How to introduce dose dispensing at hospitals, including integration and the closed loop medication administration?

Can dose dispensing in hospitals increase patient safety and improve quality?

Michael Baehr, Hamburg

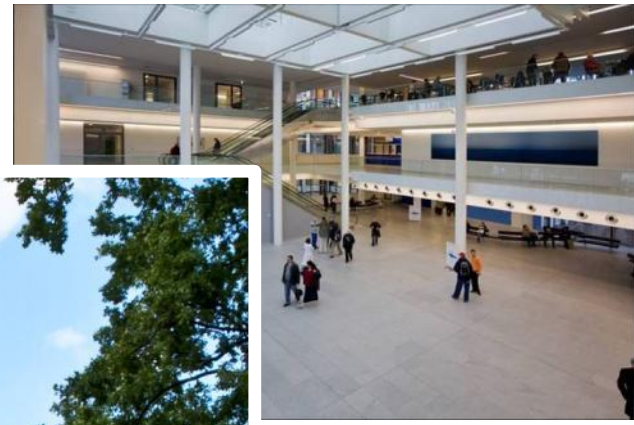
Universitätsklinikum Hamburg-Eppendorf

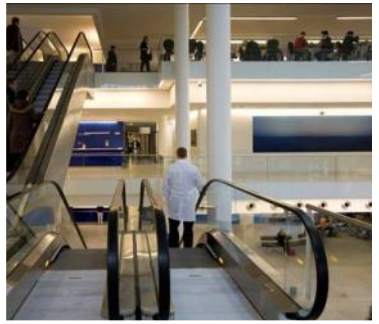
Hamburg

Universitätsklinikum Hamburg-Eppendorf

University Medical Center Hamburg Eppendorf








Where do we come from?

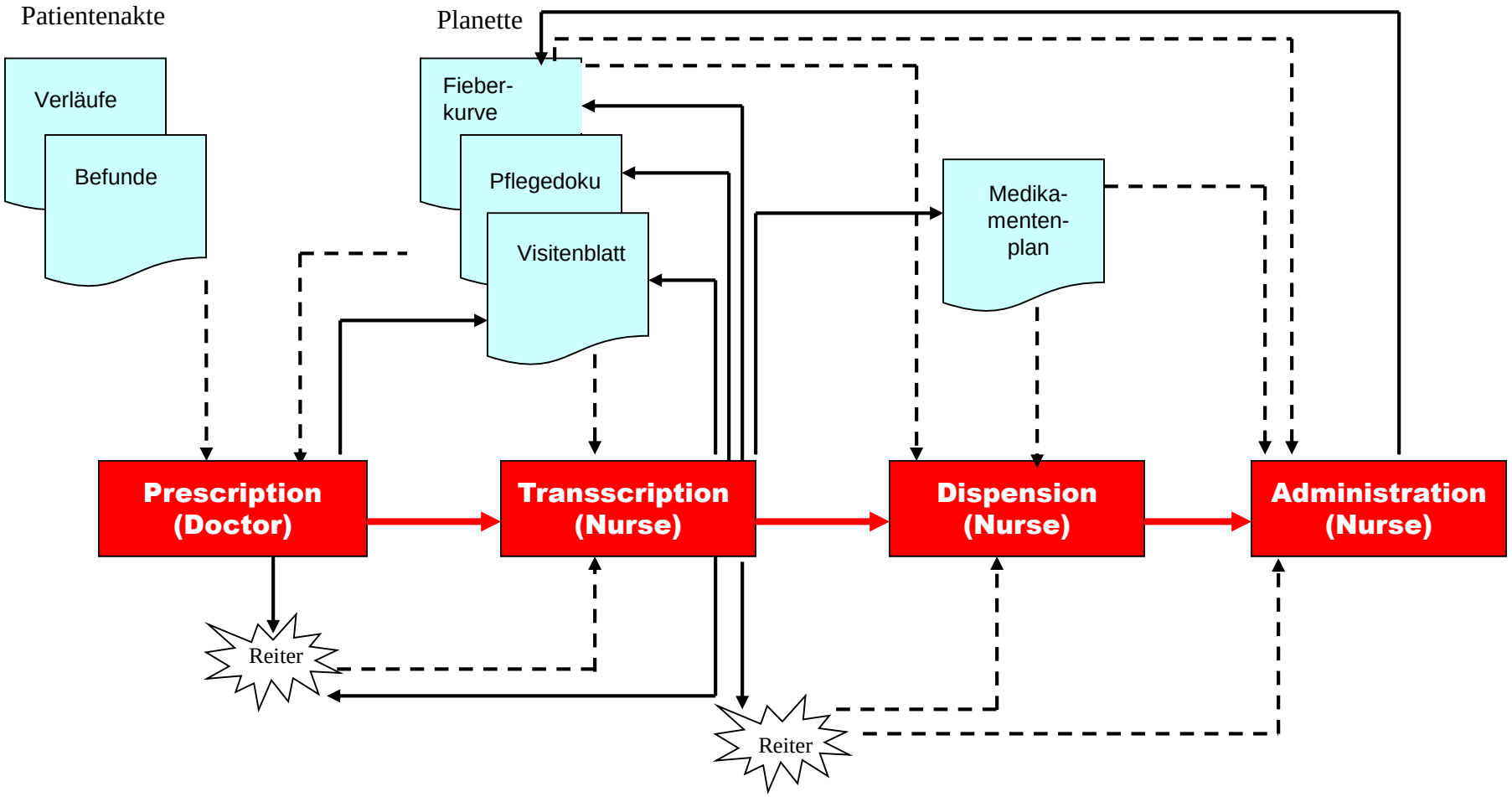
Prescription errors:

The doctor had to manage his process without electronic support.

… like the pilot 60 years ago!

Transcription errors:

Handwritten documentation using different media

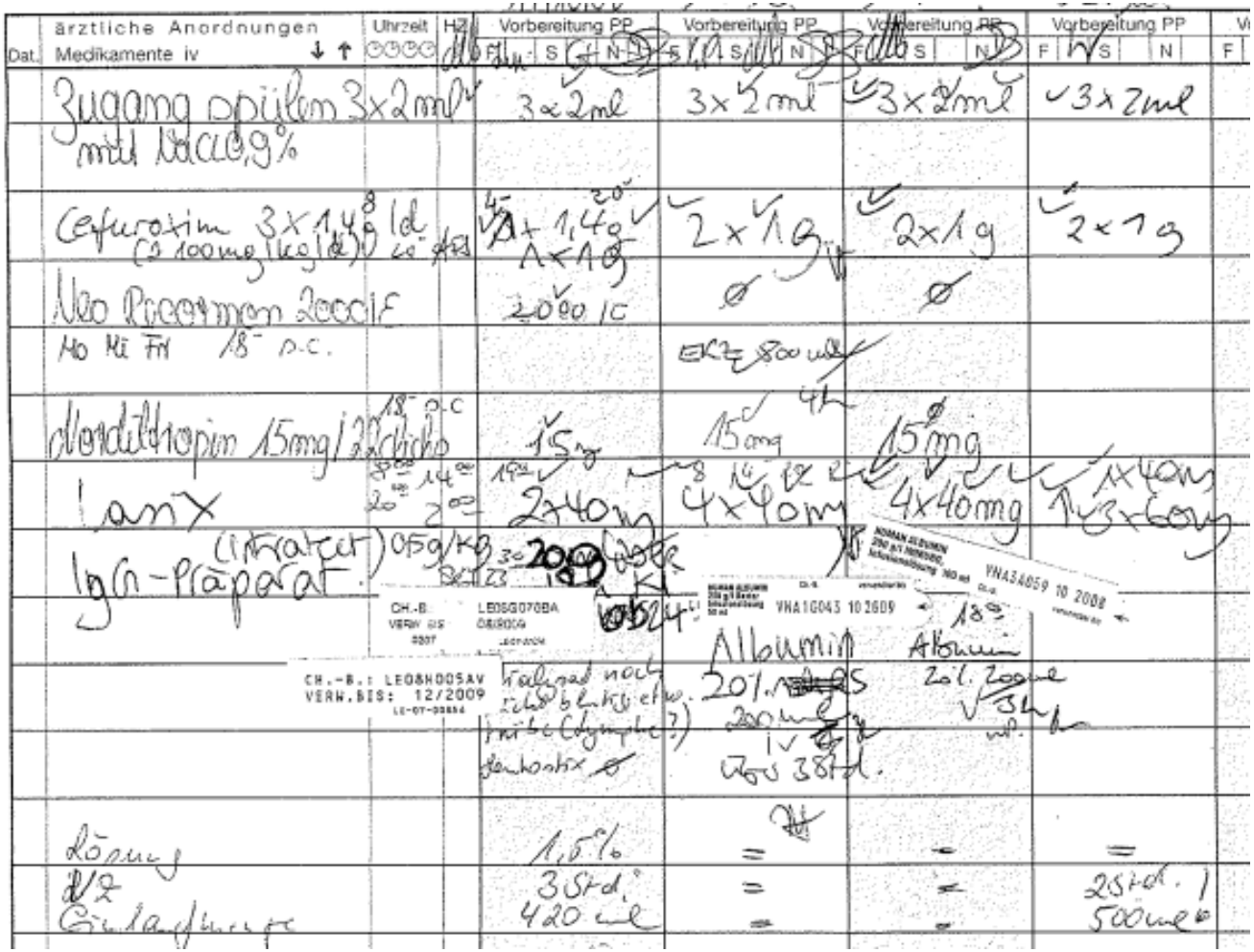


Kahnert, UKE, Okt-2002

Dispensing and Administration errors:

Medications were dispensed manually by nurses

Forensic problems due to paper based documentation



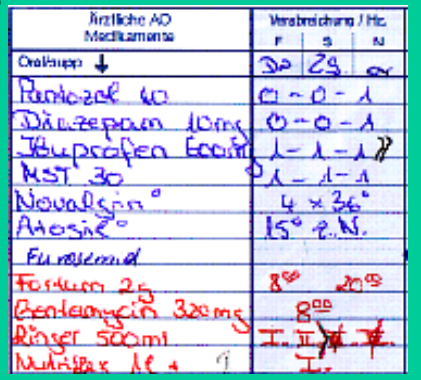
The traditional supply chain in German hospitals

