

TeleTrust-Informationstag "IT-Sicherheit in der ärztlichen Praxis"

Berlin, 31.05.2017

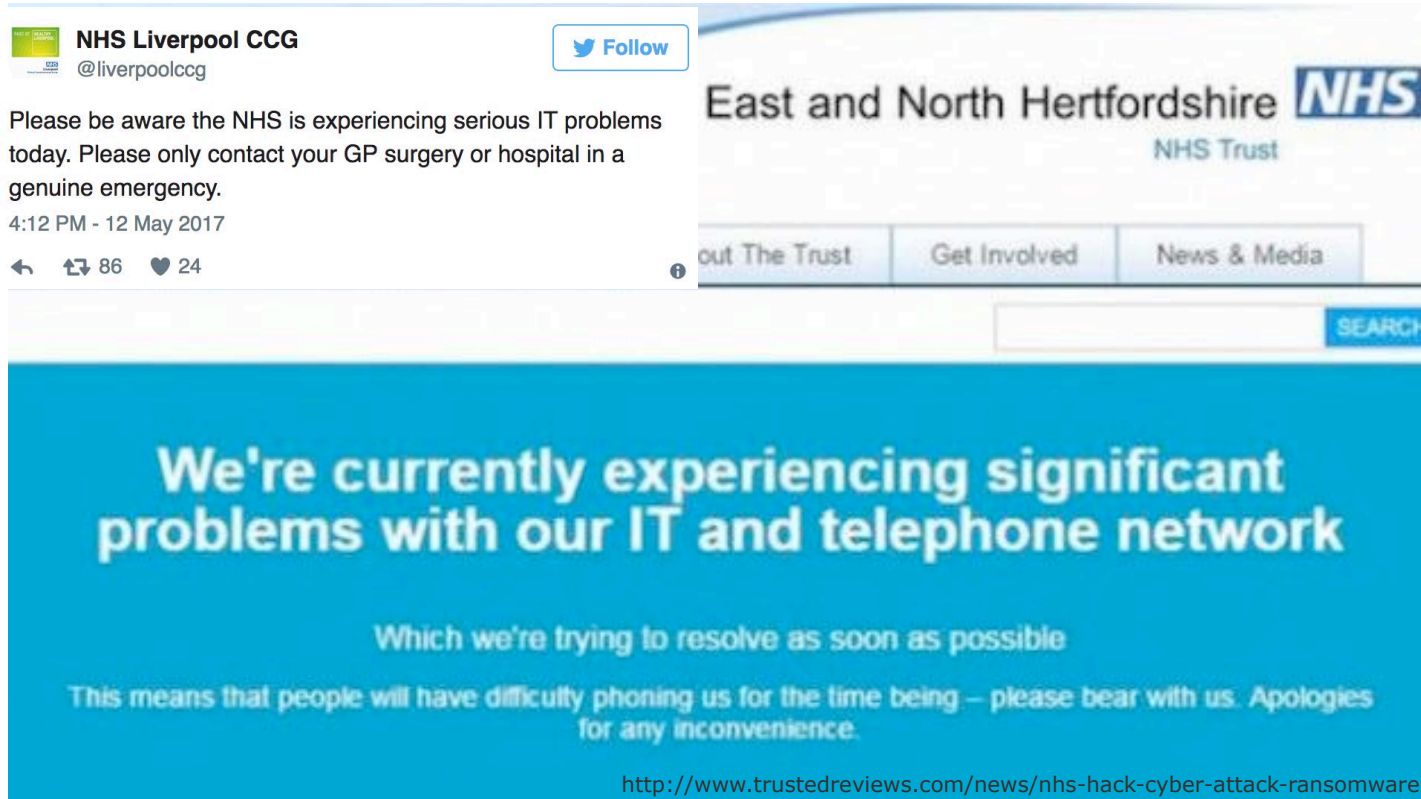
Quo Vadis: Opportunities of the Digital Transformation in Medicine

Dr.-Ing. Matthieu-P. Schapranow

Program Manager E-Health & Life Sciences

Hasso-Plattner-Institut

Recap May 2017: Wannacry ransom attack affects NHS IT systems



NHS Liverpool CCG
@liverpoolccg

Please be aware the NHS is experiencing serious IT problems today. Please only contact your GP surgery or hospital in a genuine emergency.

4:12 PM - 12 May 2017

86 24

Follow

East and North Hertfordshire **NHS**
NHS Trust

out The Trust Get Involved News & Media

SEARCH

We're currently experiencing significant problems with our IT and telephone network

Which we're trying to resolve as soon as possible

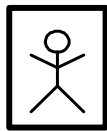
This means that people will have difficulty phoning us for the time being – please bear with us. Apologies for any inconvenience.

<http://www.trustedreviews.com/news/nhs-hack-cyber-attack-ransomware>

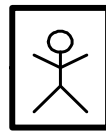
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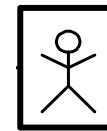
Intelligent Healthcare Networks in the 21st Century?



