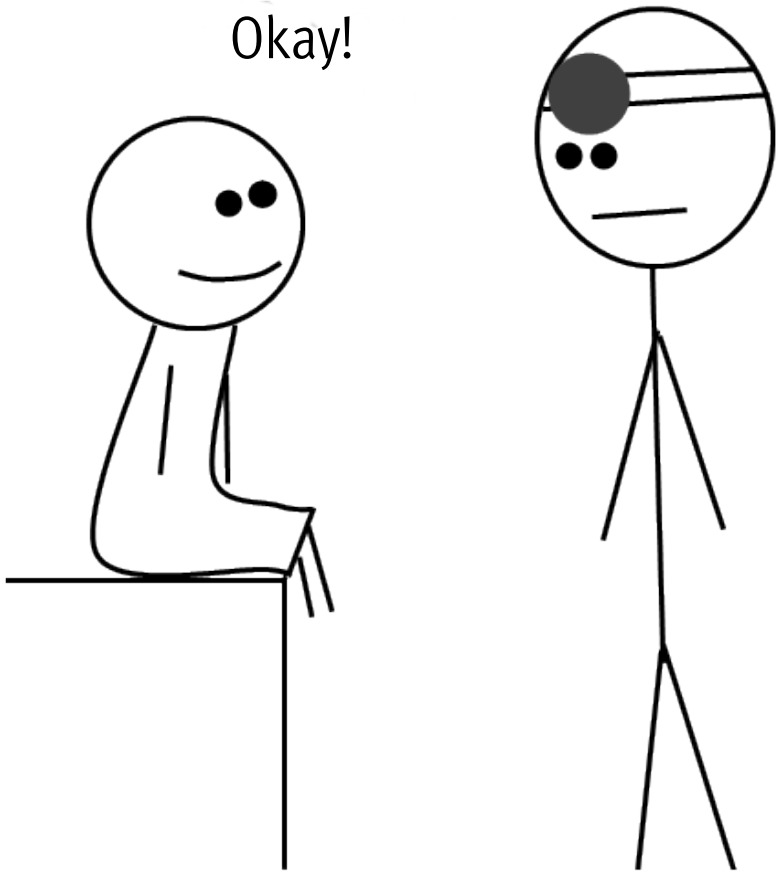
Physicists in Medicine

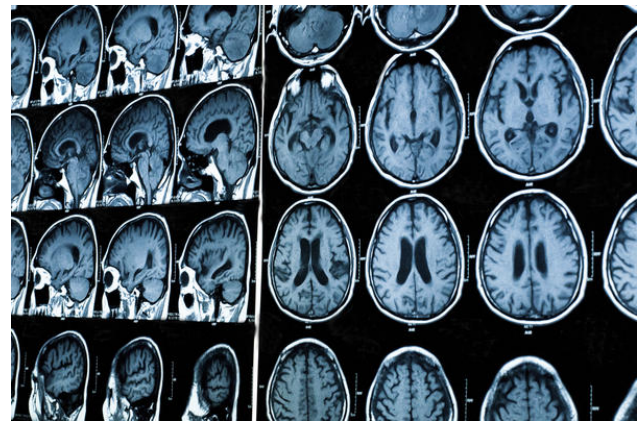
Working between patients, physicians and technicians

Anja Teuber
Institute of Epidemiology and Social Medicine
University Hospital Münster

You need a MRI.

Okay!





Germany’s healthcare system

federal/state ministries for health and social policy

stakeholders

healthcare providers

hospitals

resident physicians

public/private health insurance providers

patients

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Hospitals in Germany

2,000 hospitals (incl. 34 university hospitals)

- 600 under public ownership
- 700 charitable organizations
- 700 private institutions

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organizational structure

- management
- specialist departments (inpatients, diagnostic)
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hospital owner	=	employer
chief of department/institute	=	supervisor

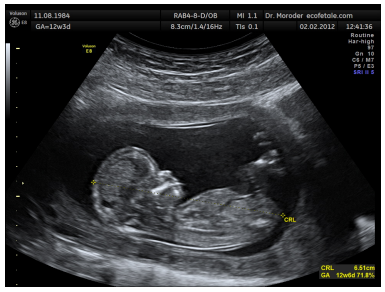
Subfields of medical physics

- healthcare engineering
- healthcare informatics
- biomedicine

Subfields of medical physics

healthcare engineering

- medical imaging
- optical imaging
- nuclear medicine
- radiotherapy
- radiation protection
- physiological measurements
- laser medicine
- clinical audiology
- guided surgery techniques



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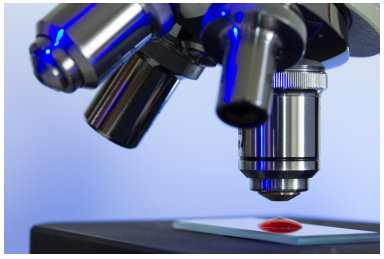

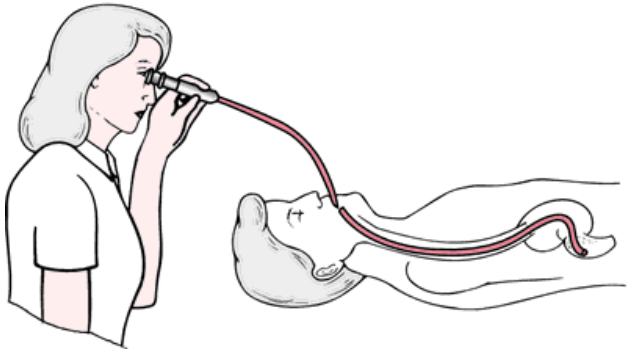

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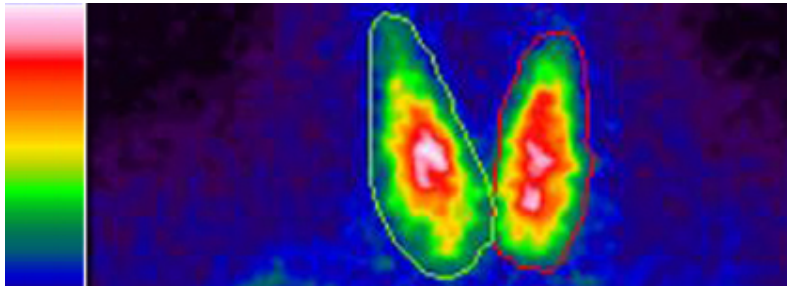

