



Digital Networks for Laboratory Data and their Potential in Clinical Decision Support

Prof. Dr. Thomas Ganslandt

Dept. of Biomedical Informatics, Mannheim University Medicine

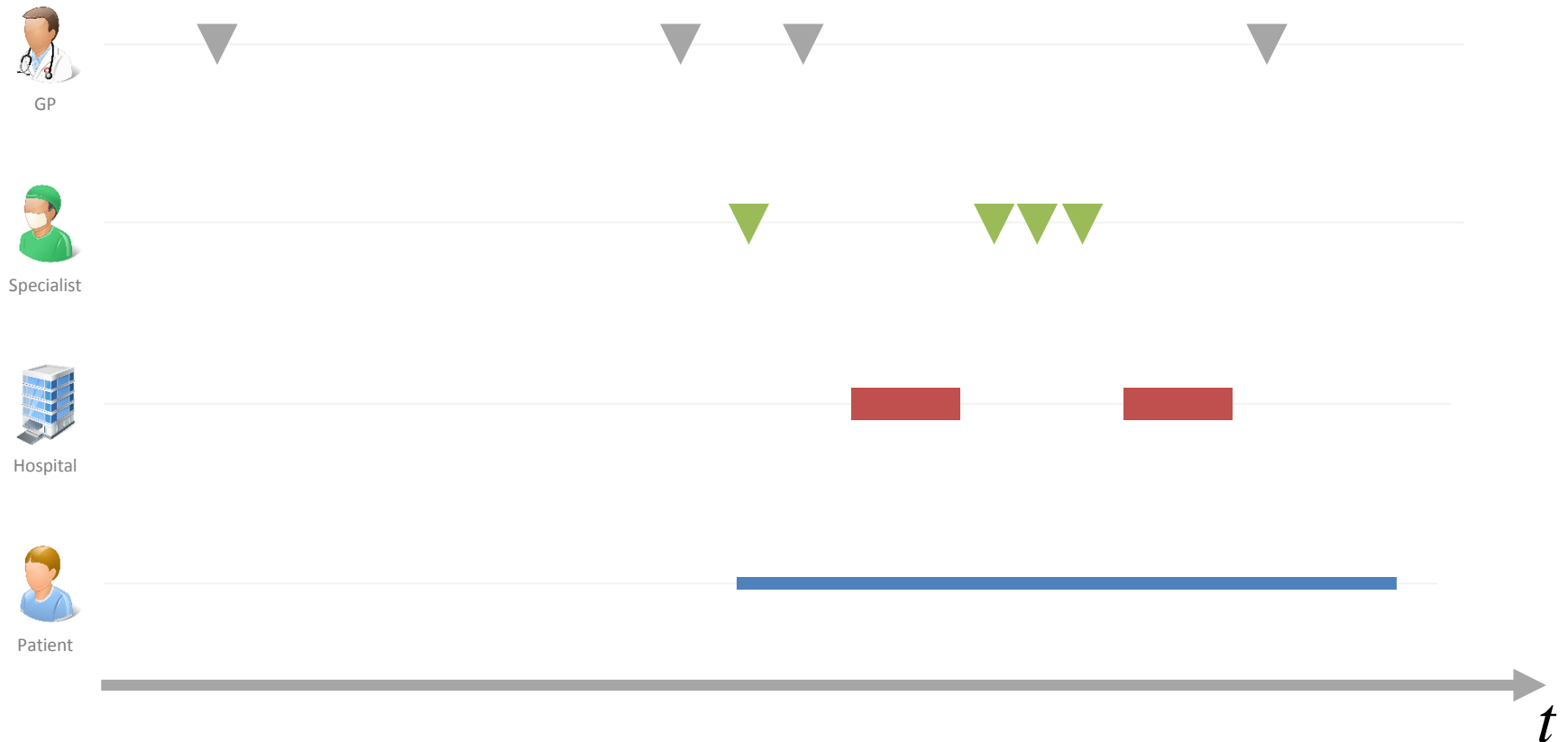
Let's Start with some Questions!

How many of you...