Decision and hand written prescription by doctors

Ward stock logistics

Dispensing and Administration

Hand written documen-tation



Order

Delivery

Pharmacy
delivers medication to the ward stock

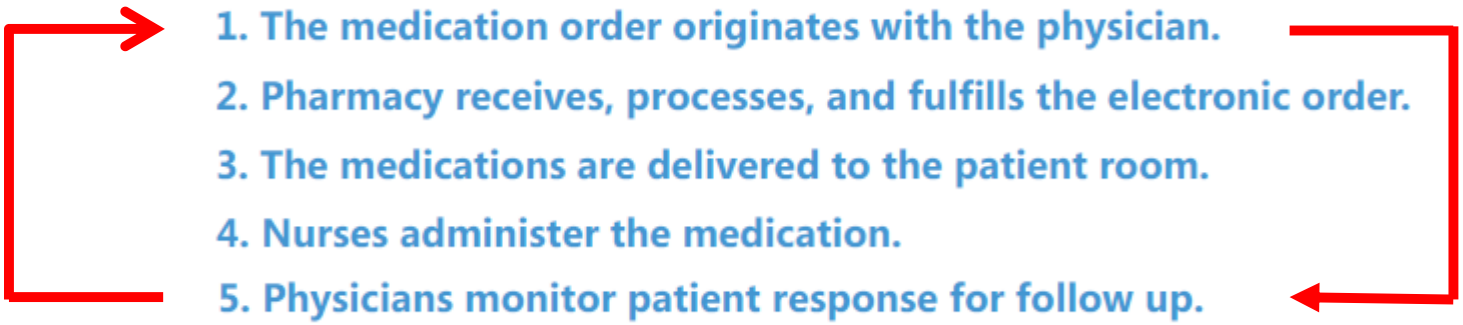
A closed loop of medication administration (CLMA) is best practice for the medication process!

Is dose dispensing the best option for the CLMA-Process?

Michael Baehr UKE Hamburg

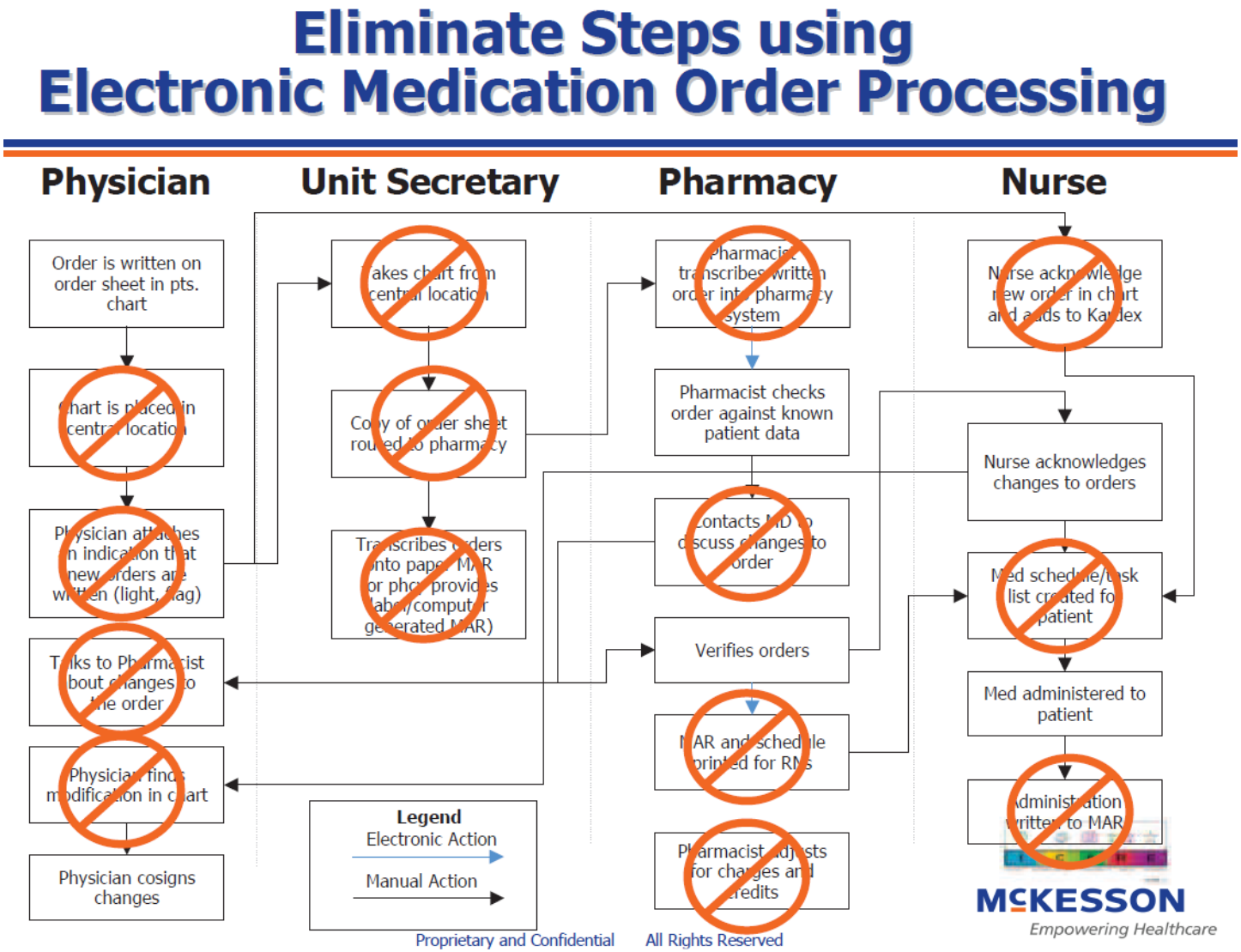
What is Closed-Loop Medication Management?

A truly closed-loop medication management system is designed to feed outcomes from medication processes back into the system to allow for future improvements and changes in a patient's course of care5. As an example:



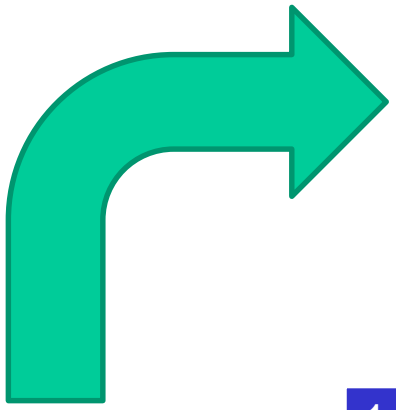
Quelle: Closing the Loop in Medication Management, Amalga Hospital Information System, April 2009

Complexity of the medication process

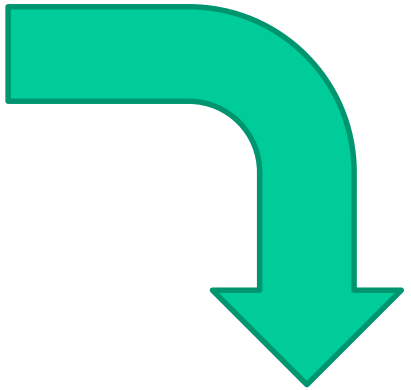


Quelle: Bryan Eckert, McKesson Nov. 2003

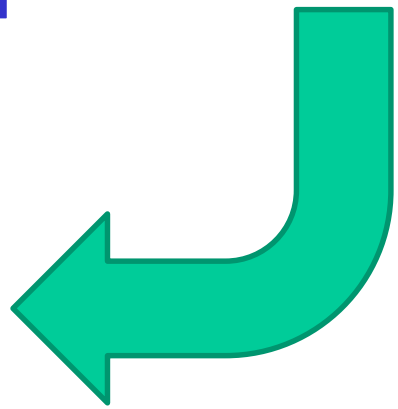
Methods to close the loop



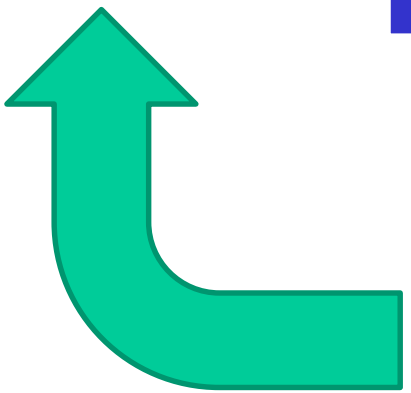
Pharmacy validation (pharmacist)
- transferring order as written to precise pharmaceutical order
- checking with regards to dosing, interactions etc.



Pharmacy service
- delivery of packs for ward stock
- filling automated ward cabinets
- delivery of unit-doses



Drug administration and documentation (nurse)
- manual picking out of ward stock
- manual picking out of automated ward cabinets
- handing over unit-doses



Electronic order (doctor)
- order as written (parac 250mg p.o. bd)
- pharmaceutically precis (Ben-u-ron™ 500mg, 0 8pm, 8am

1. Who determines the final pharmaceutical form ?
2. Who finally fixes the link between medications and patient ?
3. At which stage of the process is this done?

Pharmacy service

Pharmacy service

Traditional ward stock

pharmacy: no influence on dispensing errors
nurse: complete responsibility and workload

Correct link between medication and patient is not traceable. The loop can not be closed.

Pharmacy service

Pharmacy service

Traditional ward stock

pharmacy: no influence on dispensing errors
nurse: complete responsibility and workload

For a correct link between medication and patient bedside barcoding of any single medication is necessary.

Pharmacy service

Pharmacy service

Traditional ward stock

pharmacy: no influence on dispensing errors
nurse: complete responsibility an workload

Automated ward cabinets

pharmacy: filling cabinets, poor influence on dispensing errors
nurse: reduced responsibility, extended workload

For a correct link between medication and patient bedside barcoding of any single medication is necessary.

Pharmacy service

Pharmacy service

Medication is already linked to the patient by the label.

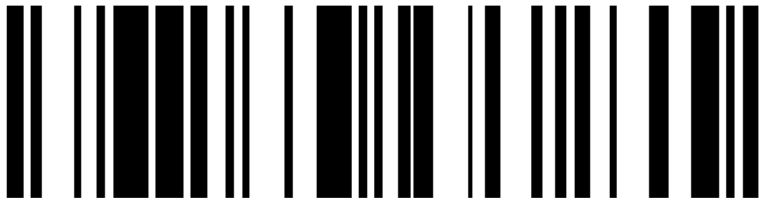
Barcoding is not necessarily needed.