Researcher



Clinician

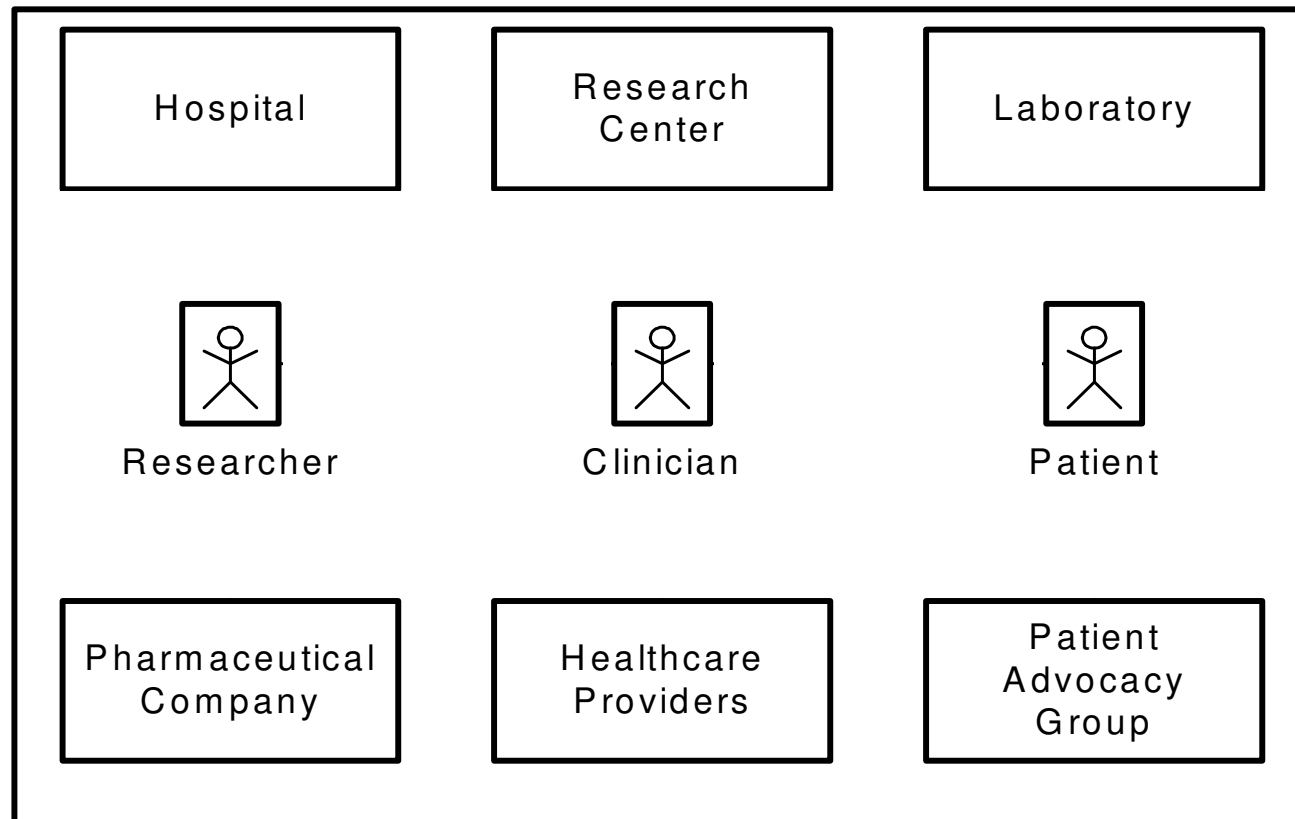


Patient

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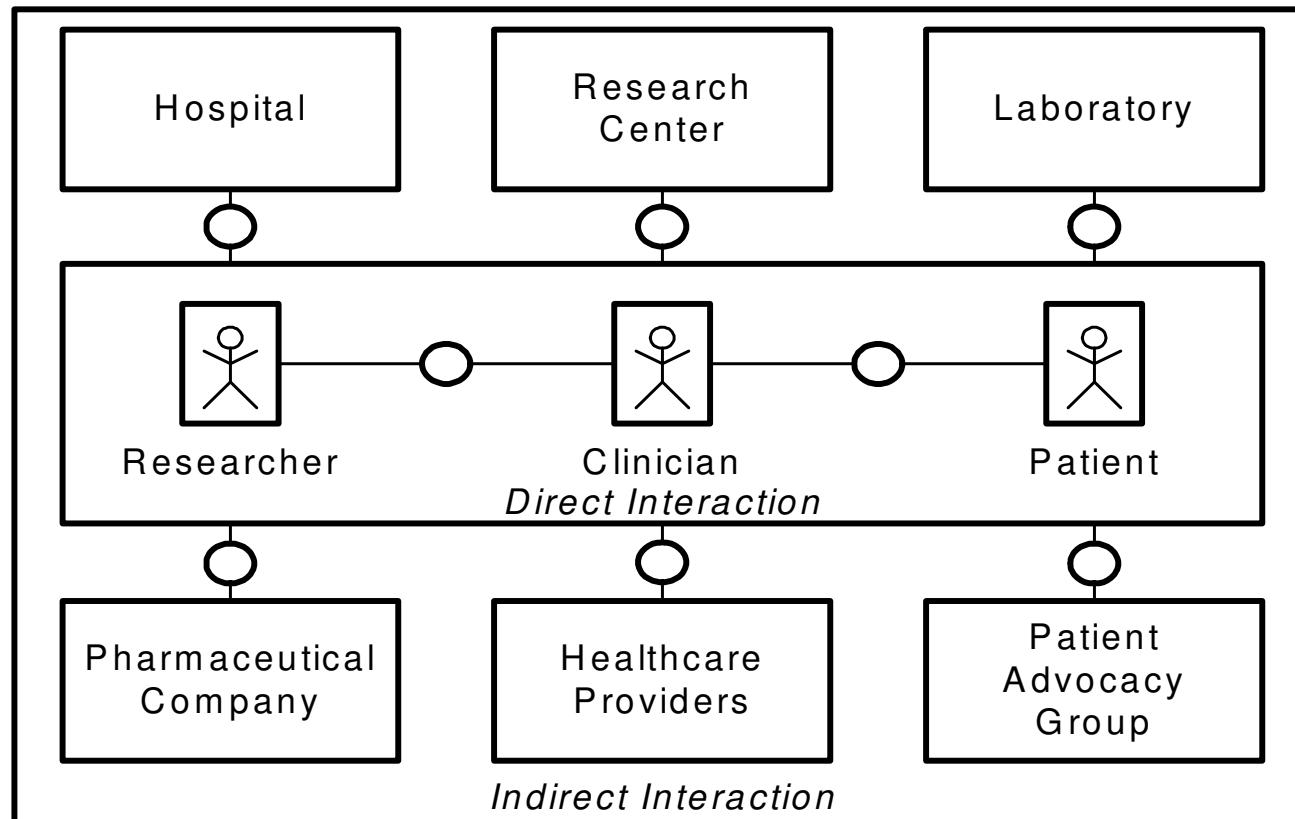
Intelligent Healthcare Networks in the 21st Century?



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Intelligent Healthcare Networks in the 21st Century!