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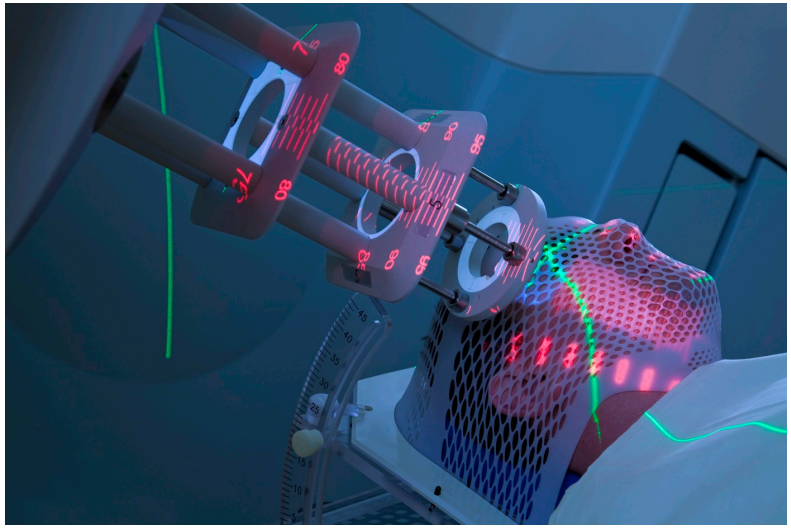

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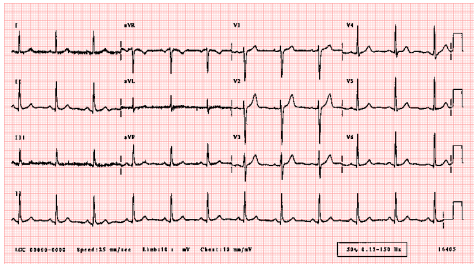

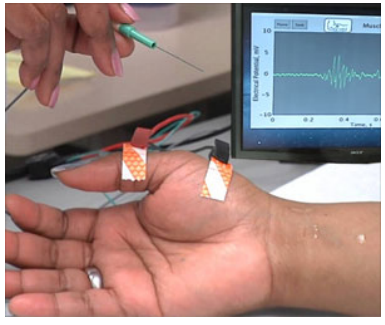

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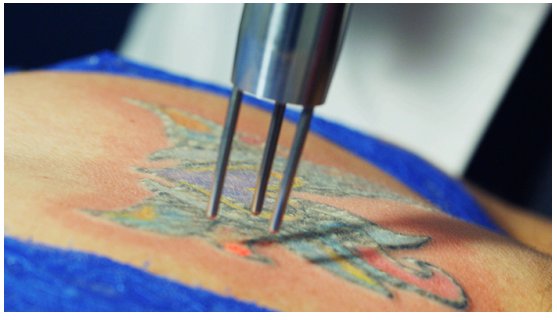

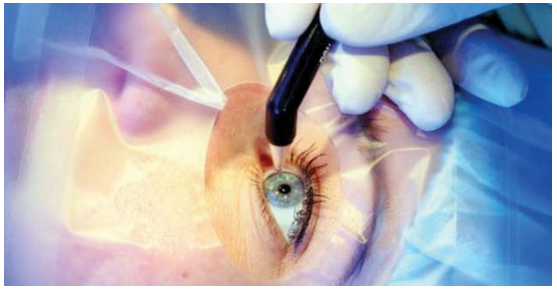

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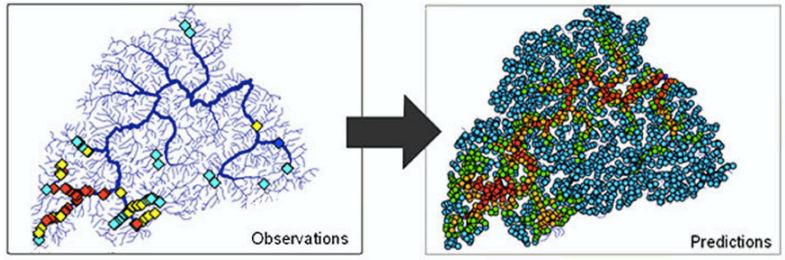
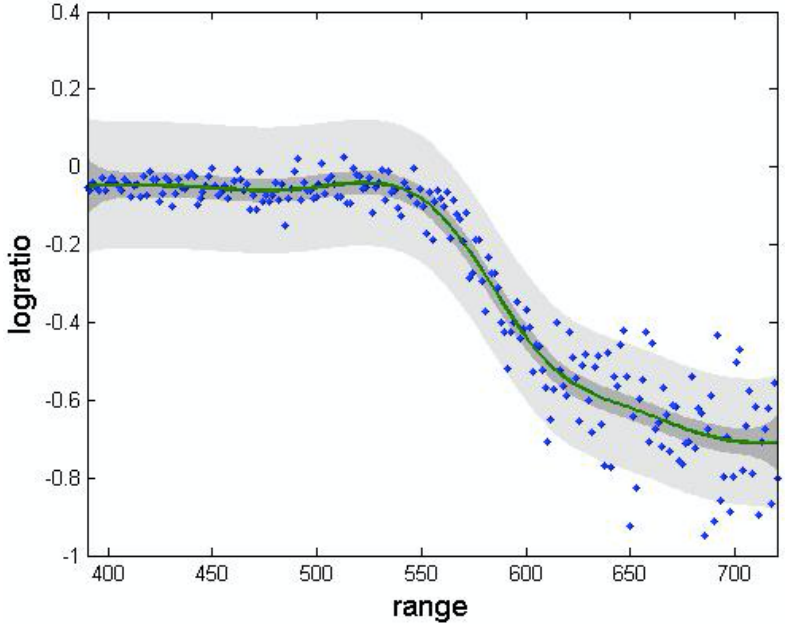
image processing, visualization

computer-aided diagnosis

hospital information systems

telemedicine,
distant monitoring





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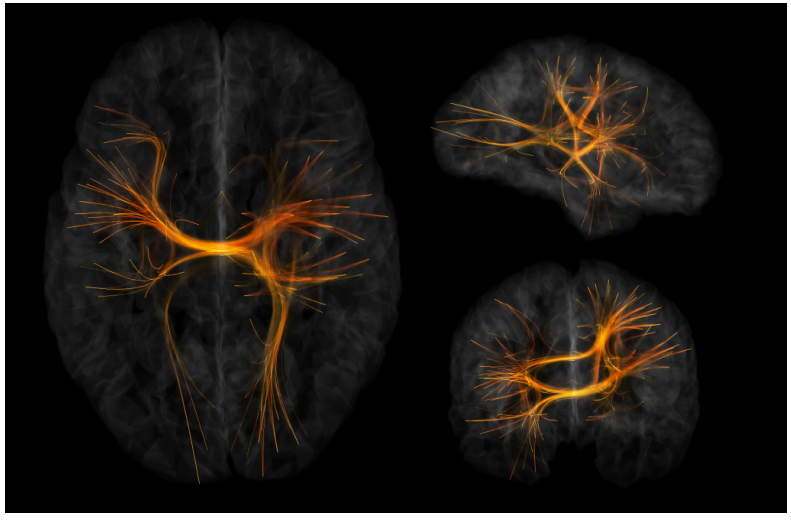