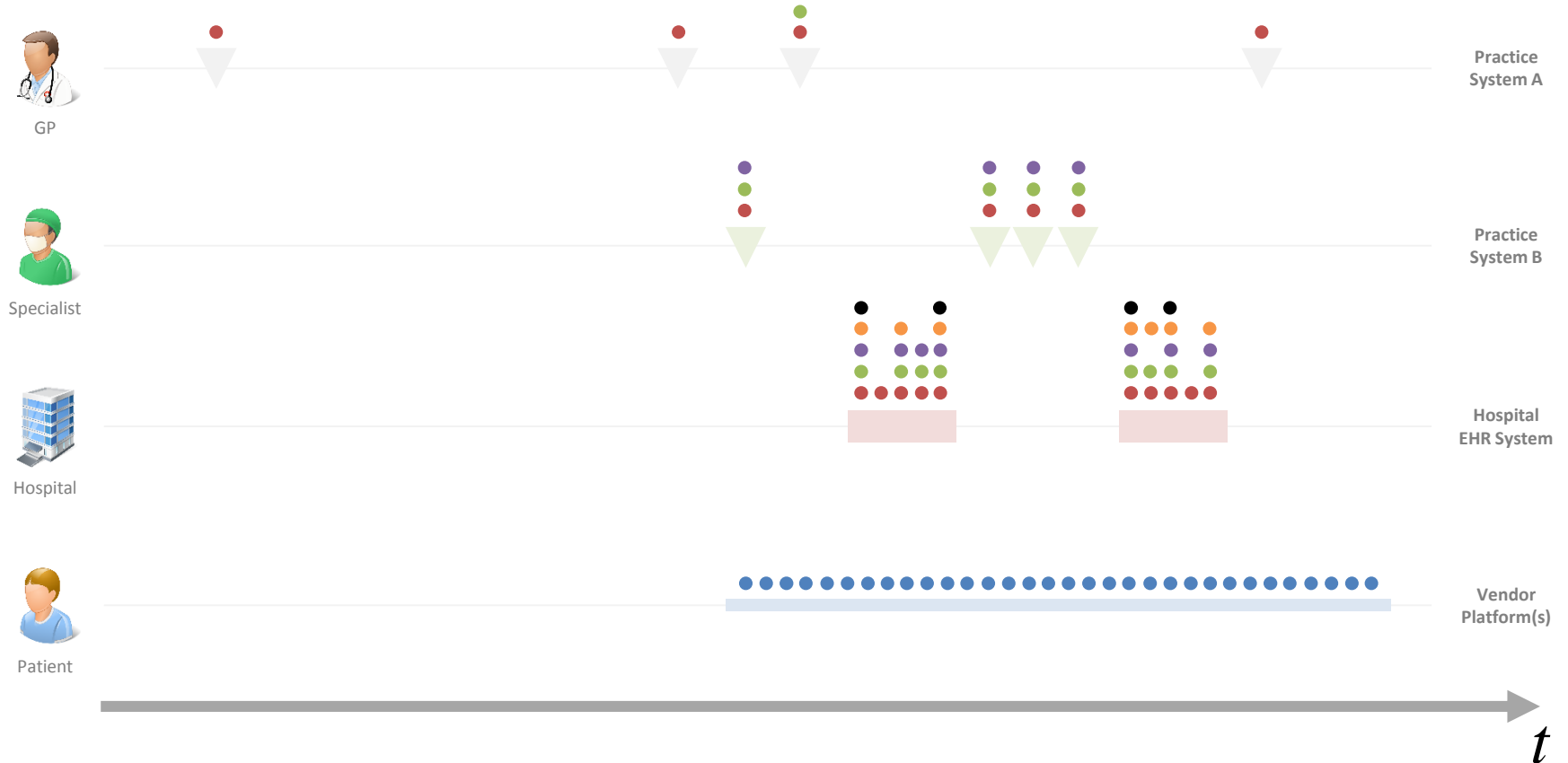
- ...have visited more than one health provider in the past year?
- ...have a personal health or fitness device (e.g. Fitbit, Apple Watch)?
- ...have used a clinical decision support tool in the past year?
- ...have accessed their own personal health record in the past year?