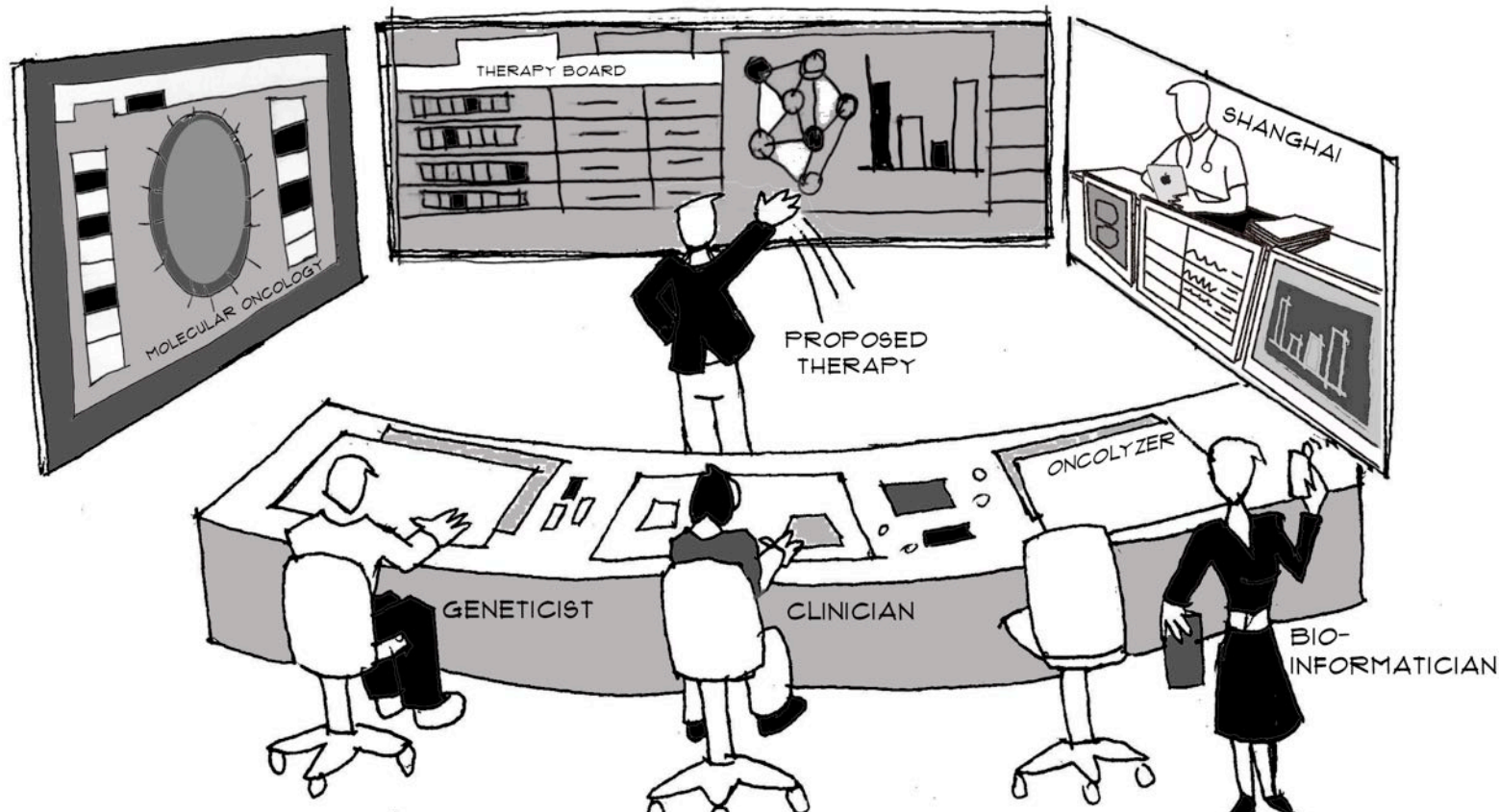


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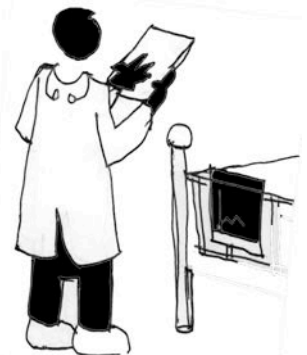
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Our Vision Medical Board Incorporating Latest Medical Knowledge



DOCTOR



What do citizens ask for?

- Myth: People are not interested in Digital Healthcare Services

Patient channel preferences,¹
frequency per year, %

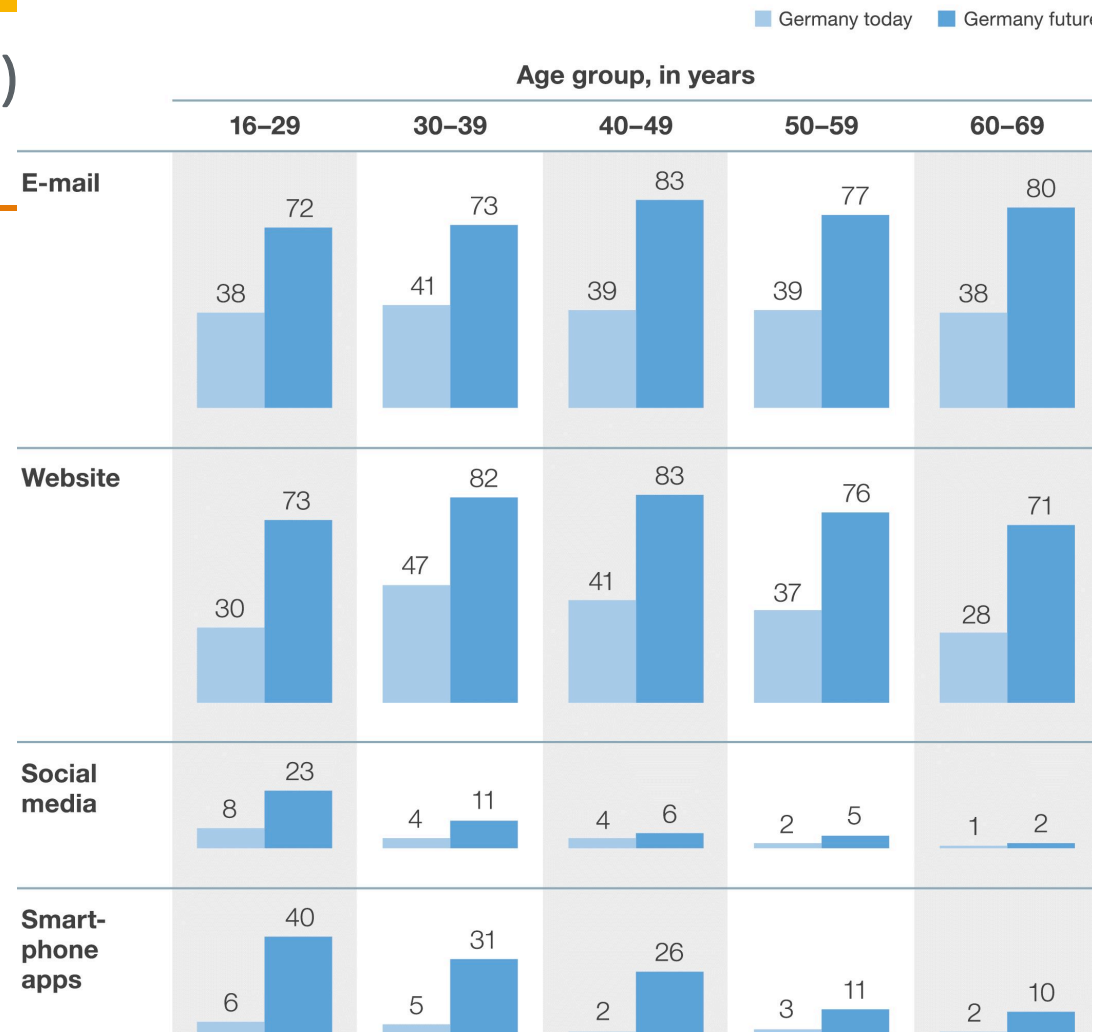
■ Not at all ■ 1 time ■ 2 times ■ 3–4 times ■ >4 times



¹Figures may not sum to 100%, because of rounding. Respondents were asked the following: *Thinking of all your interactions with your health system (doctors, hospitals, pharmacies, healthy-living websites, etc.) and social care in the last 12 months, please indicate the approximate number of times your interaction related to one of the following types.*

What do citizens ask for? (cont'd)

- Myth: The younger generation wants to use digital services only



Source: McKinsey Digital Patient Survey 2014

What do citizens ask for? (cont'd)



■ Myth: Patients require innovative features and apps in healthcare

Ranking of criteria for success of online proposition,¹ top 3 criteria, %

Germany

Ability to execute processes/receive services directly in the online platform 55

Fast availability of a personal contact person 48

Usability/accessibility of service offerings 39

United Kingdom

Increased awareness of online services 51

Ability to execute processes/receive services directly in the online platform 45

Fast availability of a personal contact person 43

Singapore

Increased awareness of online services 40

Wider range of value-added services 36

Width/clarity of information available 34

¹ Respondents were asked the following: *From your perspective, what needs to happen for you to use certain services online/on your mobile phone more frequently than in the past? Please select the three most important criteria for you.*

What do citizens ask for? (cont'd)

■ Myth: Personal healthcare data should never be donated for research purposes

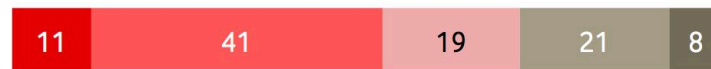
Large amounts of people's health data should be collected and analysed on an anonymous basis by health institutions, [...], to **enable improvements in the detection and treatment of diseases**.



You would give these institutions access to your health data as long as it is **amalgamated, anonymised** and **only used for statistical/research purposes**.



You would give these institutions access to your health data and **trust that they would store and use it appropriately**.



You would give these institutions permission to **store and analyse your data as personal and identifiable data** as this could help to **cure a disease** you or others might have.



■ very comfortable ■ comfortable ■ neutral ■ uncomfortable ■ it should not be allowed

Would you give permission for your insurance to **access your health and fitness data so they can adapt your insurance rate** according to your health behaviour and fitness level, i.e. you pay more or less depending on your lifestyle?



