

Medical information systems and economic aspects of facility planning

Biomedical Technologies in Diagnostics and Therapy, SS 2018

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Who I am

Jens Maschmann

- Pediatrician, M.D.
- Medical Informatics, Quality management
- Tübingen: medical school, 3 years of residency
- Würzburg: 3 years residency, pediatrician
- Bielefeld: 3,5 years strategic planning for 3 local hospitals and a league of 10 hospitals
- Tübingen: 8,5 years Head of Dept. for Medical structure, process and quality management
- Jena: Chief Medical Officer, University Hospital

Integrated action

The logo of the UKT represents its three core activities:

- Patient care
- Research
- Teaching



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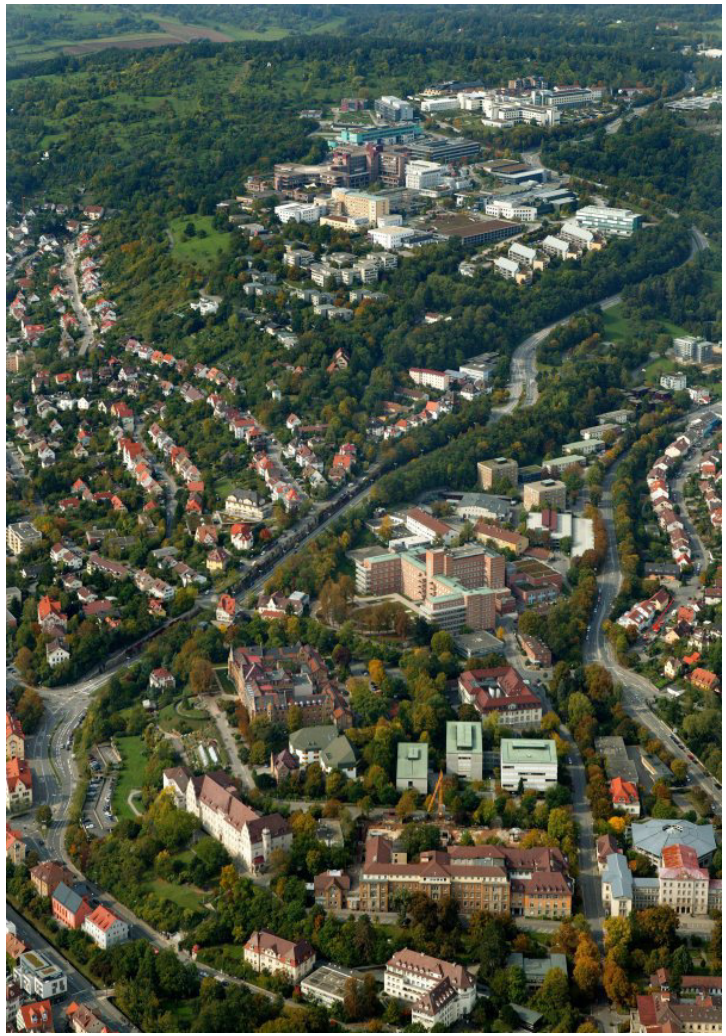
University Hospital Tübingen at a glance

- 17 departments, 38 units
- 8 institutes, 13 units
- 8500 employees
- 2 locations with approx. 1.500 beds
- Approx. 64.000 inpatients p. a.
- ca. 360.000 outpatients p.a.
- Medical competences (examples)
  - Transplantation
  - Comprehensive Cancer Center
  - Neurosciences
  - Top of the edge imaging (MRI, CT, PET, CT-PET, MRI-PET, MEG)
  - Centre of Perinatology
  - Many specialized outpatient clinics



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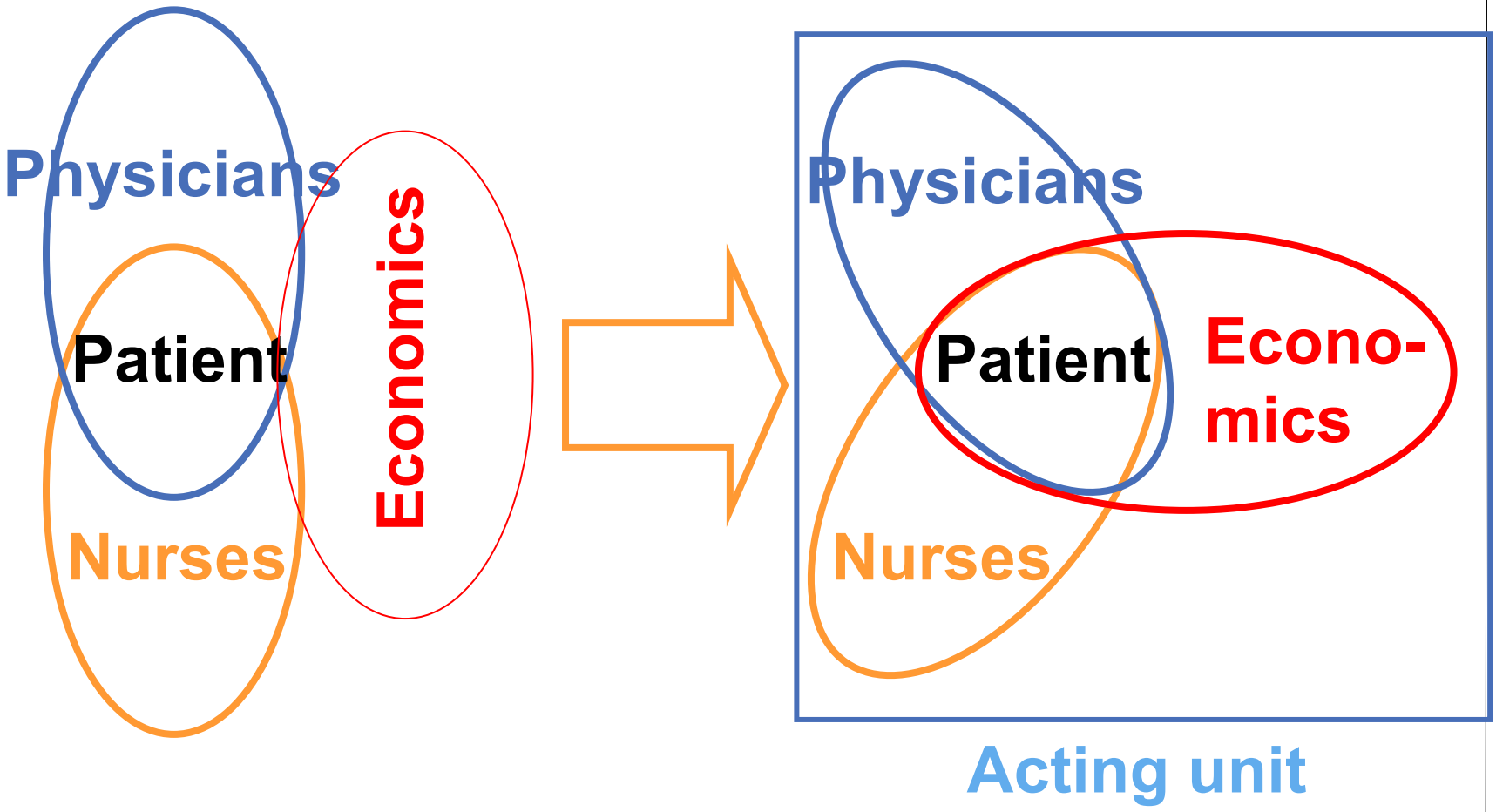
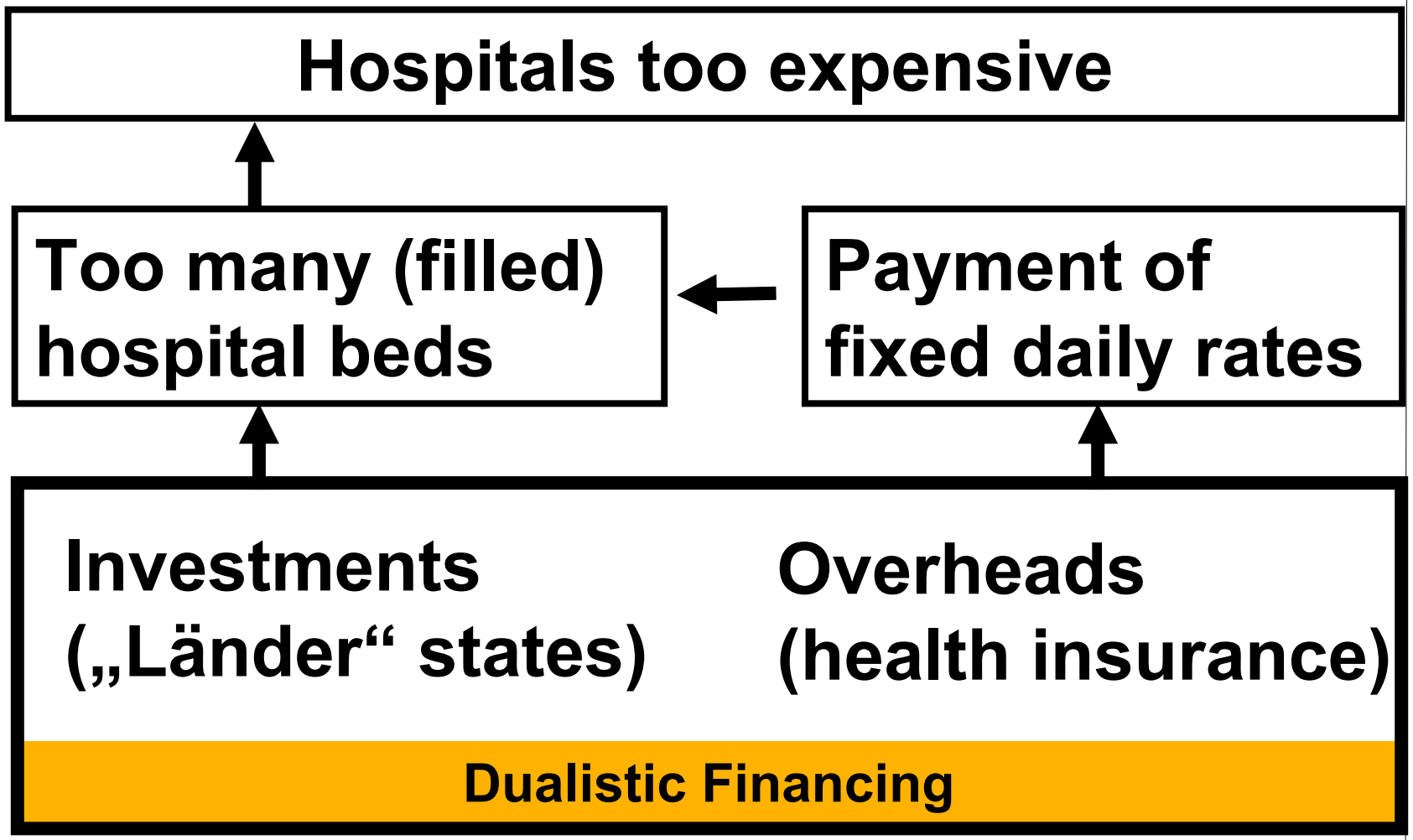
The Challenge

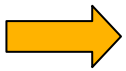


The hospital sector



The change in financing hospitals

- 1972: Selbstkostendeckungsprinzip (full coverage of all expenses in hospitals)
- 1995: Fallpauschalen/Sonderentgelte (mini-DRG) and freezing of hospital budgets
- 2000: Decision to implement DRG (AR-DRG 4.1)
- 2004-2009: period of budget convergence
- 2010: complete DRG-based reimbursement



competition between hospitals

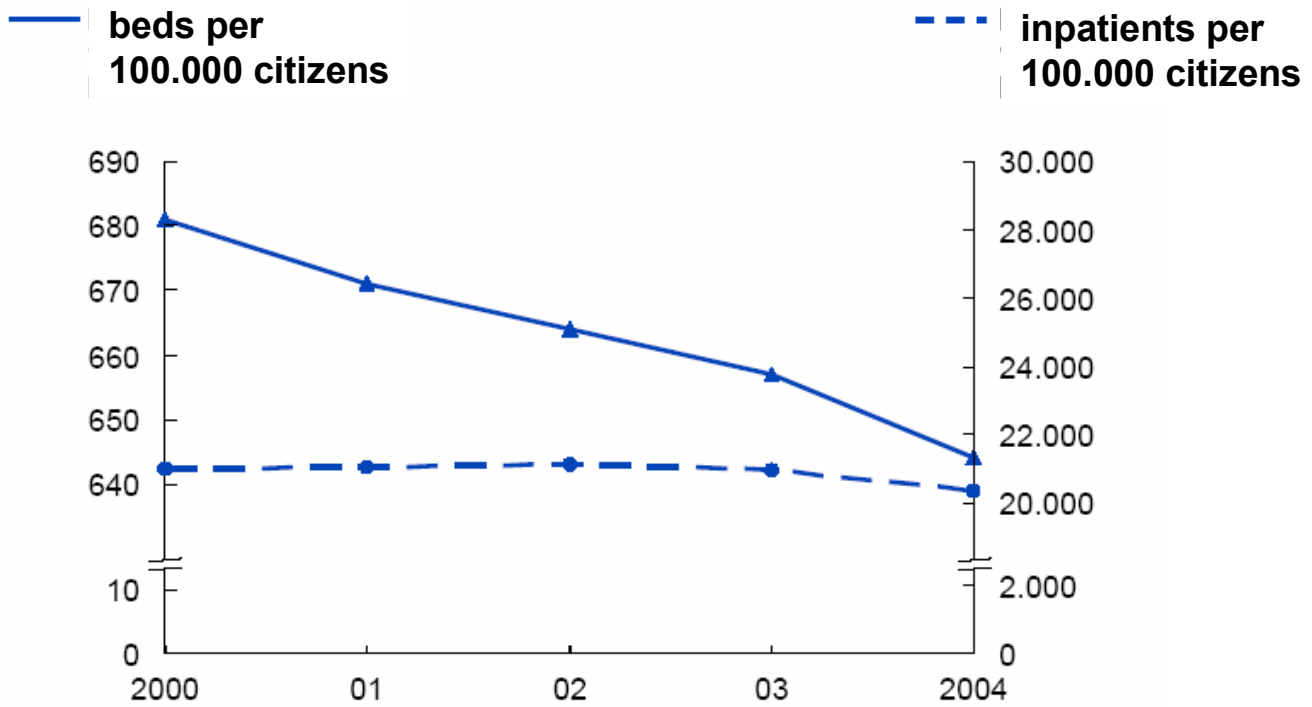
The change in financing hospitals

Principle of funding before:

- The longer you stay, the more I get

DRG-principle:

- The sooner you leave, the more I retain



* Berechnet auf Basis der Durchschnittsbevölkerung
Quelle: Statistisches Bundesamt 2004

The Challenge

$$\text{profitability} = \frac{\text{earnings}}{\text{expenditures}}$$

Increase profitabiliy:

Increase earnings/prizing:
impossible, DRG = flat rate

Decrease expenditures:
Rationalization, Process management

- **automation, information technology**

Medicine: a different point of view

Approx. 95% of medicine is information management:

- History taking
- Diagnostics (Lab, Radiology, Sono/Echo etc.)
- Continuous clinical assessment (medical record)

And only a small proportion is pure physical interaction:

- Physical examination
- Operation
- Procedures (cannulation, intubation, catheterization etc.)