Unit-dose supply

pharmacy: nearly complete responsibility and workload
nurse: reduced responsibility and workload

The „Scan for Safety“-Project 2004

Scan for Safety



Michael Baehr UKE Hamburg

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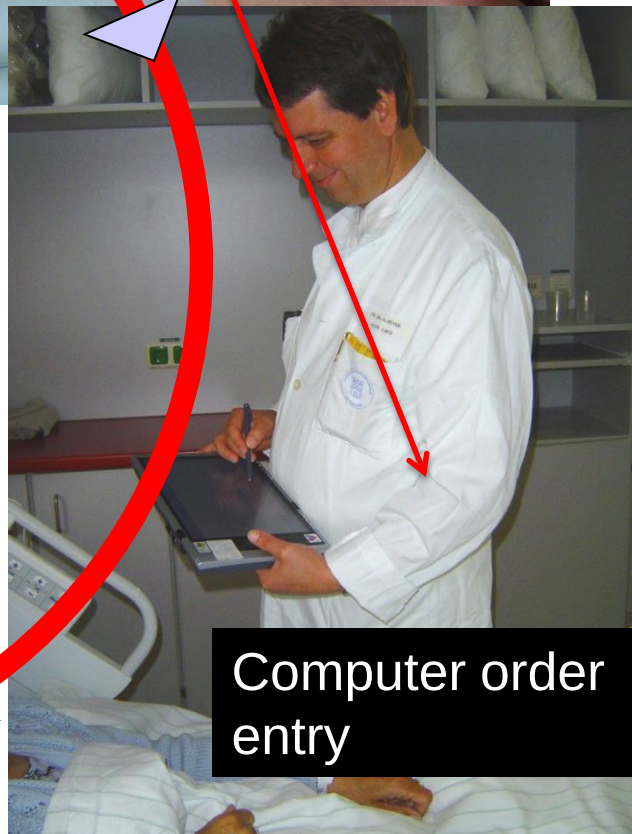
2004 Scan for Safety
The first trial

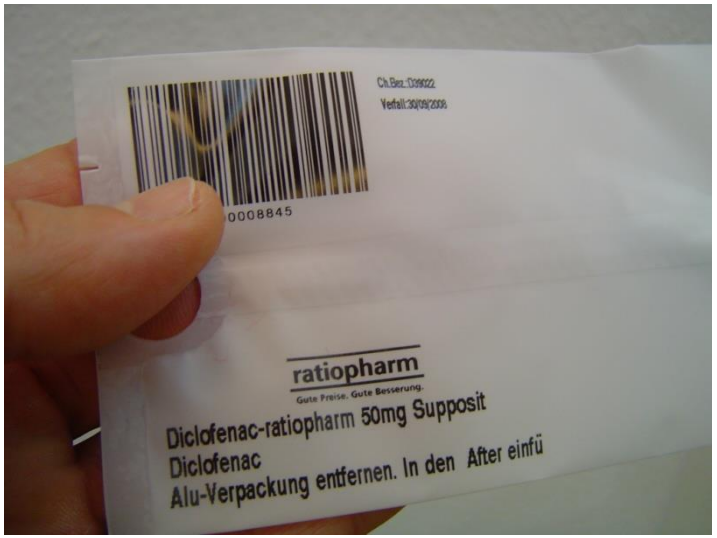
Single barcodes bags

Barcoding at point of care



Unit-dose production with pillpick

Prepacked barcoded unit doses



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Production of individual patient-rings

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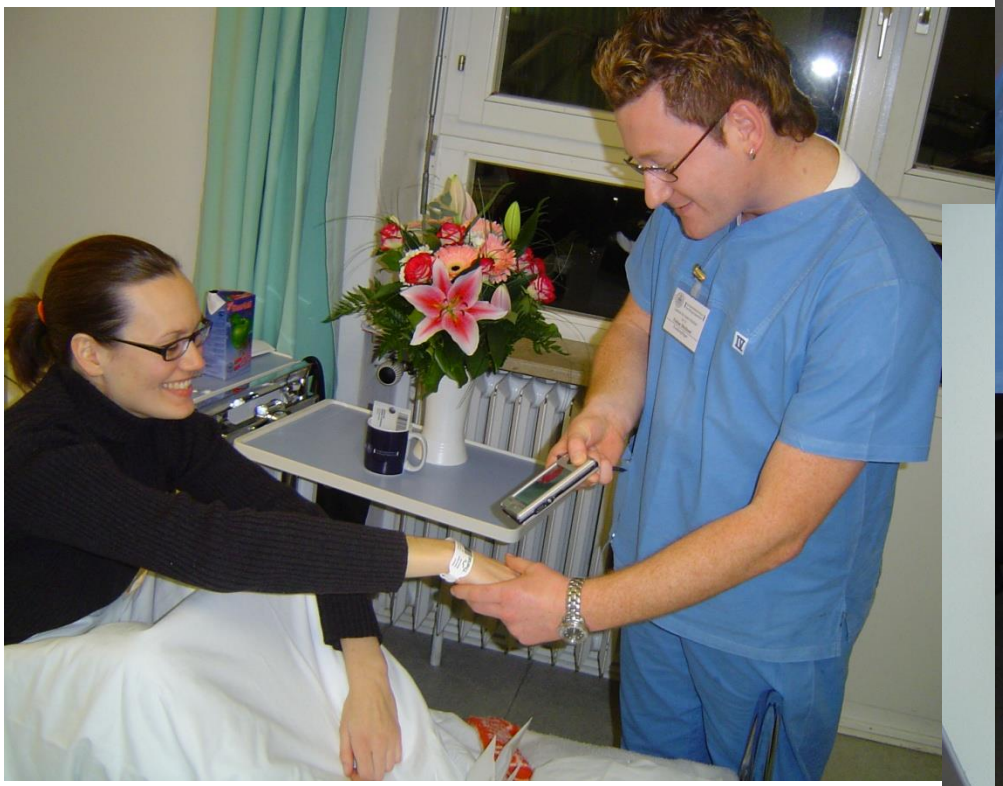
Delivery of rings and labels for multi dosed medication in special trolleys

bedside verification



2004 Scan for Safety Results of the project*

- Severe errors in the prescription software
- Standalone solution without access to an electronic health record - little acceptance among physicians and nurses
- The packaging and dispensing machine was too slow, too big, and at least too expensive
- **The logistical concept did not meet the requirements of the clinical practice**
- The packaging of parenteral drugs had no added value to the process
- For various reasons barcoding was not feasible in clinical practice

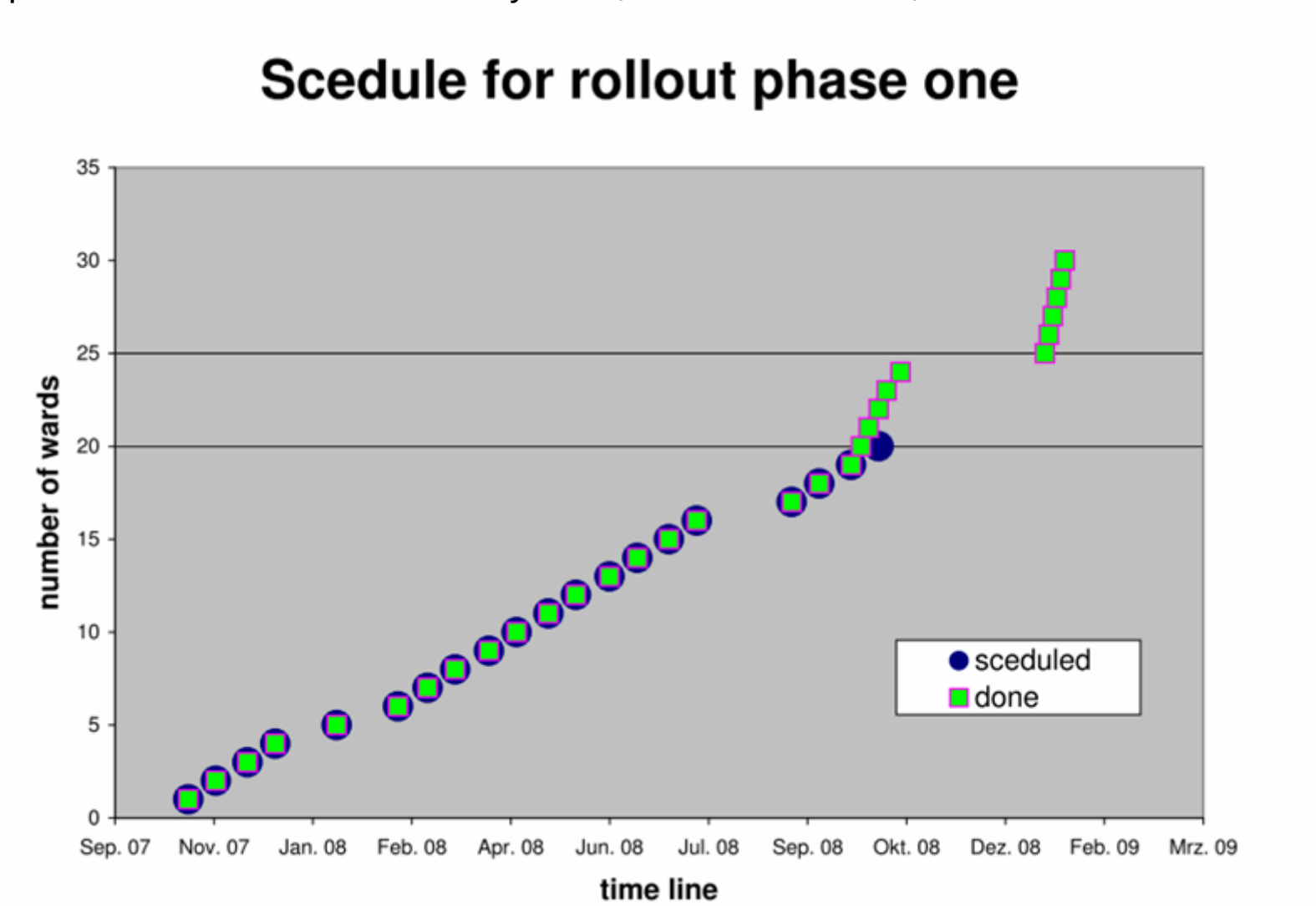
*Baehr M. Scan for Safety. Ergebnisse des Pilotprojekts in Hamburg. Krankenhauspharmazie 2007;28:129-31