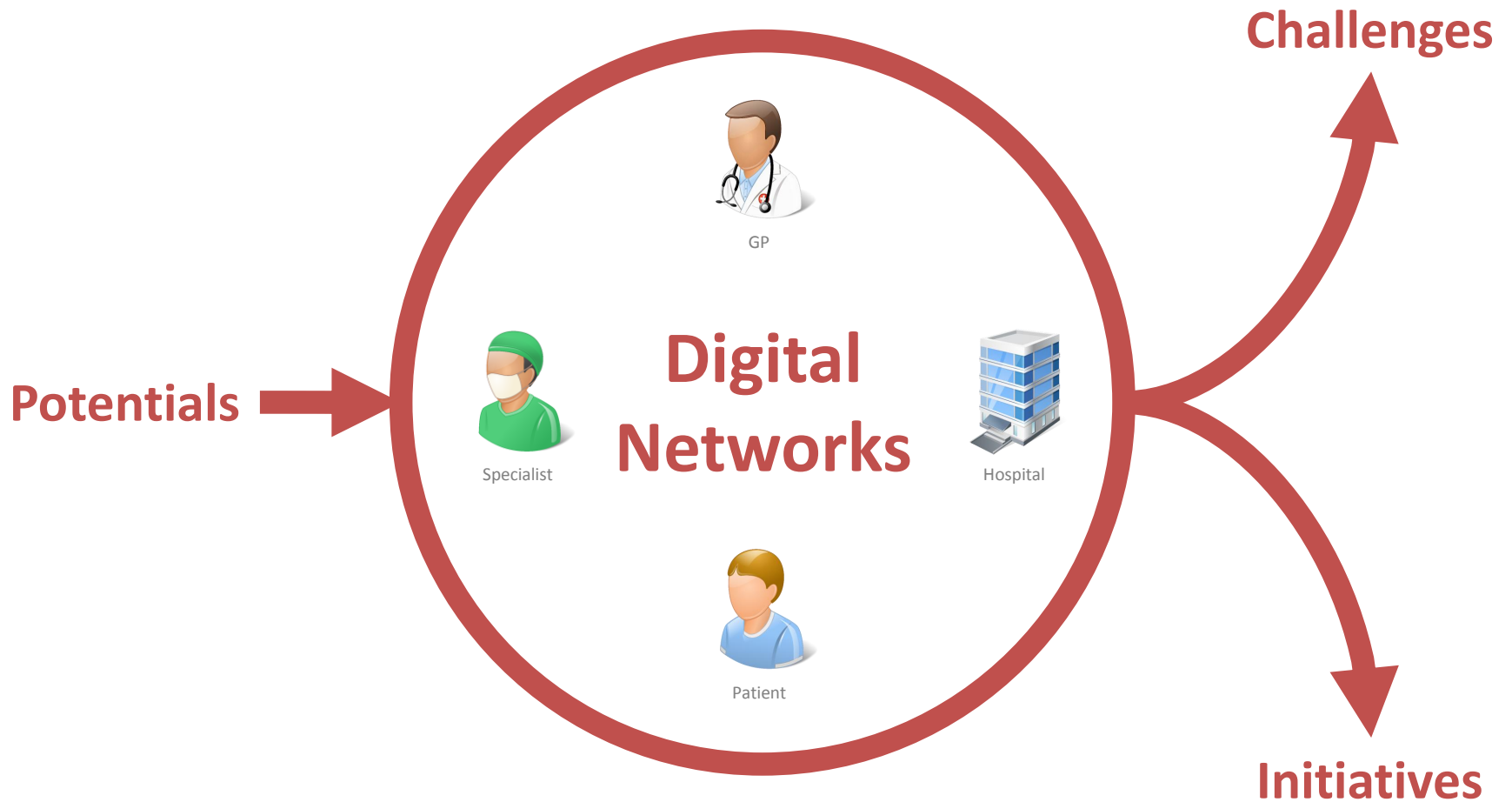
Increasingly Shared Care ...