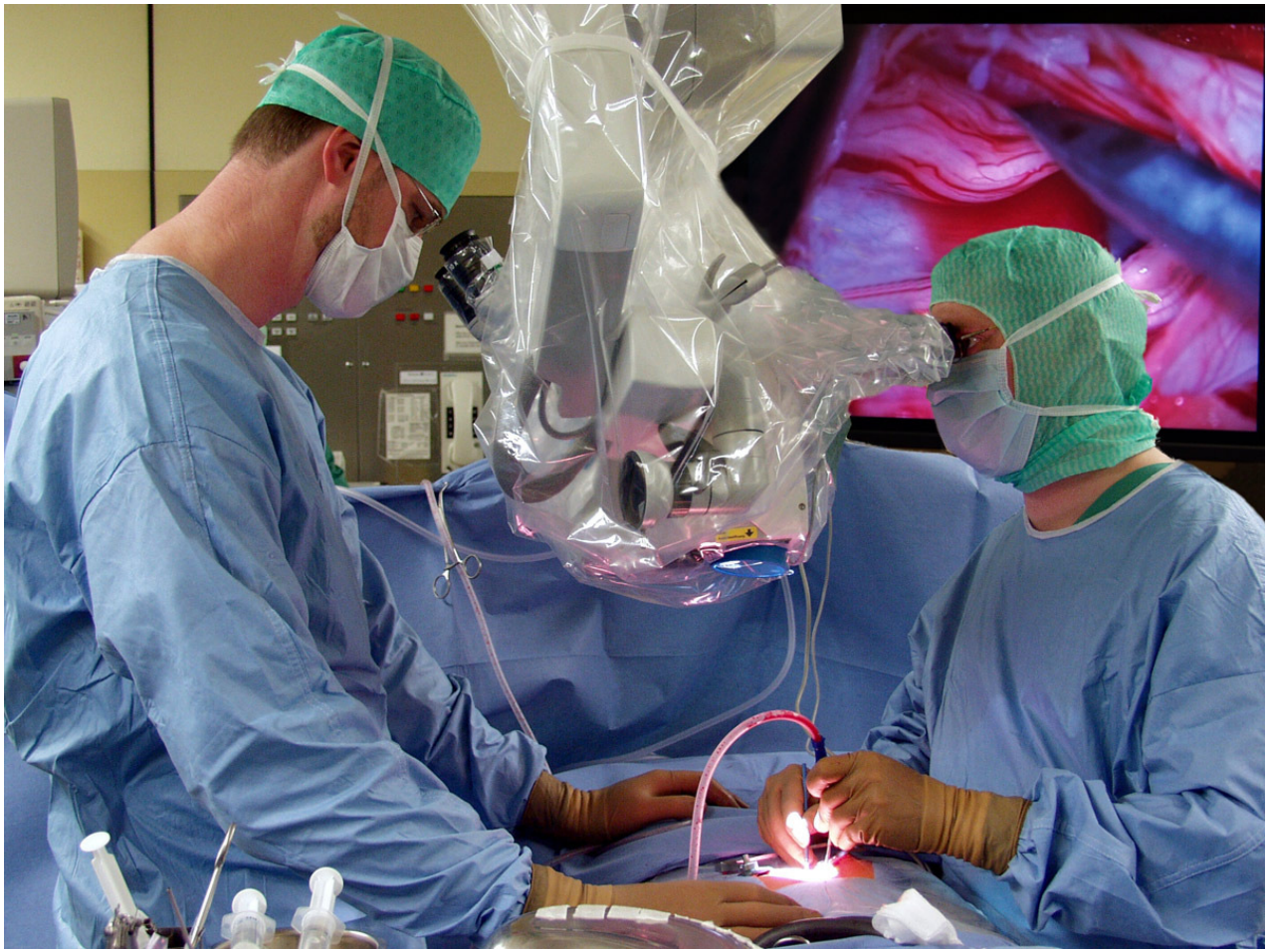
Medicine: a different point of view

- Physical examination: purely handmade?



Medicine: a different point of view

- Operation: purely handmade?



Starting point process management: within hospitals…

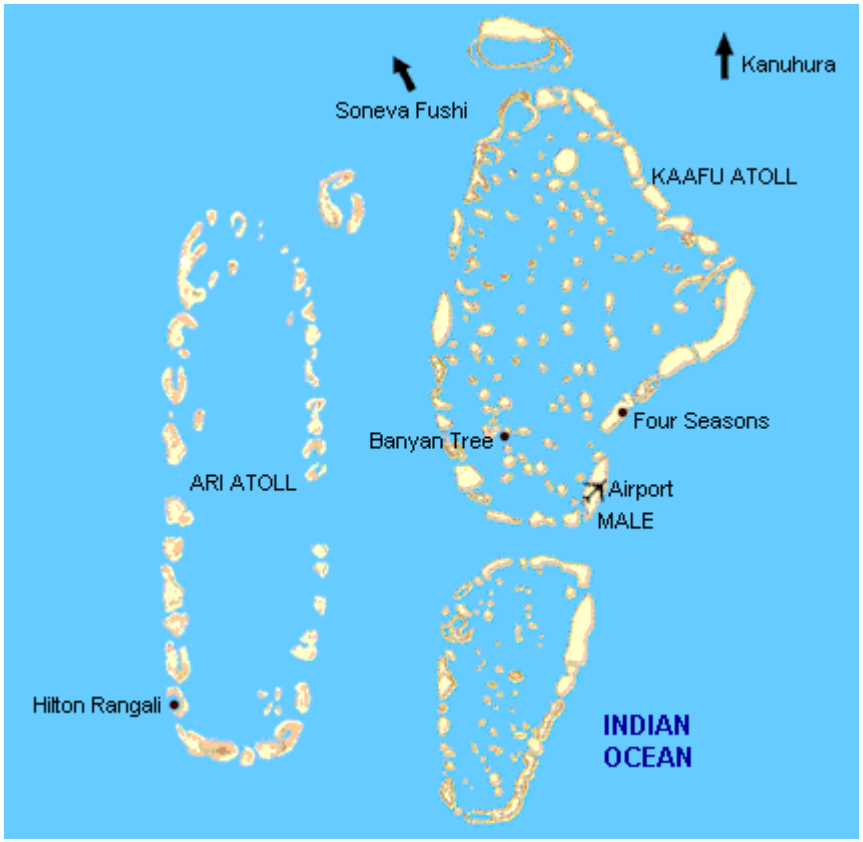
…documentation is omnipresent, yet data for process management are scarce.

…the documentation landscape is very heterogenous (mixture of paper and IT).

…at least IT-based information should serve as basis for process streamlining…

Starting point process management at UKT

…yet: landscape is rather fragmented, although SAP ish-med is the leading medical documentation system at UKT.



http://africagetaways.co.za/2009/11/07/indian-ocean-islands-maldives/, Zugriff am 11.04.2011, 16:25h

IT landscape at UKT

IT-systems with clinical relevance at UKT:

1. SAP ish-med (patient organizer, results, appointments, DRG documentation etc.)
2. CareVue/ICCA (anaesthesiology and ICU – medical record)
3. ViewPoint (endoscopy- and sonography pictures, results)
4. Carddas (cardiology: heart catheter, ECG, echo)
5. Lorenzo iSoft (Radiology information system)

IT landscape at UKT

IT-systems with clinical relevance at UKT:

6. Swisslab (laboratory information system)
7. Paschmann/nexus (pathology system)
8. LEP-documentation module
9. AIS (Eye(clinic) information system)
10. Neodat/Medipaed (neonatology)
11. Meona (pilot project: general medical record)

IT landscape at UKT

IT-systems with assisting clinical relevance at UKT:

1. LogBuch (patient and object transportation system)
2. ConSense warehouse logistics (OP warehousing, deliviery, and documentation system)
3. Kenntenich (Central sterilisation unit)
4. Hybase (hygiene/infection monitoring system)

IT landscape at UKT

IT-systems to come with assisting clinical relevance at UKT:



5. Cetrea (pilot project: inhouse clinical communication logistic system)

6. SMARTY/Careon (pilot project: cross sectoral clinical communication system)

7. Samedi (multi resource planning system)

Beyond IT: Mastering data at UKT

Collection and preparation of data must be

- possible from different source systems
- possible with high volumes of data
- performing and reliable
- flexible and adaptable without IT knowledge
- easy and intuitive for users

Beyond IT: Mastering data at UKT

Classic Business Warehouse-Systems

- are often too rigid and inflexible
- Cannot be adapted to customers needs without major effort
- thus often need external support and consulting

➢ Decision at UKT for software „QlikView“ (QlikTech)

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Principles of data preparation at UKT

- „DWH*“ is central data pool from IT-systems (SAP, sub systems, …) for a variety of applications
- avoids redundance
- Data are regularly updated
- Itegrity of data (same data at same time)
- Data security

➢ Principle: central data are stored centrally and provided decentrally

*DataWareHouse

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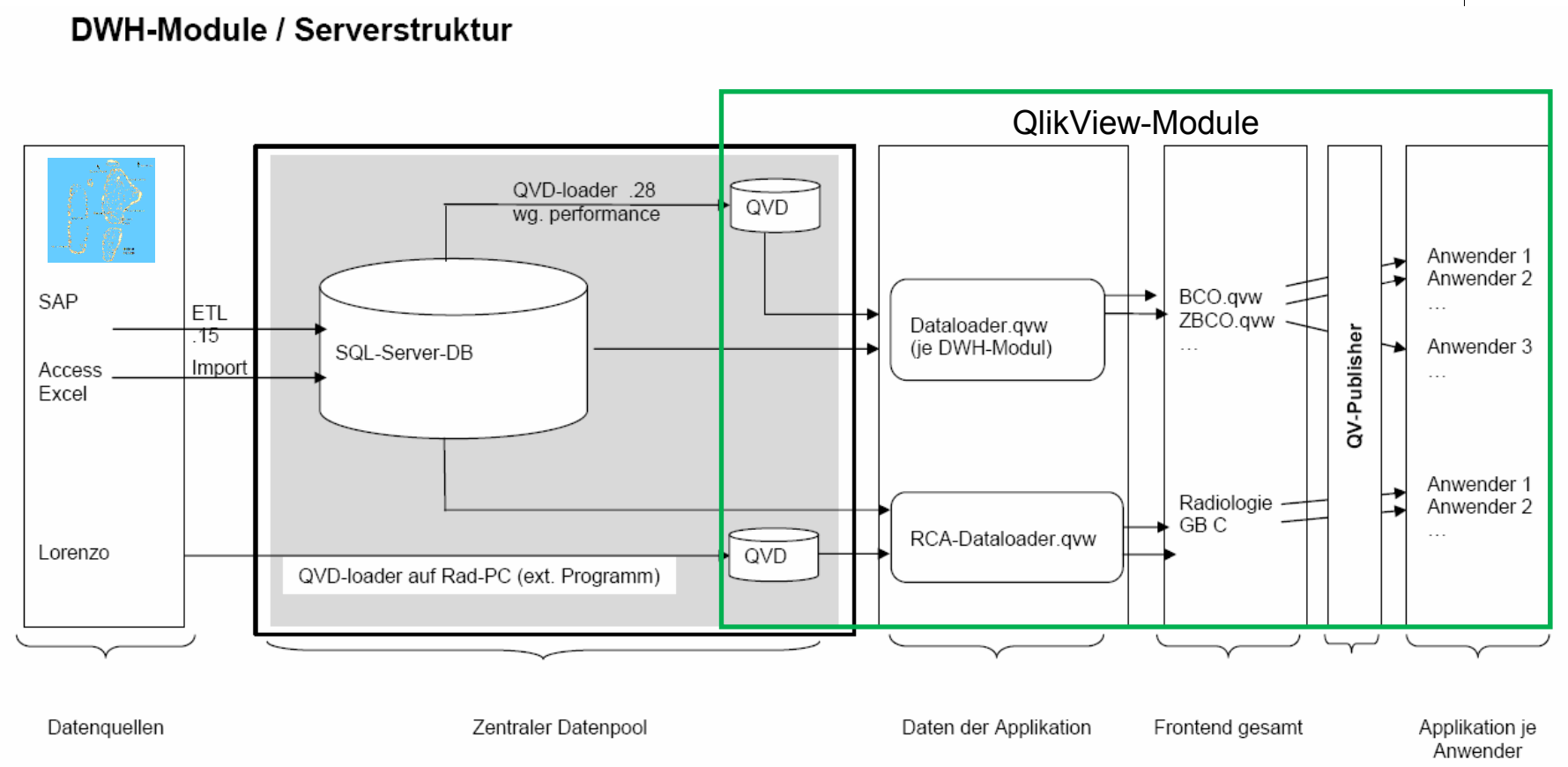
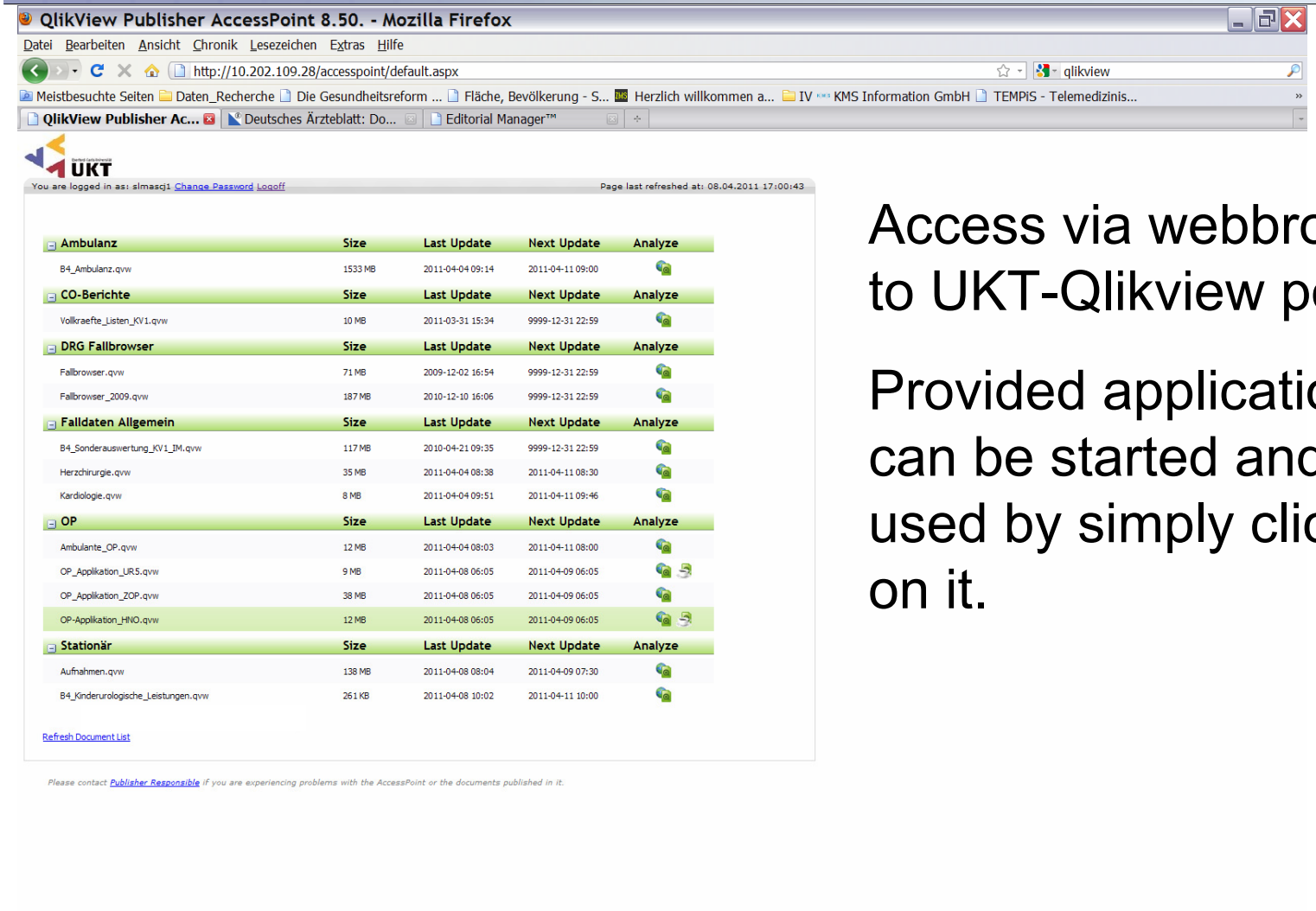
Scheme of data acquisition, -preparation, and -distribution



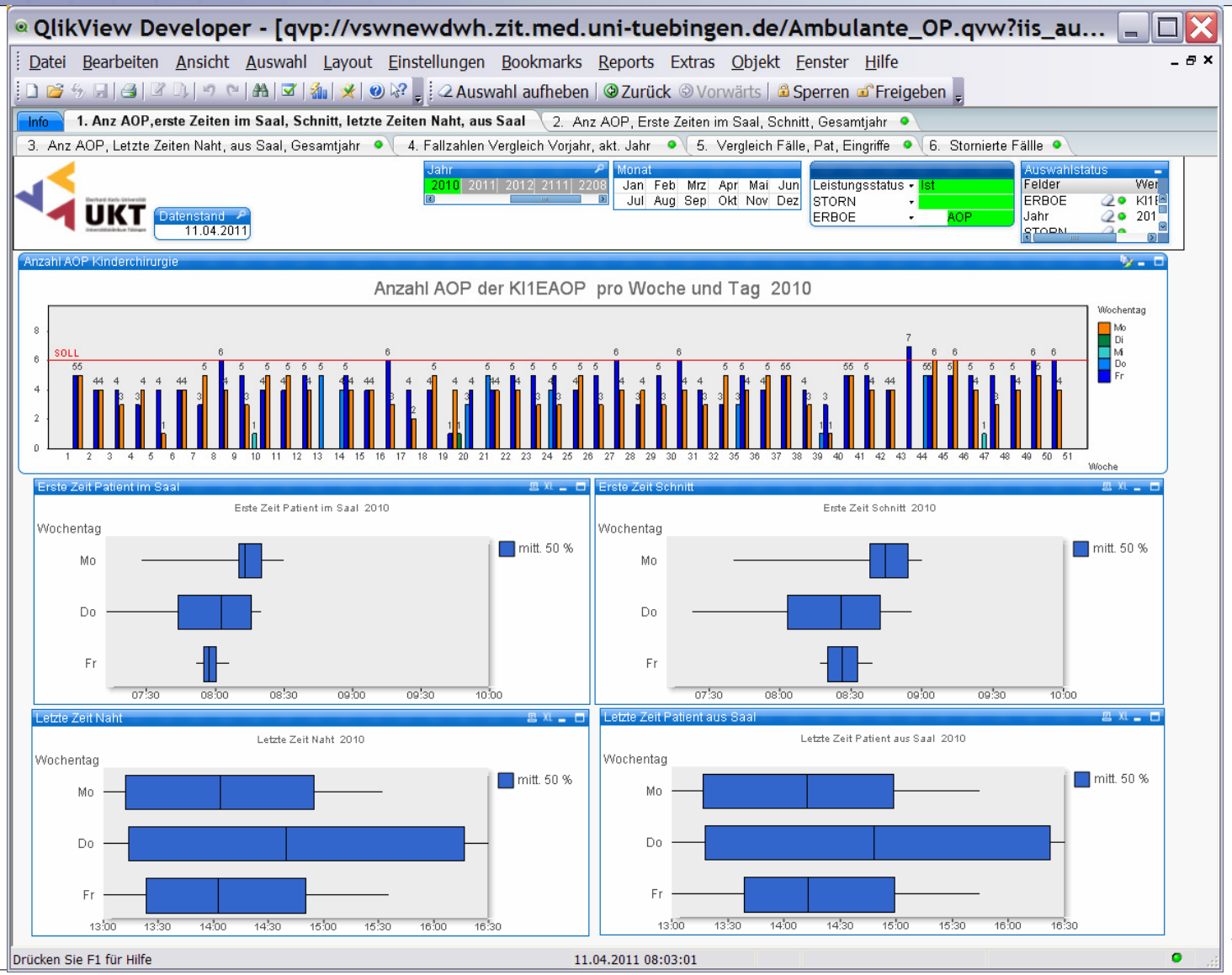
What are the results?