Would you be happy for your health and fitness data to be analysed by a **special health programme** or smartphone app, and to **receive recommendations** on how to live a healthier life and prevent the onset of certain diseases?



Source: Vodafone Inst. for Society and Commun., Big Data Survey, 2016 ■ Yes

■ No

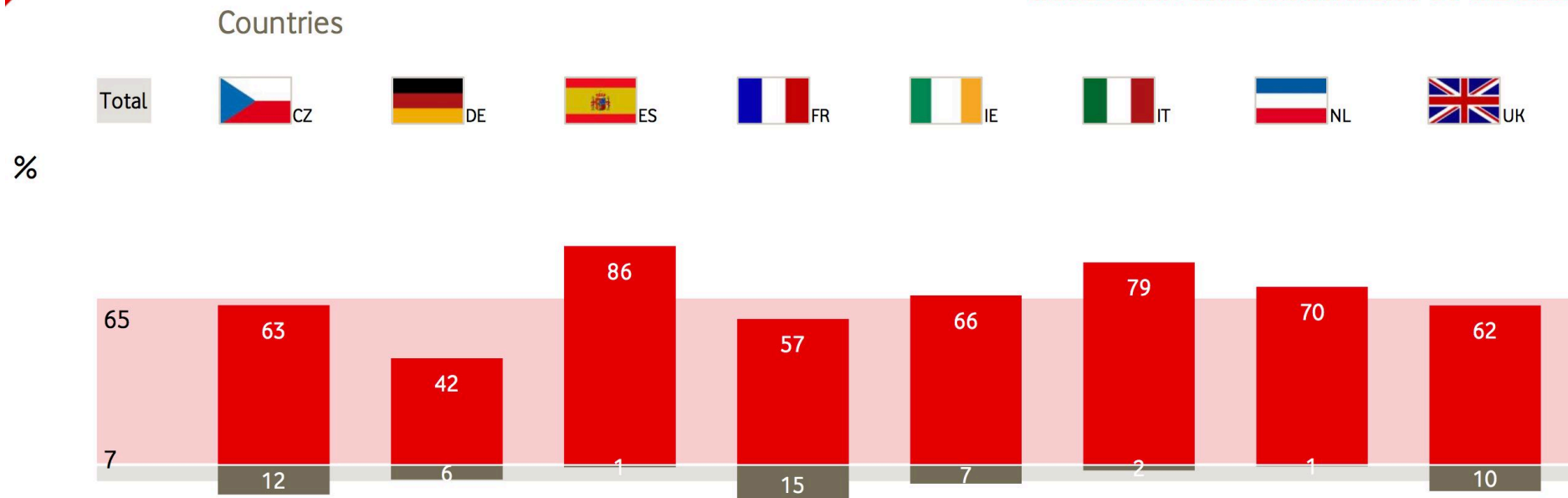
Highest rate of comfort-ability or share of Yes

Country	Age	Educat.
ES	30-49	Medium /High
CZ	30-49	High
ES	30-49	Medium
ES	18-29	Medium
UK	30-49	Medium
IE	18-29	Medium

What do citizens ask for? (cont'd)



Large amounts of people's health data should be collected and analysed on an anonymous basis by health institutions, [...], to enable improvements in the detection and treatment of diseases



Source: Vodafone Inst. for Society and Commun., Big Data Survey, 2016

Mobile Apps in Healthcare

- CHARISMHA study of the BMG 2016
- >100k health apps available
- Major focus: Well-being and fitness
- Results
 - Prevention: Adequate use of apps can support prevention
 - Medical use: Quality issues if not licensed as medicine product
 - Research: Uses mobile apps for acquisition of data
- Missing solution to bridge the gap b/w low quality and high adaption rate of users



But This is the Reality



Anadolu Agency | Getty Images

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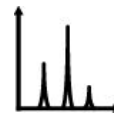
<http://www.startribune.com/how-pokemon-go-went-from-prank-to-phenomenon/387900342/>

IT Challenges

Distributed Heterogeneous Data Sources



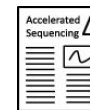
Human genome/biological data
600GB per full genome
15PB+ in databases of leading institutes



Human proteome
160M data points (2.4GB) per sample
>3TB raw proteome data in ProteomicsDB



Hospital information systems
Often more than 50GB



PubMed database
>23M articles



Cancer patient records
>160k records at NCT



Medical sensor data
Scan of a single organ in 1s
creates 10GB of raw data



Prescription data
1.5B records from 10,000 doctors and
10M Patients (100 GB)



Clinical trials
Currently more than 30k
recruiting on ClinicalTrials.gov

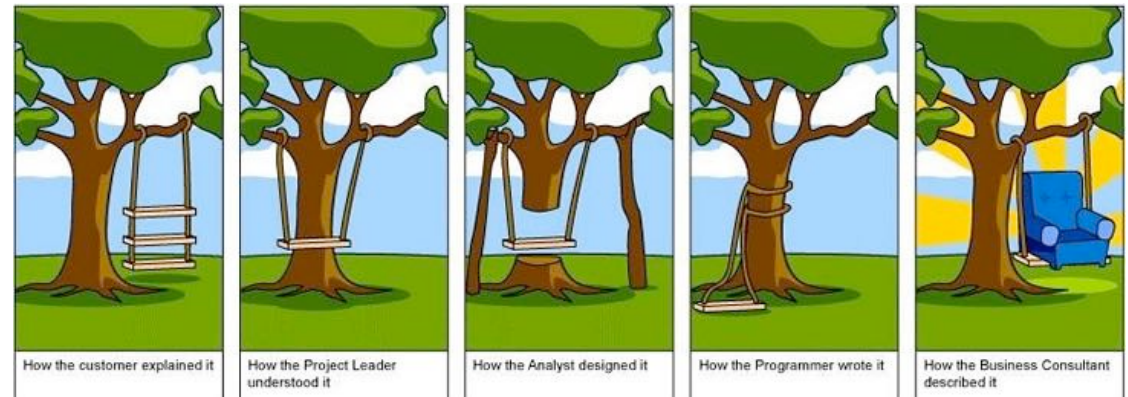
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Software Requirements in Life Sciences

- Requirements
 - Managed services
 - Reproducibility
 - Real-time data analysis

- Restrictions
 - Data privacy
 - Data locality
 - Volume of big medical data



<http://stevedempsen.blogspot.de/2013/08/agile-software-requirements-comic.html>

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AnalyzeGenomes.com
In-Memory Computing Platform for Big Medical Data