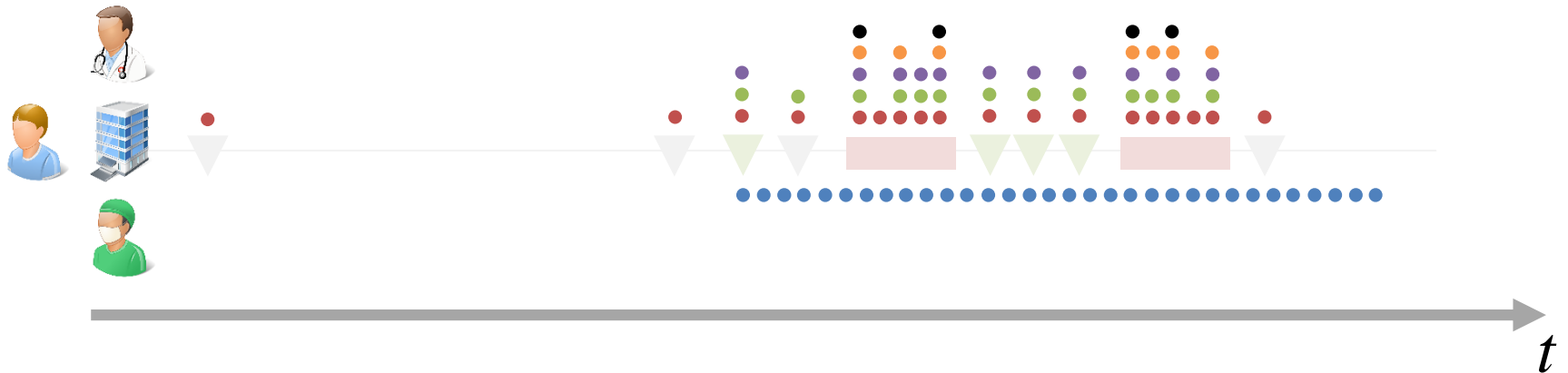
... Leading to Increasingly Fragmented Lab Data



Paradoxically, more data with less overall access?



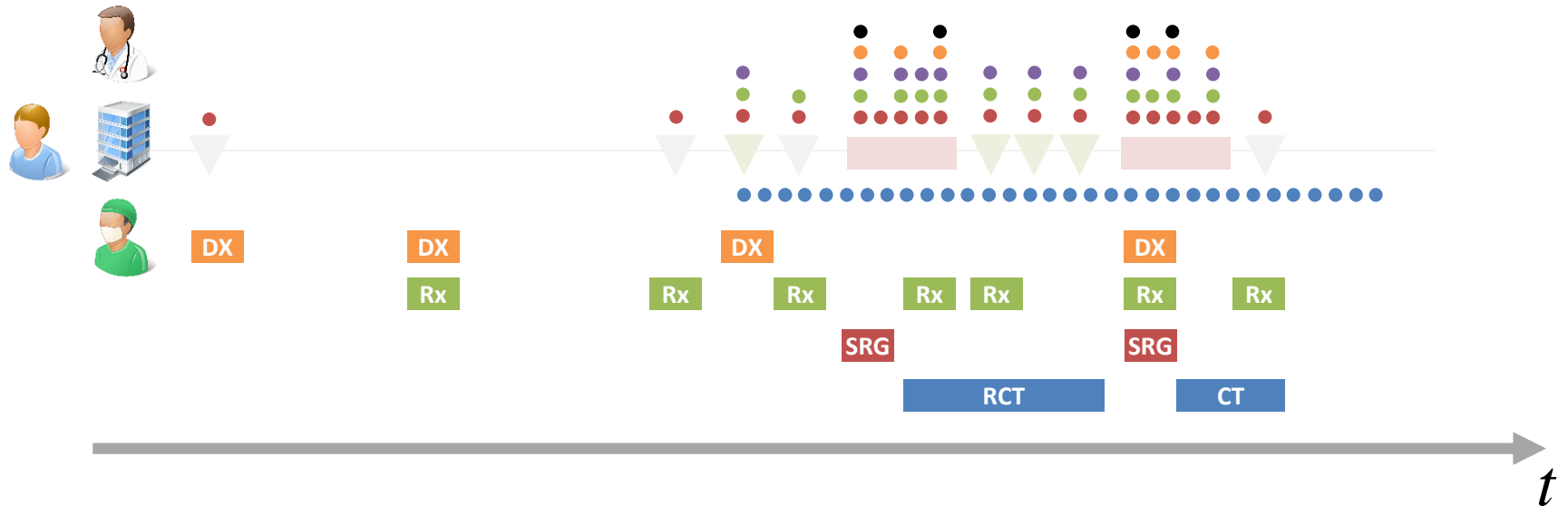
Potentials: Longitudinal View of a Patient's Lab Data