Access via webbrowser to UKT-Qlikview portal.

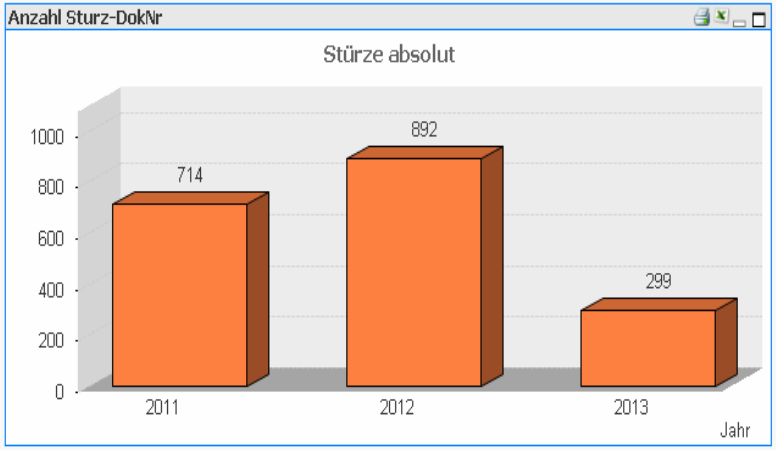
Provided applications can be started and used by simply clicking on it.

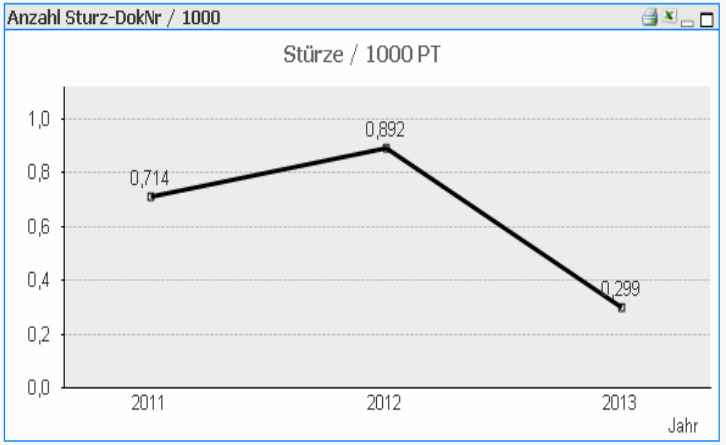
What are the results? OP-application day care

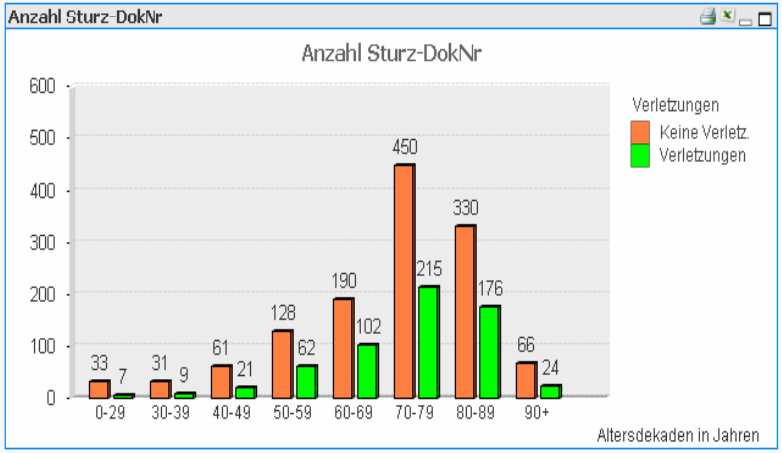


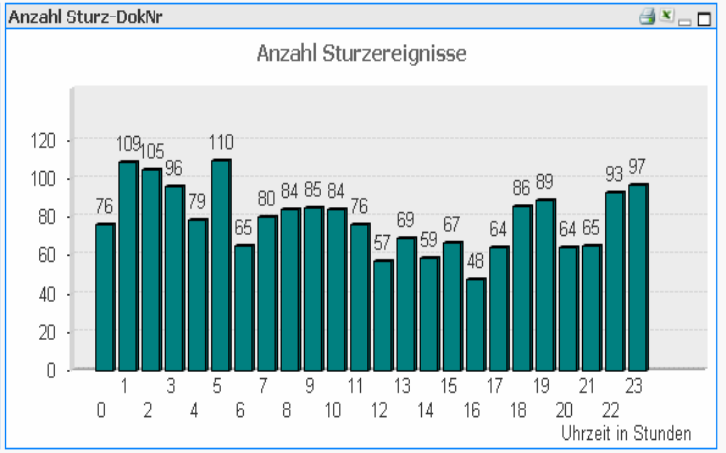
Know your risks – risk cockpit patient falls

Auswahl	
ENTL_BEZ_FACHLOE	
ENTL_BEZ_PFLOE	
AUFN_BEZ_FACHLOE	
AUFN_BEZ_PFLOE	
STU_FALLNR	
STU_DOKNR	
STU_ISHMPATNUM	









Experiences so far

- Quick disemination all over UKT
- display of data **for feed back purposes** of clinical processes very well
- Importance of working with the data: is there process improvement?

➢ **Investment in process management is worth it, much impact with relatively little investment!**

Healthcare IT systems

Healthcare IT systems in hospitals often have different „names“ and different meanings:

- HIS (hospital information system, German: KIS – Krankenhausinformationssystem)
- EMR (electronic medical record, German: KAS – klinisches Arbeitsplatzsystem)
- PDMS (patient data management system bzw. elektronische Patientenakte)
- RIS (radiology information system)
- PACS (picture archiving and communication system)

Healthcare IT systems

Healthcare IT systems in hospitals often have different „names“ and different meanings:

- LIS (laboratory information system)
- MIS (medical information system)
- EPA (elektronische Patientenakte – trans sectoral)
- HL7 (health level 7: communication standard)
- DICOM (digital imaging and communications in medicine – standard for viewing and distributing all kind of medical images)

Prokosch, 2001 http://www.imi.med.uni-erlangen.de/fileadmin/Forschung/Publikationen_pdf/ProkoschHU.2001.KAS-KIS-EKA.pdf

Healthcare IT systems: historical view

- Healthcare IT systems in hospitals were initially not designed for clinicians or even patients!
- First and still most important purpose is financing and billing!
- Systems came from other „industries/services“
- Some „freaks“ (often doctors) started programming documentation systems for patient treatment
- Integration of all these systems is still very demanding
- IT-departments are still part of the administrative branch of a hospital

Healthcare IT systems

In hospitals two principles exist:

- Heterogeneous systems, often with SAP administrative background (predominantly found at university hospitals)
- Monolithic systems (one application fits all purposes) often found at teaching and provider hospitals
- Examples (Germany): Orbis, Meierhofer, medico, iMedOne, nexus, etc.

Healthcare IT systems

Pros and Cons of the two principles:

Heterogeneous systems

- Pro: best of breed integration, flexible
- Con: Interface problems, administration costly

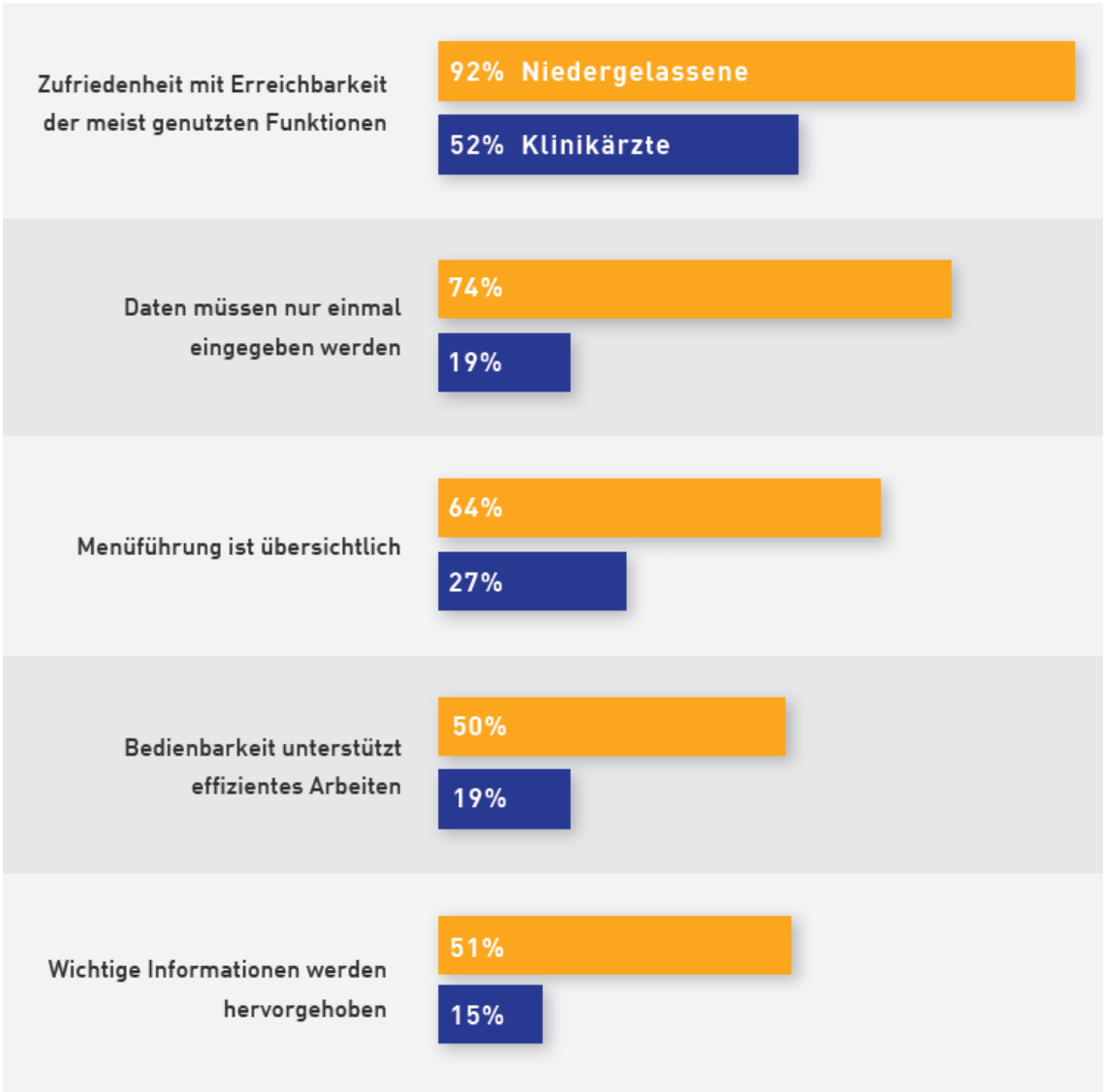
Monolithic systems

- Pro: highly integrated, less costly administration
- Con: limited funcionality for medical specialties, dependance on one supplier

Healthcare IT systems: the ambulatory sector

- Almost all medical cabinets in Germany are working with electronic patient record systems
- Forced to deliver billing data electronically to Kassenärztliche Vereinigung to get paid
- Market share: CompuGroup is leading supplier (different systems)
- Interaction between these systems and hospital systems scarce and difficult
- UKT: secure medical information portal (CompuGroup)

Satisfaction of doctors with health IT systems
bvitg/medicaltex survey 2012



Great discrepance between hospital doctors vs. doctors in medical cabinets.

http://www.bvitg.de/marktuntersuchungen.html, accessed 26.01.2014, 21:22h

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Satisfaction of doctors with health IT systems
bvitg/medicaltex survey 2012

Great discrepance between hospital doctors vs. doctors in medical cabinets.

- Does the electronic medical record present all relevant information at a glance?

  Hospital doctors: No 87%

- Does the electronic medical record present all relevant patient master data at a glance?

  Hospital doctors: No 70%

http://www.bvitg.de/marktuntersuchungen.html, accessed 26.01.2014, 21:22h

Market volume of health IT systems in Germany
bvitg/medicaltex survey 2012

Market volumes

- Hospital sector: 400 Mio. Euros
- Ambulatory sector: 270 Mio. Euros

Dynamics:

- Hospital sector: 30 Systems/a, trend to integrate specialised subsystems
- Ambulatory sector: stationary, saturated

http://www.bvitg.de/marktuntersuchungen.html, accessed 26.01.2014, 21:22h

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Data security in both sectors paramount

- Germany has high and strict data security regulations
- Difficult in hospitals: emergency situations require access to patient data even for „medical strangers“
- Logging of access data is accepted to monitor violations of patient data use
- Interaction between sectors or even between professionals and patients is limited due to scarce or complicated solutions

Data security in both sectors paramount

- Mobile devices (smart phones, tablets) evoke even higher standards of data security
- Wireless data transmission enhances the risk of unintended use of sensible medical data
- So far no widespread use of mobile devices in hospitals, although everbody talks about it.

Overall objective of the initiative

The aim of the German Medical Informatics Initiative is to ensure that, in future, each doctor, patient and researcher has **access to the information they require**. This will lead to more precise diagnostics, and better treatment decisions. It will yield **new insights** for effectively and sustainably combatting diseases, and will **help advance patient care**. At the same time, **robust data protection and security will be a top priority**.