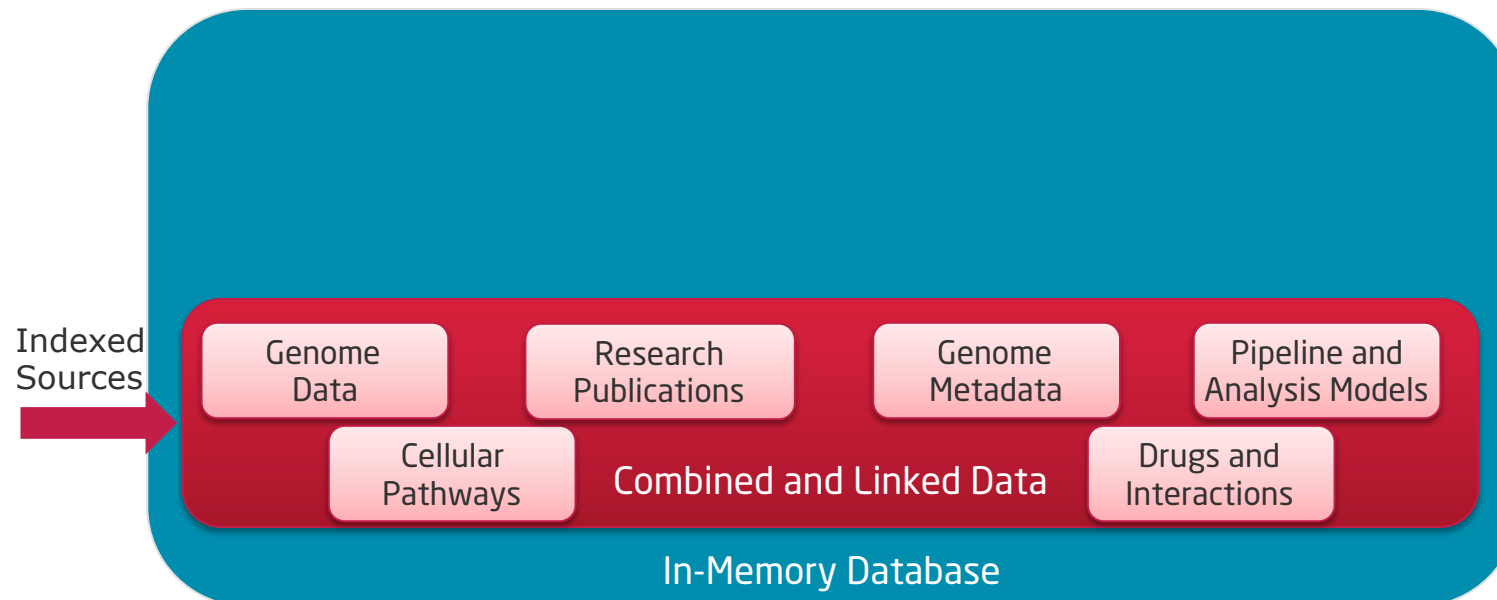
In-Memory Database

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AnalyzeGenomes.com

In-Memory Computing Platform for Big Medical Data

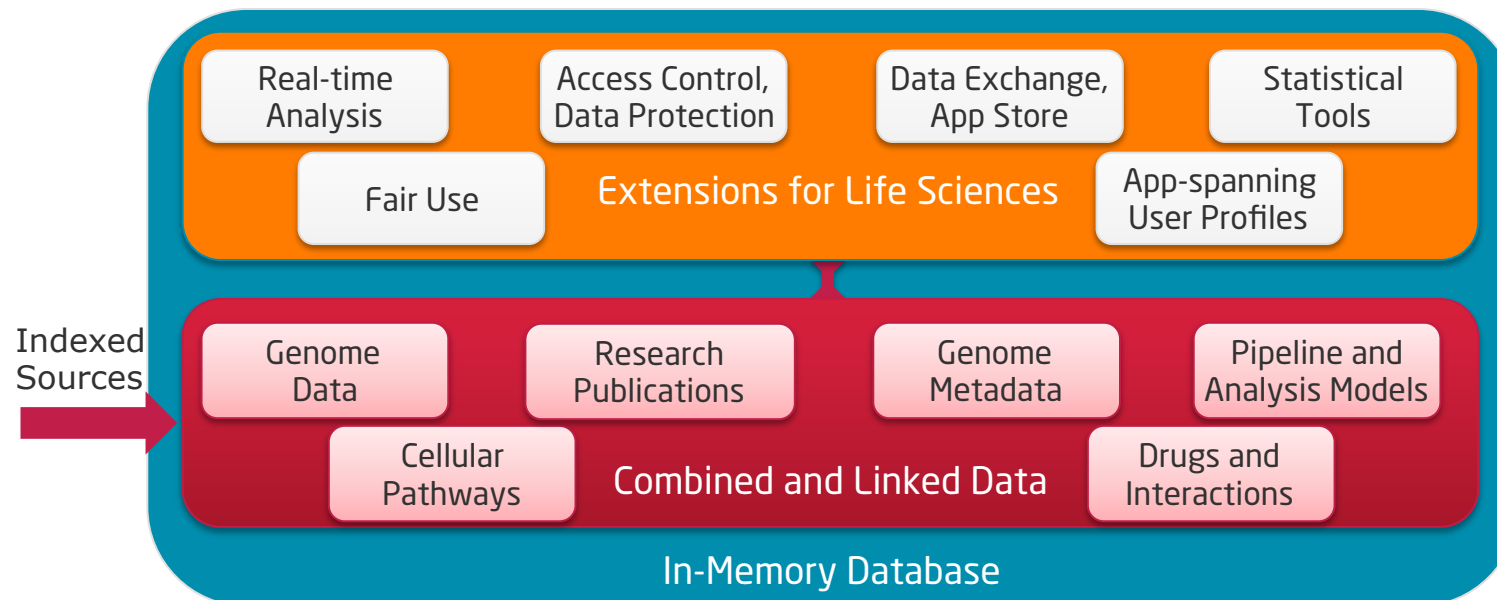


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AnalyzeGenomes.com

In-Memory Computing Platform for Big Medical Data

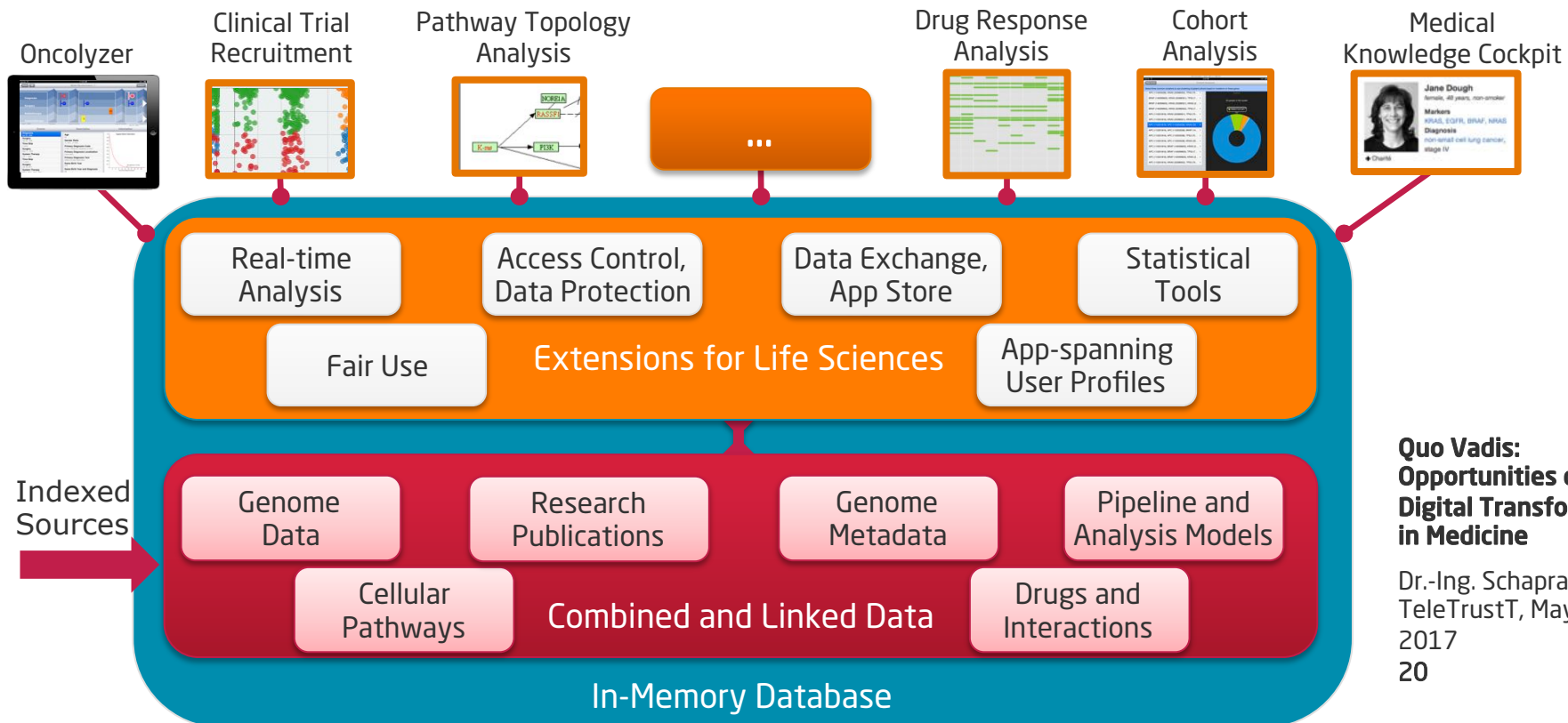


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AnalyzeGenomes.com