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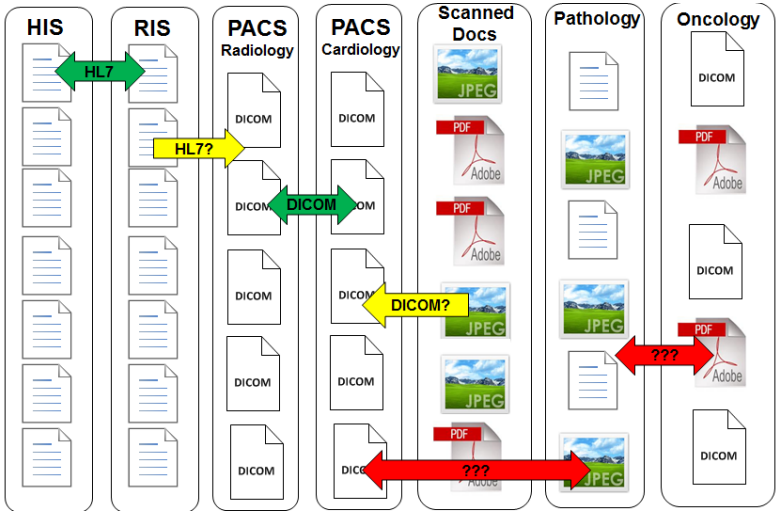

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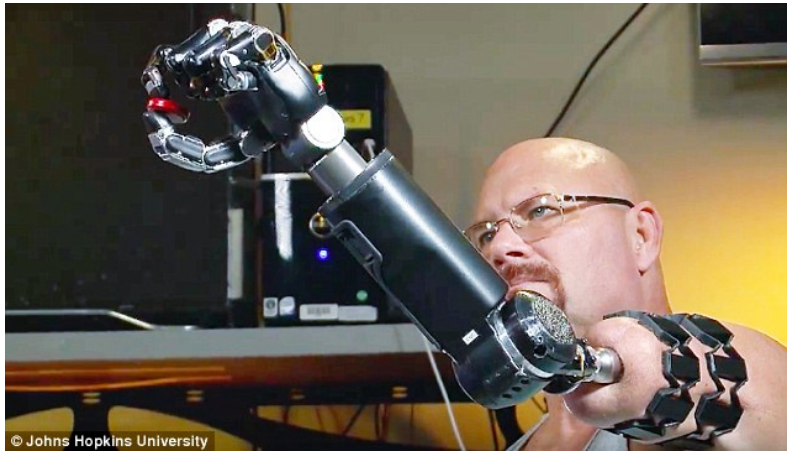

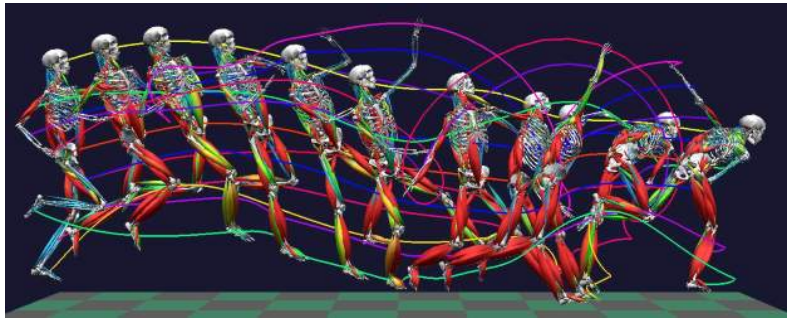

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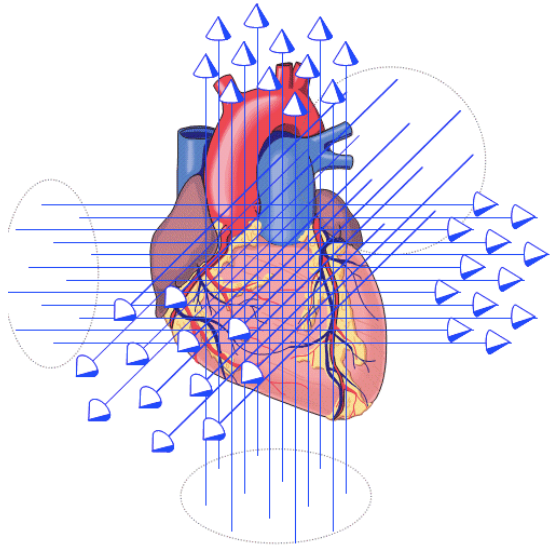

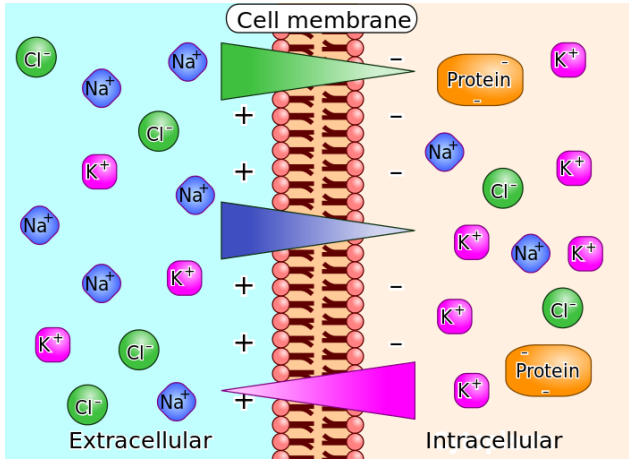

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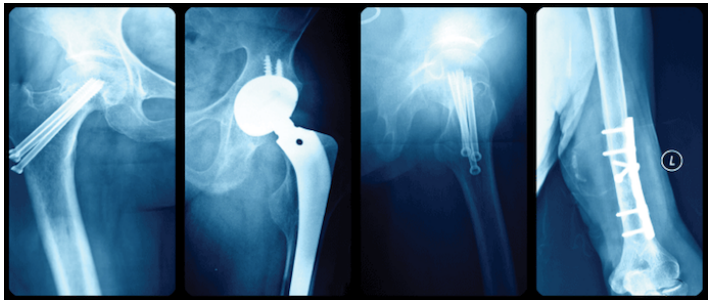

Areas of application

patient care	medical research	healthcare science
department		
legal regulations, strict protocols		
24/7 operation		
operating expenses of the hospital		
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patient care	medical research	healthcare science
department	institute/dept.	
legal regulations, strict protocols	interdisciplinary	
24/7 operation	project-based	
operating expenses of the hospital	grands (e.g. pharma-ceutical industry)	
radiation protection	animal testing	

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patient care	medical research	healthcare science
department	institute/dept.	institute
legal regulations, strict protocols	interdisciplinary	technical, epidemio-logical research
24/7 operation	project-based	project-based
operating expenses of the hospital	grands (e.g. pharma-ceutical industry)	grands (e.g. DFG, BMBF)
radiation protection	animal testing	data protection