Source: www.medizininformatik-initiative.de

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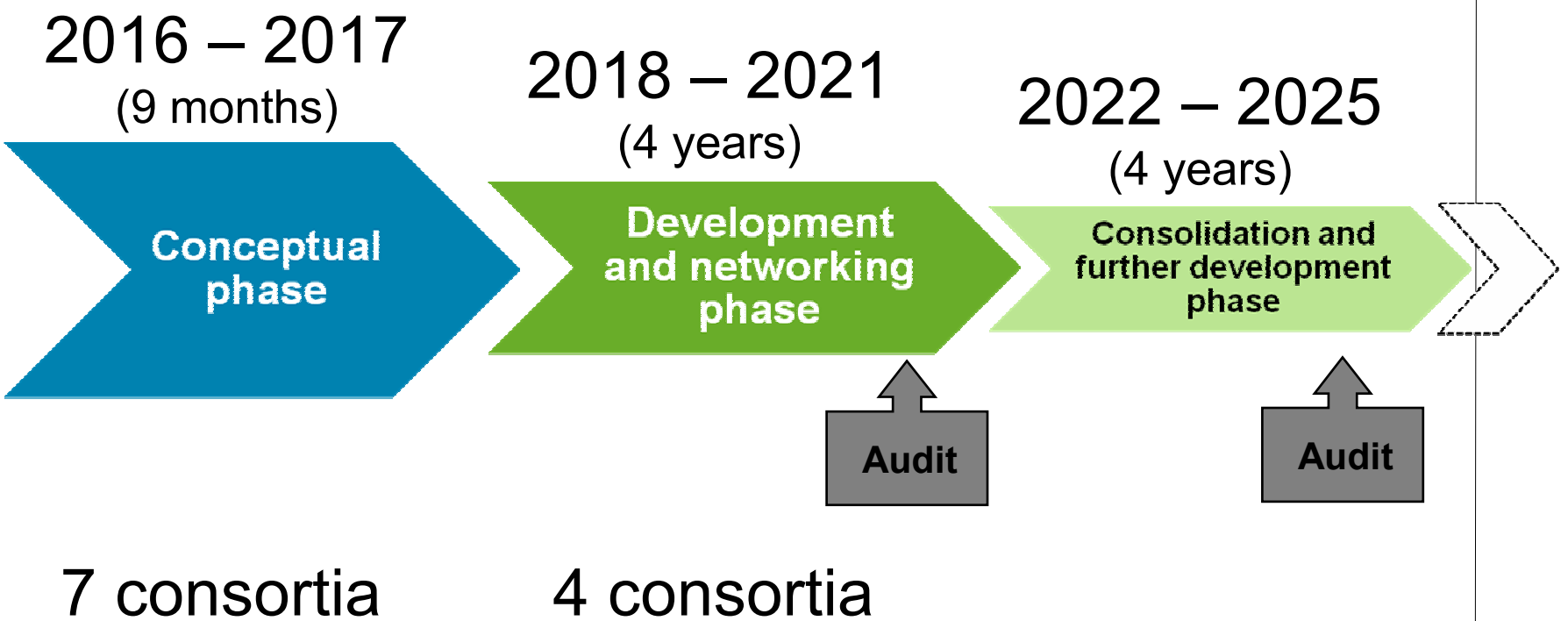

Source: www.medizininformatik-initiative.de

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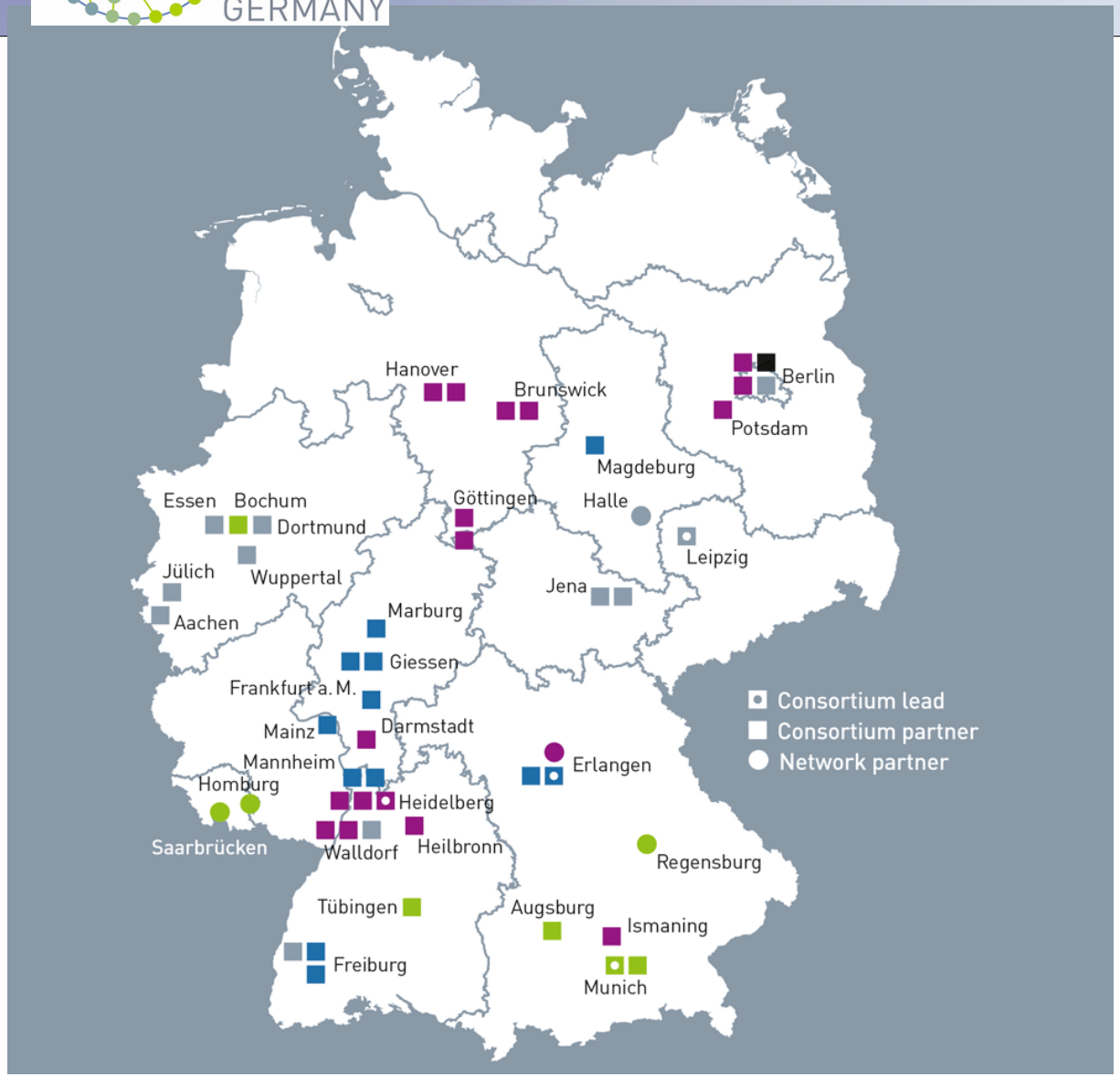


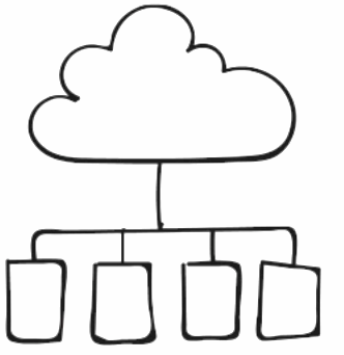
DIFUTURE
HiGHmed
MIRACUM
SMITH
Coordination office

Source: www.medizininformatik-initiative.de

SMITH

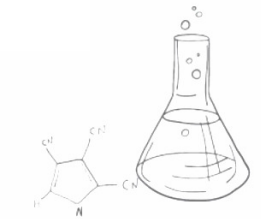
Smart Medical Information Technology for Healthcare

Making health data usable



Patient care





Patient-centered clinical research

gefördert durch:

Bundesministerium für Bildung und Forschung

www.smith.care

MEDIZIN INFORMATIK INITIATIVE

MEDICAL INFORMATICS INITIATIVE GERMANY

SMITH

Smart Medical Information Technology for Healthcare

- Long-standing cooperation in clinical research
  - Infectious diseases, intensive care medicine
- Complementary methodological expertise in
  - clinical trial research
  - epidemiology
  - medical informatics
  - systems medicine and disease modelling
  - natural language processing
- Management experience of large research clusters
- State-of-the-art intersectoral IT services for healthcare

MEDICAL INFORMATICS INITIATIVE GERMANY

SMITH

Smart Medical Information Technology for Healthcare



HELP

Hospital-wide EMR-based computerized decision support system to improve outcomes of patients with bloodstream infections



ASIC

Algorithmic Surveillance of ICU patients to improve personalized management of care

PheP

Phenotype Pipeline, algorithms for phenotyping and NLP on EMR data



Sources: UKJ (A. Schroll, M. Szabó), NVHR

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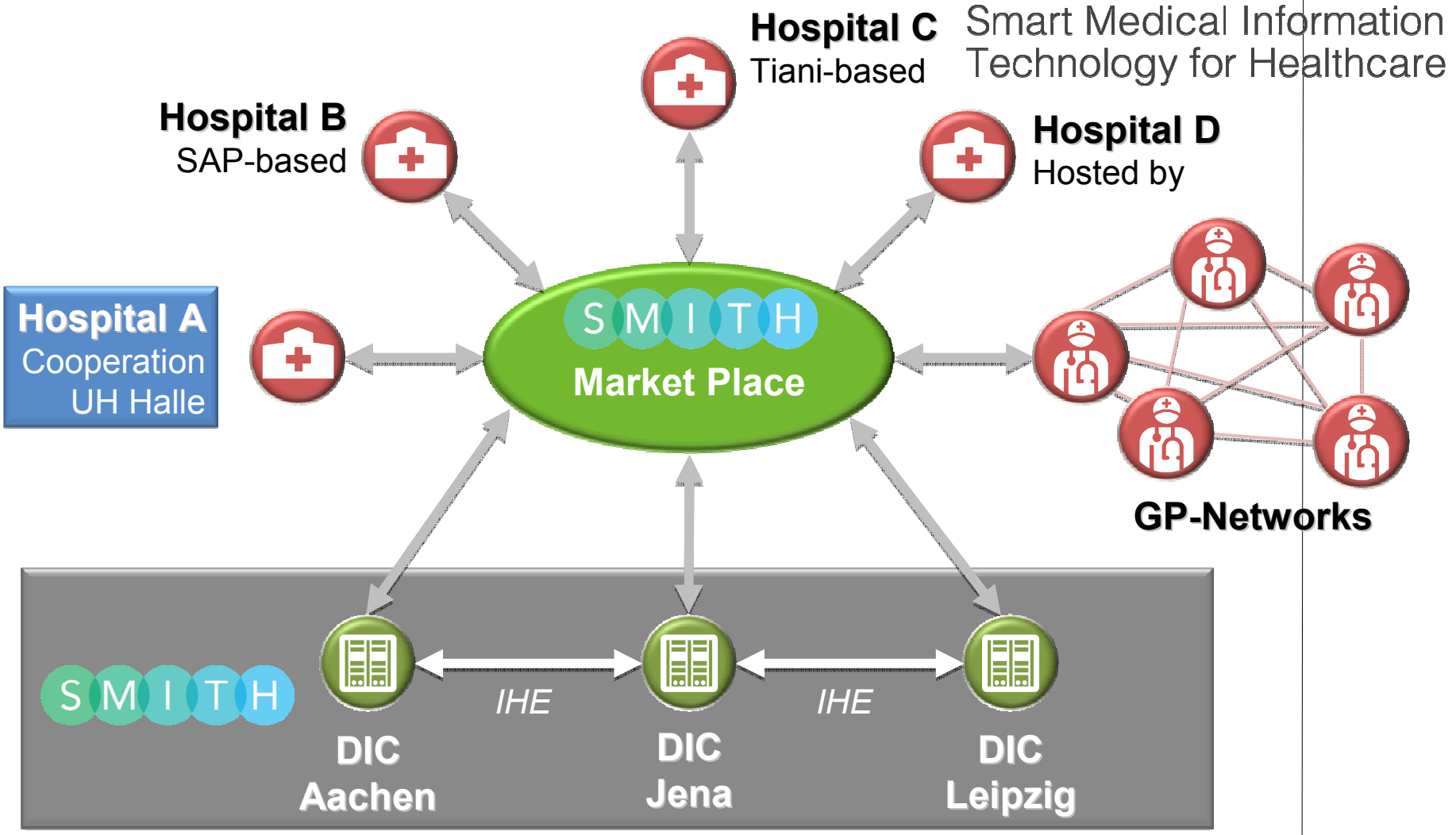
MEDICAL INFORMATICS INITIATIVE GERMANY

SMITH

Smart Medical Information Technology for Healthcare



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Education

- 3 additional professorships

- 3 MSc curricula

- 1 international postgraduate MSc curriculum

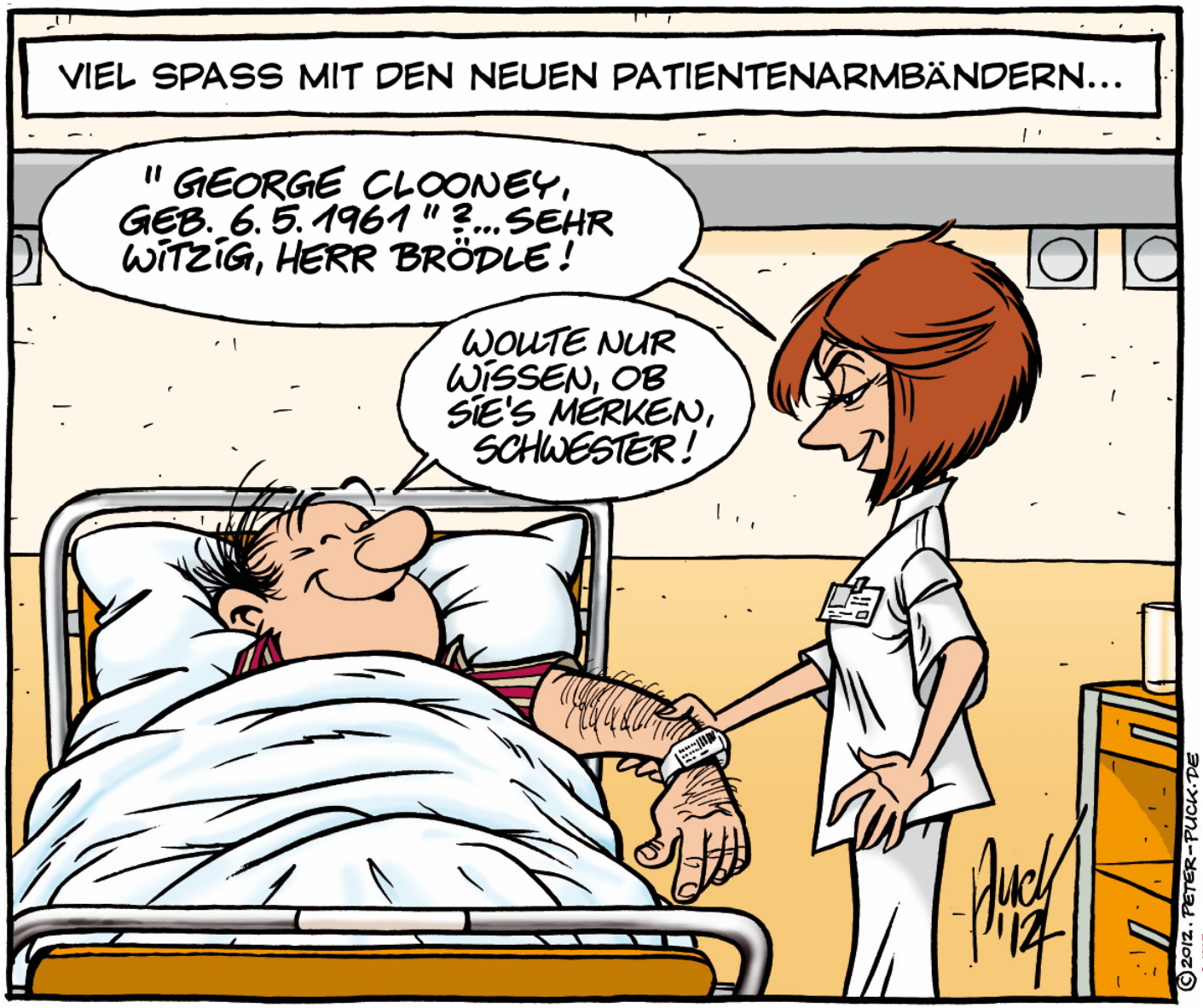


Source: www.medizininformatik-initiative.de

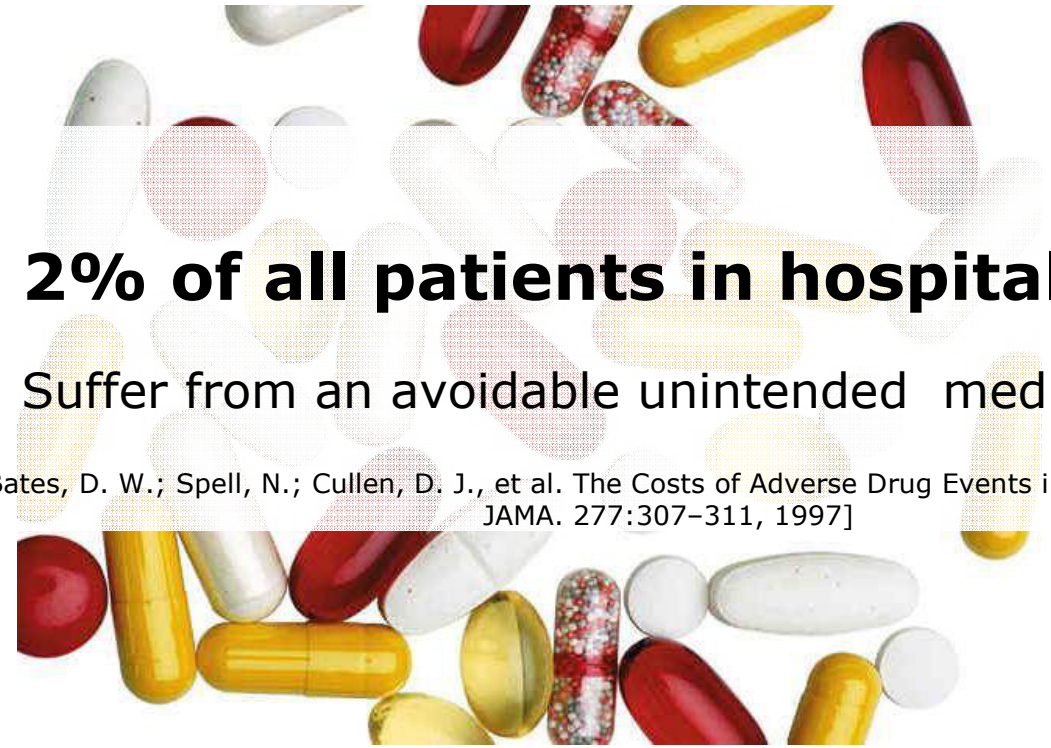
What IT-systems can help making medicine safer

- CIRS (critical incident reporting systems)
- Patient identification with bar code wrist bands
- AMTS (Arzneimitteltherapiesicherheit – medical presciption safety)
- Rule based information about process adherence

Know your risks: who is who?



