EHEALTH SUMMIT 2017

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Von der Systemmodellierung zur Szenarienrechnung - und darüber hinaus: Making sense of Big Data

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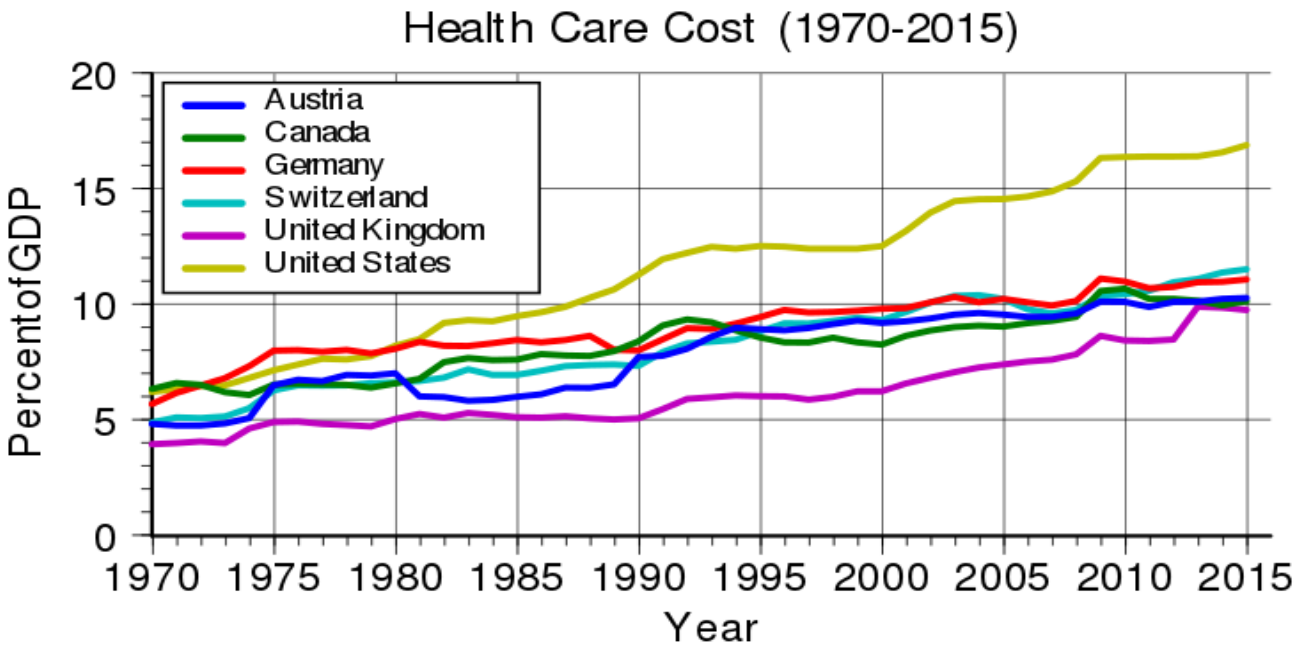
Coordinator Centre for Computational Complex Systems, TU Wien
CSO dwh GmbH – Simulation Services and Technical Solutions, Vienna

Health Systems



https://en.wikipedia.org/wiki/Healthcare_in_Austria

Health Systems

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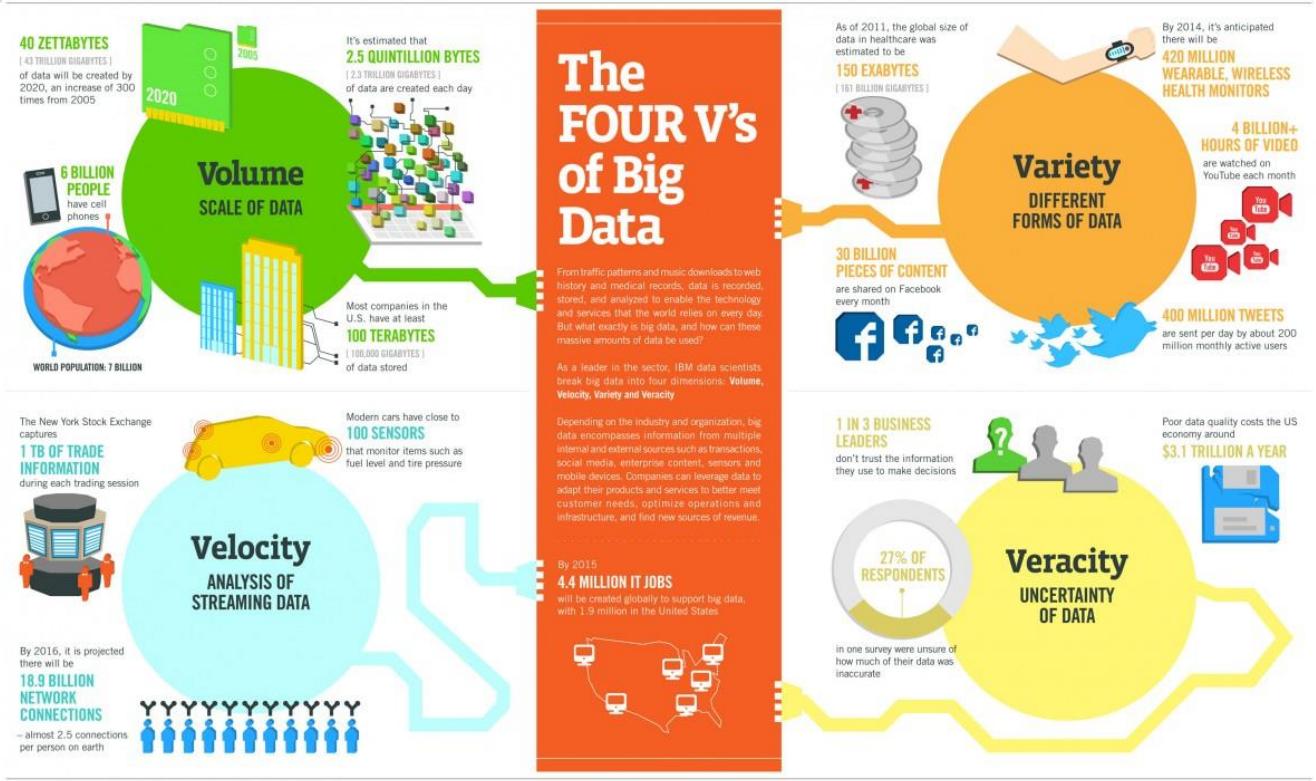
Dissociation of Prooved Benefit of Costs for Medical Care

Pharma-ceutical	Application	Discovery	Costs € (Patient/Year)	Effects (Survival)
Insulin	Typ 1 Diabetes	1920	500	Decades
Statins	Cardiology	1990	5.000	Years
Monoclonal Antibodies	Onkology	2000	50.000	Month/Weeks
Encyme Alternation	Metabolism	2010	500.000	???

Die 4 großen Vs



http://www.ibmbigdatahub.com/infographic/four-vs-big-data

Variety & Veracity

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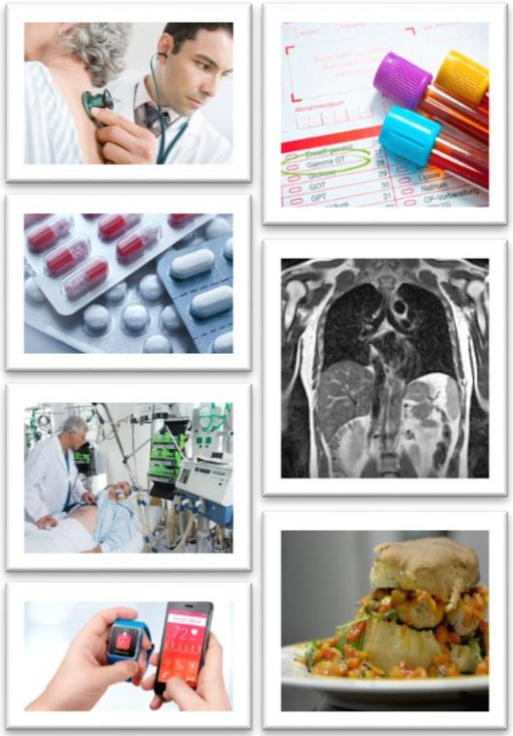
Big Data Sets



Structures & Knowledge

COMET Programm

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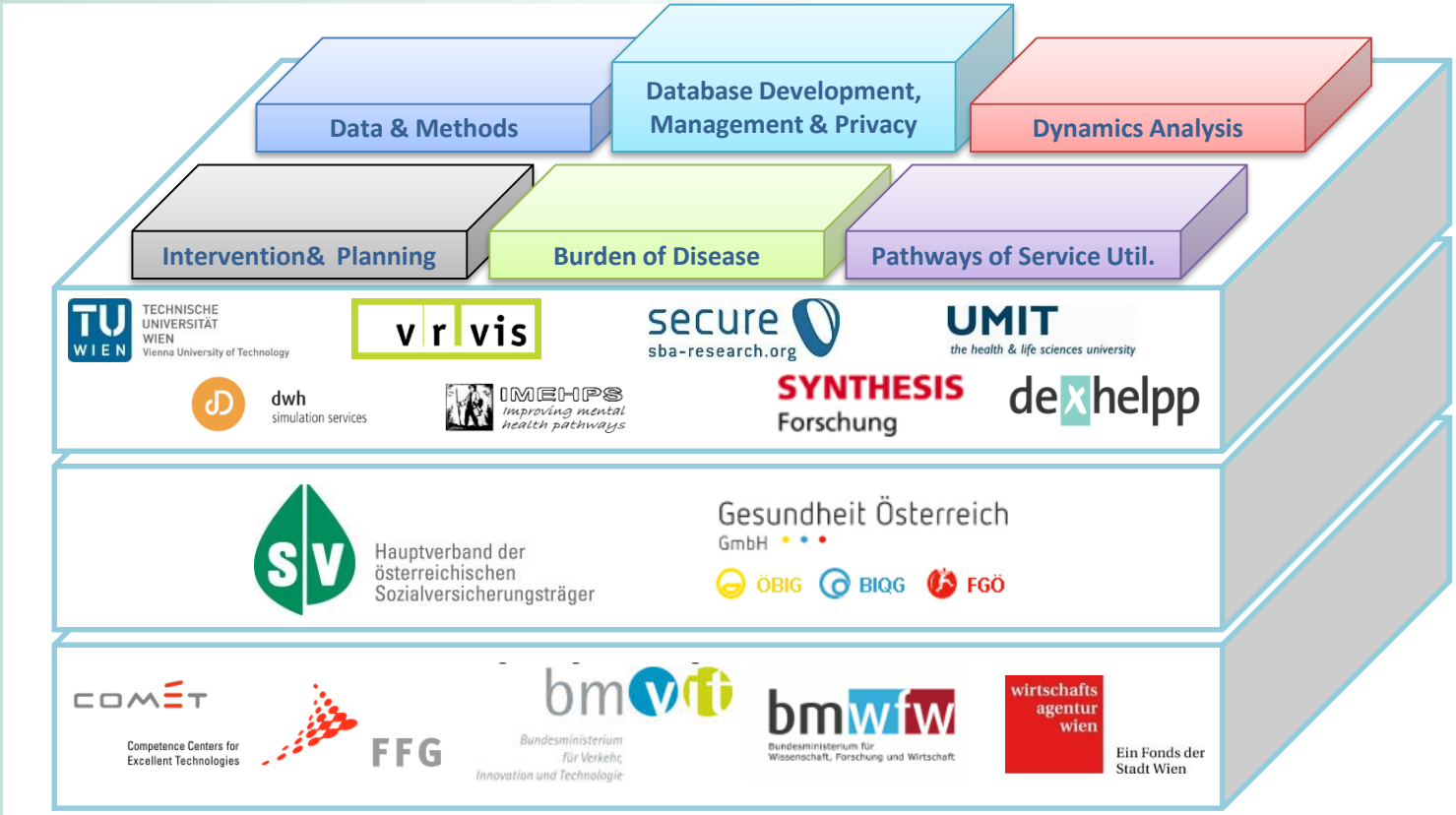
Decision Support for Health Policy and Planning: Methods, Models and Technologies based on existing health care data