The institute

University Hospital of Münster

Institute of Epidemiology and Social Medicine

epidemiology

> *study and analysis of patterns, causes and consequences of health and disease conditions in certain populations*

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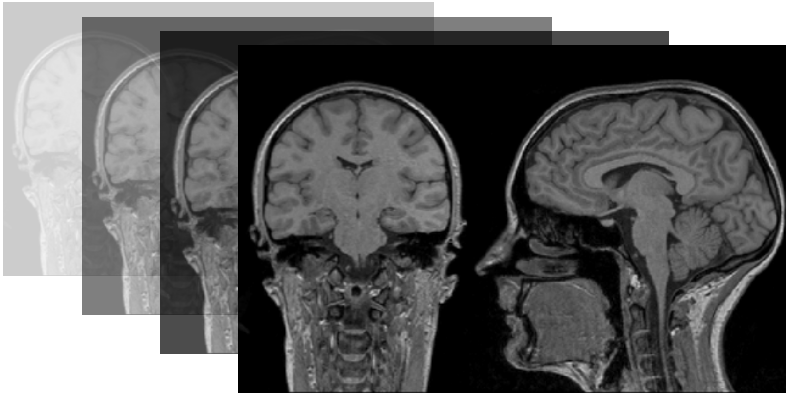
challenges

- self-willed individuals
- quantization of ‘fuzzy’ characteristics
- non-mechanistic relationships

Population Imaging



Areas of responsibility

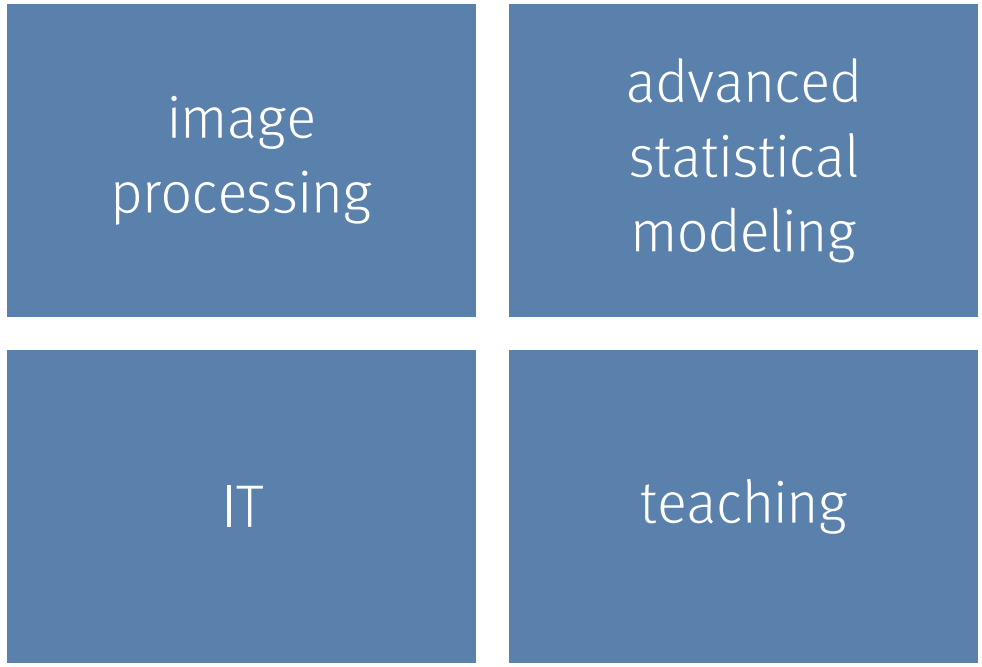
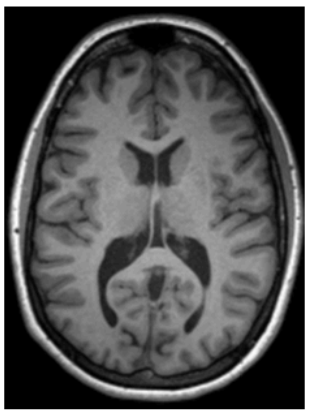
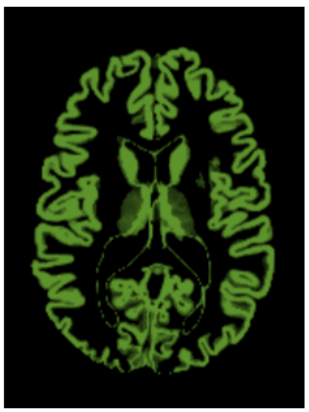