Medication errors



2% of all patients in hospitals

Suffer from an avoidable unintended medication error

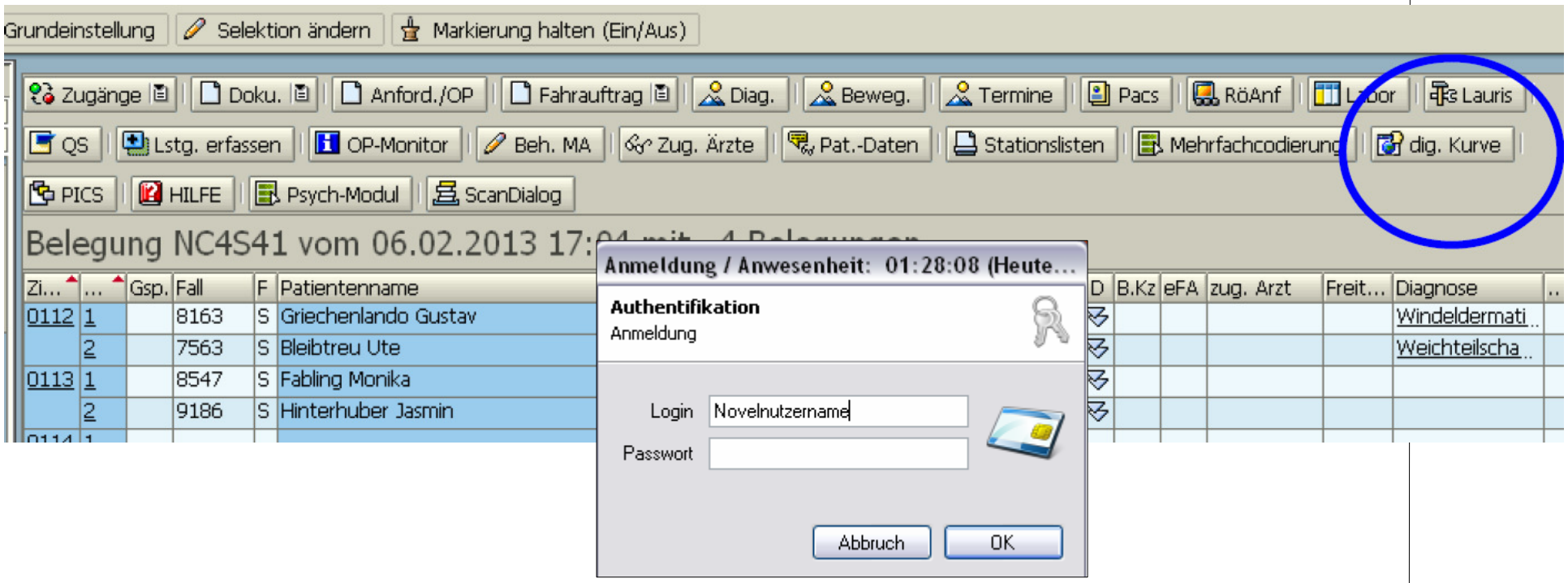
[Bates, D. W.; Spell, N.; Cullen, D. J., et al. The Costs of Adverse Drug Events in Hospitalized Patients. JAMA. 277:307–311, 1997]

UKT:

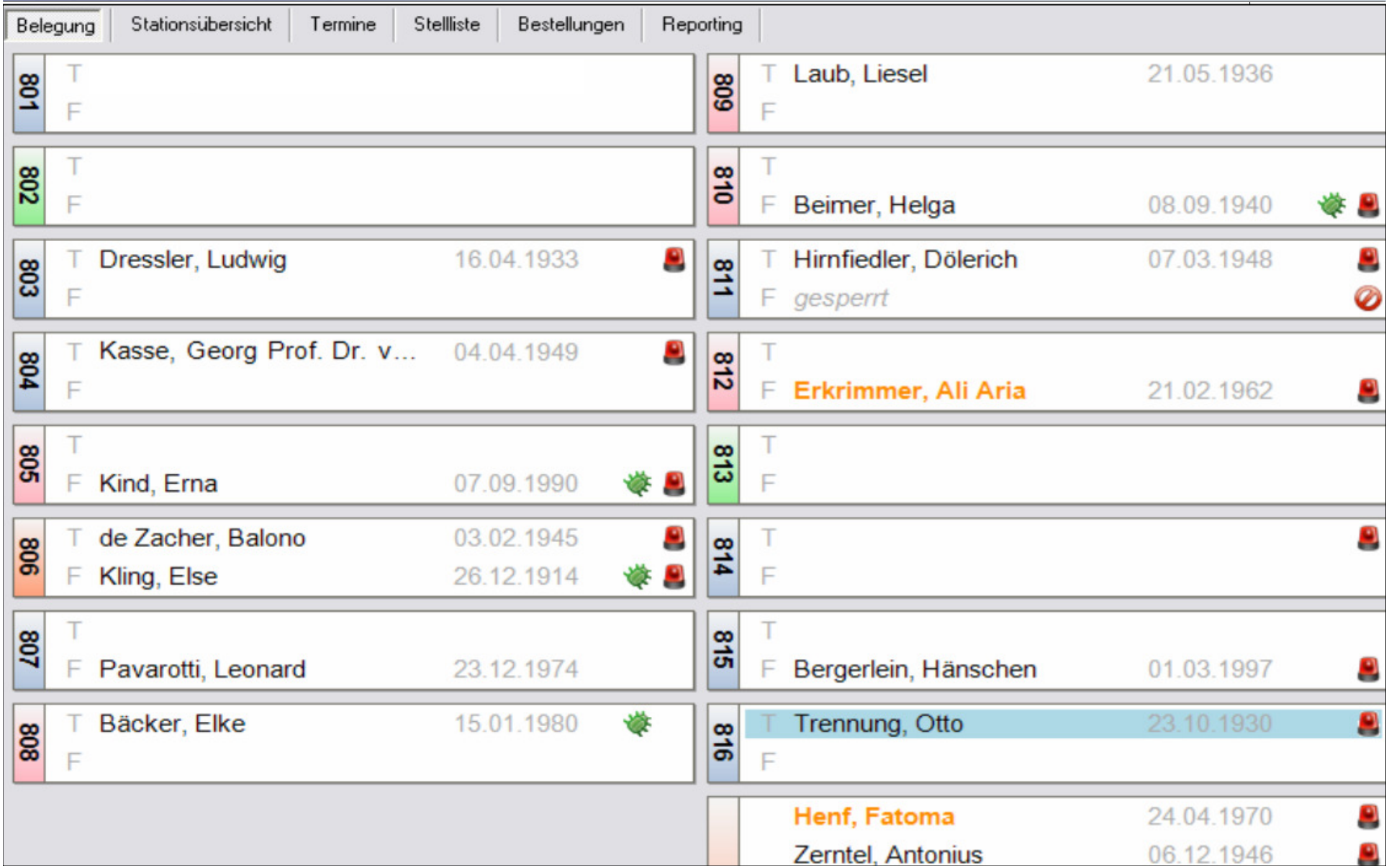
implementation of PDMS on ICU (intensive care units) – ICCA

implementation of PDMS on all wards (pilot „Meona“)

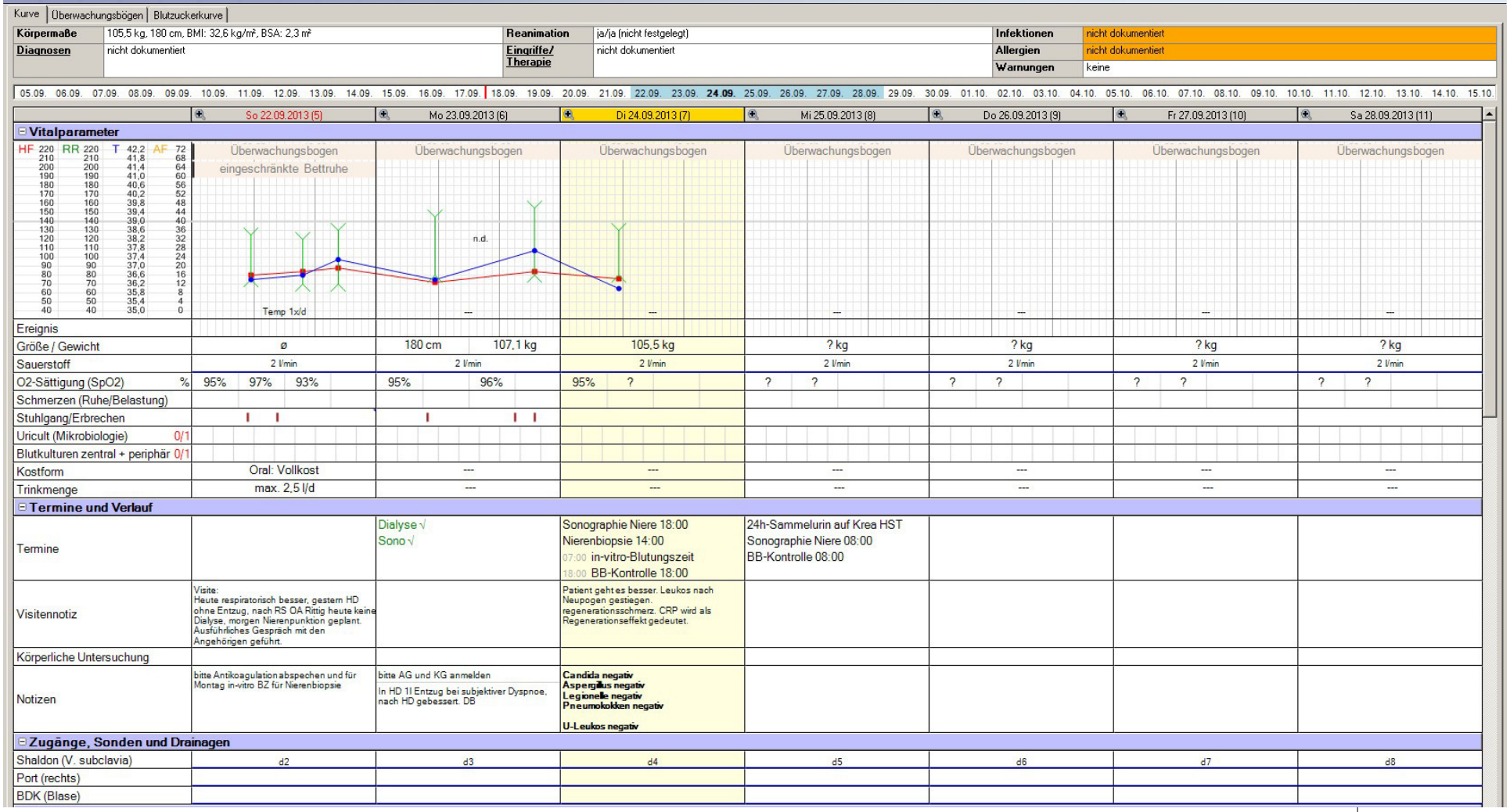
Example: Pilot installation „Meona“ – connection to KAS



Example: Pilot installation „Meona“ – ward overview



Example: Pilot installation „Meona“ – digital presentation of nursing and medical parameters



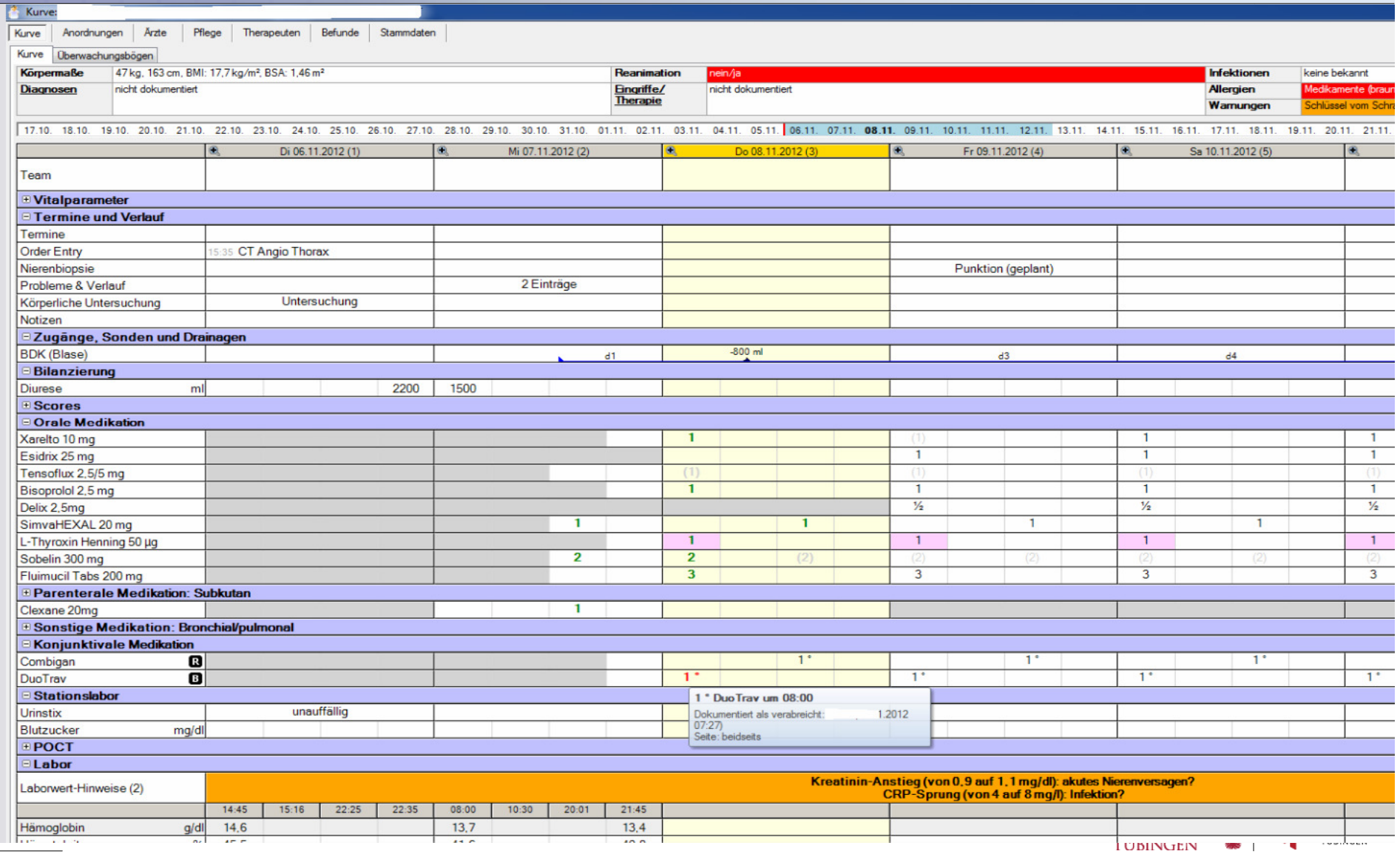
Kurve | Überwachungsbögen | Blutzuckerkurve

Körpermaße	105,5 kg, 180 cm, BMI: 32,6 kg/m², BSA: 2,3 m²	Reanimation	ja/ja (nicht festgelegt)	Infektionen	nicht dokumentiert
Diagnosen	nicht dokumentiert	Eingriffe/ Therapie	nicht dokumentiert	Allergien	nicht dokumentiert
				Warnungen	keine

05.09. 06.09. 07.09. 08.09. 09.09. 10.09. 11.09. 12.09. 13.09. 14.09. 15.09. 16.09. 17.09. 18.09. 19.09. 20.09. 21.09. 22.09. 23.09. **24.09.** 25.09. 26.09. 27.09. 28.09. 29.09. 30.09. 01.10. 02.10. 03.10. 04.10. 05.10. 06.10. 07.10. 08.10. 09.10. 10.10. 11.10. 12.10. 13.10. 14.10. 15.10.