COMET
Competence Centers for Excellent Technologies

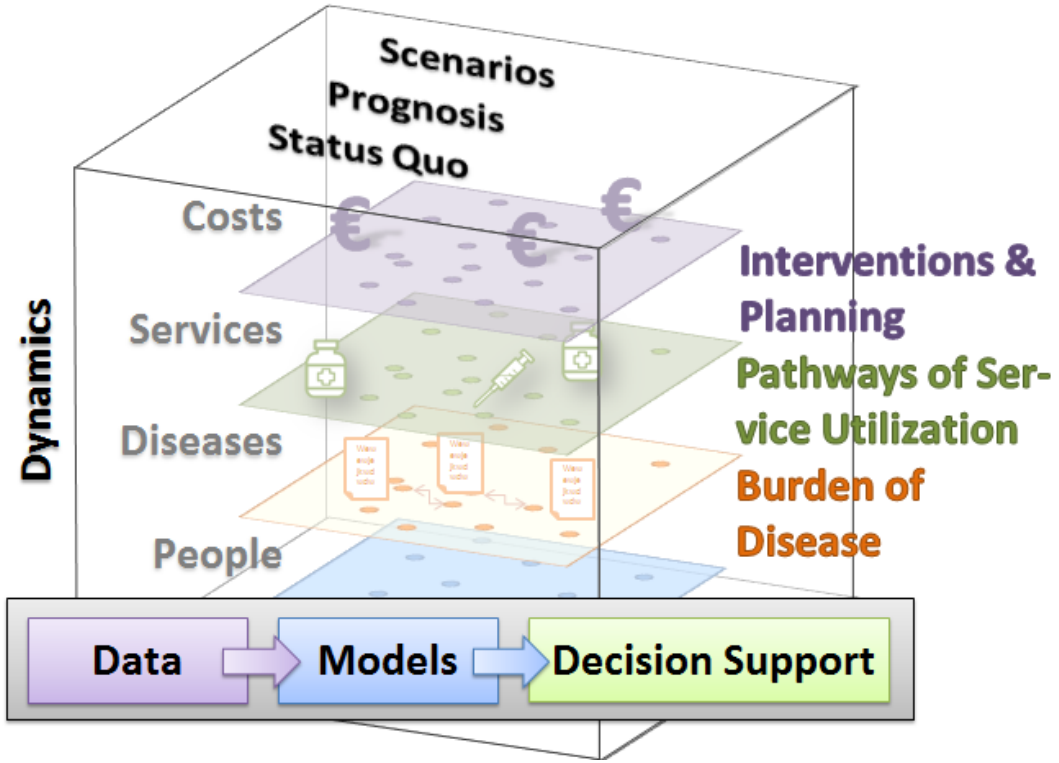
FFG

wirtschafts agentur wien
Ein Fonds der Stadt Wien

Partner & Projekte



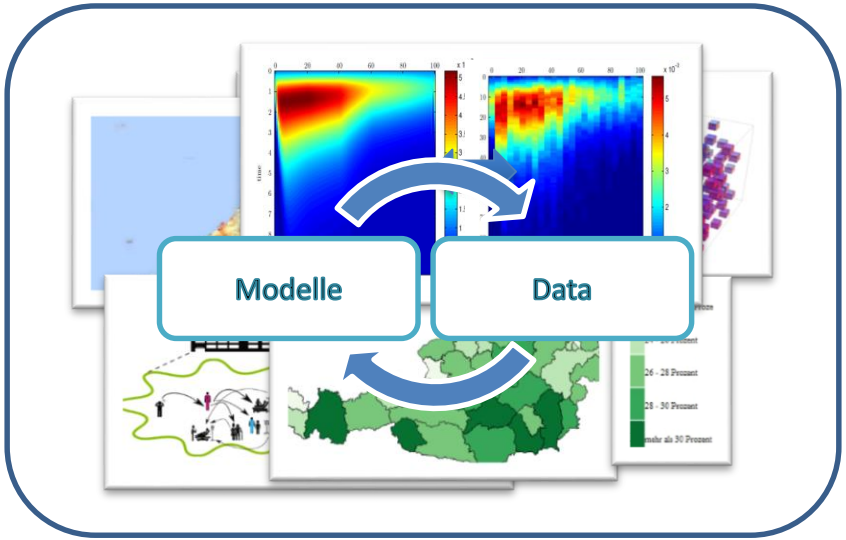
Gedankenmodell



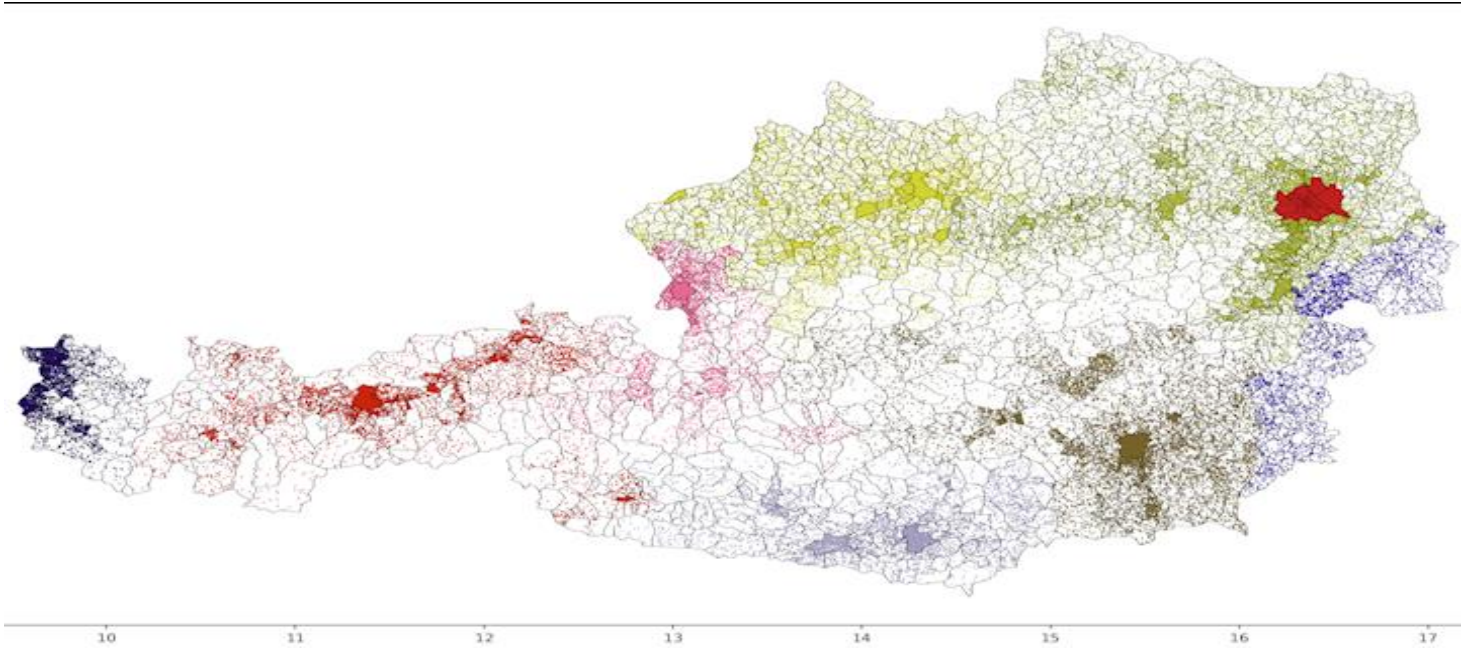
Features

1. Potential zur Integration fehlender Daten
2. Methoden zur Qualitätssicherung der Daten
3. Priorität für Datenschutz und Stakeholdersichtweisen
4. Modulare & effiziente Lösungen
5. Einfach über die Zeit “fortführbare” Konzepte
6. Reproduzierbarkeit der Prozesse
7. Differenziertere Methoden für komplexere Fragen
8. Breite Einsetzbarkeit (HTA, Versorgungsforschung, Ökonomie, etc…)
9. Offene und unabhängige Lösungen
10. Vergleichbarkeit der Ergebnisse

Schritt 1: Modellierung

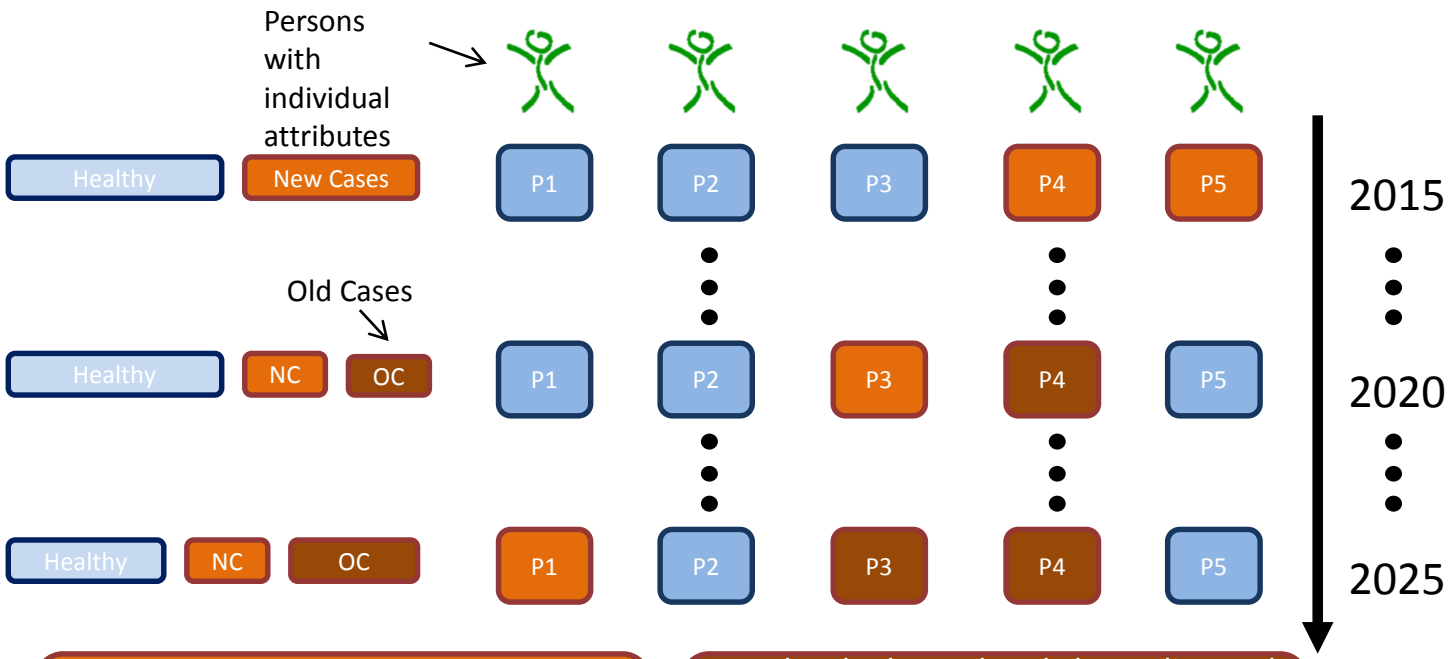


Populationsmodell



M. Bicher, F. Miksch, B. Jahn, et al: DEXHELPP GEPOC, Generic Population Concept, DEXHELPP Report

Dynamik & Diversity



New cases are independent from previous treatment, but possibly preventable

People who have already been diseased in the last observed time period and are still not healthy and therefore still occupying ressources.