Image segmentation

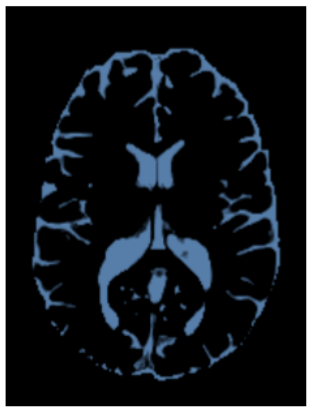


gray matter



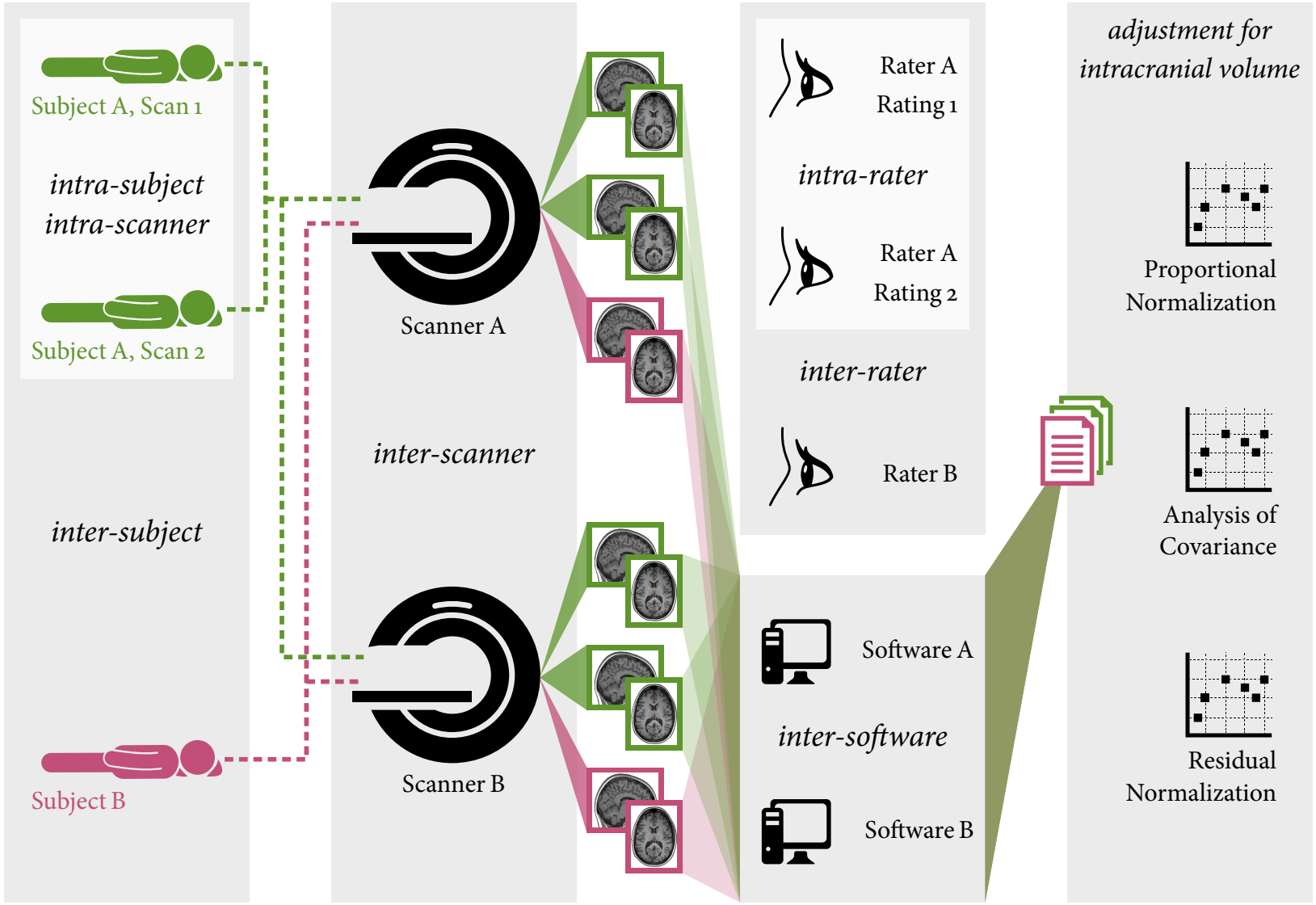
white matter

cerebro-spinal fluid



e.g. 700 ml 550 ml 250 ml

Reliability of brain tissue quantification



Voter transitions

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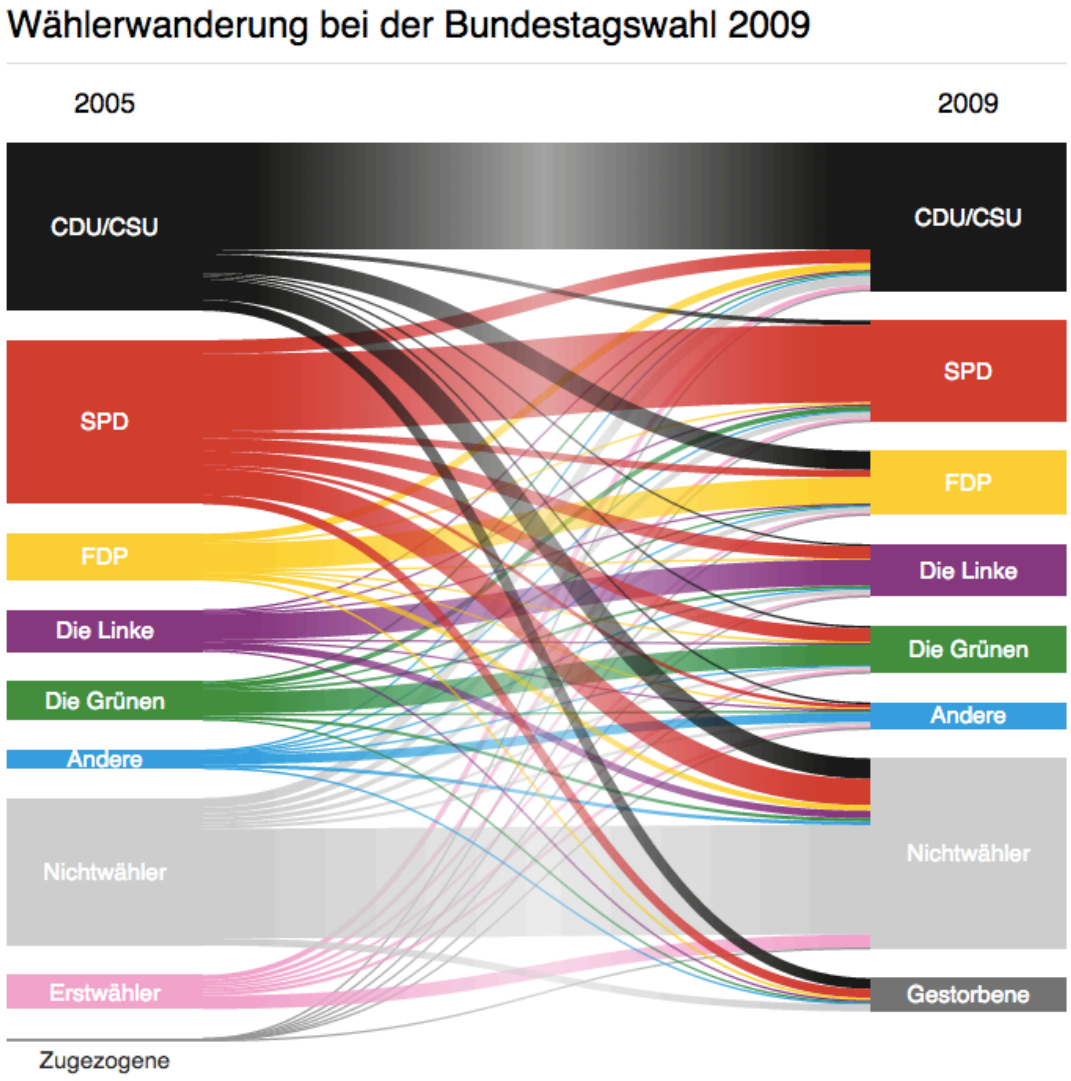