	So 22.09.2013 (5)	Mo 23.09.2013 (6)	Di 24.09.2013 (7)	Mi 25.09.2013 (8)	Do 26.09.2013 (9)	Fr 27.09.2013 (10)	Sa 28.09.2013 (11)
Vitalparameter							
HF 220–40 RR 220–40 T 42,2–35,0 AF 72–0	Überwachungsbogen eingeschränkte Bettruhe; Temp 1x/d	Überwachungsbogen; n.d.	Überwachungsbogen	Überwachungsbogen	Überwachungsbogen	Überwachungsbogen	Überwachungsbogen
Ereignis							
Größe / Gewicht	ø	180 cm 107,1 kg	105,5 kg	? kg	? kg	? kg	? kg
Sauerstoff	2 l/min	2 l/min	2 l/min	2 l/min	2 l/min	2 l/min	2 l/min
O2-Sättigung (SpO2) %	95% 97% 93%	95% 96%	95% ?	? ?	? ?	? ?	? ?
Schmerzen (Ruhe/Belastung)							
Stuhlgang/Erbrechen							
Uricult (Mikrobiologie) 0/1							
Blutkulturen zentral + periphär 0/1							
Kostform	Oral: Vollkost	---	---	---	---	---	---
Trinkmenge	max. 2,5 l/d	---	---	---	---	---	---
Termine und Verlauf							
Termine		Dialyse √ Sono √	Sonographie Niere 18:00 Nierenbiopsie 14:00 07:00 in-vitro-Blutungszeit 18:00 BB-Kontrolle 18:00	24h-Sammelurin auf Krea HST Sonographie Niere 08:00 BB-Kontrolle 08:00			
Visitennotiz	Visite: Heute respiratorisch besser, gestern HD ohne Entzug, nach RS OA Rittig heute keine Dialyse, morgen Nierenpunktion geplant. Ausführliches Gespräch mit den Angehörigen geführt.		Patient geht es besser. Leukos nach Neupogen gestiegen. regenerationsschmerz. CRP wird als Regenerationseffekt gedeutet.				
Körperliche Untersuchung							
Notizen	bitte Antikoagulation abspechen und für Montag in-vitro BZ für Nierenbiopsie	bitte AG und KG anmelden In HD 1l Entzug bei subjektiver Dyspnoe, nach HD gebessert. DB	**Candida negativ** **Aspergillus negativ** **Legionelle negativ** **Pneumokokken negativ** **U-Leukos negativ**				
Zugänge, Sonden und Drainagen							
Shaldon (V. subclavia)	d2	d3	d4	d5	d6	d7	d8
Port (rechts)							
BDK (Blase)							

Example: Pilot installation „Meona“ – medication overview



Example: Pilot installation „Meona“ – history taking

Kurve | Anordnungen | Ärzte | Pflege | Therapeuten | Befunde | Stammdaten

Aktuelle Anamnese | Sozial-/Familienanamnese | Aufgaben | Aufnahmemedikation | Entlassmedikation | Wissen

Leitsymptom / Einweisungsdiagnose

ANV a.e. postrenal bei Tumorprogress

Aktuelle Anamnese

Vorstellung in der onkologischen Tagesklinik zur geplanten Transfusion bei metastasierten Chordom.
Der Patient gibt vermehrten Durst und öfteres Wasserlassen an, außerdem Müdigkeit.
Zudem in den letzten Wochen einige Male erhöhten Blutdruck bis zu 190 mmHg gemessen.

Laborchemisch zeigte sich ein akutes Nierenversagen mit Krea 4,6 mg/dl, Harnstoff 250 mg/dl.
U-Status: Natrium erniedrigt mit 46mmol/l, kein Hinweis auf HWI
In der BGA metabolische Azidose mit pH 7,30, BE -5,5, HCO2 22.
zudem steigendes CRP, kein Infektfokus.
Hypothyreose.

Körperliche Untersuchung

Reduzierter Allgemein- und Ernährungszustand.
Cor: Herztöne rein, keine vitientypischen Herzgeräusche.
Pulmo: leises Atemgeräusch beidseits seitengleich, keine Dämpfung, keine Nebengeräusche.
Abdomen: prall, Darmgeräusche leise, kein Druckschmerz, Resistenzen und sichtbare Raumforderung im rechten Oberbauch bei bekannten Lebermetastasen.
Kopf/Hals: keine vergrößerten LK tastbar.
Extremitäten: keine Ödeme.
Neuro: wach, orientiert, keine fokalneurologischen Defizite, kein Meningismus. Kein urämischer Fötor.

Vegetative Anamnese — Strukturierte Eingabe...

Diskussion, Procedere

Sono-Abd: Harnstau II° beidseits. Harnblase mit 175ml gefüllt. Uretheren nicht beurteilbar. Vena cava: Durchmesser 1,5cm, leichte Atemmodulation, nicht kollaptisch.

Diagnosen

Hauptdiagnose für Kurve

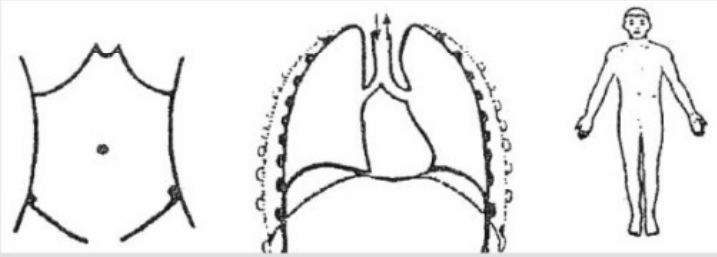
ANV (Krea 4,6mg/dl, HST 250mg/dl), Infektkonstellation

Vor- und Begleiterkrankungen

1. **Weichteilsarkom ED 05/2006**
- Histologie: Chordom
- Lokalisation: Sakral, lokal destruierend, Lebermetastasen
- Primäre Größe: 17 x 17 x 18 cm
- Immunhistochemie: PAS+/SA100-/MIB-1 3 %/ PDGF-R positiv
- 06/2006 Operation: Sakrektomie unterhalb von S1 und Rektosigmoidresektion nach Hartmann mit Anlage eines Kolostomas
- 04/2008- 08/2012 Imatinib mono
- von 08/2012 bis 04/2013 individuelle Therapie mit Rapamune in Kombination mit Glivec bei fragl. Rapamune –Tox: derzeit Imatinib mono

2. Emphysembullae und beginnende Lungenfibrose, Erstdiagnose 06/2007
3. Große parastomale Bauchwandhernie
4. Harninkontinenz, am ehesten durch Neurogen durch Tumorinfiltration sacral, EM ca. 08/2009
5. Seropneumothorax unklarer Ätiologie, ED 03/2013

Lokalisation



Vorliegende Befunde

Sonstiges

Zuständiger Assistenzarzt

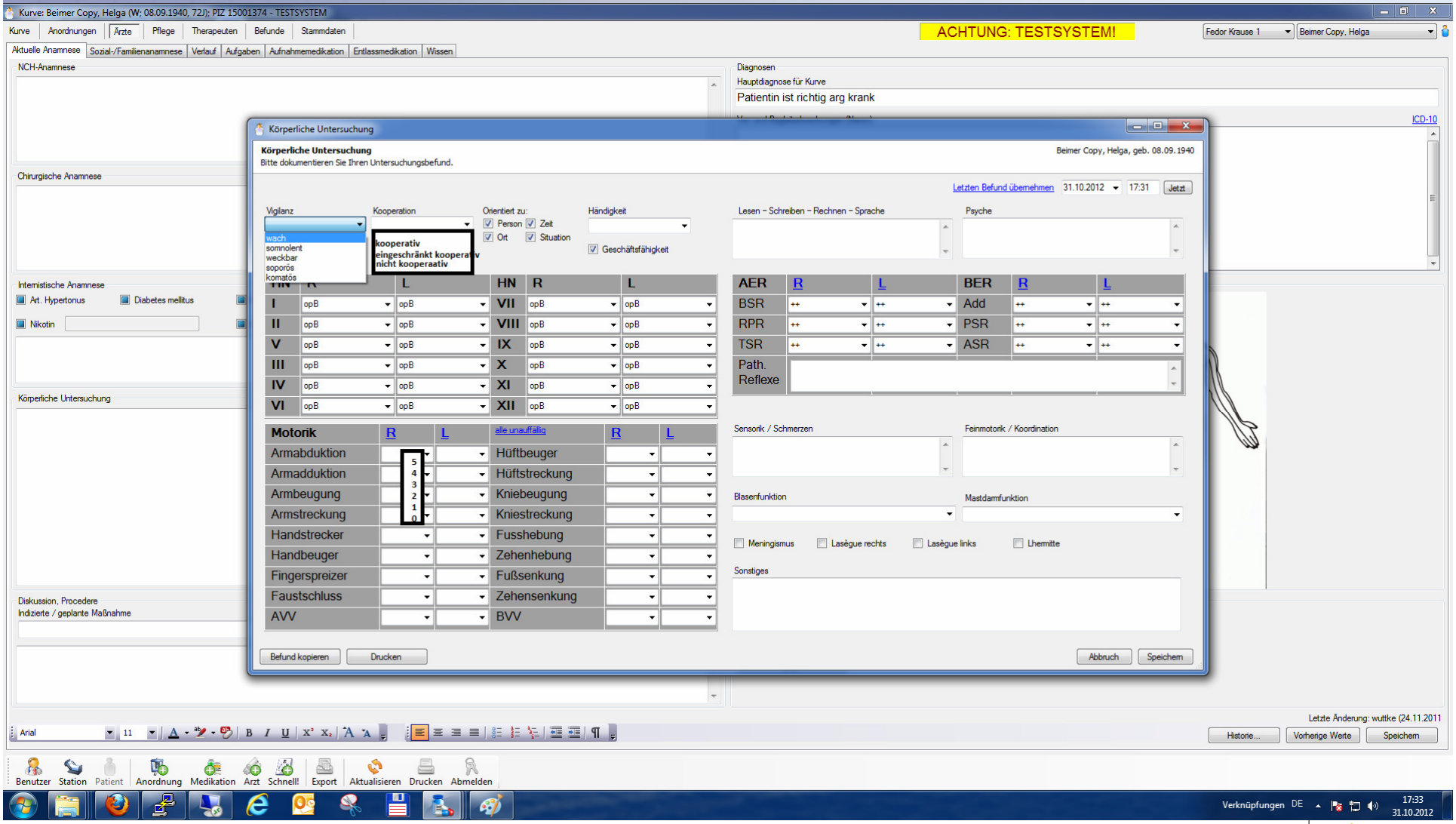
Aufnehmender Arzt

Reanimation

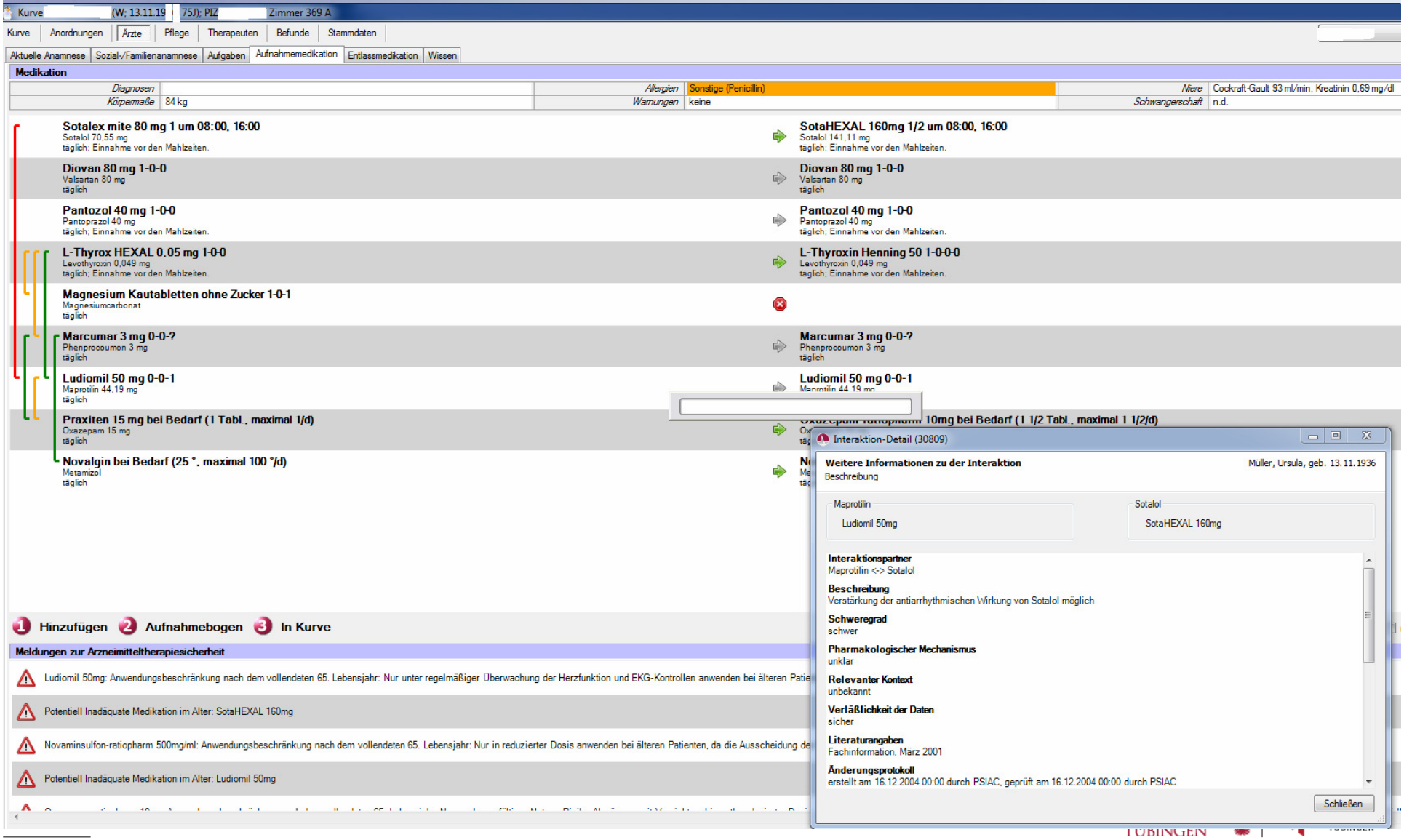
ja/ja (nicht festgelegt)

Implantierte Systeme

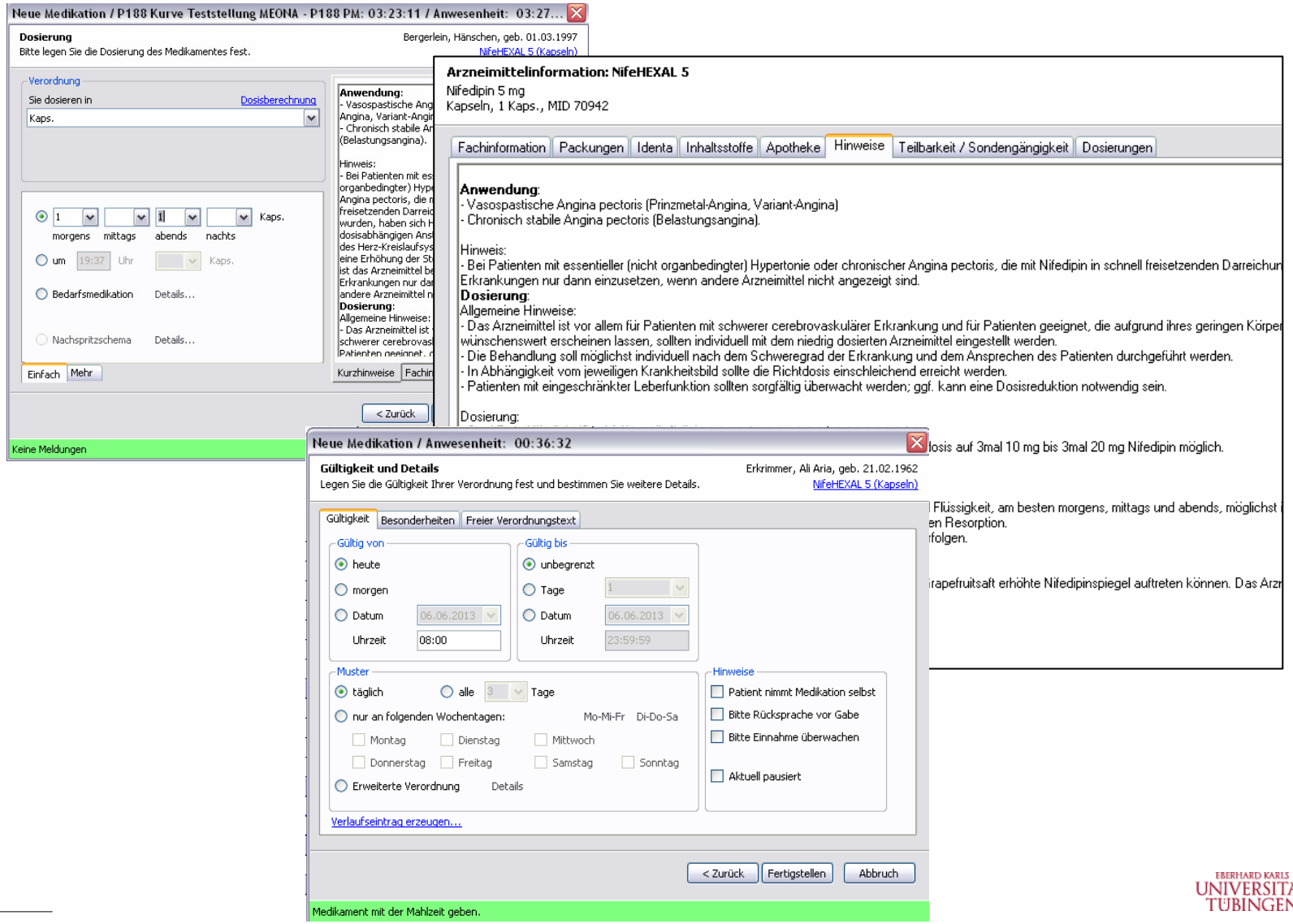
Example: Pilot installation „Meona“ – physical examination