Interaction & Networks

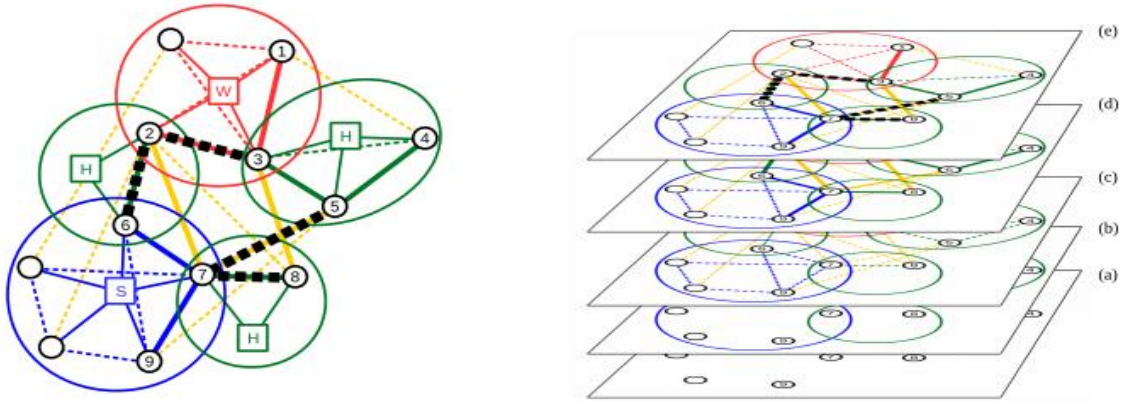
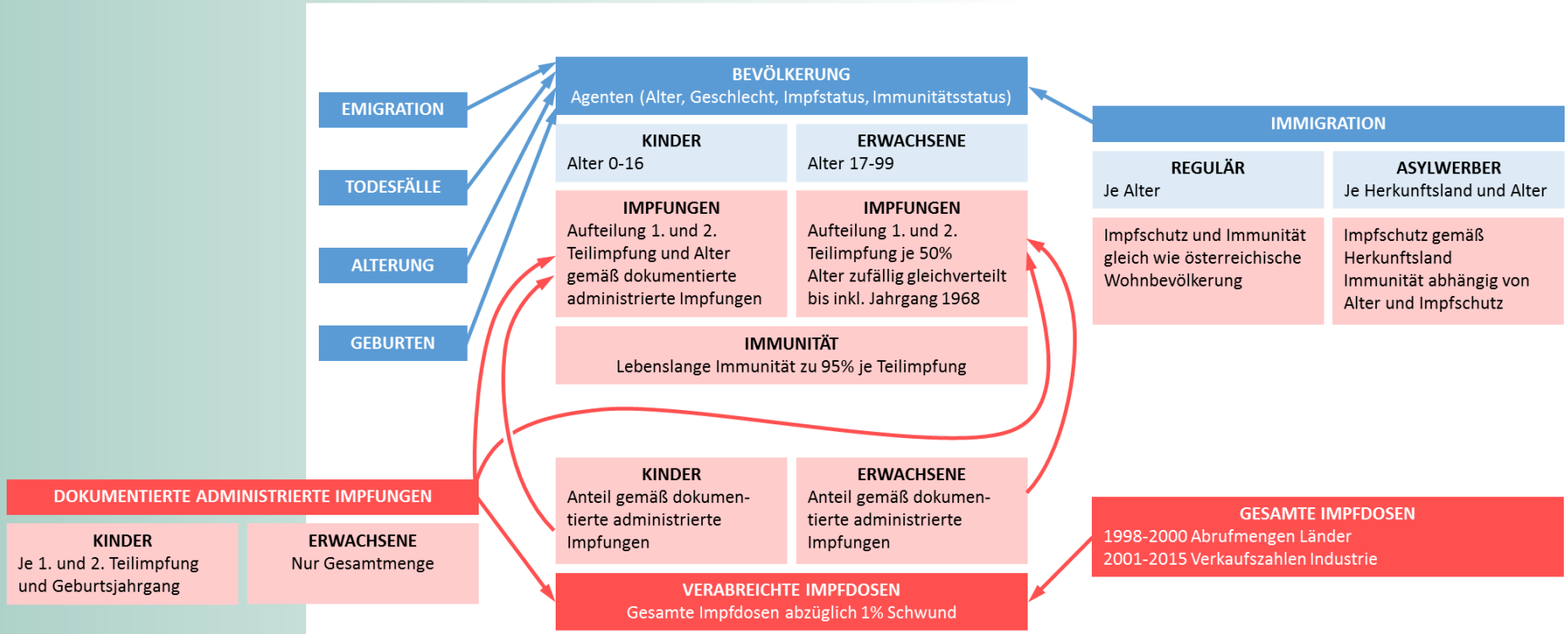


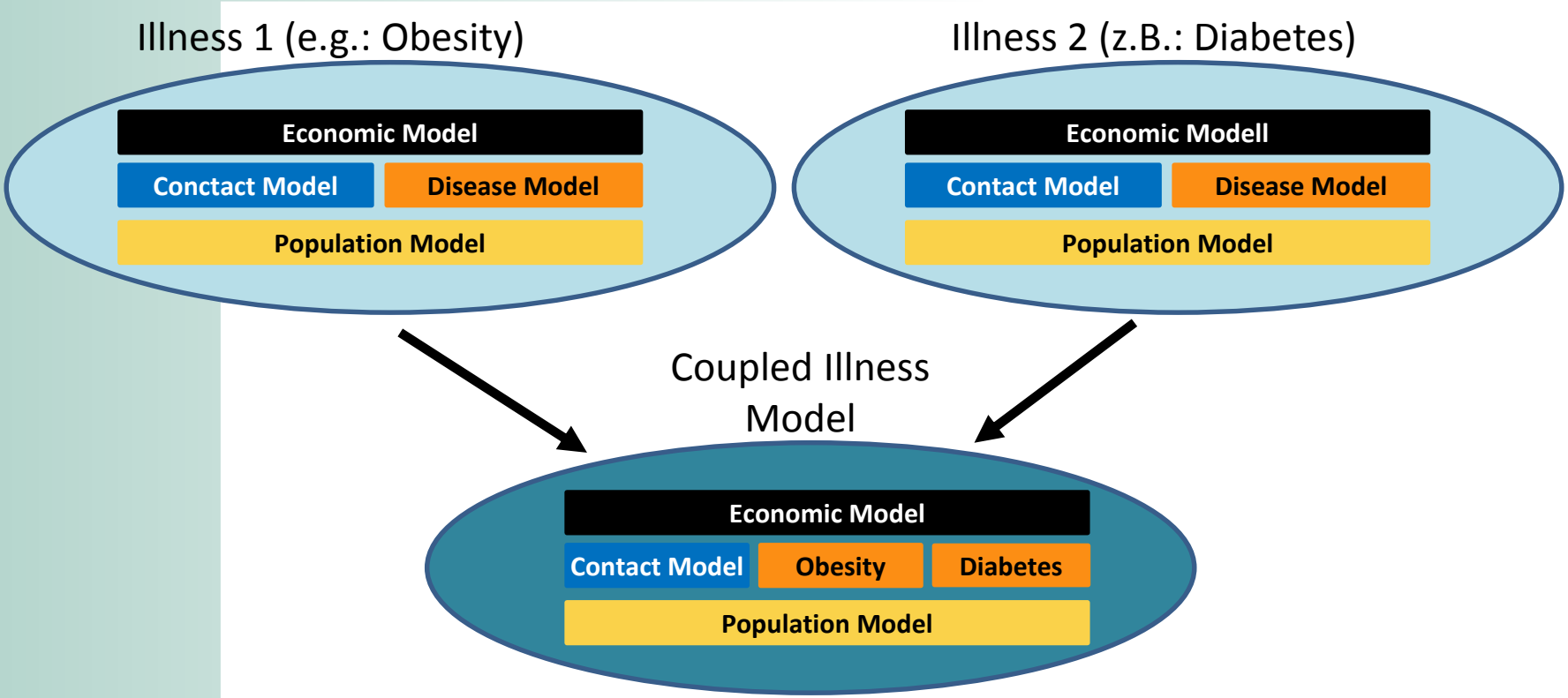
Figure 1: Visualization of the basic network layout. Households (H), workplaces (W) and school classes (S) and their memberships are depicted as green, red and blue blocks (b) of nodes (a). Social ties are indicated by dashed lines (c), derived contact patterns are shown as thick lines (d). Inter-block connections are distinguished by yellow lines. Instantiated temporal contacts are visualized as an overlaid black dashed pattern (e).

G. Schneckenreither, N. Popper, „Dynamic Multiplex Social Network Models on Multiple Time Scales for Simulating Patterns in Contact Formation and Epidemic Spread“ submitted Winter Simulation Conference 2017