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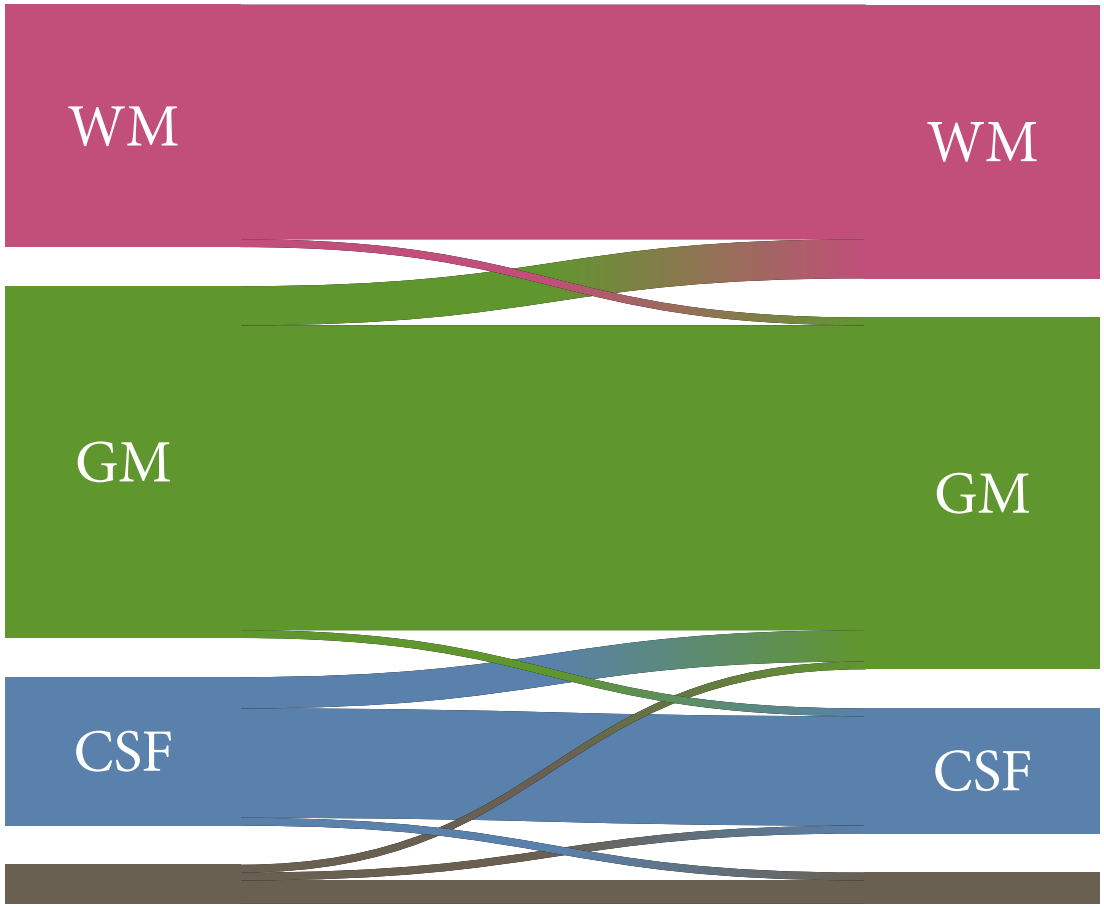

The reproducibility problem

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Study delivers bleak verdict on validity of psychology experiment results

Of 100 studies published in top-ranking journals in 2008, 75% of social psychology experiments and half of cognitive studies failed the replication test

Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

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Essay

Why Most Published Research Findings Are False

John P. A. Ioannidis

It can be proven that most claimed research findings are false. [...] Simulations show that for most study designs and settings, it is more likely for a research claim to be false than true.

Meta-Research

Meta-Research is known as 'research on research' as it uses research methods to study how research is done and where improvements can be made.

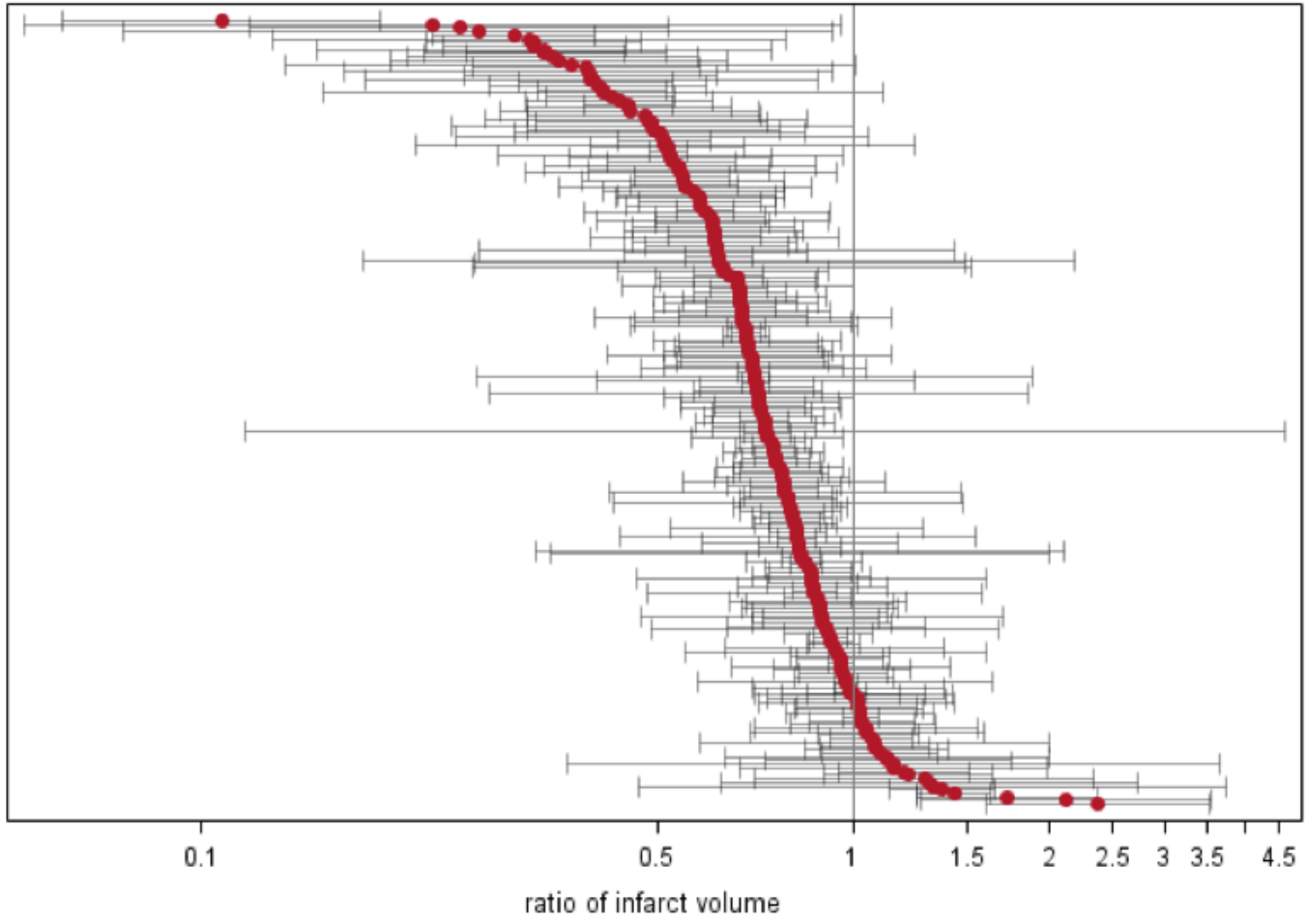
Neuro-protective substances

Preliminary results

- 35 substances presumed to protect brain from cell loss after stroke
- 1984 – 2017
- 330 studies
  - 208 preclinical animal experiments
  - 75 early clinical trials
  - 47 phase-III studies
- › 6,000 animals
- › 50,000 human subjects