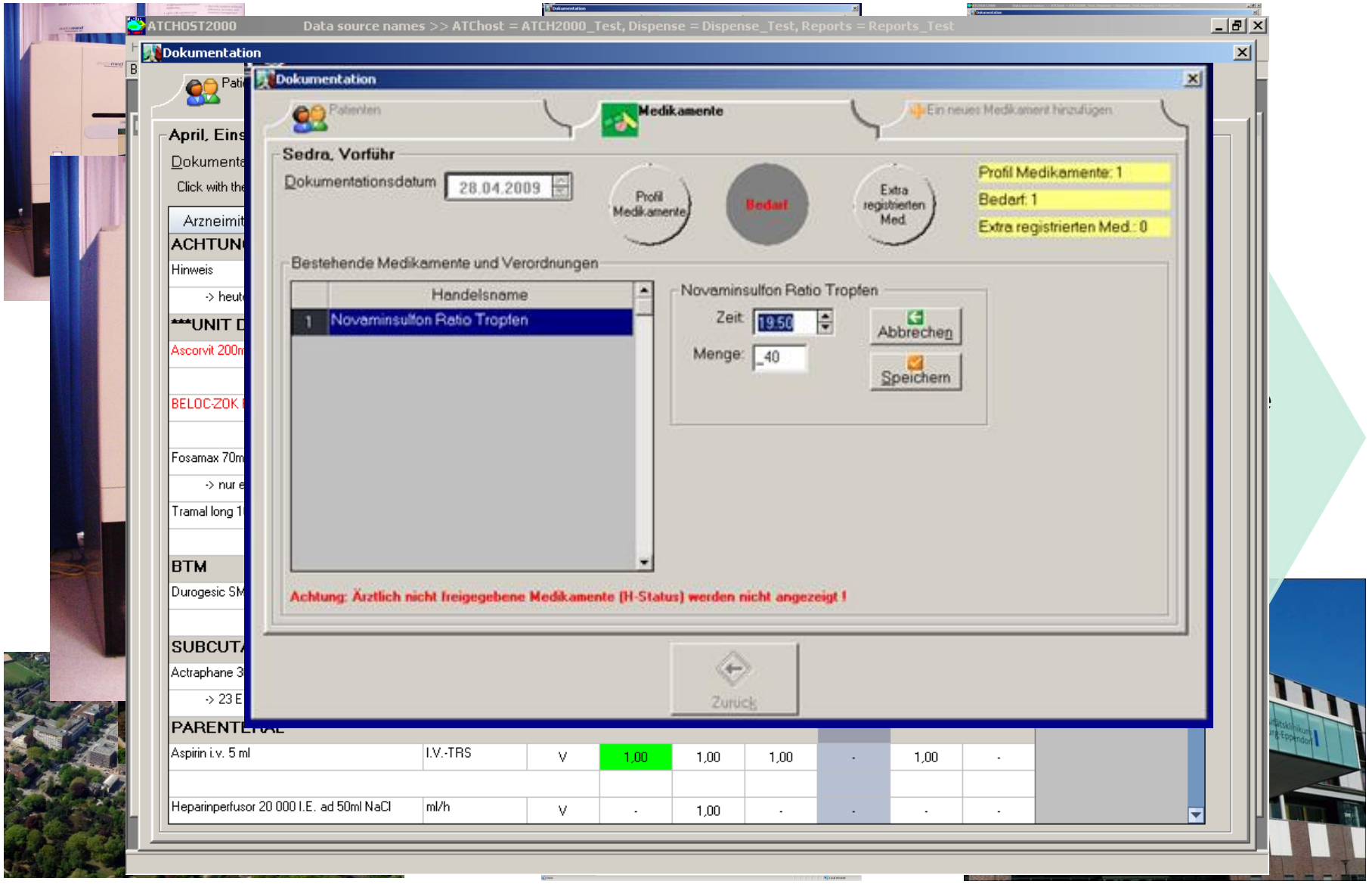
Safe Medication in Time

CLMA projekt at UKE 2007

Michael Baehr UKE Hamburg

Implementation of SMiT:
First phase November 2007 - January 2009, 26 normal wards, 7 ICUs




ATCHOST2000
Data source names >> ATChost = ATCH2000_Test, Dispense = Dispense_Test, Reports = Reports_Test
Dokumentation
Dokumentation
Patienten
Medikamente
Ein neues Medikament hinzufügen
Sedra, Vorführ
Dokumentationsdatum
28.04.2009
Profil Medikamente
Bedarf
Extra registrierten Med.
Profil Medikamente: 1
Bedarf: 1
Extra registrierten Med.: 0
Bestehende Medikamente und Verordnungen
Handelsname
1 Novaminsulfon Ratio Tropfen
Novaminsulfon Ratio Tropfen
Zeit: 19.50
Menge: 40
Abbrechen
Speichern
Achtung: Ärztlich nicht freigegebene Medikamente (H-Status) werden nicht angezeigt !
Zurück
April, Eins
Dokumenta
Click with the
Arzneimit
ACHTUN
Hinweis
-> heut
***UNIT D
Ascorvit 200m
BELOC-ZOK
Fosamax 70m
-> nur e
Tramal long 1
BTM
Durogesic SM
SUBCUTA
Actraphane 3
-> 23 E
PARENTERAL
Aspirin i.v. 5 ml
I.V.-TRS
V
1,00
1,00
1,00
-
1,00
-
Heparinperfusor 20 000 I.E. ad 50ml NaCl
ml/h
V
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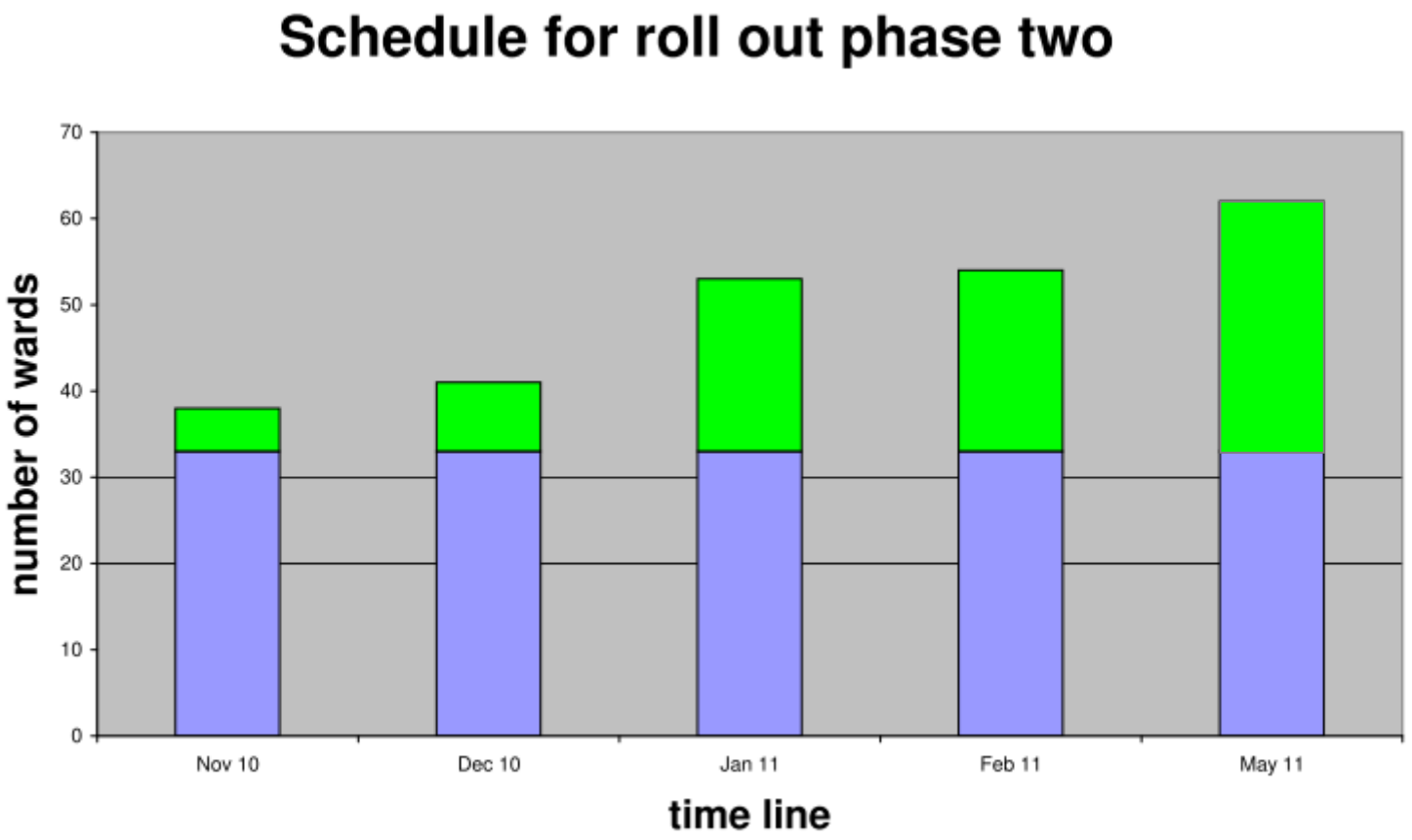
Implementation:
Second phase November 2010 - May 2011, Additional 29 wards



Today 70 wards, 1.400 patients, 12.000 units/day

Medikationsübersicht | **Musterfrau, Malene** (*17.07.1964), 50 Jahre, weiblich | **Hinweise**

Zeitraum: **06.05.2015** (00:00 **Uhr** - 23:00 **Uhr**) ⇒ Heute — Ansicht: 24 Stunden

<< 30.04. (Do.) | 01.05. (Fr.) | 02.05. (Sa.) | 03.05. (So.) | 04.05. (Mo.) | 05.05. (Di.) | **06.05. (Mi.)** | 07.05. (Do.) | 08.05. (Fr.) | 09.05. (Sa.) | 10.05. (So.) | 11.05. (Mo.) | 12.05. (Di.) | 13.05. (Mi.) >>

<< 00:00 | 01:00 | 02:00 | 03:00 | 04:00 | 05:00 | 06:00 | 07:00 | 08:00 | 09:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 >>