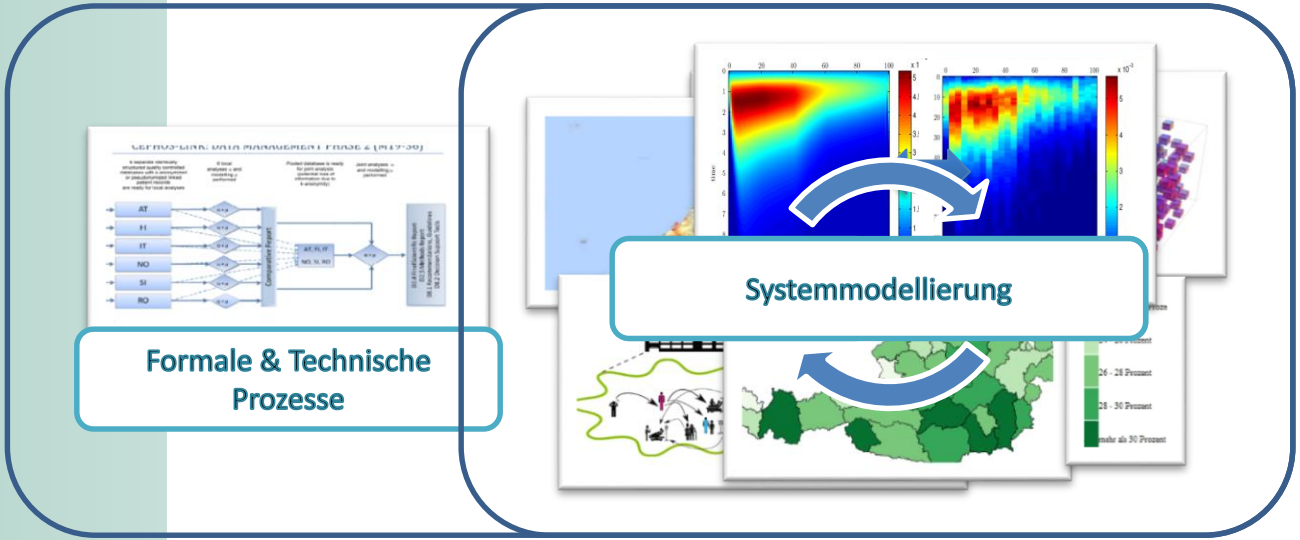
Intervention: Masernimpfung



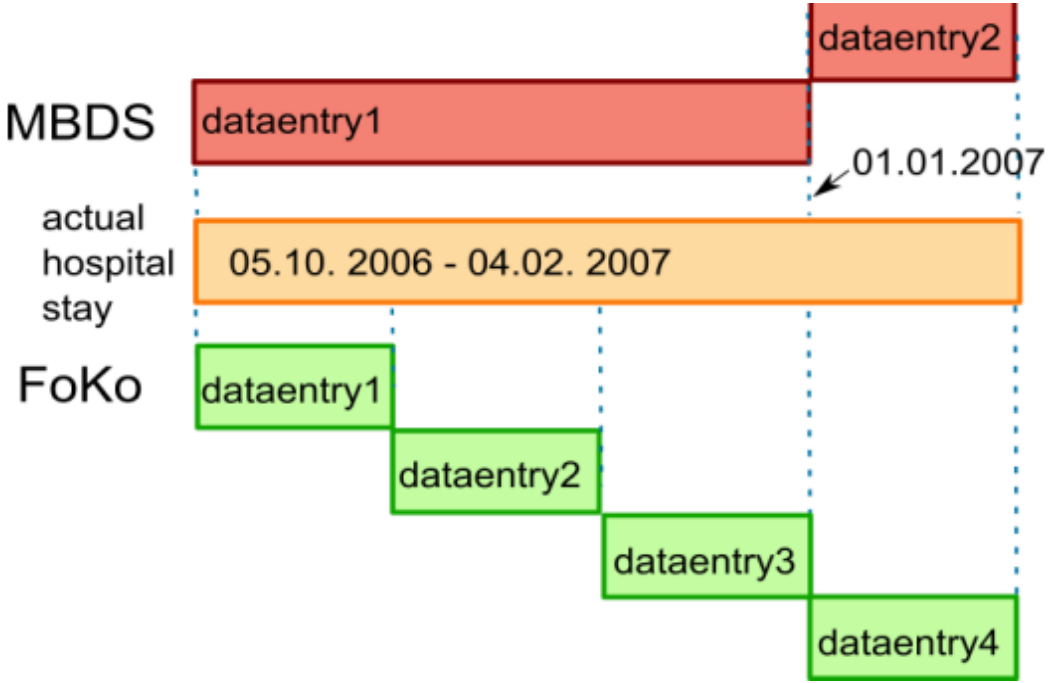
Modularität



Schritt 2: Datenintegration

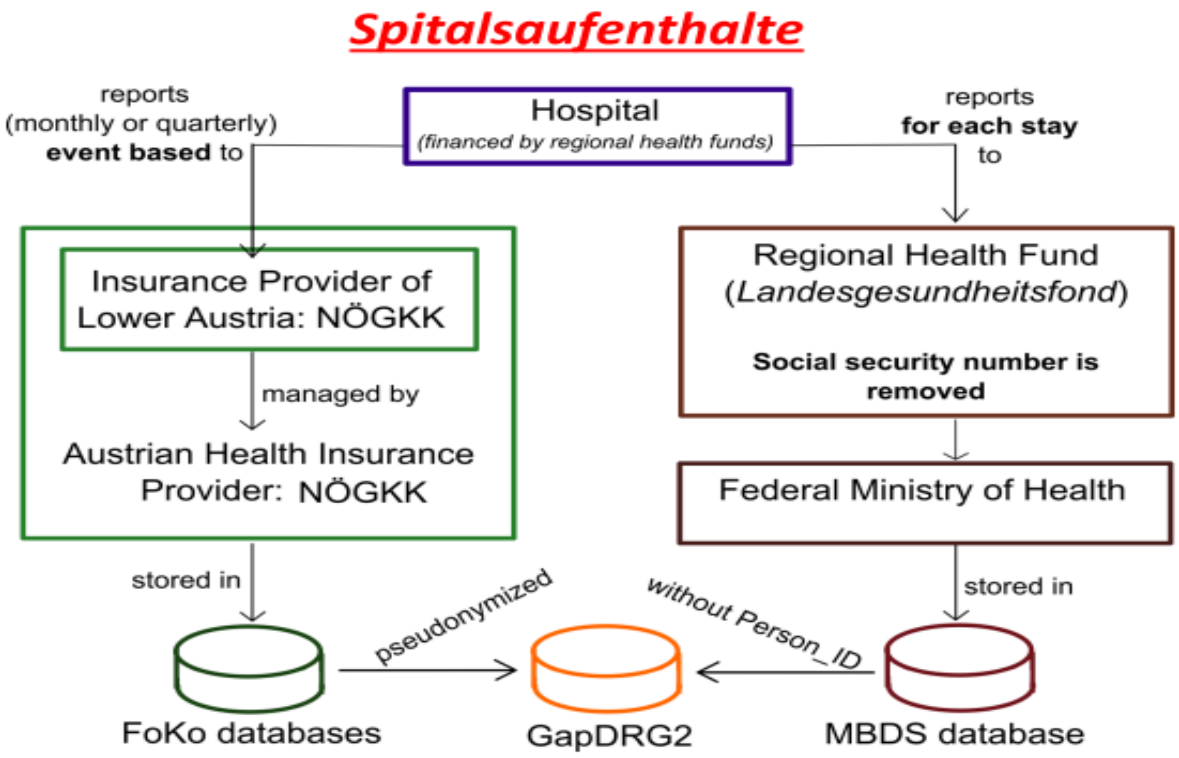


Record Linkage

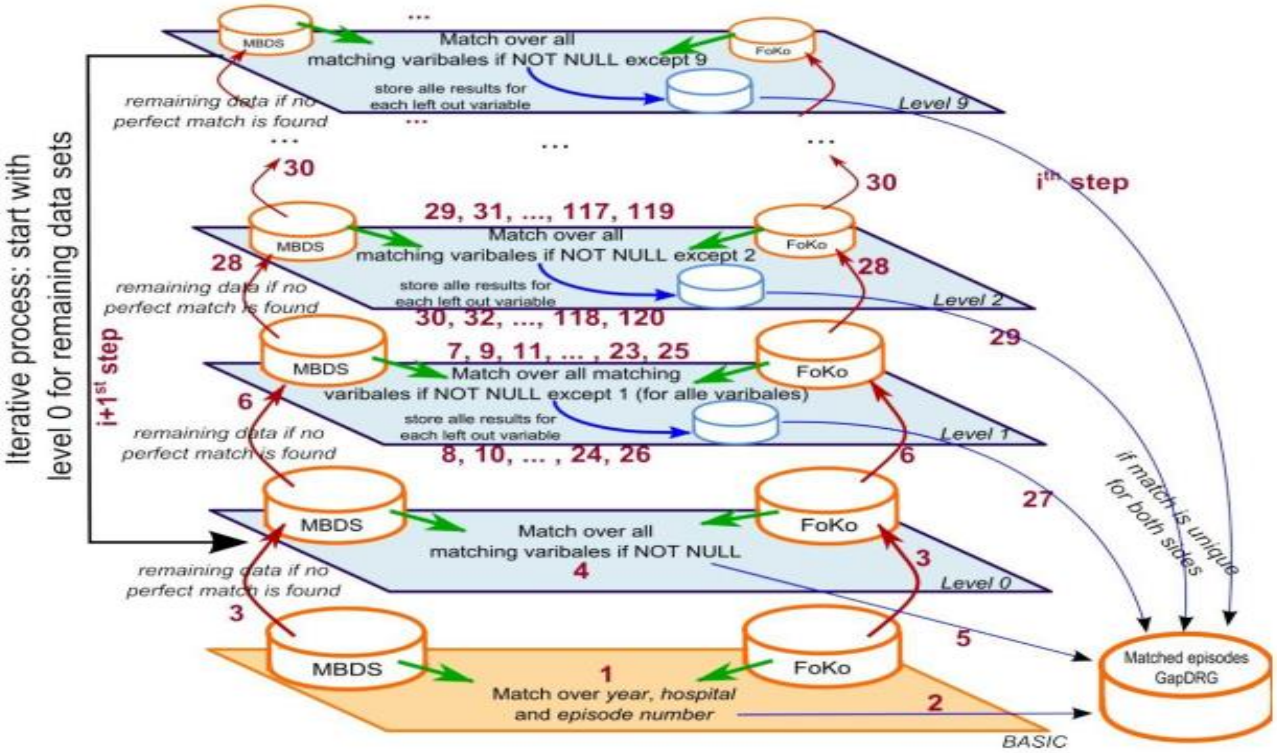


B. Glock, F. Endel et al: Challenges and Results with the Record Linkage of Austrian Health Insurance Data of Different Sources, Informatics for Health Conference 2017 (24 – 26. April, Manchester, UK)

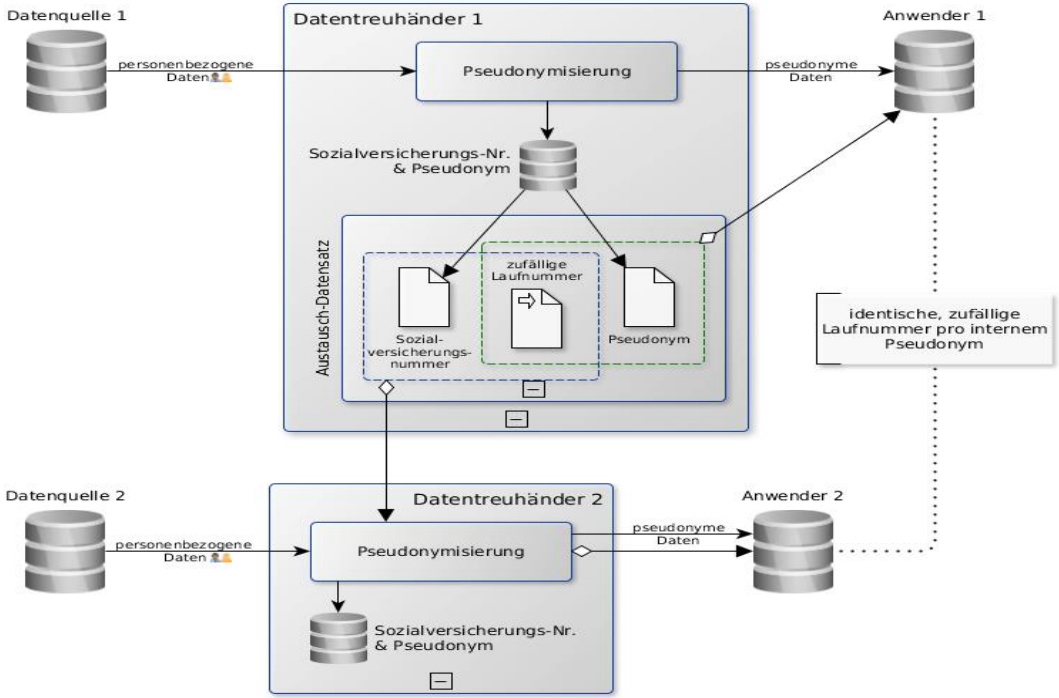
Record Linkage



Record Linkage

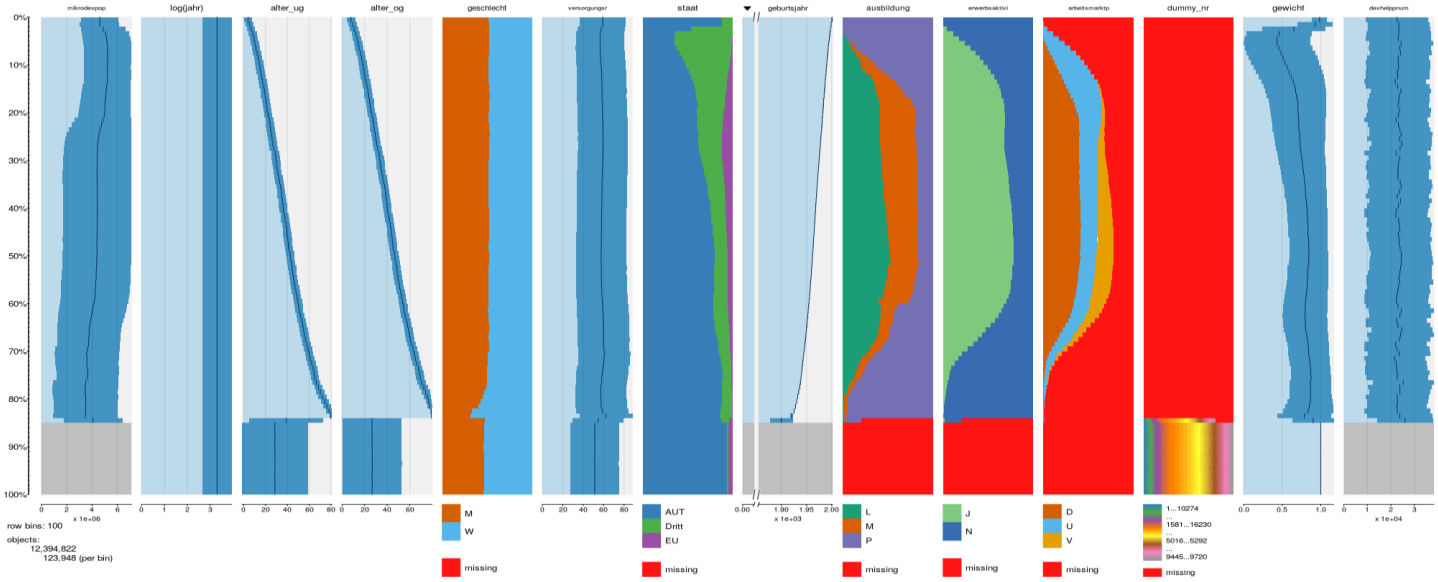


Record Linkage



F. Endel, M. Wagner-Pinter et al: Austausch pseudonymer Daten am Beispiel Osttirol – DEXHELPP Report

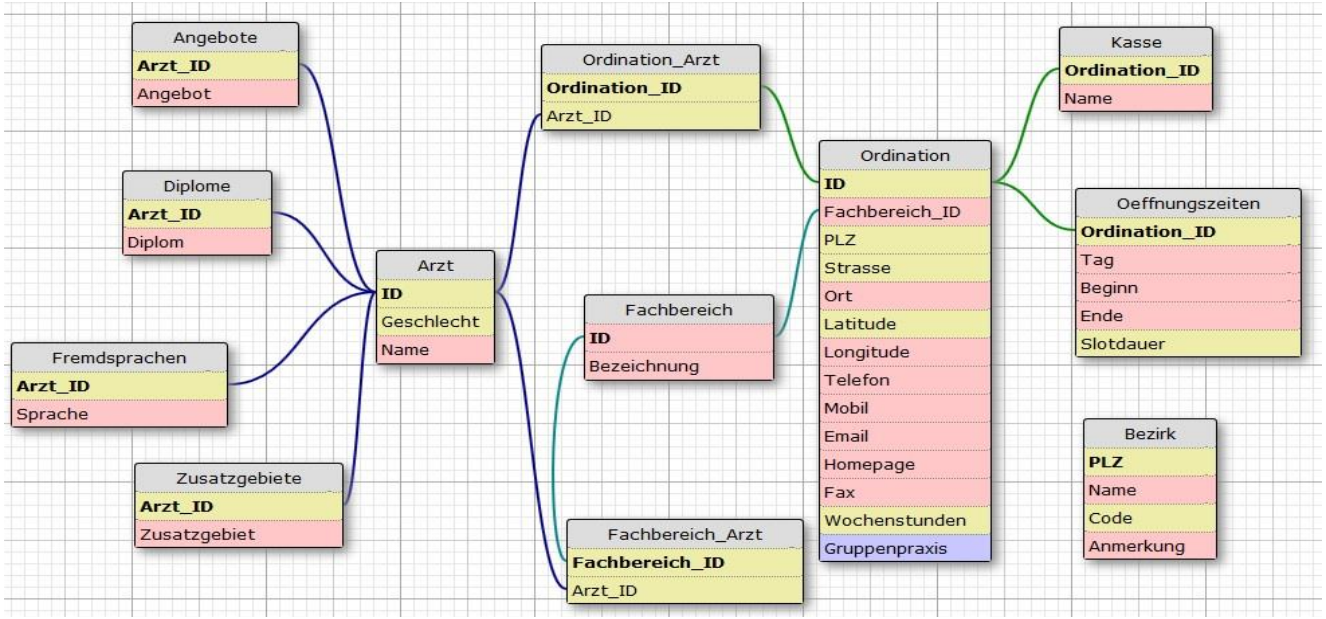
Qualitätssicherung



F. Endel, M. Wagner-Pinter et al: Austausch pseudonymer Daten am Beispiel Osttirol – DEXHELPP Report

Versorgungsatlas

Integration von Daten von Ärztekammer-Homepages, monatlich aktualisiert



M. Rossler, M. Wastian et al: Webscraping von Gesundheitssystemdaten, DEXHELPP Report

Versorgungsatlas

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- Ärzte gesamt: 16.500
- Ordinationen: 20.219
- Ordinationen mit Geokoordinaten: 13.607
- Gesamtwochenstunden: 193.899 h
- Allgemeinmedizin:
  - Ordinationen: 8.062
  - Ordinationen mit Vertrag: 3841
  - Gesamtwochenstunden: 89.594 h