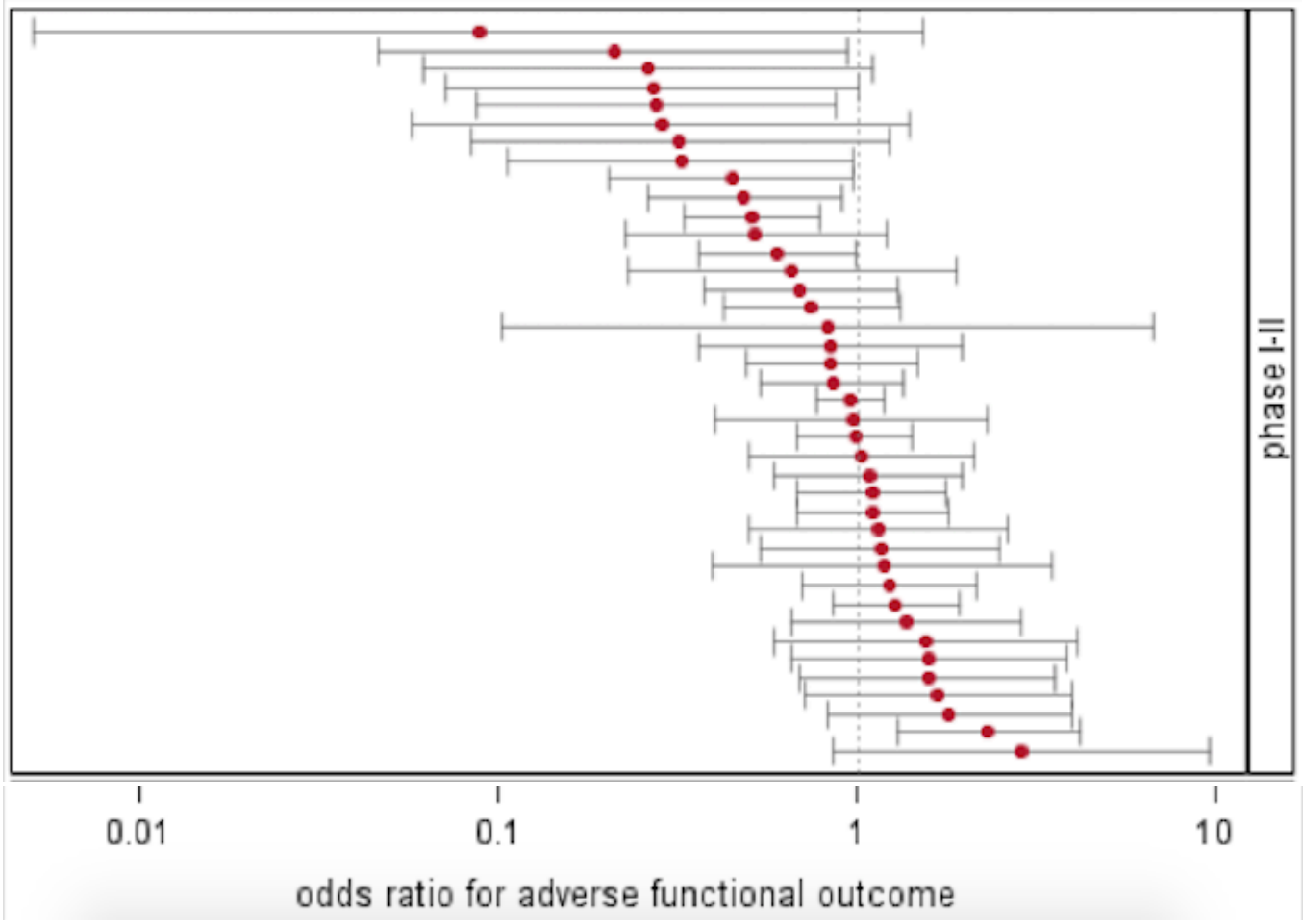
Effect sizes of preclinical animal experiments