Kompakte Ansicht

Handelsname / Wirkstoff	07:00	12:00	18:00
- intravenös			
Human-Albumin 20% 50ml INF - (P) (CHARGE)	1 Flasche		
Human-Albumin 20% 50ml INF - (P) (CHARGE) 2-2-2 Flasche		2 Flasche	2 Flasche
Meropenem Eberth 500mg TRS - (P) 1-0-1 Flasche;1-0-1 Flasche	1 Flasche		1 Flasche
Sterofundin ISO 500ml Ecoflac Inf. - (S) ... ;... ;1-0-1 Flasche	1 Flasche		
Vancomycin 500mg TRS - (P) X-0-0 Flasche;... ;X-0-0 Flasche	X Flasche		
- subcutan			
Actrapid 100 IE/ml Amp - (S) X-0-0 I.E.	X I.E.		
Lantus Insulin 100IE/ml Amp - (S) 0-0-28 E.			28 E.
- peroral/oral			
Bifiteral Sirup - (S) 30-30-30 ml	30 ml	30 ml	30 ml
Citalopram Hexal 40mg FTA - (A) 1-0-0 Tabl.	1 Tabl.		
Decortin H 10mg Tab - (A) 1-0-0 Tabl.	1 Tabl.		
Decortin H 5mg Tab - (A) 1-0-0 Tabl.	1 Tabl.		
Dekristol 20.000 IE Kps - Intervall beachten - (A) Mo 1-0-0 Kaps.			
Epivir 150mg FTA - (A) 1-0-0 Tabl.	1 Tabl.		
Ferro Sanol Duodenal (Fe2+) 100mg Kps - (A) ... ;08:00 1 Kaps.	1 Kaps.		

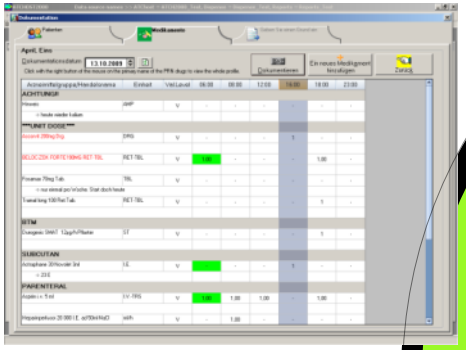
+ Neue Verordnung

Aktiv

Universitätsklinikum Hamburg-Eppendorf

CLMA medication process today

CPOE
at bedside via
Soarian platform

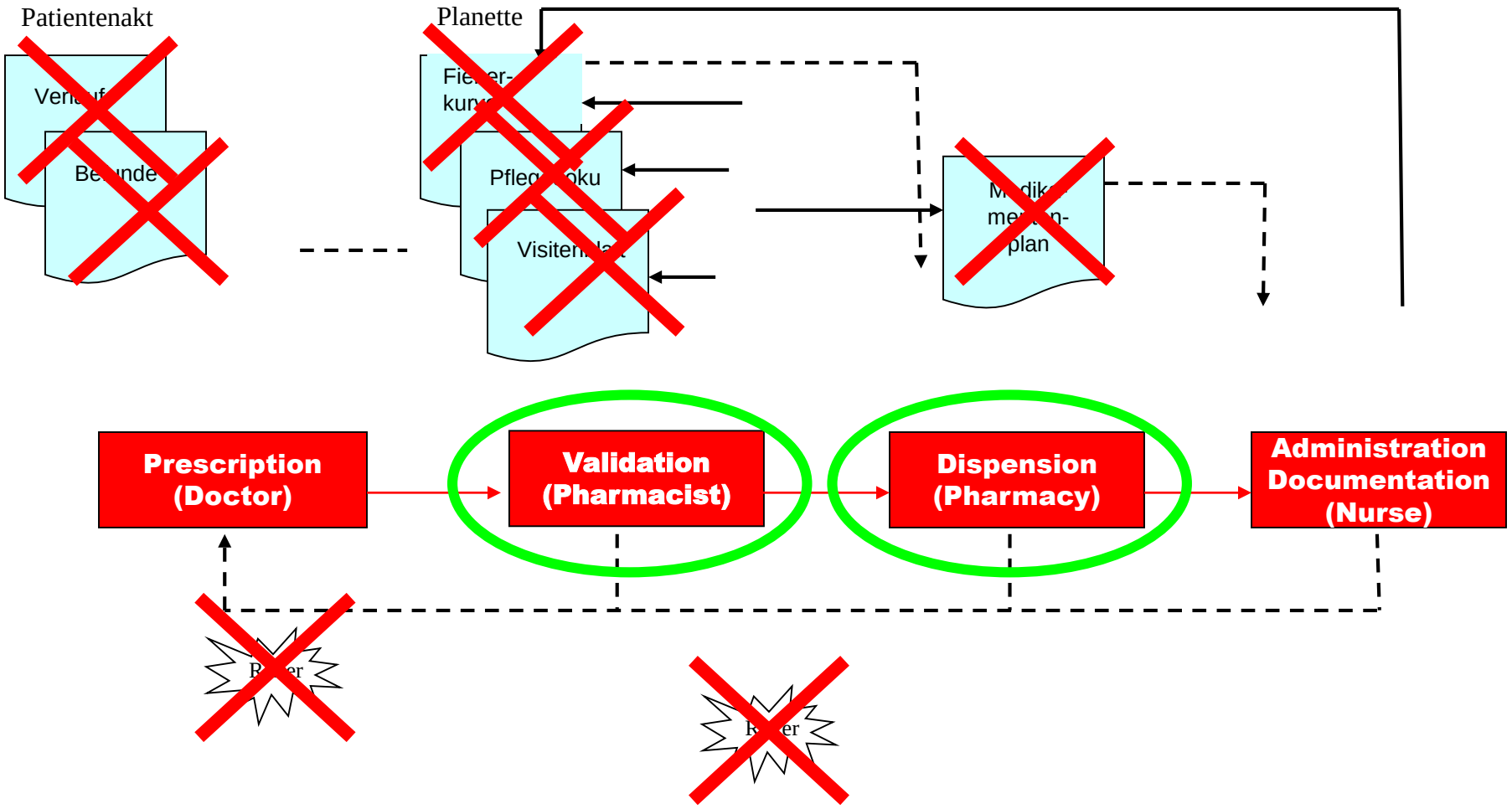


registration of
administration

Pharmacy validation on the ward

Unit dose
production
by
pharmacy

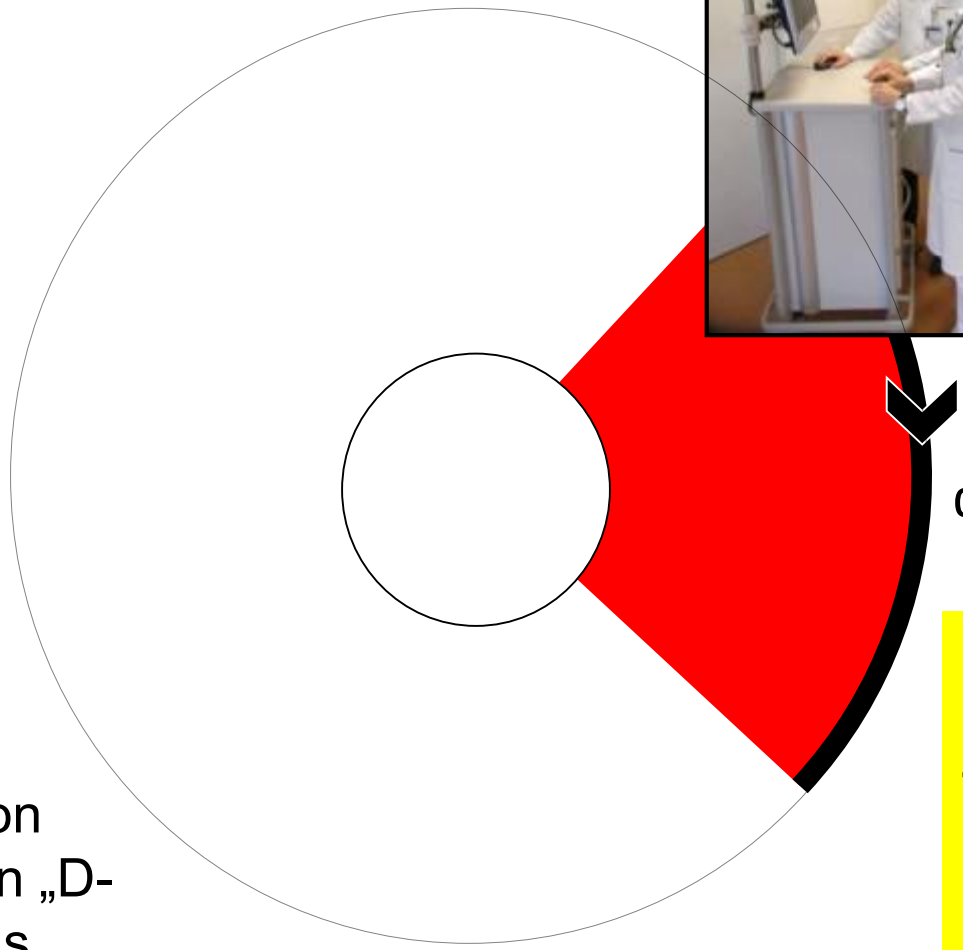
The new paperless process



CPOE

CPOE via mobile PCs

Doctors can access any relevant patient data directly while prescribing.