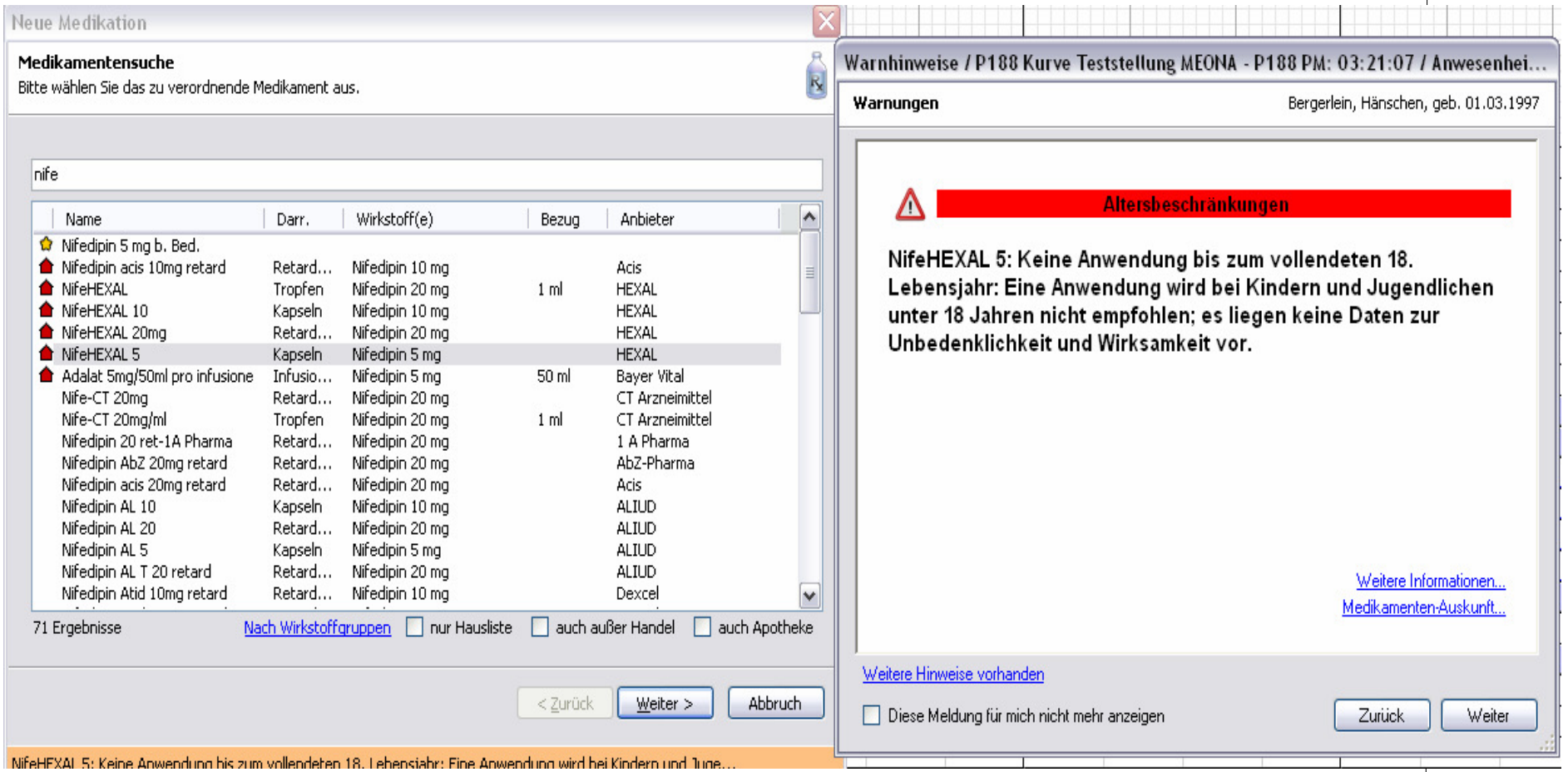
Example: Pilot installation „Meona“ – medication on admission



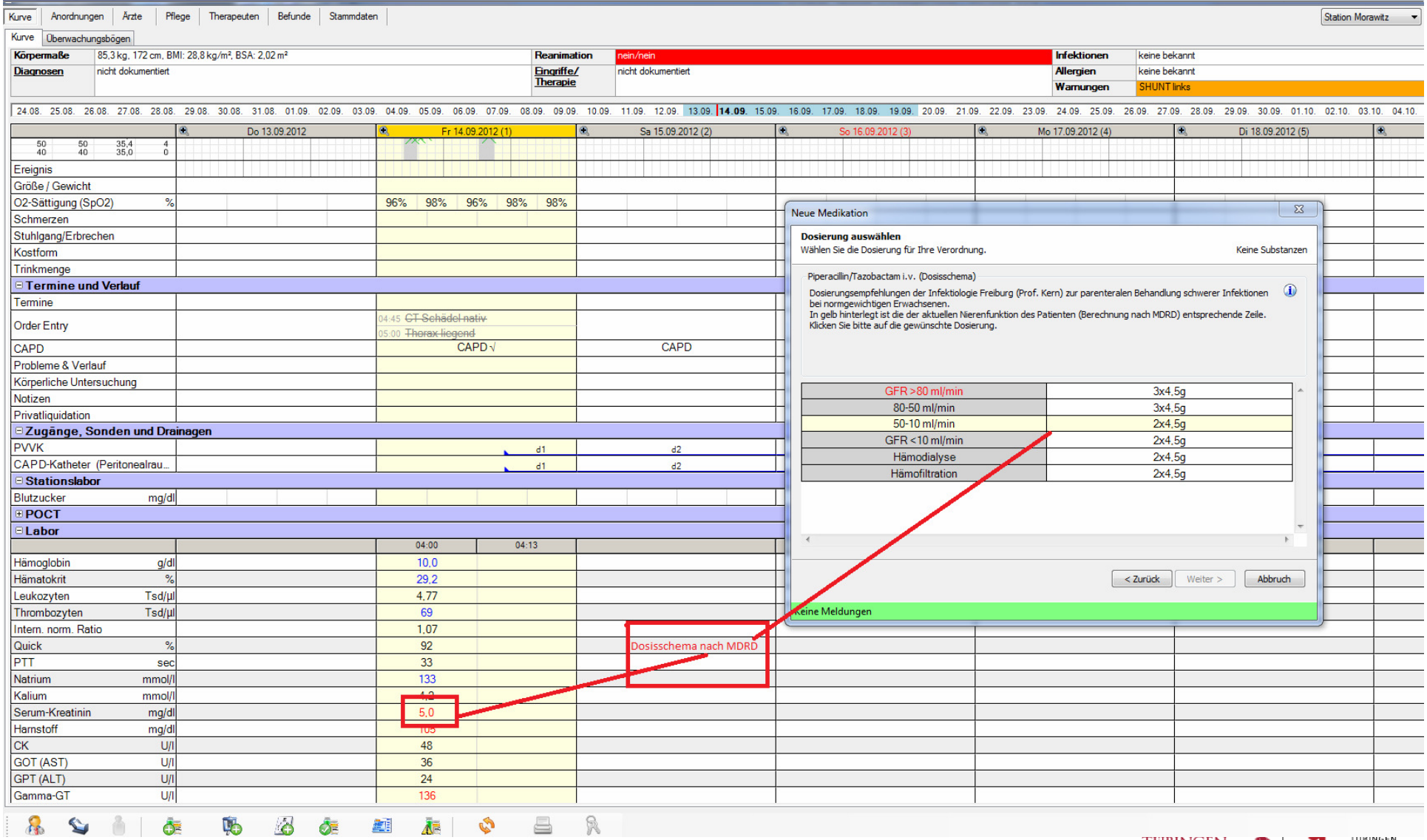
Example: Pilot installation „Meona“ – medication dosing and special information



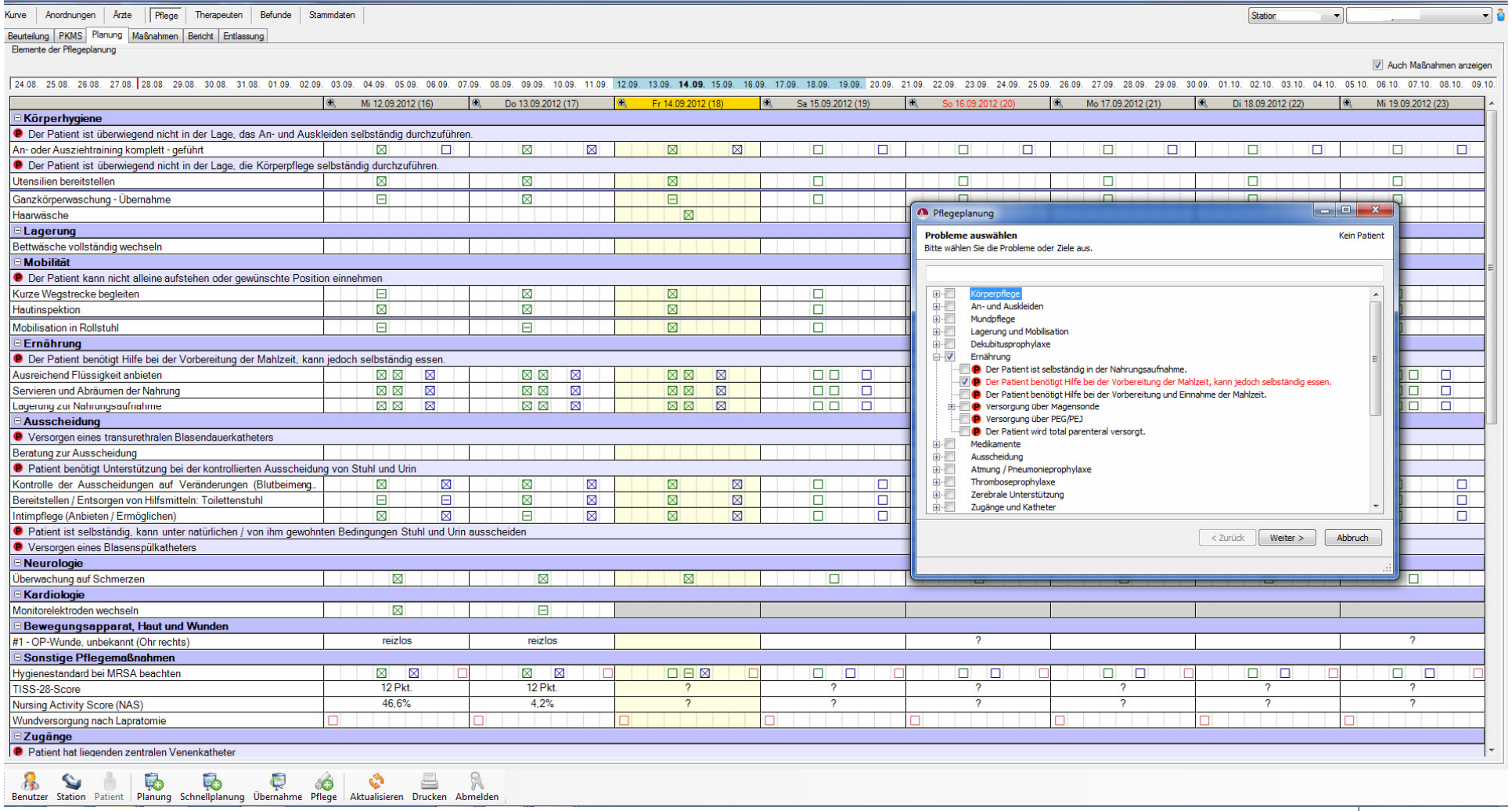
Example: Pilot installation „Meona“ – medication prescription



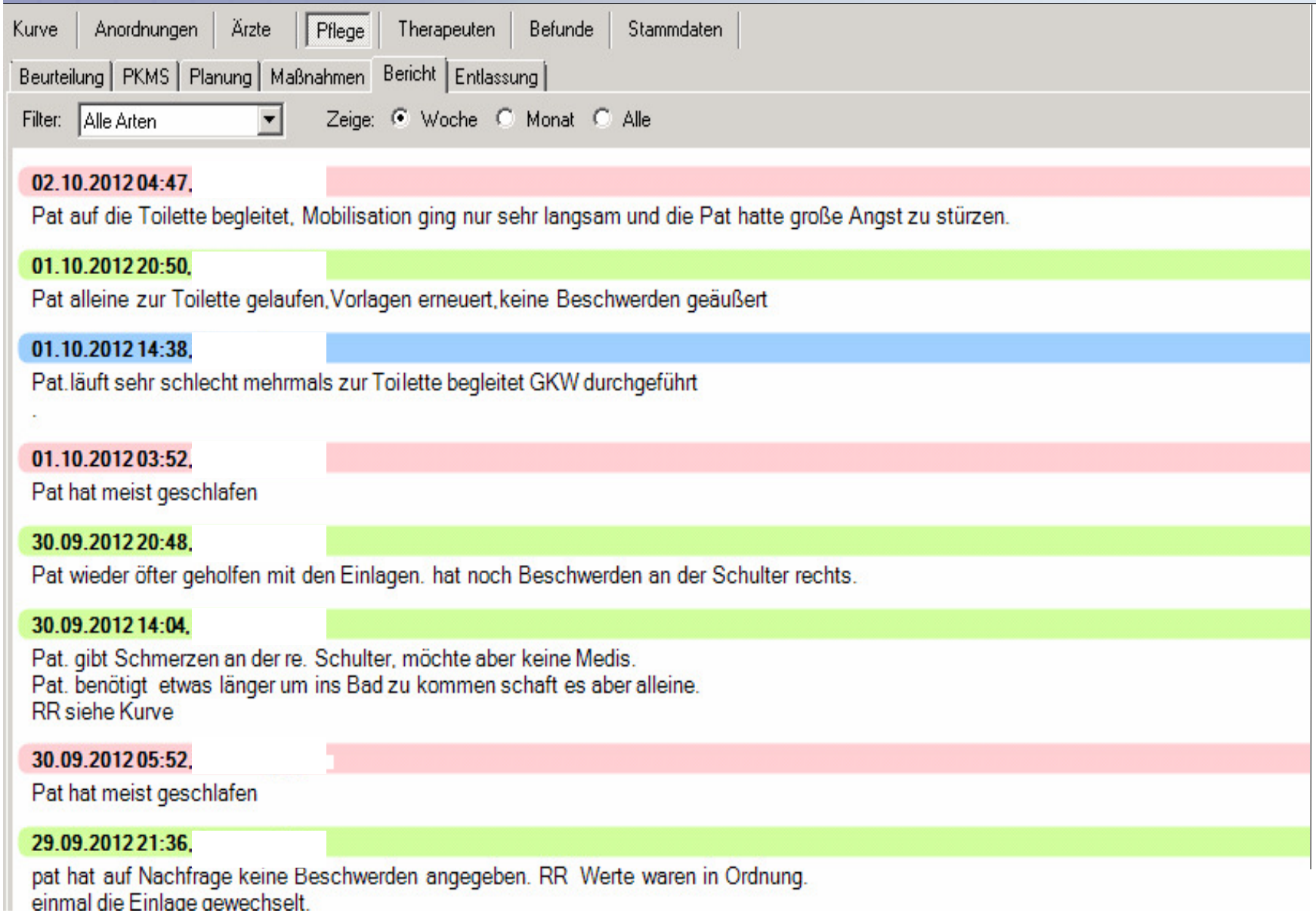
Example: Pilot installation „Meona“ – medication prescription schemes



