post market surveillance of medical devices





Summary

- Robots have arrived in ORs
- AI in the OR has not yet arrived
- Technologies have digital footprints that enable continuous ebM without cognitive biases

If you can't measure it, you can't improve it.

(Peter F. Drucker)

Thank you.

Prof. Dr. Thomas Neumuth

Innovation Center Computer Assisted Surgery (ICCAS)

thomas.neumuth@iccas.de

www.iccas.de, Twitter: [@iccasLeipzig](https://twitter.com/iccasLeipzig)





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