In-Memory Computing Platform for Big Medical Data

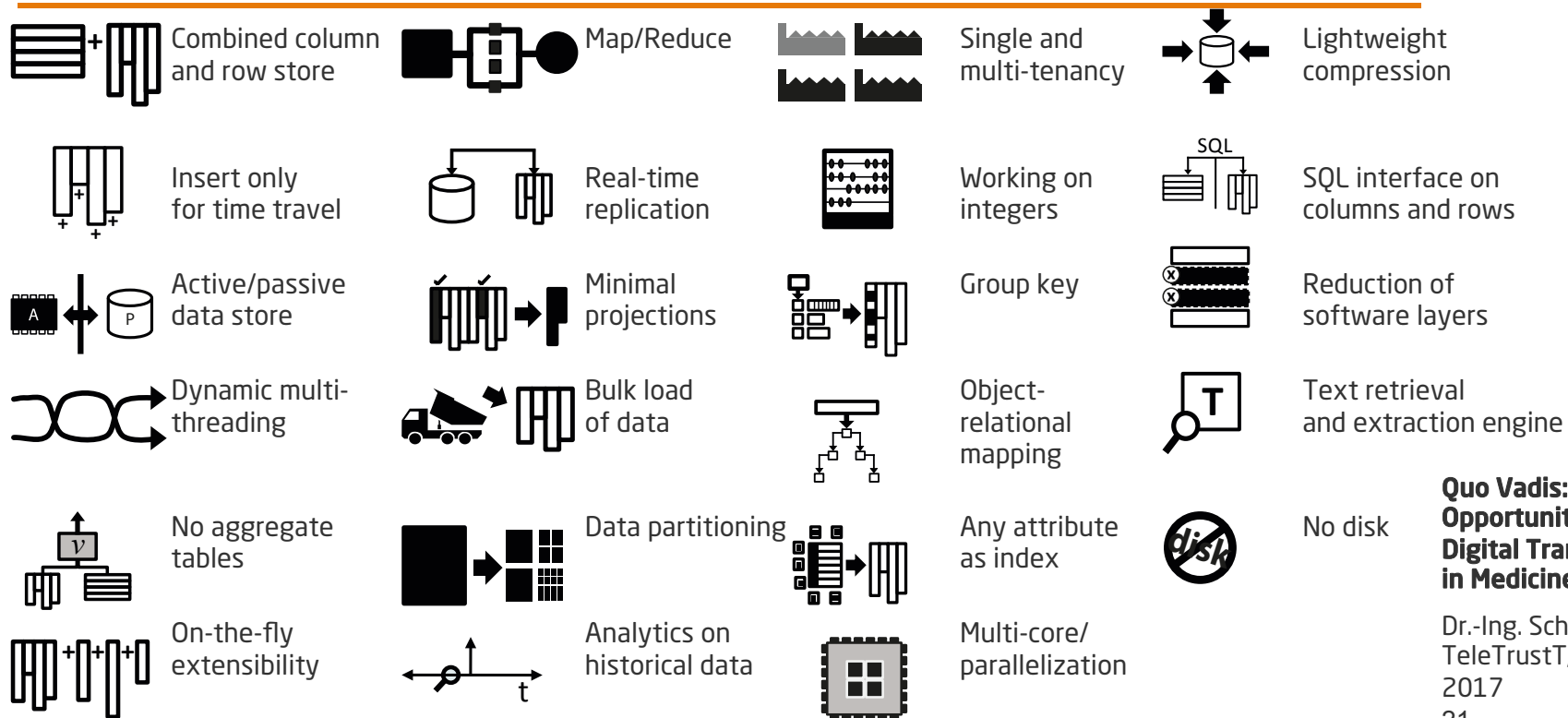


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Our Technology

In-Memory Database Technology



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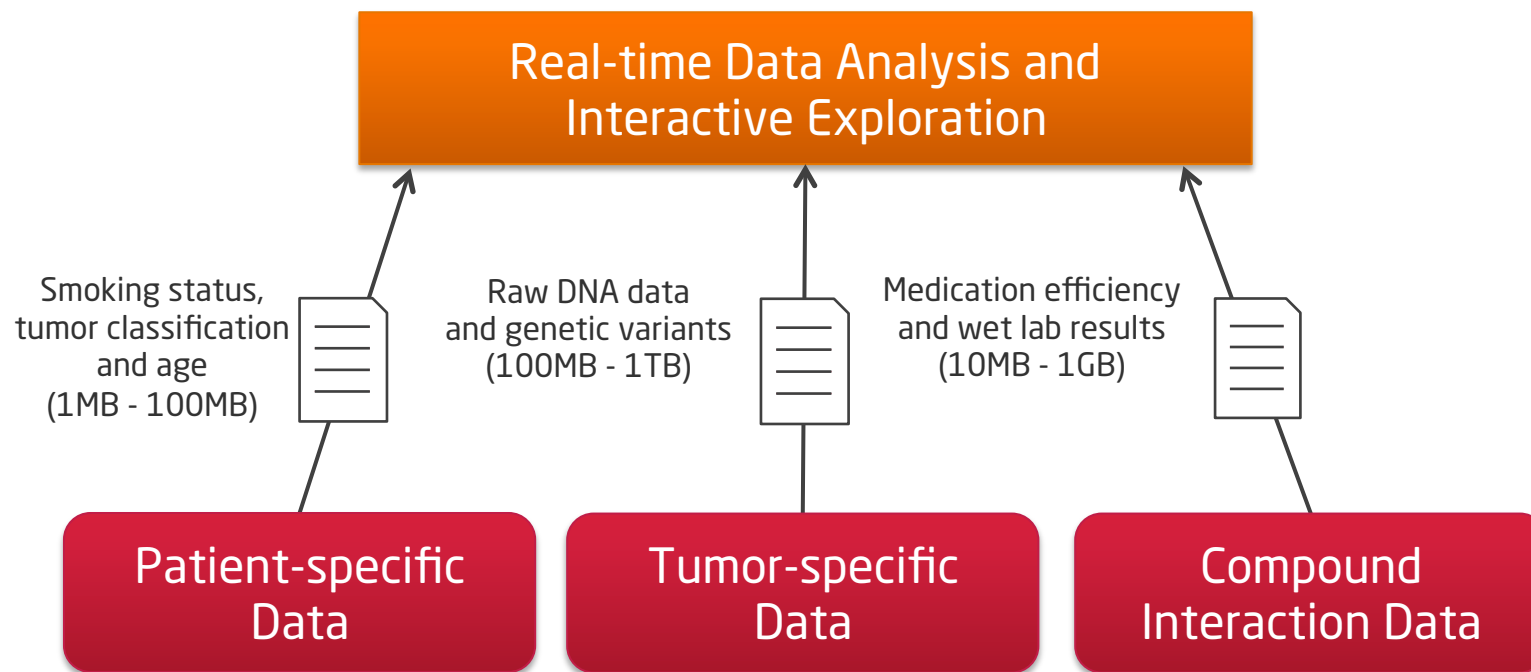
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App Example: Identification of Optimal Chemotherapy