Versorgungsatlas

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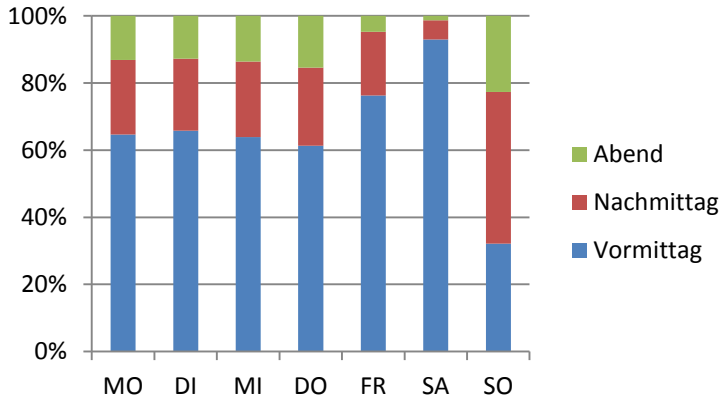
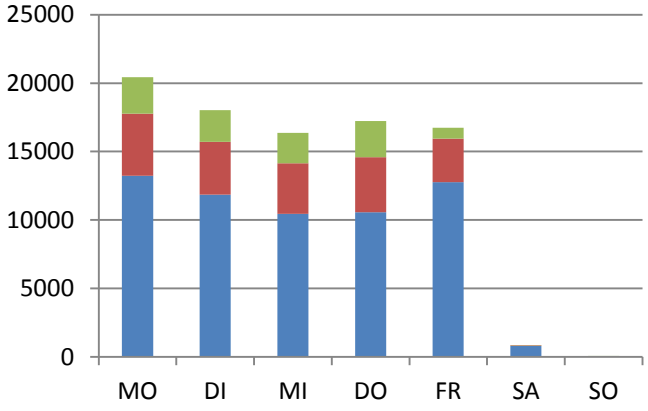
Beispiel Ordinationszeiten:

relativ



absolut



Schritt 3: Decision Support

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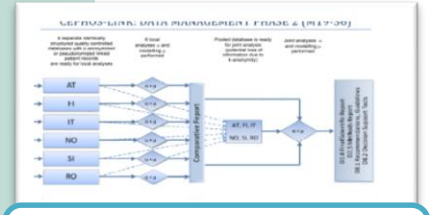
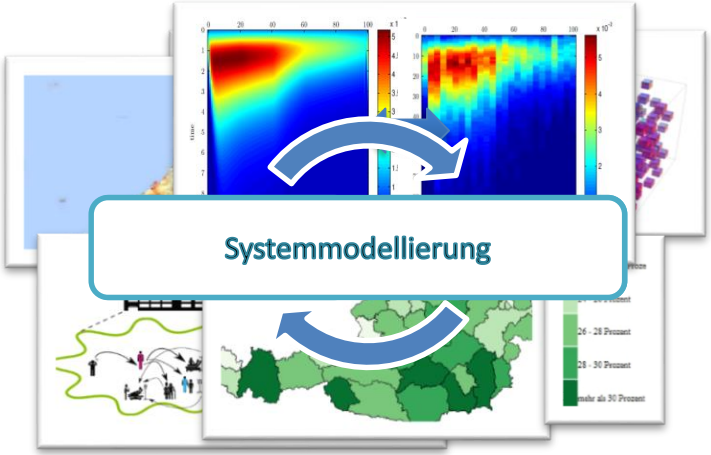
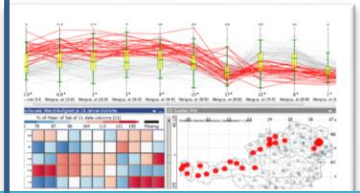


Formale & Technische Prozesse

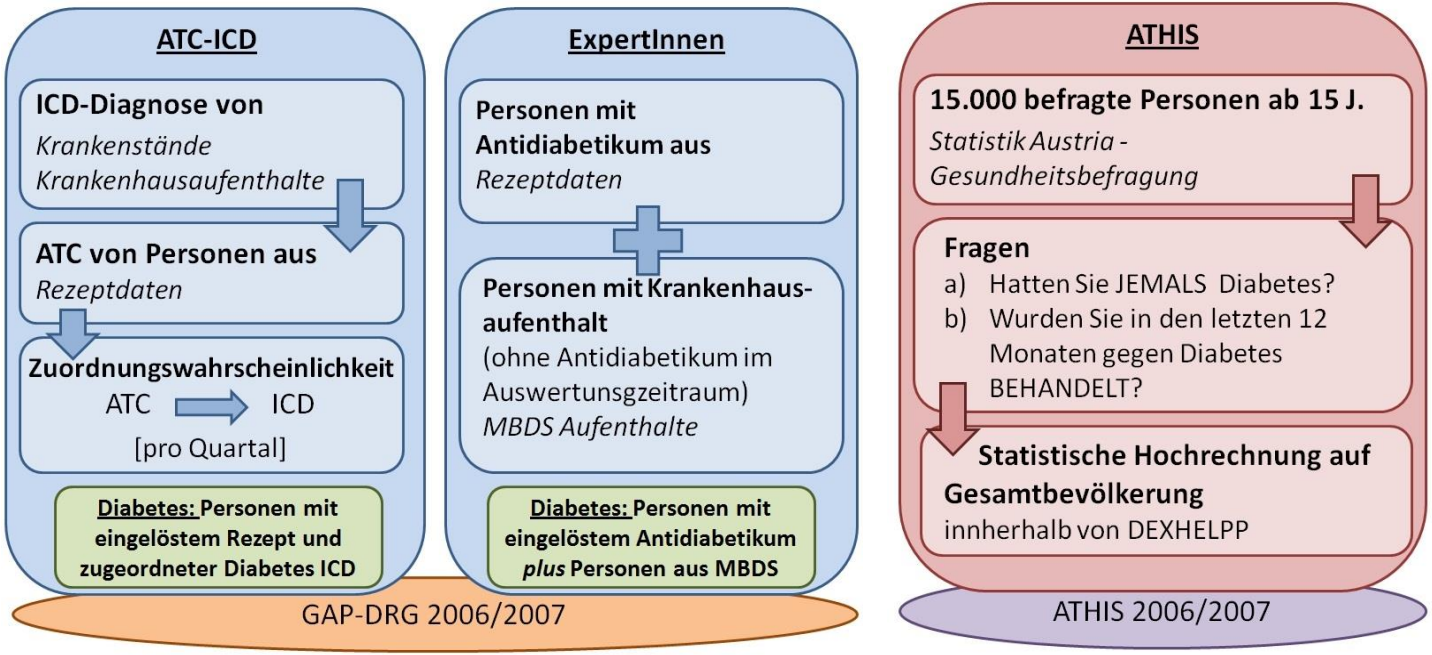


Systemmodellierung



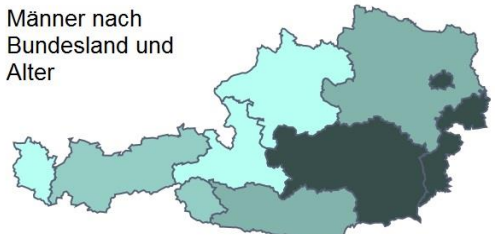
Decision Support & Anbindung an Prozesse (z.B: HTA)

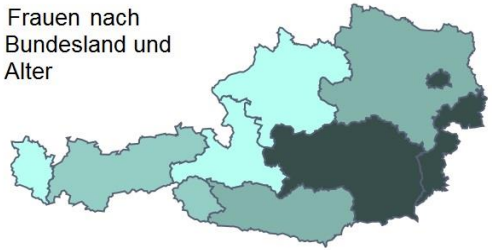
Unterschiedliche Quellen

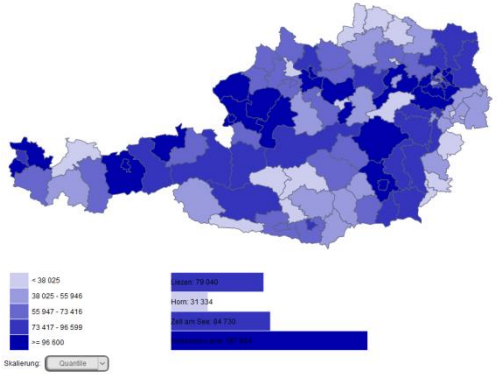


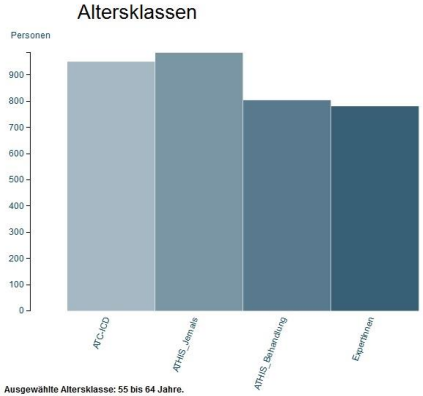
Epidemiologie Atlas, DEXHELPP Webseite www.dexhelpp.at