Example: Pilot installation „Meona“ – nursing planning



Example: Pilot installation „Meona“ – nursing protocol



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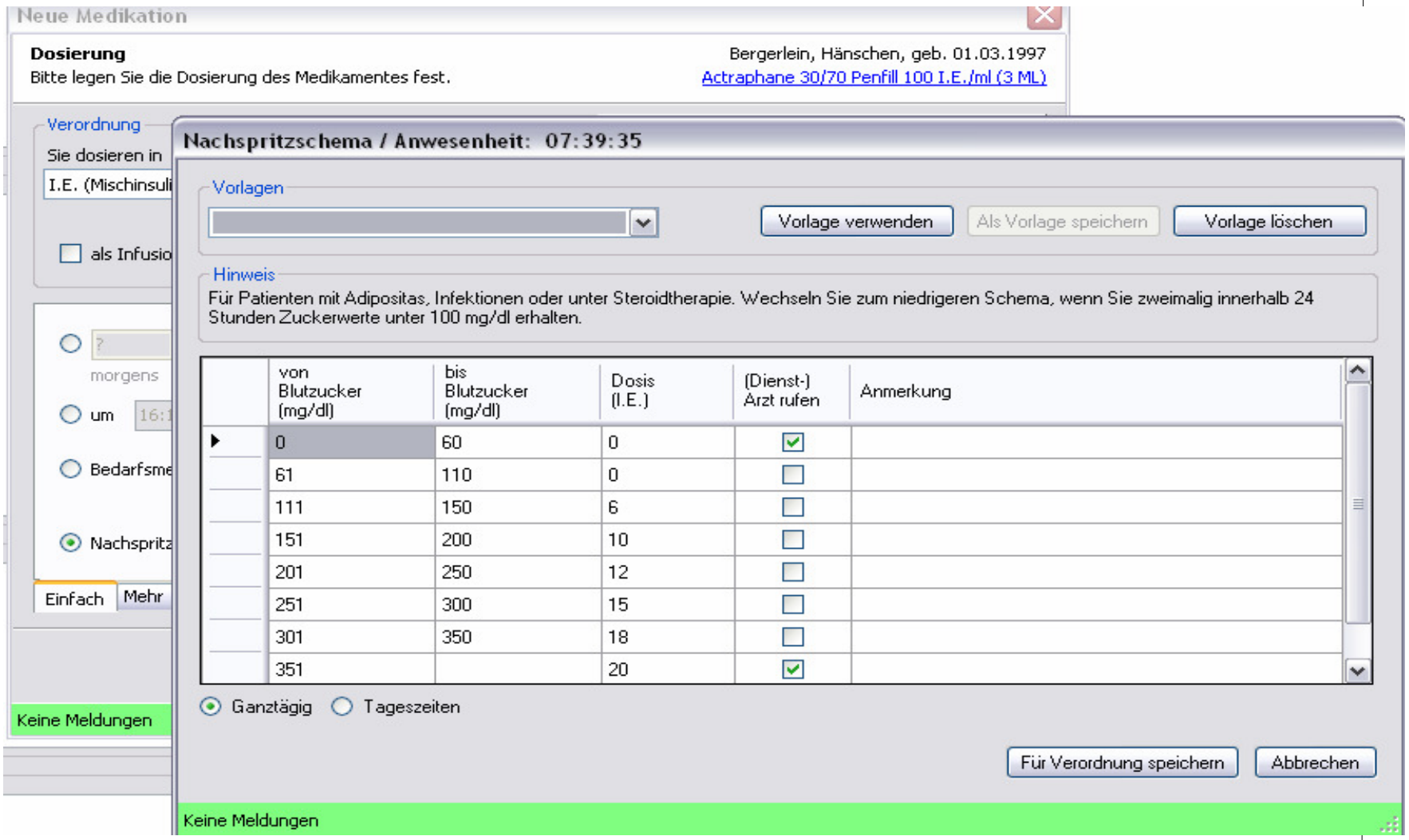
Example: Pilot installation „Meona“ – nursing schemes



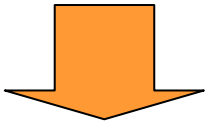
Process adherence: clincal pathways

multidisciplinary plans of

best clinical practice for

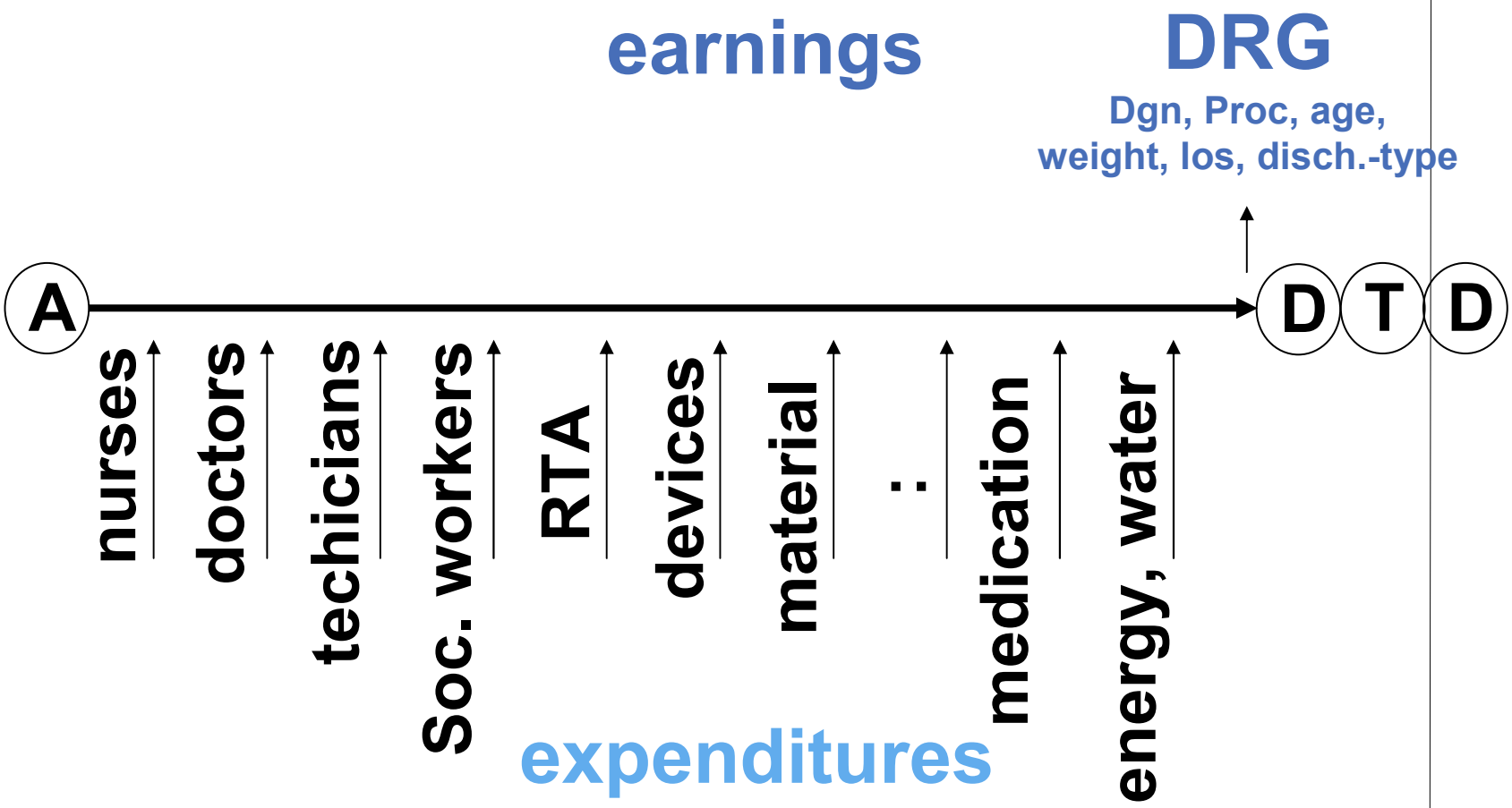
specified groups of patients with a

particular diagnosis



- aid the coordination and delivery of high quality care
- popular method of reducing costs

CP: why?



A: admission, D: discharge, T: transfer, D: death

CP: why?

Legal obligations:

§ 135a SGB V: „...verpflichtet, sich an einrichtungsübergreifenden Maßnahmen der Qualitätssicherung zu beteiligen, die insbesondere das Ziel haben, die Ergebnisqualität zu verbessern.“

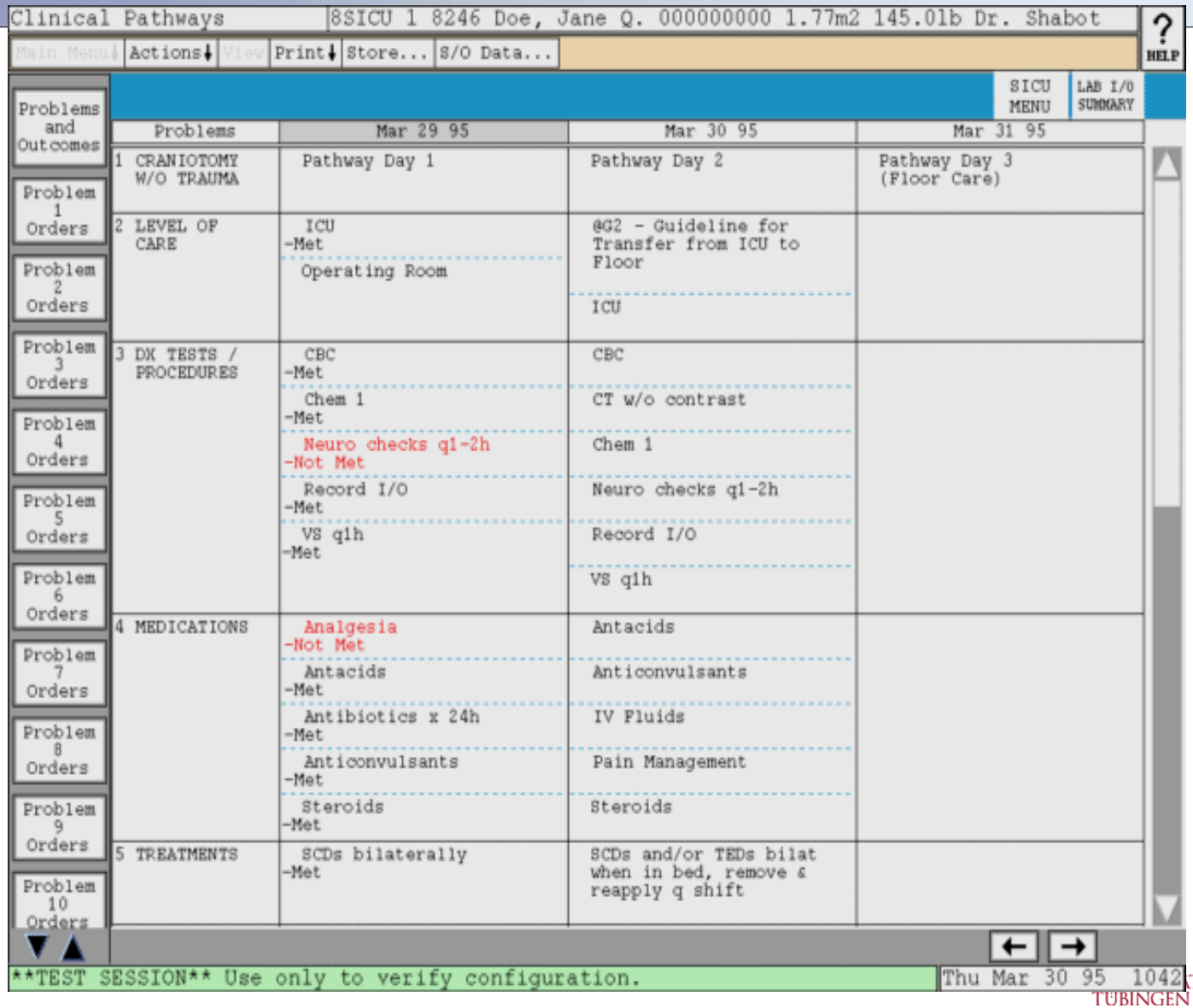
§ 137 SGB V: „ 2: Kriterien für die indikationsbezogene Notwendigkeit und Qualität der im Rahmen der Krankenhausbehandlung durchgeführten diagnostischen und therapeutischen Leistungen, insbesondere aufwendiger med.-technischer Leistungen.“

CP: what is needed?

Four essential components according to Hill (1995)

- **timeline**
- **categories of care or activities and their interventions**
- **intermediate and long term outcome criteria**
- **variance record**

CP: example screen shot



Clinical Pathways | 8SICU 1 8246 Doe, Jane Q. 000000000 1.77m2 145.01b Dr. Shabot | HELP

Main Menu | Actions | View | Print | Store... | S/O Data...

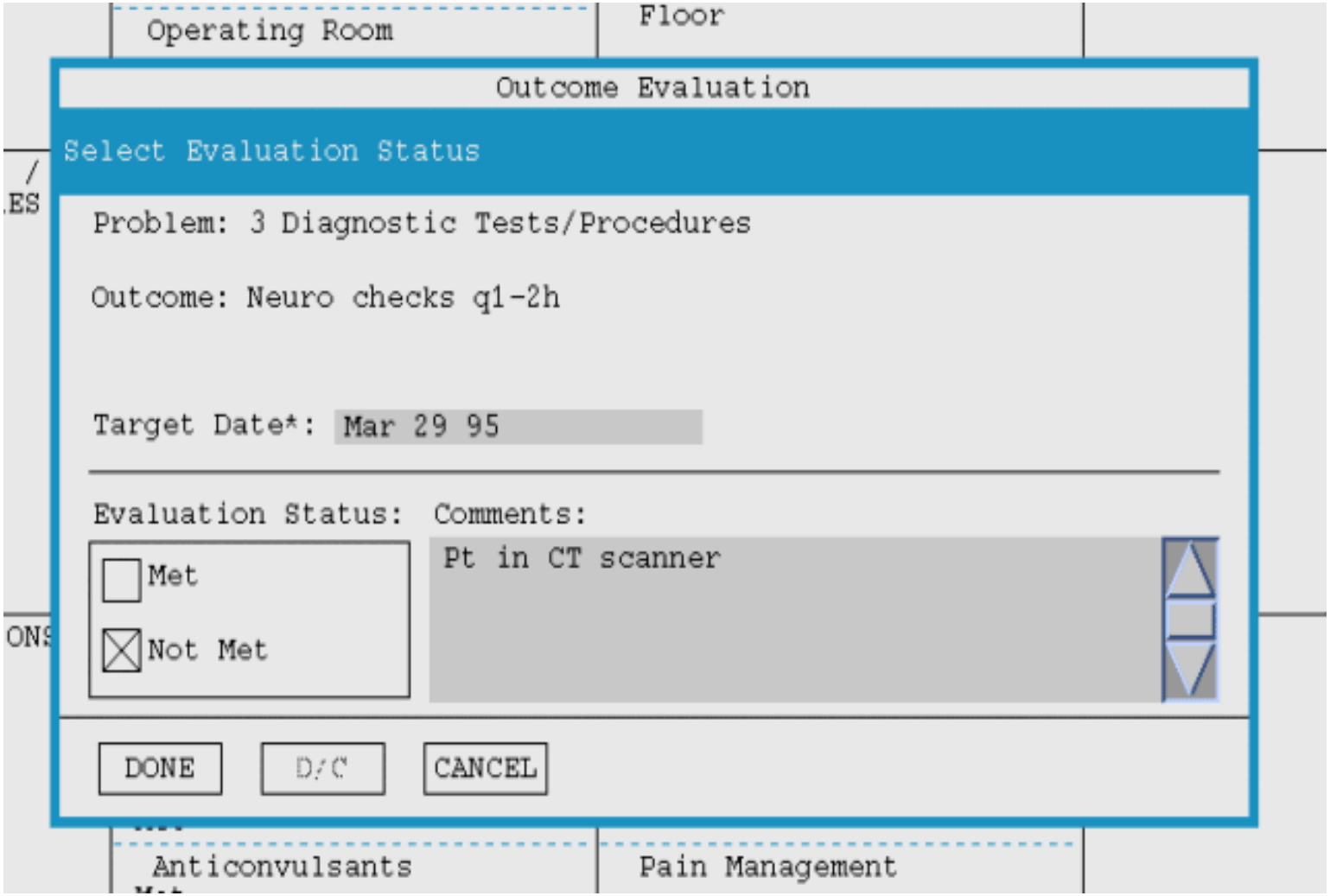
Problems and Outcomes | Problem 1 Orders | Problem 2 Orders | Problem 3 Orders | Problem 4 Orders | Problem 5 Orders | Problem 6 Orders | Problem 7 Orders | Problem 8 Orders | Problem 9 Orders | Problem 10 Orders

SICU MENU | LAB I/O SUMMARY

Problems	Mar 29 95	Mar 30 95	Mar 31 95
1 CRANIOTOMY W/O TRAUMA	Pathway Day 1	Pathway Day 2	Pathway Day 3 (Floor Care)
2 LEVEL OF CARE	ICU -Met Operating Room	@G2 - Guideline for Transfer from ICU to Floor ICU	
3 DX TESTS / PROCEDURES	CBC -Met Chem 1 -Met Neuro checks q1-2h -Not Met Record I/O -Met VS q1h -Met	CBC CT w/o contrast Chem 1 Neuro checks q1-2h Record I/O VS q1h	
4 MEDICATIONS	Analgesia -Not Met Antacids -Met Antibiotics x 24h -Met Anticonvulsants -Met Steroids -Met	Antacids Anticonvulsants IV Fluids Pain Management Steroids	
5 TREATMENTS	SCDs bilaterally -Met	SCDs and/or TEDs bilat when in bed, remove & reapply q shift	

TEST SESSION Use only to verify configuration. | Thu Mar 30 95 1042

CP: example screen shot



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IT within hospitals…

- Is not just an end in itself
- Always interferes with processes and has to serve and to facilitate them
- Can help in automation and error reduction of medical processes
- Has to have a smart interface with the users
- Is a risk because it has to work 24/7 and shut-downs are critical for patient care

- Never consider an IT-project a mere IT-project, always consider the expertise of clinicians!*

*Dtsch Arztebl 2001; 98(14): A-892 / B-757 / C-715

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IT-system implementation and facility planning…

- Are for the sake of staff and patients
- Are done best with a project management approach
- Integration of and interaction with front side staff and users during planning and implemention stages is essential for a good result
- Even if it takes longer and the obvious costs are higher: an integrative approach pays in the long run


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