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■ Honored by the 2015 PerMediCon Award

Configuration

Results

1

First step: Choose which drugs' values should be predicted

- ☐ 5-FU
- ☐ Methotrexat
- ☒ Carboplatin
- ☐ Docetaxel
- ☒ Cetuximab
- ☐ Everolimus

carboplatin or cetuximab:
which to choose?

2

Second step: Choose which data should be factored into the prediction. You can choose a preset (click on the row) or create an own set.

Available Presets

Preset Name	Drug T/C	Drug Recist	Non-functional Changes	Functional Changes via RS	Functional Changes via Genes	Age	Gender	T	N	M	Grading
T/C Basic	✓		✓								
Recist Basic		✓	✓								
T/C Functional RS	✓			✓							
Recist Functional RS		✓		✓							
T/C Basic Complete	✓		✓			✓	✓	✓	✓	✓	✓
Recist Basic Complete		✓	✓			✓	✓	✓	✓	✓	✓
T/C Functional RS Complete	✓			✓		✓	✓	✓	✓	✓	✓
Recist Functional RS		✓		✓		✓	✓	✓	✓	✓	✓

☐ Predict Drug Responses

OR

☒ Classify Drug Responses

You need to define the class borders, which distinguishes effectivity classes of drugs.
You can choose to use a predefined set, or define your own classes and save them for later use.

Available Classification Presets Choose one by clicking on a table row

Preset Name	Definition
Recist Basic	0.7 (good) 1.2 (stable) 2.0 (bad)
T/C Basic	25.0 (good) 60.0 (stable) 100.0 (bad)
test2	1.0 (good) 10.0 (ok) 50.0 (bad)

Custom Set Give a class a name and a class border

Keep in mind whether you want T/C or recist values to be classified, since they differ greatly in value ranges.

The lowest class border will go from 0 to the defined border.. Subsequent classes set the end of the defined class (so the class ranges from the predecessor class border to the defined border for this class). The largest class border (= the last class) will include all values, which do not fit into any other class, so the last border value is actually not that important.

Example: 25 (good), 75 (stable) and 100 (bad) - good ranges from 0-25, stable from >25 to 75, bad from >75 upwards.

Add Class:

+

Current Classes:

Save Class:

Predict Drug Response

Configuration

Results

Result SVM run for Carboplatin

	Drug Class Probabilities <small>Recist</small>			
Tumor	good	stable	bad	Actual Class
10927	0.067	0.205	0.728	bad

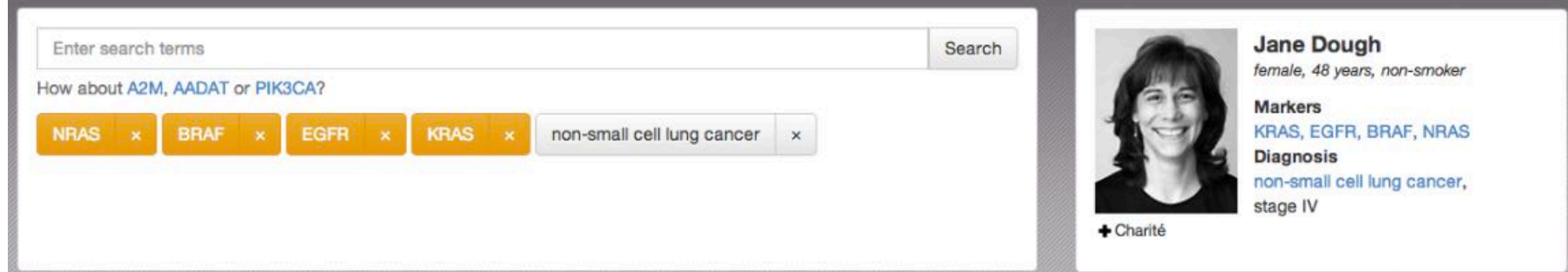
Result SVM run for Cetuximab

	Drug Class Probabilities <small>Recist</small>			
Tumor	good	stable	bad	Actual Class
10927	0.469	0.200	0.331	good

**cetuximab might be more
beneficial for the current case**

App Example: Medical Knowledge Cockpit for Patients and Clinicians

Medical Knowledge Cockpit



The screenshot shows a web interface for a medical knowledge cockpit. On the left, there is a search bar with the placeholder text "Enter search terms" and a "Search" button. Below the search bar, a suggestion text reads "How about A2M, AADAT or PIK3CA?". Underneath, there are four orange buttons labeled "NRAS", "BRAF", "EGFR", and "KRAS", each with a small "x" icon to its right. To the right of these buttons is a grey button labeled "non-small cell lung cancer" with an "x" icon. On the right side of the interface, there is a profile card for "Jane Dough". It includes a black and white headshot of a woman, her name "Jane Dough", and her details "female, 48 years, non-smoker". Below this, it lists "Markers" as "KRAS, EGFR, BRAF, NRAS" and "Diagnosis" as "non-small cell lung cancer, stage IV". At the bottom of the profile card, there is a small icon of a cross and the word "Charité".

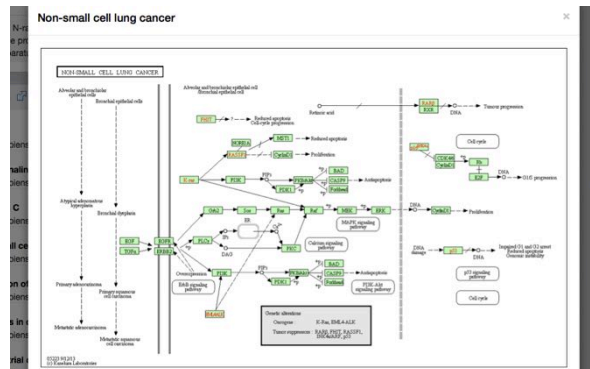
- Query-oriented search interface
- Seamless integration of patient specifics, e.g. from EMR
- Parallel search in international knowledge bases, e.g. for biomarkers, literature, cellular pathway, and clinical trials

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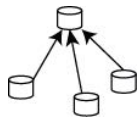
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Medical Knowledge Cockpit for Patients and Clinicians

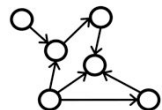
Pathway Topology Analysis



- Search in pathways is limited to “is a certain element contained” today
- Integrated >1,5k pathways from international sources, e.g. KEGG, HumanCyc, and WikiPathways, into HANA
- Implemented graph-based topology exploration and ranking based on patient specifics
- Enables interactive identification of possible dysfunctions affecting the course of a therapy before its start



Unified access to multiple formerly disjoint data sources



Pathway analysis of genetic variants with graph engine

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App Example: Data Donation Pass Control Your Personal Health Data