Darstellung Online







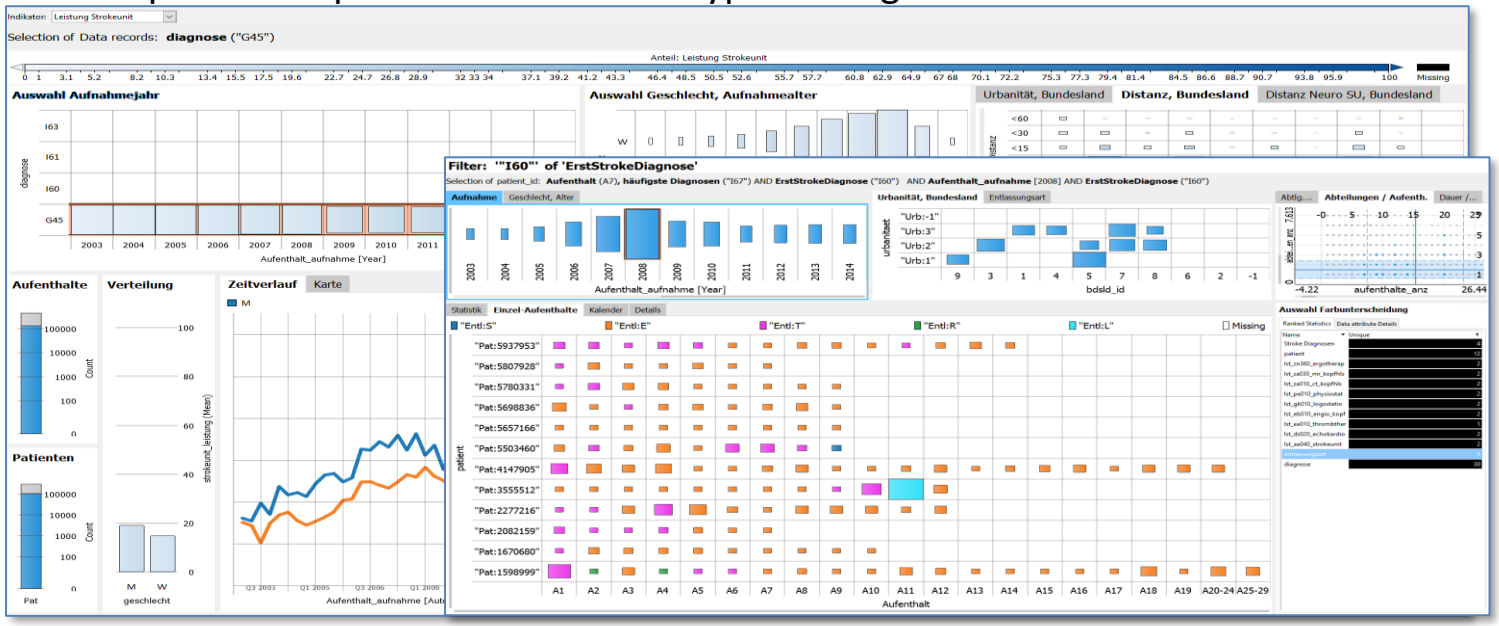


Epidemiologie Atlas, DEXHELPP Webseite www.dexhelpp.at

Schlaganfälle

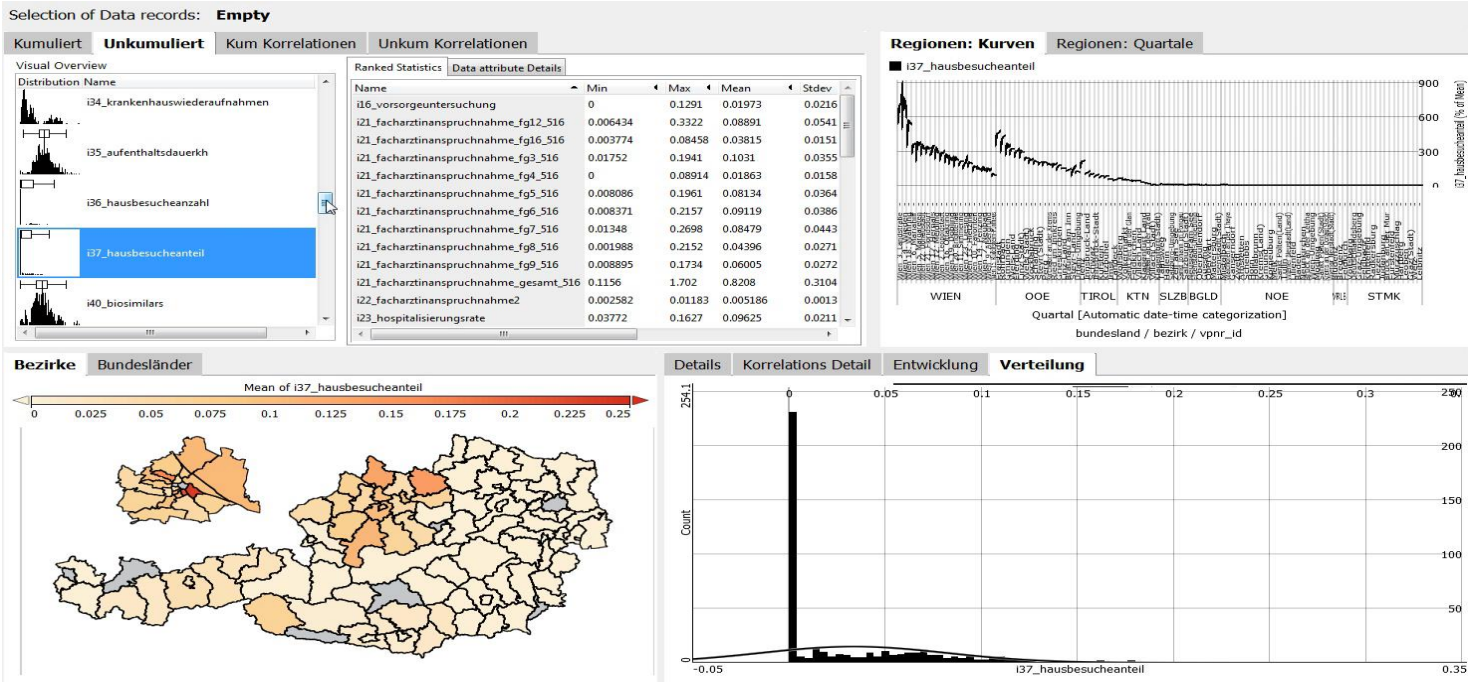
Applied to: Trend analysis of stroke treatment

- Percentage of patients being treated in stroke units
- Inspection of patient histories for hypothesis generation



M. Gyimesi et al: Stroke Analyse und Modellierung, DEXHELPP

Interaktive Dashboards



Schritt 4: Sichere Prozesse

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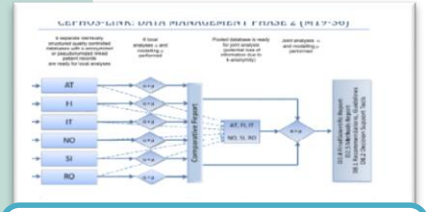
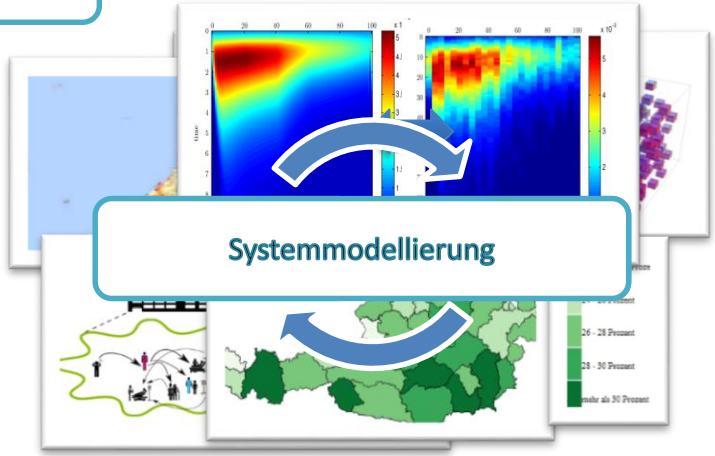
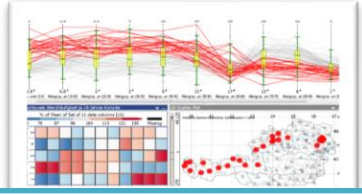
Szenarienrechnung



Formale & Technische Prozesse



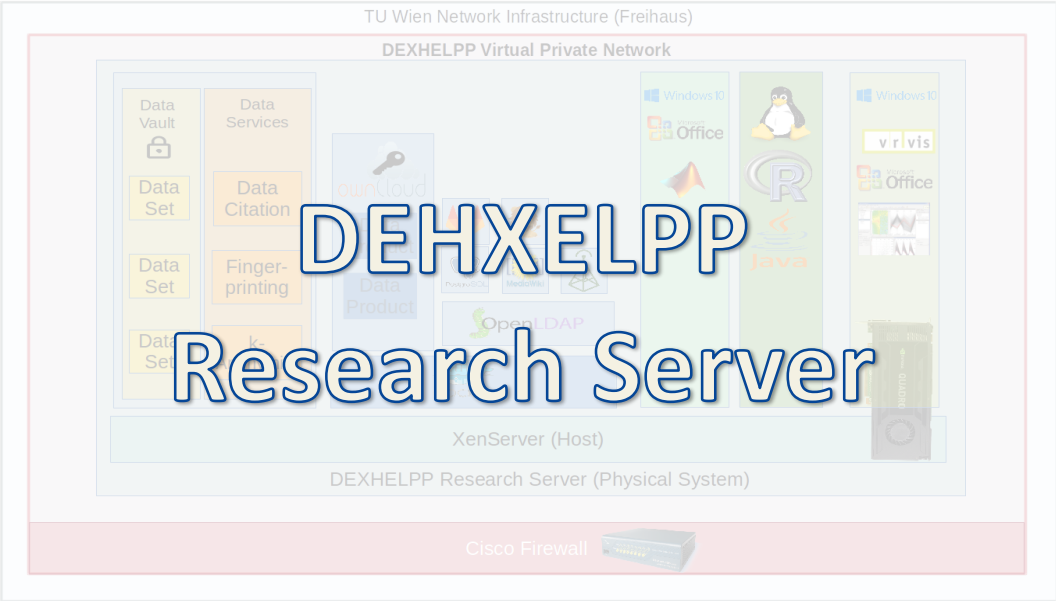
Systemmodellierung



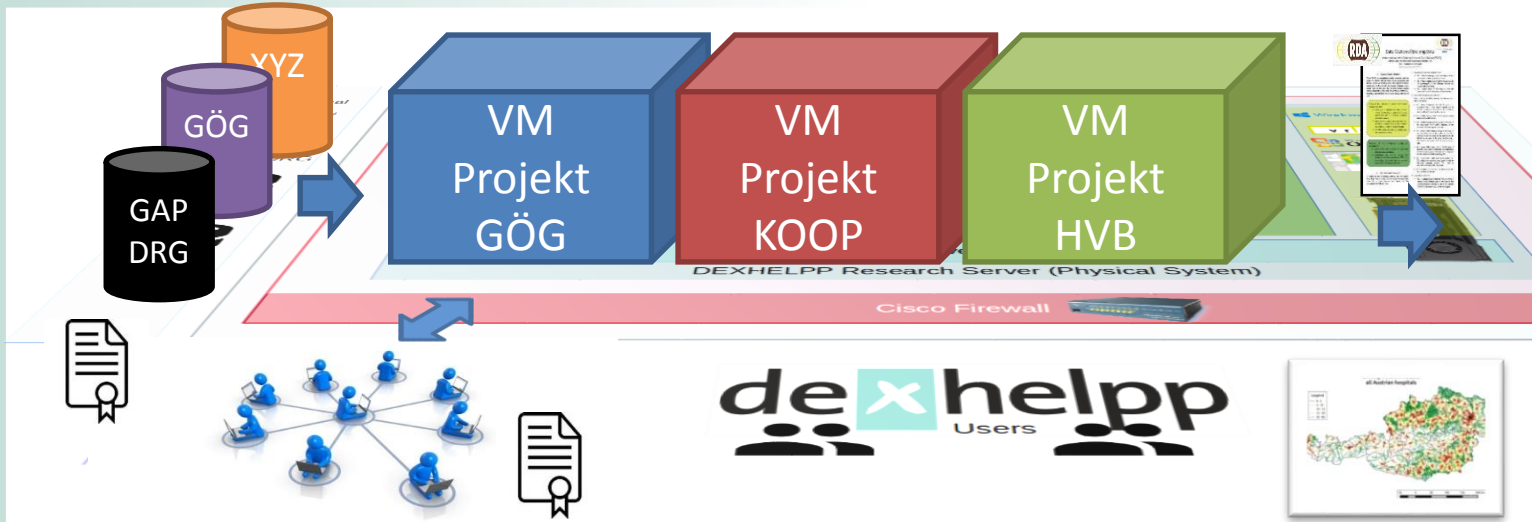
Decision Support & Anbindung an Prozesse (z.B: HTA)

Infrastruktur
DEXHELPP Server & Services

DEXHELPP Server



DEXHELPP Server



1. **Data:** Temporary and restricted to well defined Research
2. **Access:** Restricted and Reproducible
3. **Methods:** Usage of all Modelling & Simulation Methods
4. **Export:** Well defined Rules for Export and Usage

Best Practice CEPHOS

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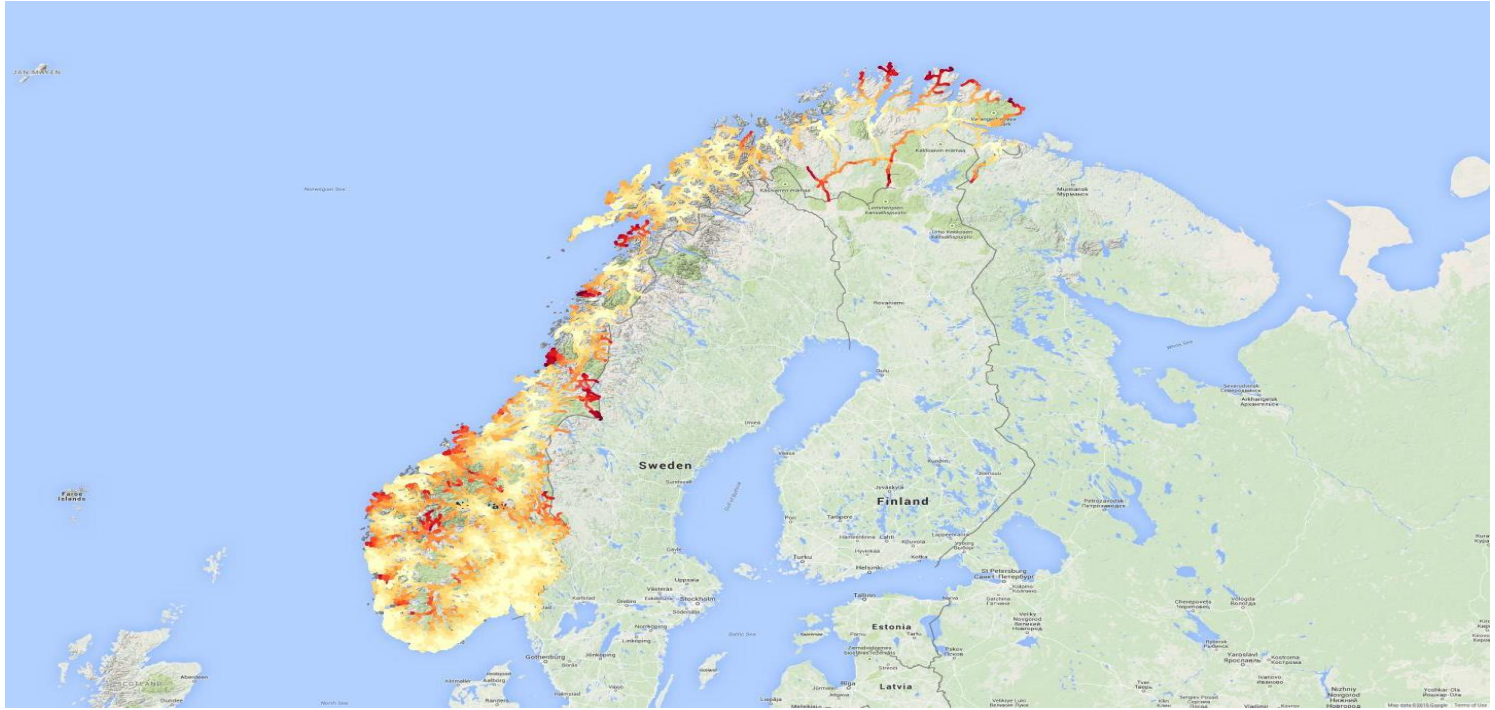
Comparative Effectiveness Research on Psychiatric Hospitalisation