Filling in the gaps

- include data from other departments/facilities (and the patient)
- follow disease progression
- avoid unnecessary repeat-testing

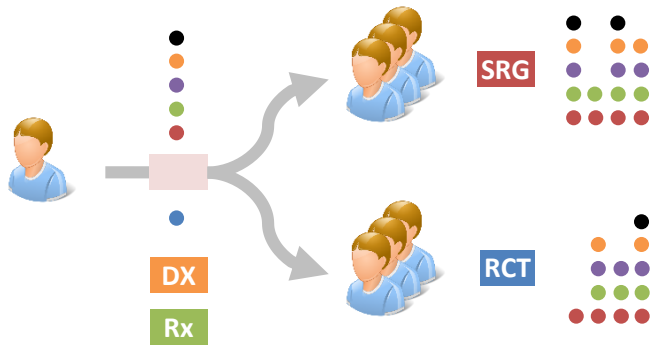
Potentials: Holistic View of a Patient's Health Record



Putting lab data into context

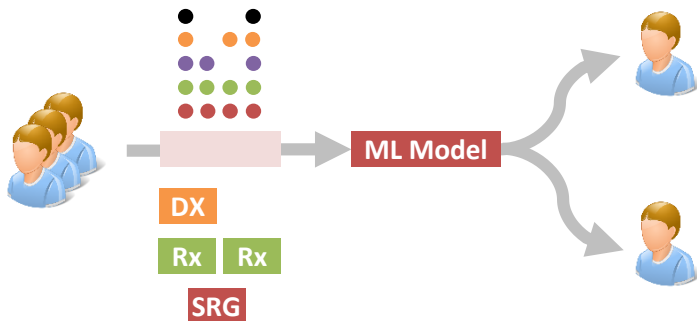
- identify relevant conditions, events or treatments
- interpretation that includes possible confounders
- decision support for lab/treatment orders, clinical trial recruitment

Potentials: Analysis of Large Patient Cohorts



Case-based reasoning

- identify similar cohorts of previous patients
- compare treatment alternatives and outcomes



Disease-modelling

- derive model from patient cohort
- apply model to individual patients
 - for subgroup identification
 - for prognostic indicators
 - for therapeutic decision support

Challenges: Legal Requirements

Data Protection
Patient Participation



Patients

- Patient Empowerment
- Informed Consent (or Research Exemptions)
- Ethics Approval
- Technical & Organizational Measures

Data Ownership
Medical Device Regulation



Doctors

- Contracts for shared care
- Framework for scientific use
 - Use & Access Policies
 - Governance Structures
- Validation Studies



Challenges: Semantic Integration

**Terminologies
& Data Structures**

Interfaces



Labs &
IT Departments

Comparability

- LOINC-Mapping
- HL7 FHIR Resources
- Common Data Models

- HL7 Interfaces
- IHE Integration Profiles

- Method descriptions
(and standardization)
- Ring Trials



Challenges: Presentation & Visualization

Intuitive data selection
Presentation of context
Integrating similar findings



Doctors

- Semantic navigation
- Novel visualization paradigms
 - timelines, streamgraphs
 - combination charts
- scale transformations (e.g. zlog)

**Comprehensible
visualization**



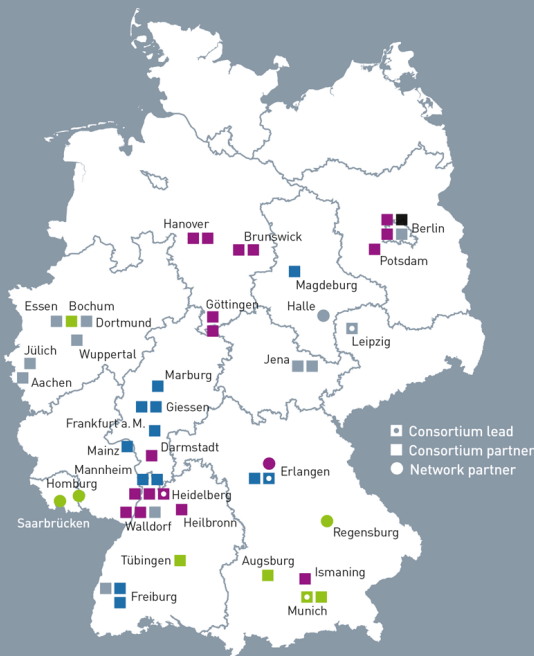
Patients

- Mobile, touch-based apps
- Reduction to relevant features
 - However: needs & capabilities may vary widely