After prescription medication is on „D-level“ that needs pharmacy validation

Doctors determine the final

- **medication**
- **dose**
- **route**
- **precise time**

Pharmacy validation

CPOE pharma-ceutically precise order

Pharmacy validation on the ward

Clinical pharmacists verify the right

- **medication**
- **dose**
- **route**
- **time**

Pharmacy validation

Pharmacy validation comprises:

- medication reconciliation
- allergy check
- interaction counseling
- dosage check and adjustment
- early change to oral medication
- implementation of guidelines
- …

Pharmacists have an **unlimited access** to all patient relevant data (clinical chemistry, microbiology…)

Unit-dose production

The final link between medication and patient is fixed automatically by pouch production in the pharmacy

CPOE pharma-ceutically precise order

Pharmacy validation on the ward

Production of unit-doses in the pharmacy

Unit-dose production

Unit-dose production

Unit-dose medication is individually labelled with:

- patient ID (barcode)
- patient name
- ward, room
- medication, dose, route
- time
- advice for administration

Unit-dose supply

Solid oral medication

All other single dosed medications

Special workflow for intensive care units

Unit-dose supply

Two deliveries a day:

- main delivery
  - status after main ward round
  - contains all medications for the next 24 h starting with 6pm
- second delivery
  - contains latest changes between main ward round and 4 pm

- Additional deliveries
  - only small amounts if urgently needed by tube system

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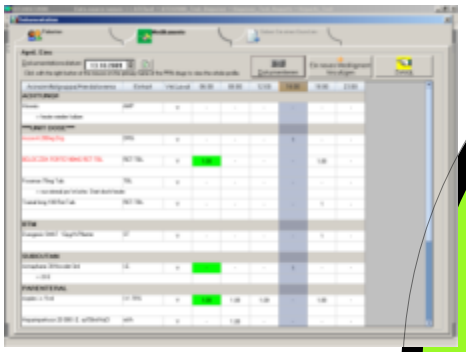
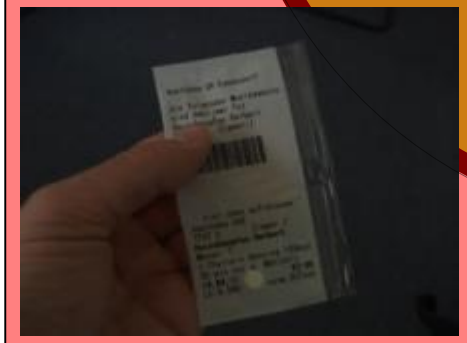
Final documentation closes the loop



registration of administration on the ward

CPOE pharma-ceutically precise order

Pharmacy validation on the ward



of unit-doses in the pharmacy

Michael Baehr UKE Hamburg

Barcoding

5 Rights of medication administration

Power of barcoding to achieve the “5 Rights”

Right	Verification
1. Right patient	Software checks right patient
2. Right time 2a. Right interval	Software checks current time versus prescribed time
2b. Before, during, after meal	Beginning and end of meal has to be documented in the software. Nurse supervises every single meal at bed side
3. Right medication	Software checks right medication
4. Right dose	Software checks correct dose
5. Right route	Software checks correct route

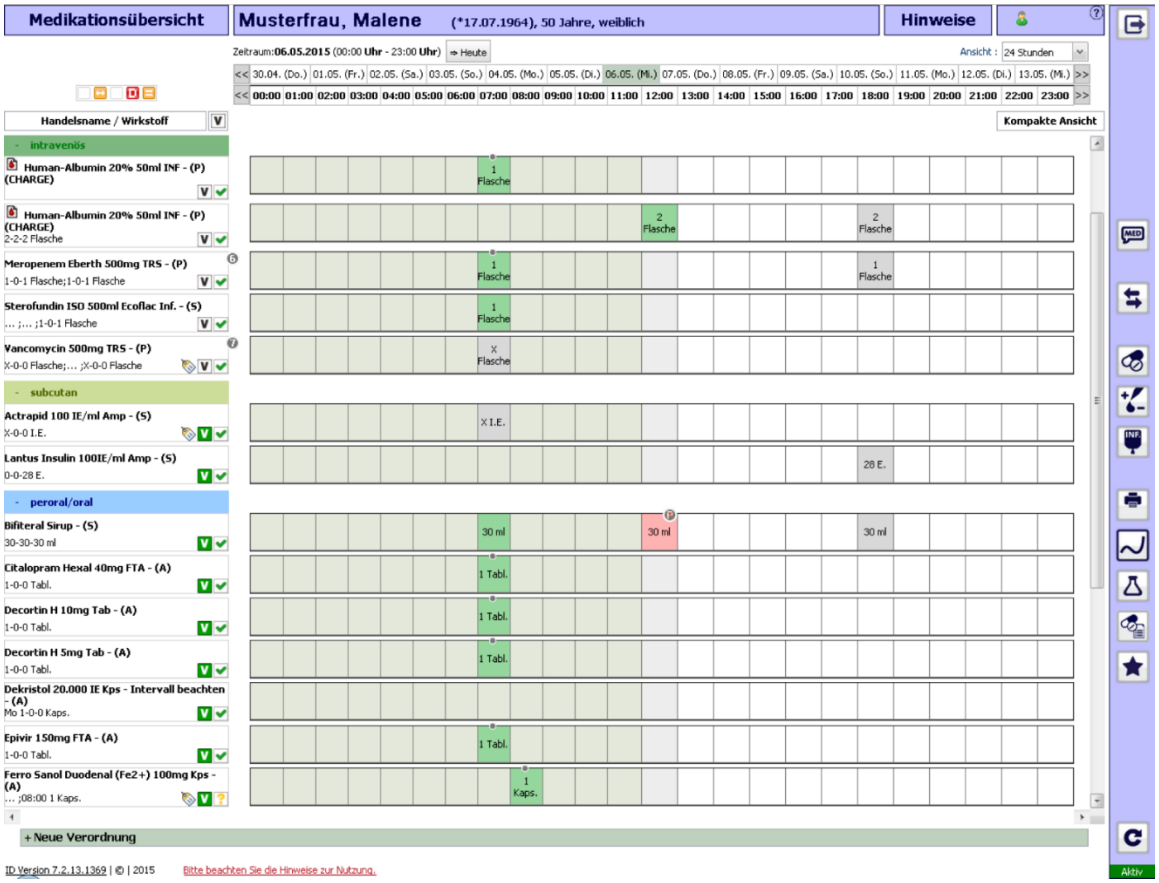
Michael Baehr UKE Hamburg

5 Rights of medication administration

With a our unit-dose system we can achieve 4 out of 5 Rights with a single barcode scan

	Right	Verification
✓	1. Right Patient	Software checks accordance of patient ID on wristband and unit-dose strip
	2. Right Time 2a. Right interval	Software checks current time versus prescribed time
	2b. Before, during, after meal	Beginning and end of meal has to be documented in the software. Nurse supervises every single intake at bed side
✓	3. Right Medication	Ensured by pharmacy production
✓	4. Right Dose	Predetermined by CPOE
✓	5. Right Route	Predetermined by CPOE

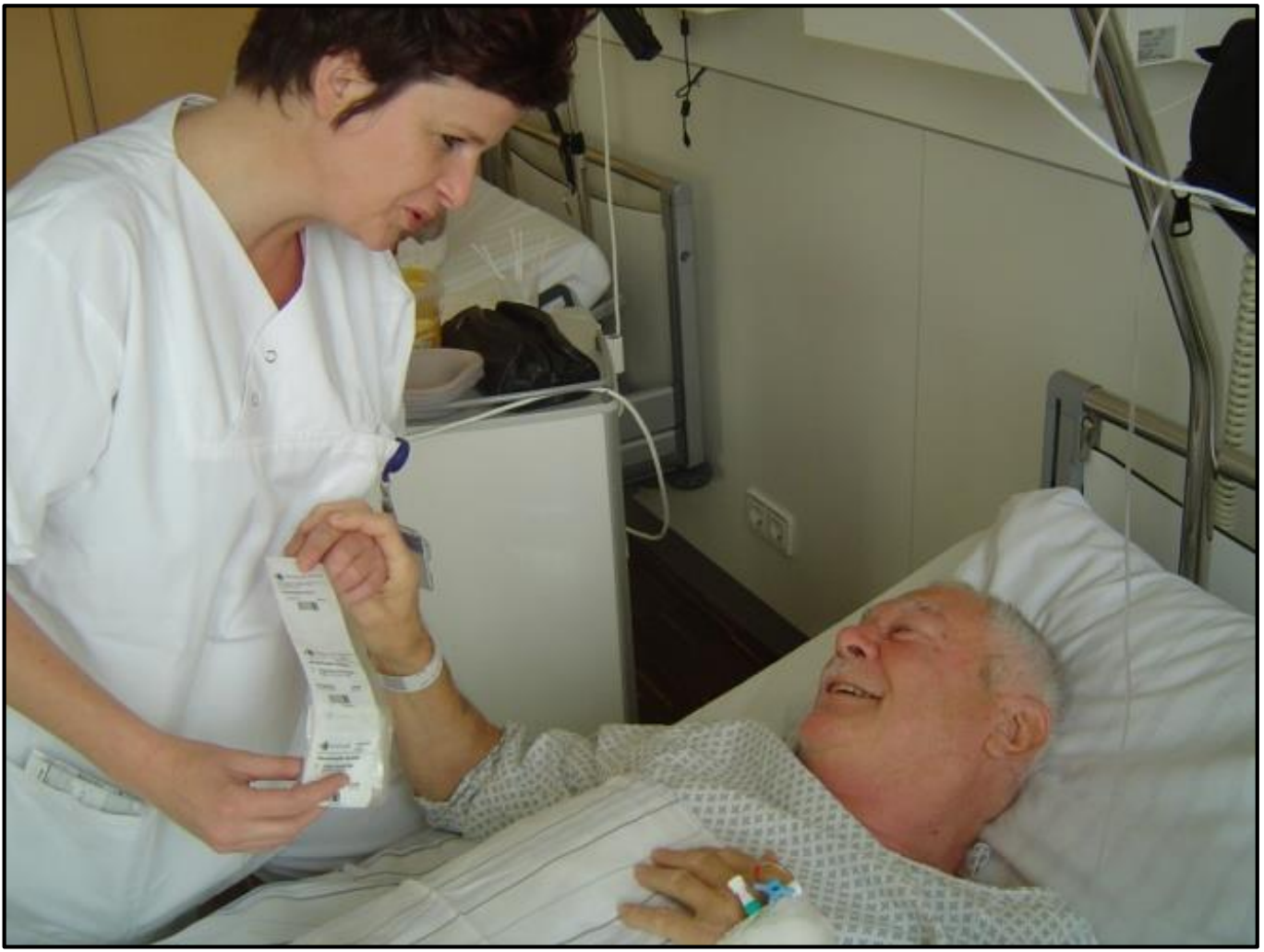
Administration



1. Nurse checks delivered medication against profile

2. Nurse notices and acknowledges changes (displayed in red)

Administration



3. Nurse hands over medication
4. Depending on patients behavior intake is supervised directly or at later visit
5. Discrepancies are documented in the software

Feasibility and practicality

- Comprehensive rollout at UKE 71 wards (including 11 intensive care units + 1 emergency unit)
- Supply of 1,400 patients a day with 12,000 delivered units/day
- pharmaceutical service on site with about 760,000 medication reviews/year