Description: Comparative Effectiveness Research on Psychiatric Hospitalisation by Record Linkage of Large Administrative Data Sets

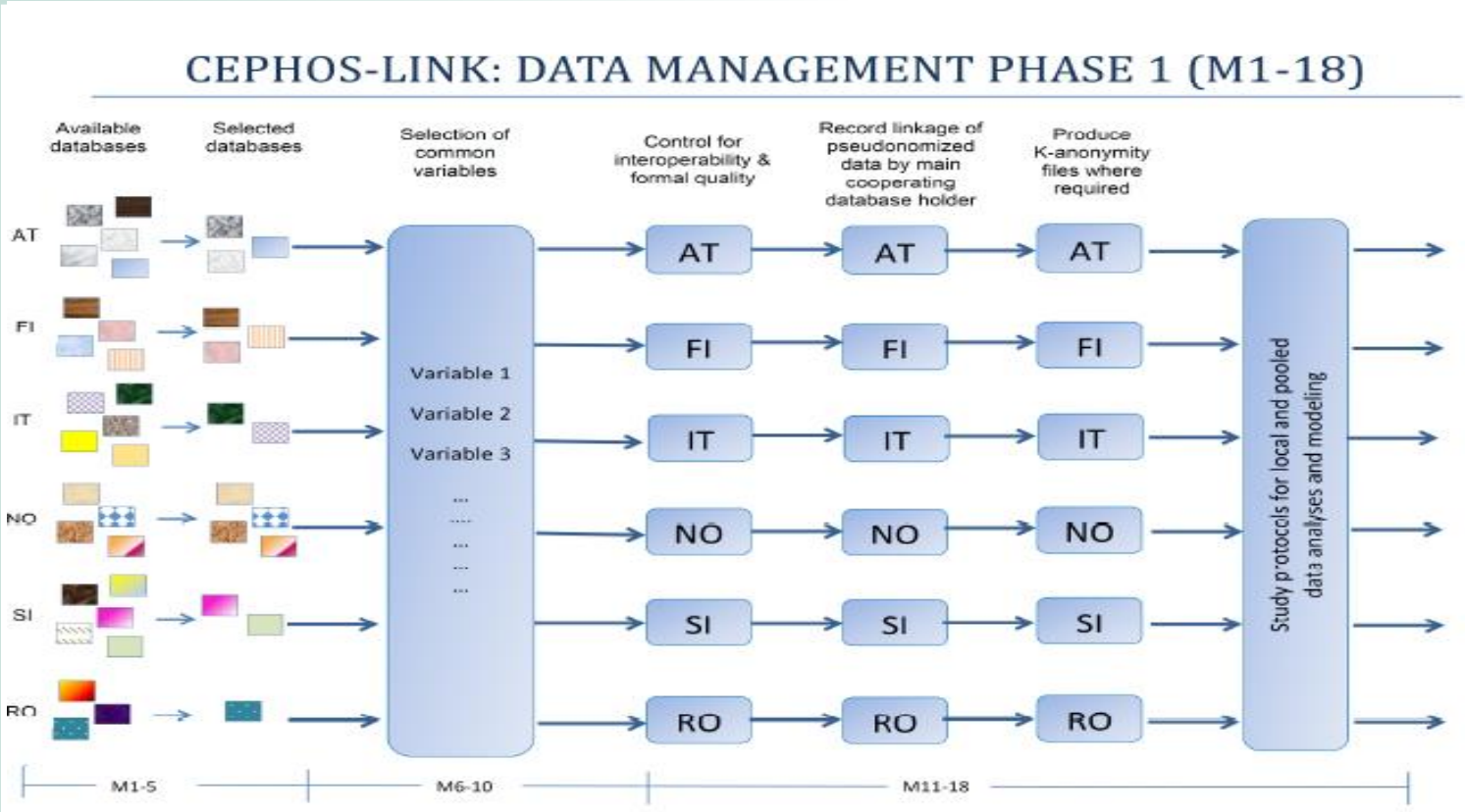
CEPHOS-LINK is a comparative European register-based study, performed by record linkage technique. It will develop a methods toolkit for conducting record linkage studies in the mental health care field and produce recommendations, guidelines and a set of decision support tools for decision makers in the field of mental health system.

Best Practice CEPHOS

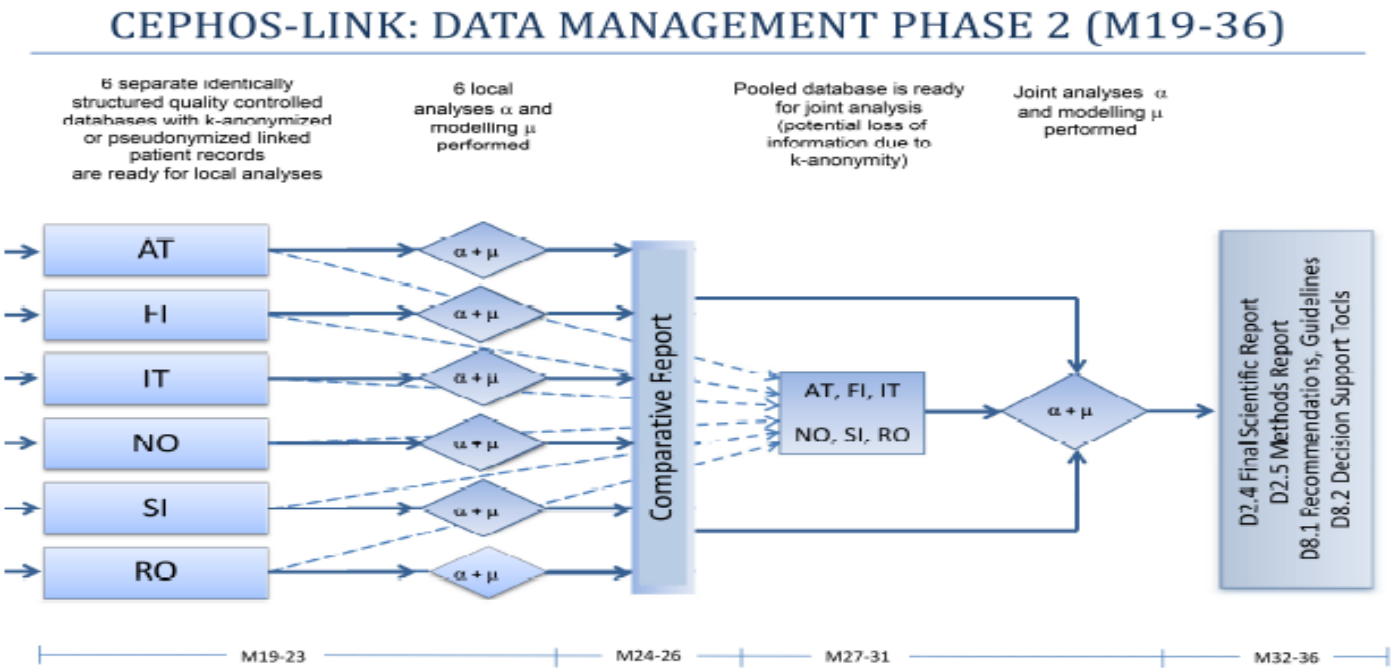


C. Urach, G. Zauner et al "Statistical methods and modelling techniques for analysing hospital readmission of discharged psychiatric patients: a systematic literature review"; BMC Psychiatry (2016)

Best Practice CEPHOS



Best Practice CEPHOS



Schritt 5: Integration

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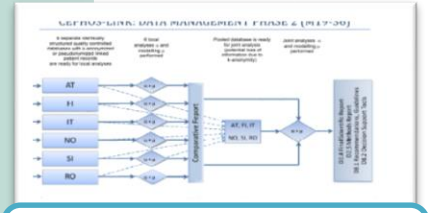
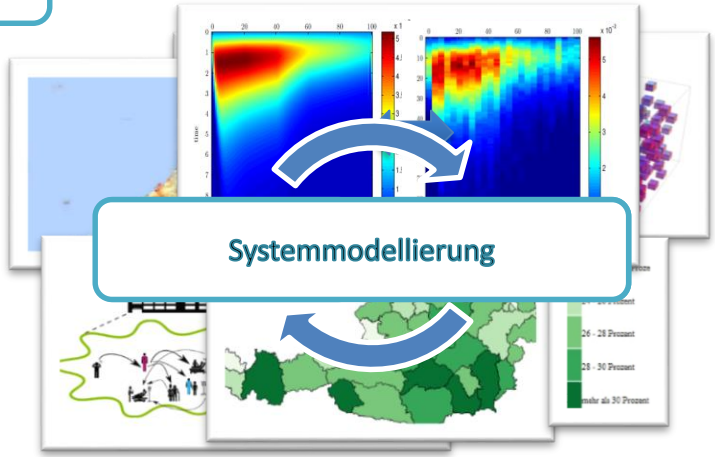
Umsetzung
Entscheidungsträger nat./int.

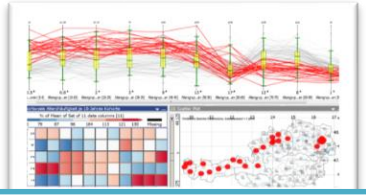
Szenarienrechnung



Formale & Technische Prozesse



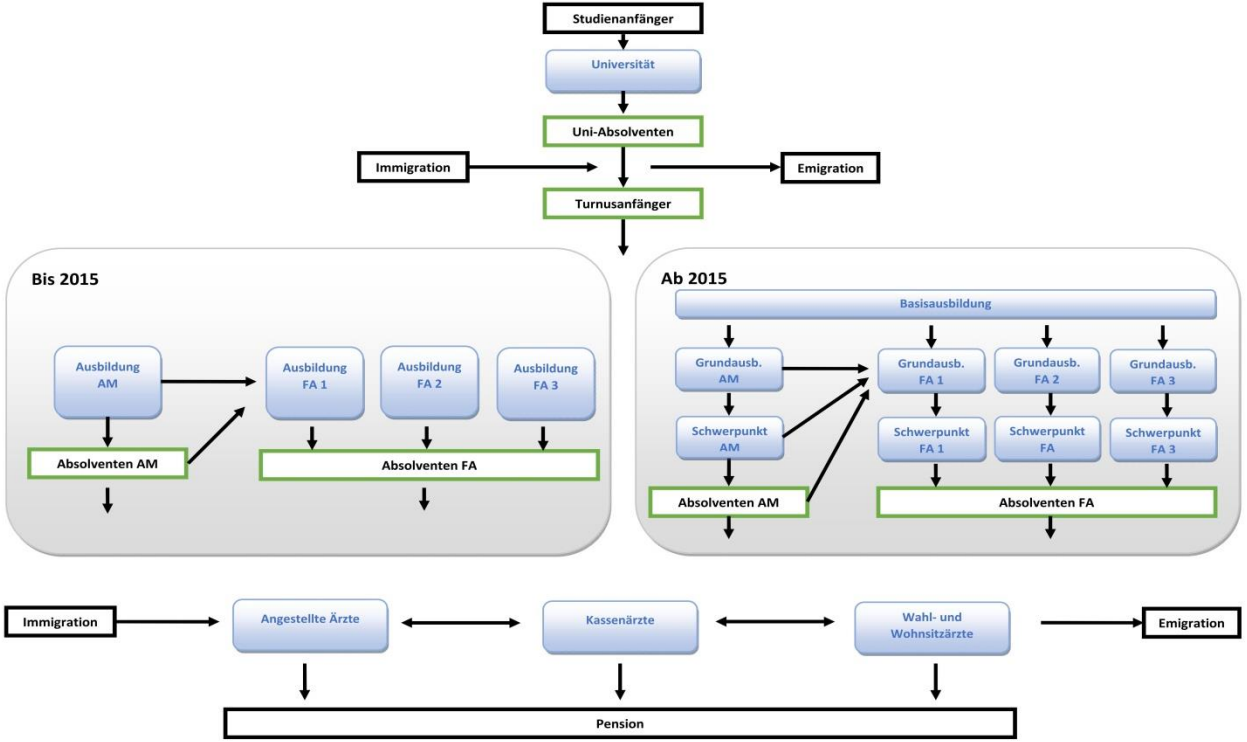
Systemmodellierung



Decision Support & Anbindung an Prozesse (z.B: HTA)

Infrastruktur
DEXHELPP Server & Services

Health Workforce Prognosis



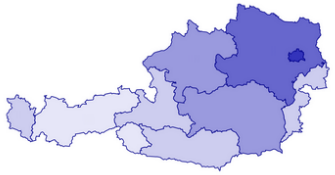
I. Czasny, C. Rippinger et al, Entwicklung HWFP Modell und Decision Support Tool, DEXHELPP Report intern