- Holistic access to your personal health record
- Subscribe to personalized notifications, e.g. about latest healthcare programs and clinical trials
- Donate your de-identified healthcare data to support registered research projects all over the globe



Smart Analysis Health Research Access (SAHRA)



- Interdisciplinary partners collaborate on enabling interactive health research
- Current funding period: Aug 2015 – July 2018

■ Funded consortium partners:



- AOK
German healthcare insurance company



- data experts group
Technology operations



- Hasso Plattner Institute
Real-time data analysis, in-memory database technology



- Technology, Methods, and Infrastructure for Networked Medical Research
Legal and data protection

Supported by:



on the basis of a decision
by the German Bundestag



Smart Data

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App Example: Stratification of Hypertension Patients and Longitudinal Data Analysis

- Stratification of patient cohorts using patient specifics
- Automatic matching of similar patients and patient anamnesis
- Interactive graphical exploration of longitudinal patient data

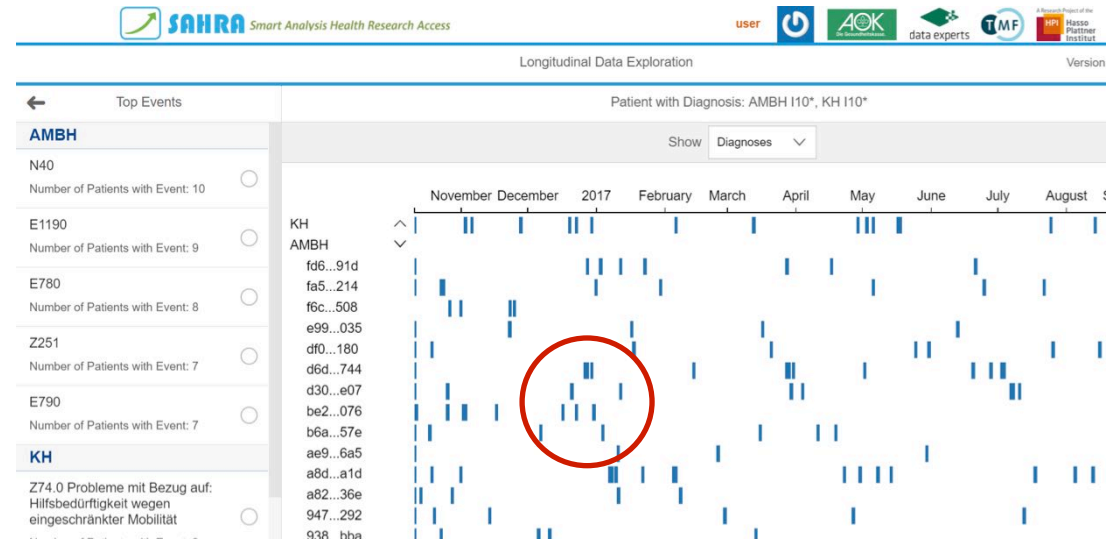


There are 1025 patients in 17 categories.

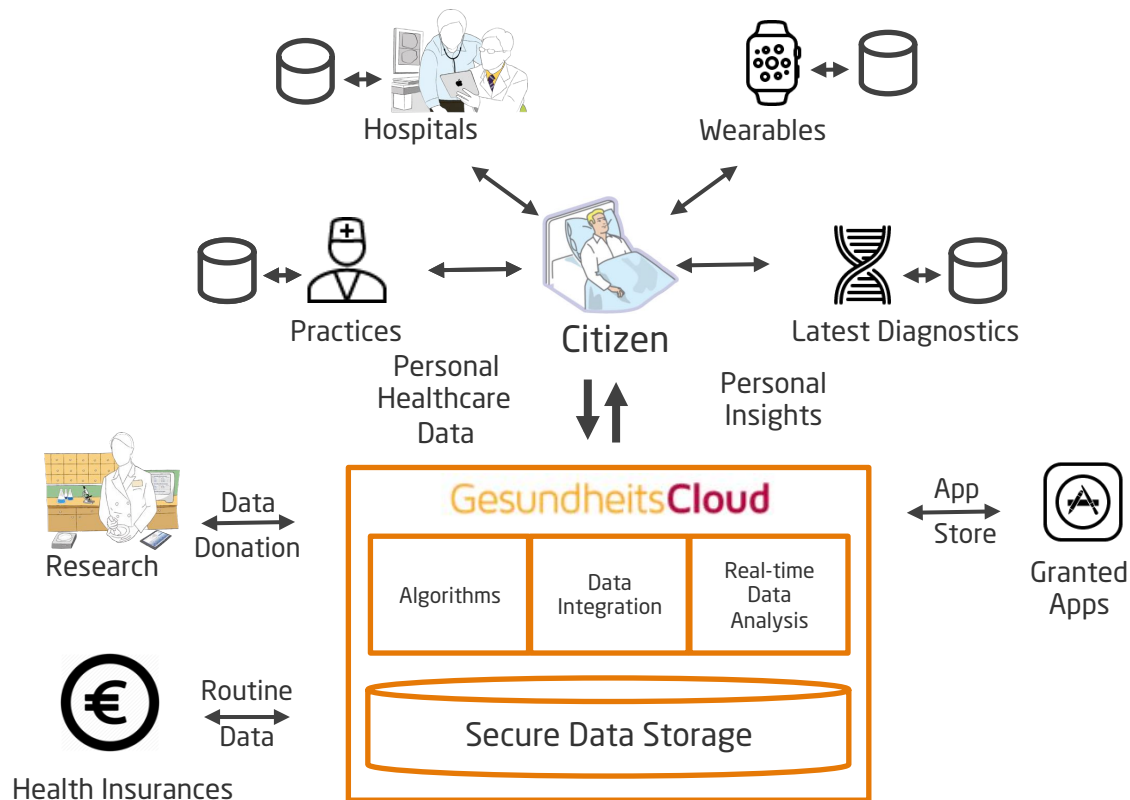
Show cluster within range

between 0 and 1025 patients

Cluster	Patients	Average Demographic Similarity	
▶ Timeline (16)	3	0	✓
▶ Timeline (15)	4	0	+
▶ Timeline (14)	11	0	✓
▶ Timeline (13)	17	0	+
▶ Timeline (12)	9	0	+
▶ Timeline (11)	4	0	+



GesundheitsCloud: Sovereign Control of your Personal Health Data



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What to Take Home?

Learn more and test-drive it yourself: AnalyzeGenomes.com

■ For patients



- Identify relevant clinical trials and medical experts
- Become an informed patient

■ For clinicians



- Identify pharmacokinetic correlations
- Scan for similar patient cases, e.g. to evaluate therapy efficiency

■ For researchers



- Enable real-time analysis of medical data, e.g. assess pathways to identify impact of detected variants
- Combined mining in structured and unstructured data, e.g. publications, diagnosis, and EMR data

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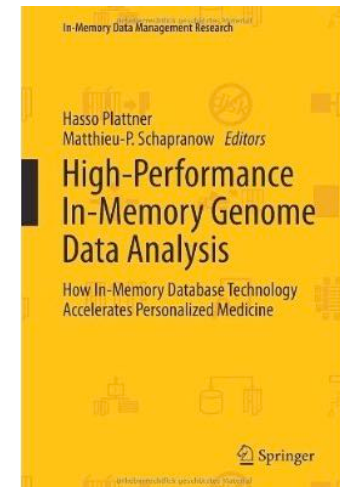
Keep in contact with us!



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