Initiatives: German Medical Informatics Initiative (MII)

Consortia and participants during the development and networking phase



DIFUTURE
HIGHmed
MIRACUM
SMITH
Coordination office



150 M€ Funding by Federal Research Ministry

- 4 consortia

Goals

- establish local Data Integration Centers
- achieve interoperable data access
 - including MII core dataset
- implement clinical use cases
- strengthen medical informatics

Similar initiatives in Europe

- SPHN: Swiss Personalized Health Network
- EH DEN: European Health Data Network



Initiatives: MII - MIRACUM Consortium



Medical Informatics in Research and Care in University Medicine



Largest German MII Consortium

- 10 university hospitals
- data of >12 million patients

Clinical Use Cases

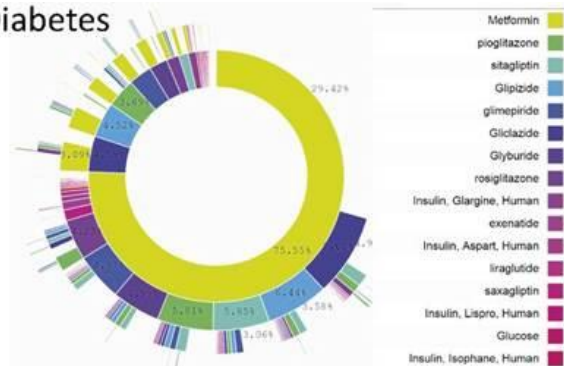
- recruitment support for clinical trials
- prediction models for COPD/asthma & neurooncology
 - focus: federated machine learning, decision support
- Precision medicine for Molecular tumor boards
 - focus: standardized bioinformatics pipelines, visualization of findings



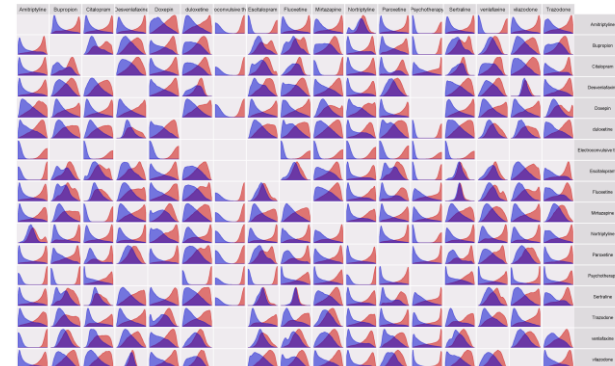
Observational Health Data Sciences & Informatics

- international collaboration for secondary use of routine clinical data
- highlight feature: detailed common data model
 - covering data structures as well as terminologies
 - including LOINC-coded lab data structures
- integrated tools for cohort discovery, statistical analysis and federation
- data of >500 million patients

A Diabetes



Source: www.pnas.org/content/early/2016/06/01/1510502113.full



Source: George Hripcsak, MIRACUM Symposium 2018, Erlangen

Initiatives: Personal Access to Health Data

Government-driven



- download EHR data
- HL7 CCD format
- e.g. for referrals, data donations

Academic



- personal health record for Heidelberg region
- interfaces between providers
- controlled by patients



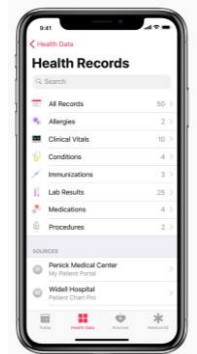
Insurance-driven



- e.g. TK-Safe, Vivy
- provided as part of insurance coverage

Vendor-driven

- e.g. Apple Health
- integration of providers using HL7 FHIR interfaces
- includes device data
- re-use for research & care



Digital Networks for Laboratory Data: Conclusions & Outlook

Opportunity for integrating fragmented data silos

- lab findings as a central, high-quality component, EHR provides context
- novel methods for holistic visualization, analysis and decision support

Multiple challenges need to be solved

Several initiatives are tackling them

- large-scale academic consortia on a national & international level
- integration into care process still daunting