Health Workforce Prognosis dexhelpp

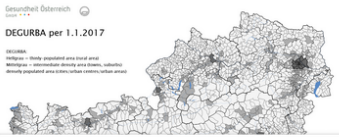
Gesundheit Österreich GmbH

HWFP-Core

dexhelpp



Darstellung auf Bundeslandebene



Darstellung nach Urbanisationsebene

Alle Geschlechter | Alle Fächer | Zugänge: Alle Sektoren | Abgänge: Alle Sektoren

Setting 1: Basisvariante (abgestimmt) | Setting 2: Frei wählbar

Karenzen berücksichtigt: ☐
Migration: ☐

Karenzen berücksichtigt: ☐
Migration: ☐

Kumuliert: ☐

Beschreibung Zugangsszenario:

Ausbildungsstellen

AllgemeinmedizinerInnen:	2000
FachärztInnen:	4700
Wechsel:	mittel

Beschreibung Zugangsszenario
Wechsel von AM zu FA während der Ausbildung
bis 2015: 22%
nach 2015: 10%
Zusätzliche FA-Ausbildung nach abgeschlossener AM-Ausbildung:
bis 2015: 50%
nach 2015: 5%

Beschreibung Abgangsszenario:

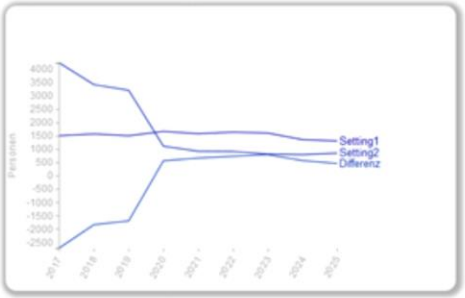
	Pensionsalter (55-70)	verl.*
niedergelassene Ärzte:	55	☐
niedergelassene Ärztinnen:	55	☐
angestellte Ärzte:	55	☐
angestellte Ärztinnen:	55	☐

Zusätzliche Annahmen:
Jährlich geht die Hälfte der Personen, die länger arbeiten, in Pension.
*) verlängerbar:
ja: die Personen können bis maximal 5 Jahre länger arbeiten
nein: Alle Personen gehen mit Erreichen des Pensionsantrittsalters in Pension
Niedergelassen: bezeichnet §2-KassenärztInnen, ÄrztInnen mit kleinen Kassen, sowie Wahl- und WohnsitzärztInnen

Vergleich der Abgänge

Jahr	Setting1	Setting2	Differenz
2017	1498	4216	-2718
2018	1565	3404	-1839
2019	1496	3195	-1699
2020	1660	1104	556
2021	1572	914	658
2022	1632	906	726
2023	1598	810	788
2024	1351	786	565
2025	1301	845	456

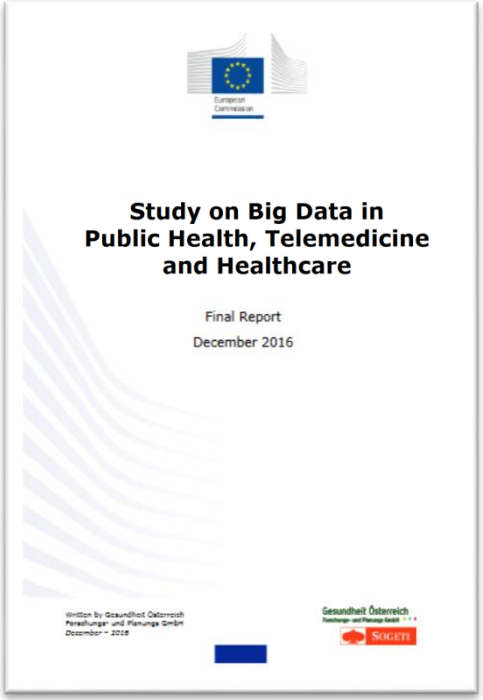
Export: Copy | CSV | Excel

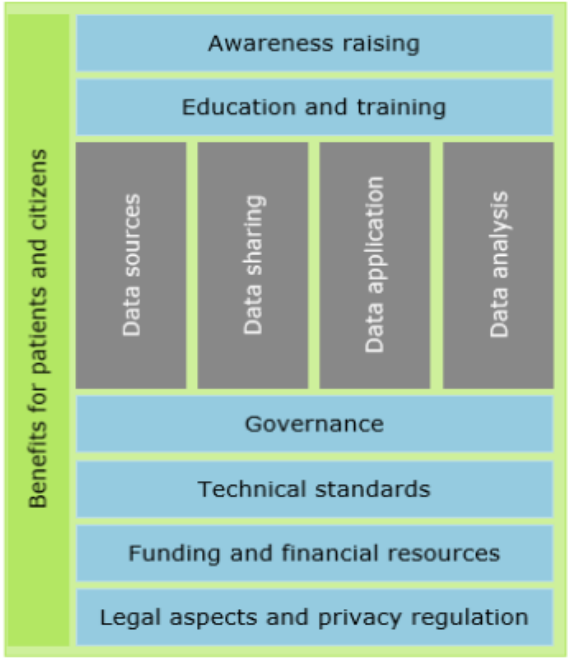


Features

1. Potential zur Integration fehlender Daten
2. Methoden zur Qualitätssicherung der Daten
3. Priorität für Datenschutz und Stakeholdersichtweisen
4. Modulare & effiziente Lösungen
5. Einfach über die Zeit “fortführbare” Konzepte
6. Reproduzierbarkeit der Prozesse
7. Differenziertere Methoden für komplexere Fragen
8. Breite Einsetzbarkeit (HTA, Versorgungsforschung, Ökonomie, etc…)
9. Offene und unabhängige Lösungen
10. Vergleichbarkeit der Ergebnisse

Policy





Overview of fields of policy recommendations

https://ec.europa.eu/health/sites/health/files/ehealth/docs/bigdata_report_en.pdf

Policy

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The following twenty examples of use of Big Data in Health were identified and selected for further analysis:

- Comet K-Project DEXHELPP – AT
- The Shared Care Platform – DK
- E-Estonia – National Identity Scheme – EE
- AEGLE (An analytics framework for integrated and personalized healthcare services in Europe) – UK, IT, GR, SE, BE, NL, PT, FR
- The Business Intelligence database system – GR
- PASSI (Progressi delle Aziende Sanitarie) – IT
- Arno Observatory – IT
- The Swedish Big Data Analytic Network – SE
- Clinical Practice Research Datalink (CPRD) – UK
- Sentinel Stroke National Audit Programme (SSNAP) – UK
- Hospital Episode Statistics (HES) – UK (England)
- The YODA Project (Yale University open data access) – US
- FDA Adverse Event Network Analyser - US
- CEPHOS-LINK – FI, AT, RO, NO, SI, IT
- Twitter (Adverse drug reactions and public health) – International
- Flatiron – US
- UK Biobank – UK
- Semantic Data Platform for Healthcare (SEMCARE) – DE, NL, AT, UK, ES
- Integrated BioBank of Luxembourg (IBBL) – LU
- Spanish Rare Diseases Registries Research Network (SpainRDR) – ES

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Recommendations

- Recommendation 1 on Awareness Raising:
  Develop and implement a communication strategy to increase the awareness of the added value of Big Data in Health and encourage a positive public mind set towards Big Data in Health
- Recommendation 2 on Education and Training
  Strengthen human capital with respect to the increasing need for a workforce that can utilize the potential of Big Data in Health
- Recommendation 3 on Data Sources:
  Expand existing and explore new sources of Big Data in Health and secure their quality and safety
- Recommendation 4 on Open Data and Data Sharing:
  Promote open use and sharing of Big Data in Health without compromising patients' rights to privacy and confidentiality
- Recommendation 5 on Applications and Purposes:
  Increase target-oriented application of Big Data analysis in health based on the needs and interests of stakeholders including patients

Policy

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Recommendations

- Recommendation 6 on Data Analysis:
  Identify the potentials of Big Data analysis, improve analytical methods and facilitate the use of new and innovative analytical methods
- Recommendation 7 on Governance of Data Access and Use:
  Implement governance mechanisms to ensure secure and fair access and use of Big Data for research in health
- Recommendation 8 on Standards:
  Develop standards for Big Data in Health to enhance and simplify its application and improve interoperability
- Recommendation 9 on Funding and Financial Resources:
  Ensure purposeful investment steered by the European Commission to warrant cost-effectiveness and sustainability
- Recommendation 10 on Legal Aspects and Privacy Regulations:
  Clarify and align existing legal and privacy regulation of Big Data in Health

Validierung

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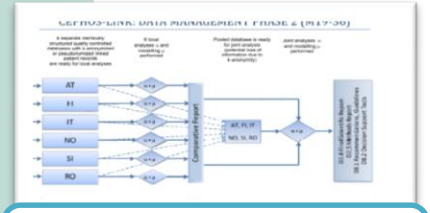
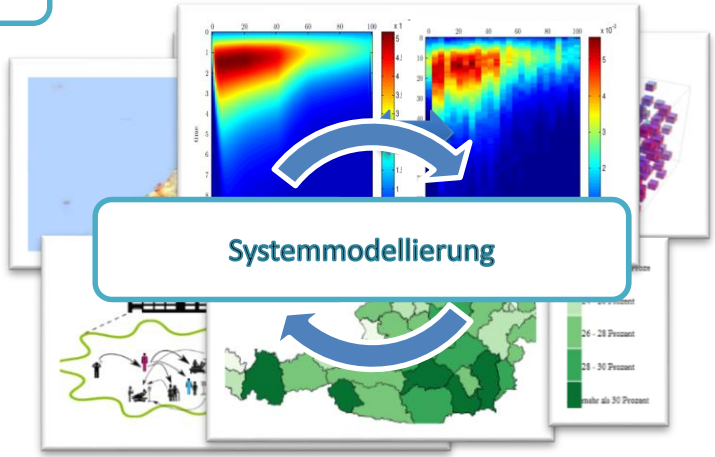
Umsetzung
Entscheidungsträger nat./int.

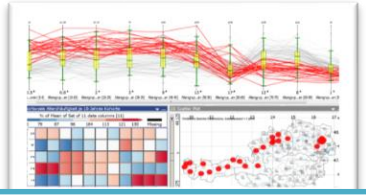
Szenarienrechnung



Formale & Technische Prozesse



Systemmodellierung



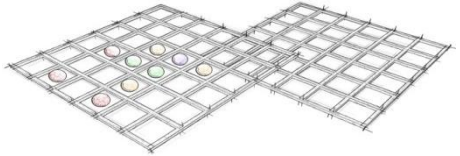
Decision Support & Anbindung an Prozesse (z.B: HTA)

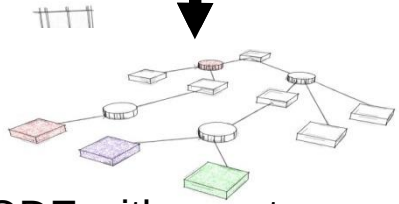
Infrastruktur
DEXHELPP Server & Services

Validierung

Modelling of infectiuous diseases: Pneumococcal modelling systems

Real world



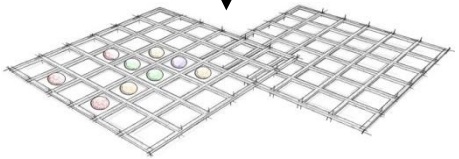


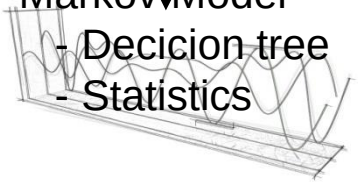
AB with const. population

ODE with const. population

Markov Model

- Decicion tree
- Statistics





AB with populationdynamics

ODE with populationdynamics

Validierung

a) Gebräuchliche Prognosemodelle (Markov-Modelle, auf Österreich umgerechnet):
E.D.G. McIntosh, P. Conway, J. Willingham, R. Hollingsworth, and A. Lloyd. The cost-burden of paediatric pneumococcal disease in the UK and the potential cost-effectiveness of prevention using 7-valent pneumococcal conjugate vaccine. Vaccine, 2003 Jun 2,21(19-20):2564-72

b) Dynamisches Pneumokokkenmodell, 2009 – Simulationsergebnisse:
u.a.: C. Urach, "Modellierung und Simulation von Impfstrategien gegen Pneumokokkenerkrankungen: Markov- und Differentialgleichungsmodelle im Vergleich" (Diploma Thesis, Inst. f. Analysis und Scientific Computing, Vienna University of Technology, 2009).

c) Erhebung aus den USA, 2010 (auf Österreich umgerechnet):
Hsu KK et al. Changing serotypes causing childhood invasive pneumococcal disease: Massachusetts, 2001–2007. Pediatr Infect Dis J 2010 Apr; 29:289

Ausblick

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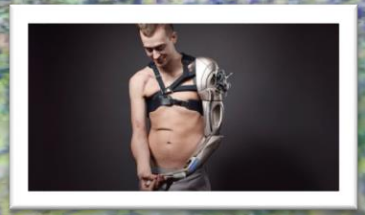

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FFG

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Ein Fonds der Stadt Wien