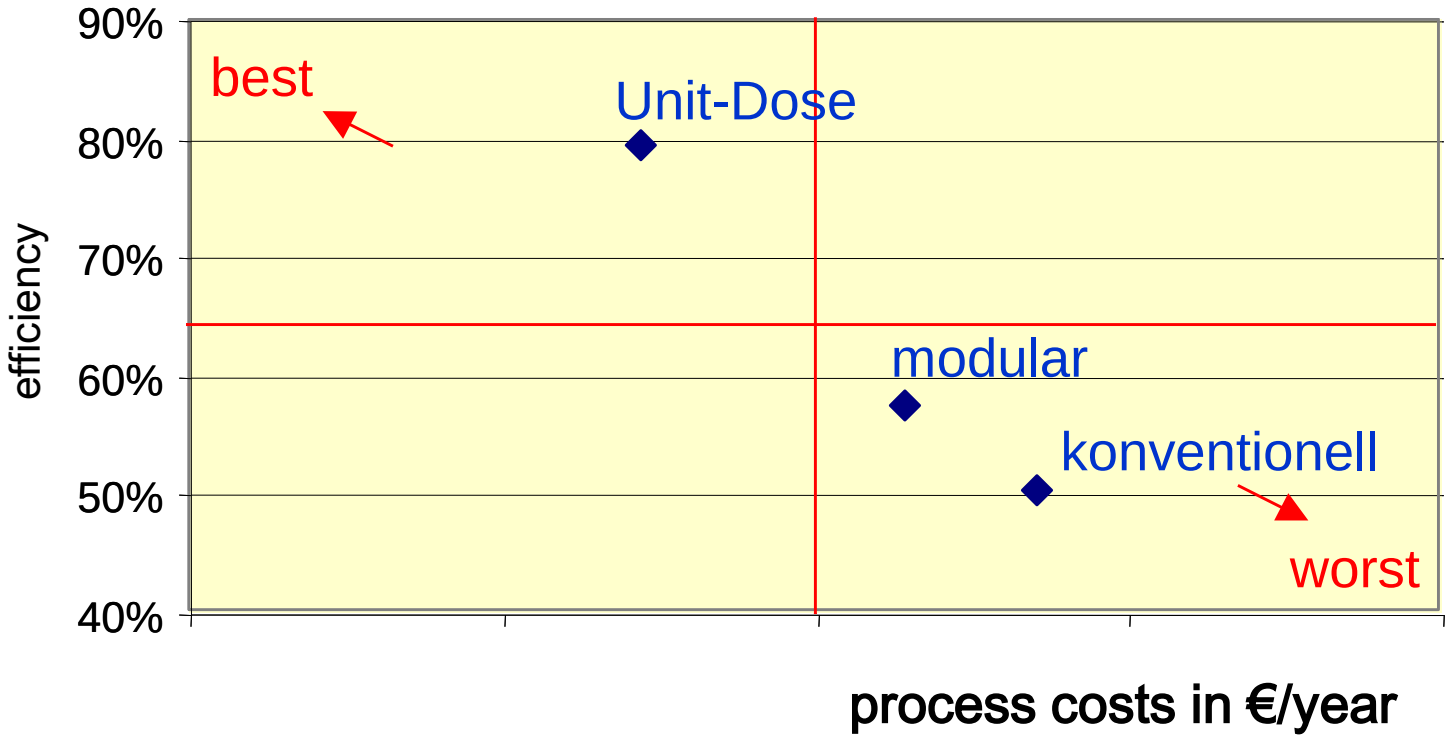
Cost effectiveness

Resources for 1.400 beds
6 days a week

- Personal
  - 7,45 pharmacists
  - 6.2 technicians
  - 6.4 workers
  - (2 persons for ICU data transfer, depends on special software solution at UKE)

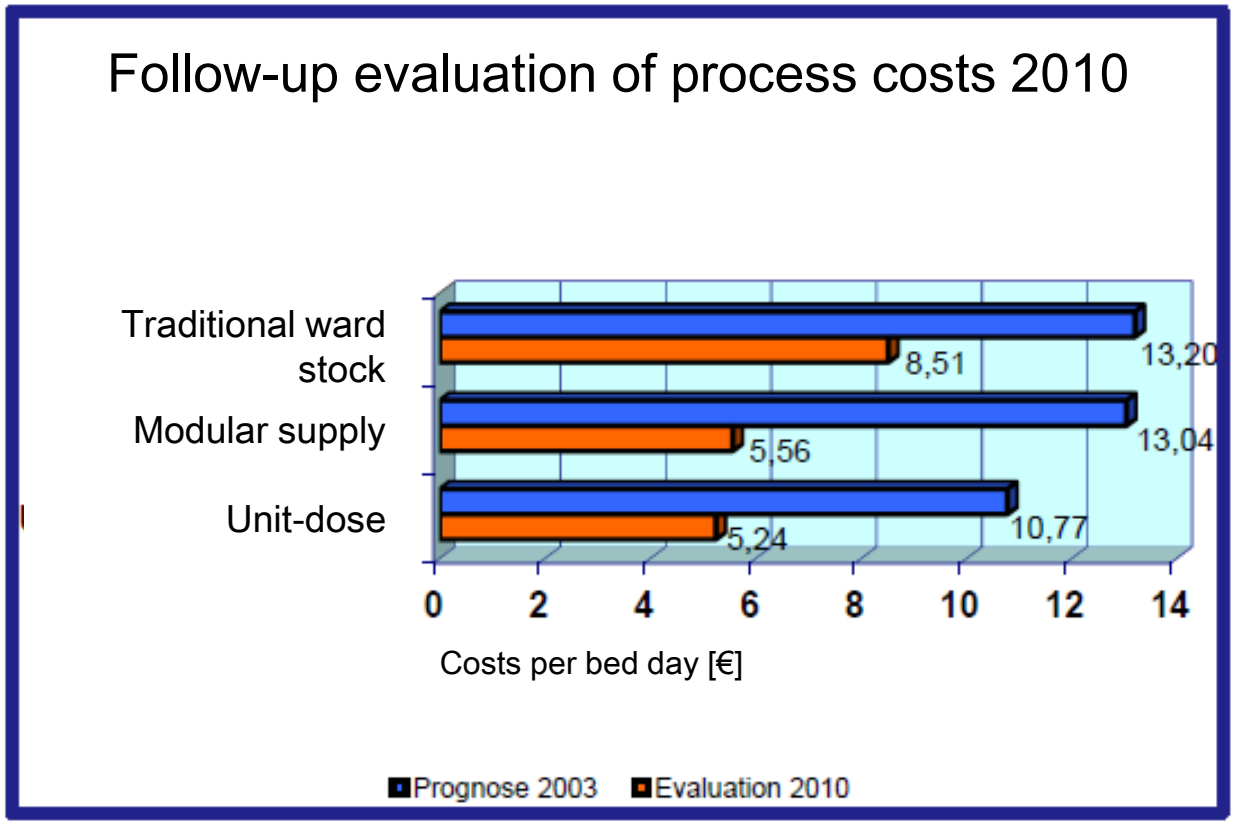
- Investment costs:
  - two unit-dose packaging machines are sufficient for 1.500 beds (appr. 200.000 € / machine)
  - no additional equipment on the ward required
  - rebuilding in the pharmacy must be taken into consideration

Cost effectiveness



Zukünftige Arzneimittelversorgunssysteme
Baehr, M., Giebe, T. Jahnke, C., Schulz, S.: Krankenhauspharmazie 25, 438-442 (2004)

Cost effectiveness



Prozesskostenrechung der Arzneimittelversorgung am Universitätsklinikum Hamburg-Eppendorf
Schomann L, Baehr M 2011

Can dose dispensing in hospitals increase patient safety and improve quality?

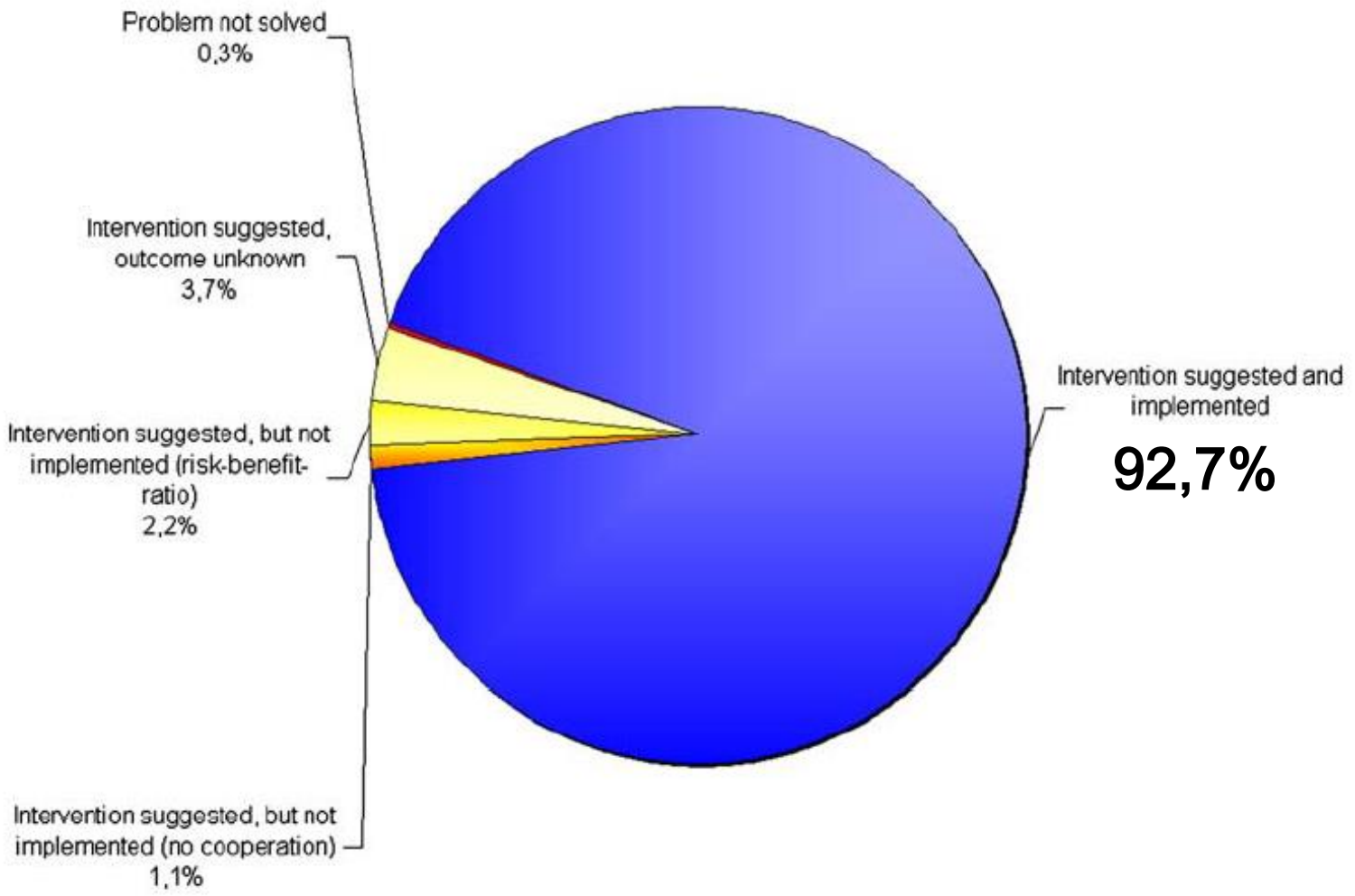
What means quality for whom?