Preliminary results



Effect sizes of early clinical trails

Preliminary results



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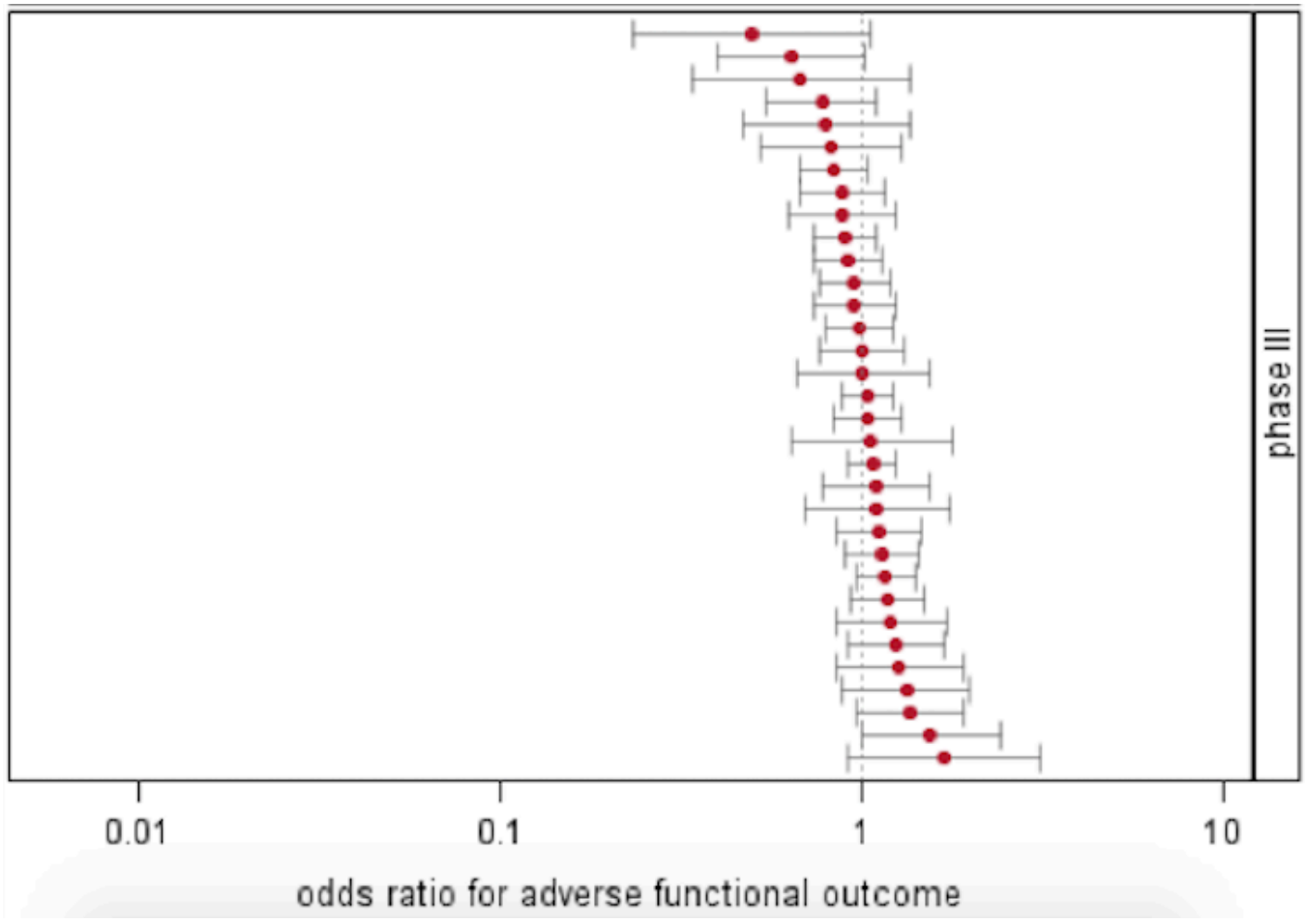
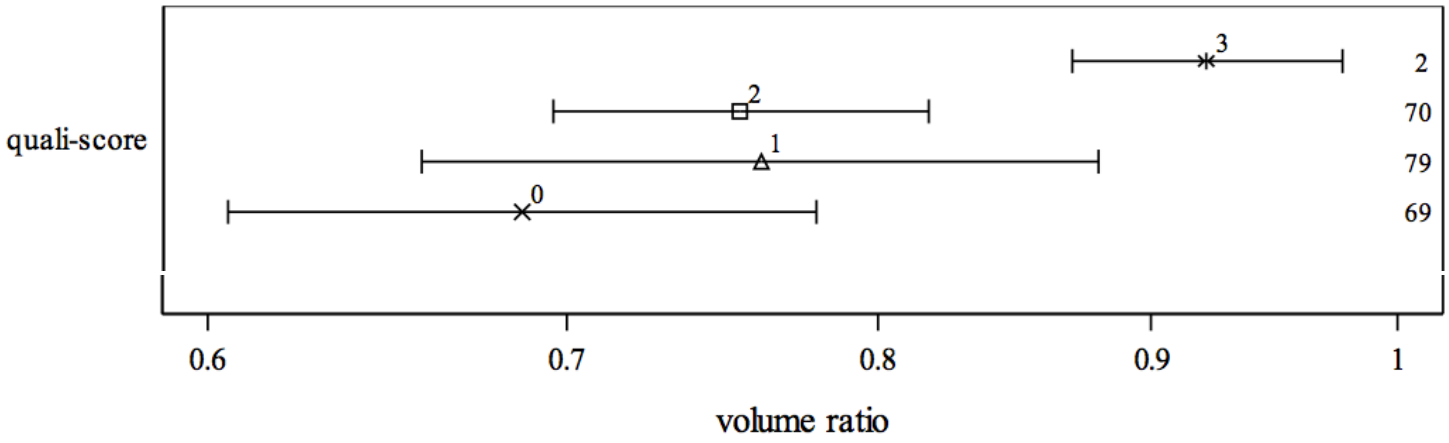
Preliminary results



Pooled effects for different quality scores

Preliminary results



Requirements

Medical physics might be an option if you…

- enjoy engineering, coding/informatics
- are willing to learn ‘medical language’
- are willing to acquire knowledge of anatomy, physiology and some clinical basics
- are prepared for interdisciplinary teamwork (with all pros and cons)
- like to work independently
- can cope with working in a hospital

Education und training

degree programs

- BSc/MSc at universities of applied science
- MSc via distant learning
- PhD programs

training courses

- professional societies
- manufacturer
- summer schools

self-study

- textbooks / internet
- dialogues with other scientists

My opinion: Colleagues and supervisors

most people you meet…

- have no scientific background
- dislike maths
- have no idea what data processing and programming mean

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- avoid seminars for employee motivation and personnel management?
- more interested in their career than in patient care/science?

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better look for…

- other physicists, statisticians, engineers, computer scientists
- motivated technical assistants, workshop employees, IT specialists
- biologists, chemists

Contracts and payment

- fixed-term contracts, even in patient care
  for open-ended contracts: strong advocate and lot of patience needed
- no room to negotiate for scientists
  - collective agreements in public owned hospitals (TV-L, TVöD)
  - special regulations in church-owned hospitals
  - company agreements in private institutions
- pay group depends on job specification not academic qualification!

Thanks for using Medical Physics

Evaluation

fascination	★★★★★
curiosity	★★★★★
flexibility	★★★★☆
circumstances	★★☆☆☆
payment	★★★☆☆

Would you recommend Medical Physics to a friend?

☑ yes ☐ no but not @UKM

Comments:

- think twice, circumstances can be really bad
- check conditions carefully

University Hospital Münster

operated by: North Rhine-Westphalia

45 departments
39 institutes

1,460 beds

72,000 inpatients
440,000 outpatients / year

10,000 employees

940 physicians *
1,800 nurses *
320 social occupations *
320 technical assistants *
150 administrative assistants *

* Full Time Equivalents

MSc Medizinische Physik / TU Kaiserslautern

Grundlagenstudium

MPT0001: Anatomie und Physiologie

MPT0002: Biochemie und Biophysik

MPT0003: Biomathematik, insbesondere Statistik

MPT0004: Informatik: Grundlagen und Einsatz in der Medizin

MPT0005/0021: Medizintechnik (Technik und gesetzlicher Rahmen)

MPT0006: Organisatorische und rechtl. Grundsätze im Gesundheitswesen

MPT0007: Einführung in den Strahlenschutz

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Vertiefungsstudium

Alle Fachrichtungen:

MPT0017: Physikalische Messtechniken in der Medizin

MPT0022: Grundlagen der Diagnostik

Fachrichtung Medizinische Strahlenphysik:

MPT0009: Physik und Technik der Nuklearmedizin

MPT0010: Physik und Technik der Röntgendiagnostik

MPT0008: Physik und Technik der Strahlentherapie

Fachrichtung Medizinische Laserphysik:

MPT0011: Medizinische Optik

MPT0012: Grundlagen von Lasern

MPT0013: Medizinische Anwendung von Lasern

Fachrichtung Medizinische Bildverarbeitung:

MPT0015: Physik und Technik der Ultraschallanwendung in der Medizin

MPT0016: Bilderzeugung und Bildverarbeitung in der Medizin

MPT0018: Kernspintomografie und Kernspinspektroskopie

MPT0019: Bilderzeugung und Bildbewertung in der Strahlenphysik

MPT0023: Fortgeschrittene Methoden der medizinischen Bildverarbeitung

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Graduierungsphase

Alle Fachrichtungen:

MPT0104: Klinische Studien

MPT0107: Qualitätsmanagement in Gesundheits- und Sozialeinrichtungen

Masterarbeit

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