What comes to mind of physicians?

Physicians appreciate

- the quick and unlimited access to the chart
- the decision support features of the software
- the collegial support and supervision by clinical pharmacists.

Acceptance of pharmaceutical interventions

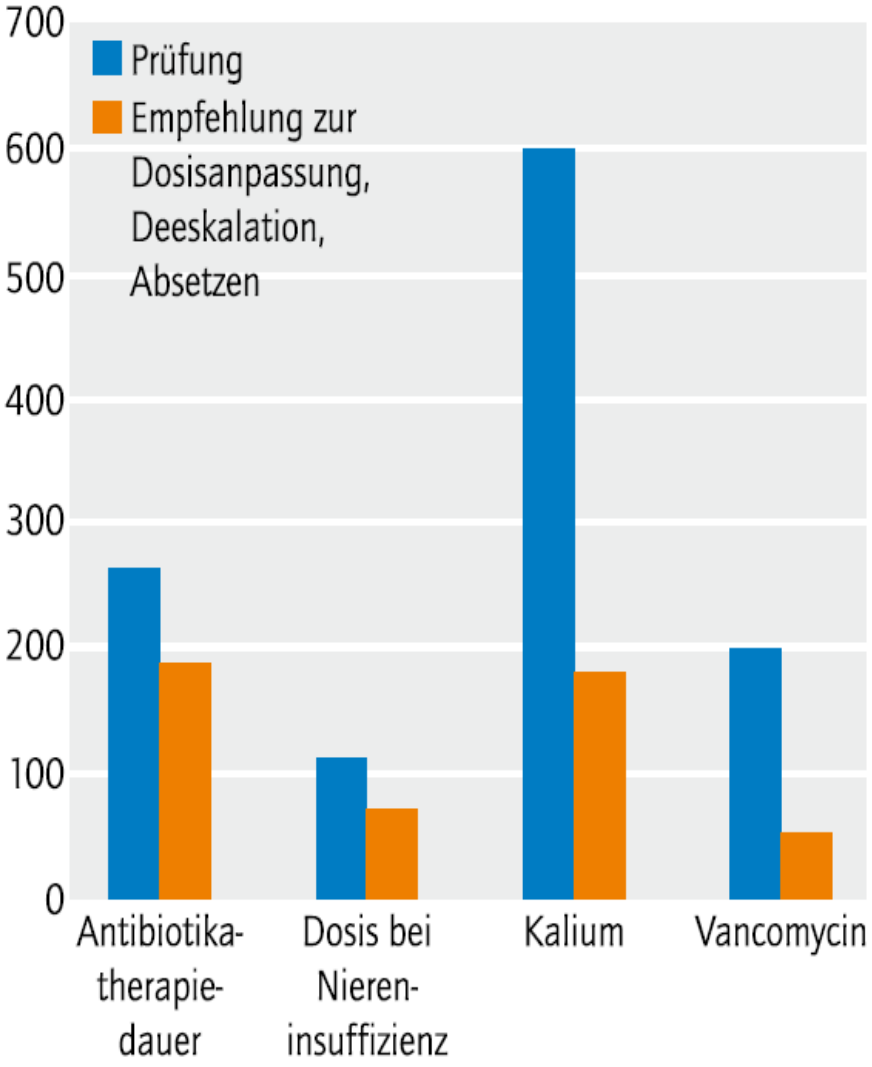


Claudia Langebrake, Heike Hilgarth: Clinical pharmacists' interventions in a German University Hospital. Pharm World Sci, DOI 10.1007/s11096-010-9367-z

Study on Interventions by Clinical Pharmacists A Two Month Survey*

- 854 pharmaceutical ward rounds
- 3809 documented interventions
- 4,5 interventions per ward round (differences amoung the clinical specializations highes value in surgery departments)
- 93% of the suggested interventions were accepted

*** Was leisten klinische Pharmazeuten im Rahmen der Unit-Dose-Versorgung?**
Langebrake C, Melzer S, Dartsch DC, Baehr M. Krankenhauspharmazie 34: 178-86 (2013)



Check of duration of antibiotic therapy : n=271, adjustments: 190 (70 %)

Check of potassimum level: n=602 subsequent dose adjustments: 182 (30 %)

Check of vancomycin level: n=198 subsequent dose adjustments : 54 (27 %)

Check of correct dosing in patients with renal failure: n=114 subsequent dose adjustments : 71 (62%)

What comes to mind of nurses?

Nurses appreciate:

- the reduction of work load
- that pharmacy took over the error-prone process
- the regulated timing
- that pharmacy prepares discharge medication
- the support provided by clinical pharmacists

Does unit- dose dispensing increase collaboration of ward and pharmacy?*

Evaluation of collaboration	Bewertung Zusammenarbeit	Pflegende			Ärzte		
Hospital	Krankenhaus	**UKE**	DKH	UHZ	**UKE**	DKH	UHZ
Number of participants	Anzahl geantworteter Teilnehmer	**117-161**	41-77	20-36	**29-46**	17-25	2-3
Availability of Pharmacy	B.1: Apotheke gut zu erreichen	1,97	2,06	2,22	1,67	2,48	2,33
Pharmacy is open for questions	B.2: Apotheke offen für Fragen	1,45	2,16	2,00	1,41	2,08	2,33
Pharmacy supports in case of ambiguities	B.3: Apo gewillt, Unklar-heiten zu beseitigen	1,38	1,92	2,71	1,26	1,88	2,00
Pharmacy advises doctors comprehensively	B.4: Apotheke berät Ärzte umfassend	1,79	2,47	2,81	1,47	2,42	3,33
Pharmacy advises nurses comprehensively	B.5: Apotheke berät Pflege umfassend	1,84	2,54	2,58	1,83	2,53	4,00
Doctors accept advices	B.6: Ärzte nehmen Beratung dankend an	2,23	2,41	2,80	1,58	2,08	3,00
General appraisal of collaboration	B.7: Beurteilung der Zu-sammenarbeit mit Apo	1,74	2,34	2,44	1,53	2,28	2,67

Gutknecht M, Baehr M, Melzer S, Framke S. Poster anl. ADKA Kongress Mainz 2012

What comes to mind of managers?

Managers appreciate

- risk reduction of drug therapy
- process optimization
- cost transparency
- external effects

HIMSSanalytics
STAGE 7
AWARD

University Medical Center Hamburg-Eppendorf first in Europe to achieve HIMSS Analytics' top-rating for paperless, digital workflows

German hospital reaches Stage 7 on the HIMSS Analytics EMRAM scale

LEIPZIG and HAMBURG, GERMANY – (October 26, 2011) – HIMSS Analytics Europe announced today that the University Medical Center Hamburg-Eppendorf (UKE) in Germany has achieved Stage 7 of the Electronic Medical Record Adoption Model (EMRAM). It is the first hospital in Europe to achieve the top rating on HIMSS Analytics' EMRAM scale, which evaluates the digitisation level of a hospital; stage 7 is awarded for achieving a paperless medical record environment. The University Hospital of Hamburg Eppendorf will be officially recognised for their achievements at the CIO Summit in Geneva, 20-22 November 2011.

"The University Hospital of Hamburg Eppendorf provides a blueprint for transforming healthcare through IT: in just three years it has implemented a hospital-wide IT system based on Soarian® Clinicals and Soarian® Health Archive from Siemens that allows the entire continuum of care to be managed through an electronic patient record. Paper is now superfluous. The benefits are apparent on several levels: thanks to IT systems, patient healthcare can now be delivered more quickly and to a higher standard," says Uwe Buddrus, CEO of HIMSS Analytics Europe.

What comes to mind of patients?

Patients

- feel unit doses as "personal attention“
- value the unit-dose supply as safer
- appreciate the opportunity to speak with a pharmacist
- **get really what was prescribed !**

Increased medication safety

Does CPOE improve medication safety?*

It is generally assumed that computerized physician order entry (CPOE) significantly improves medication safety. However, recently conflicting results have been reported in the literature [1, 4, 5, 6]. Aim of the present study was to investigate the effect of the implementation of CPOE on the individual steps of the medication process. For this purpose incomplete prescriptions and the number of deviations from the physician`s prescription and specifications of the manufacturer were identified on two wards (ward A = handwritten prescription, ward B = computerized prescription). For this study only oral drugs were considered. Twelve criteria to judge the medication process have been included. On ward A a total of 1,155 and on ward B a total of 1,855 medications were checked. During the investigation we found 647 (56%) deviations on ward A and 720 (38,8%) on ward B. Differences regarding the identity of administered product and the physician`s prescription were 10,4% on ward A versus 43,8% on ward B.

Our study demonstrates that implementation of CPOE does generally decrease the number of medication errors caused by inaccurate prescription. The medication safety however is not increased necessarily.

*Groth-Tonberge C, Häckh G, Strehl E, Hug M. Krankenhauspharmazie 33:476-479 (2012)

Results of the study

CPOE reduces overall discrepancies by 17%

(56% paper based prescribing
39% CPOE)

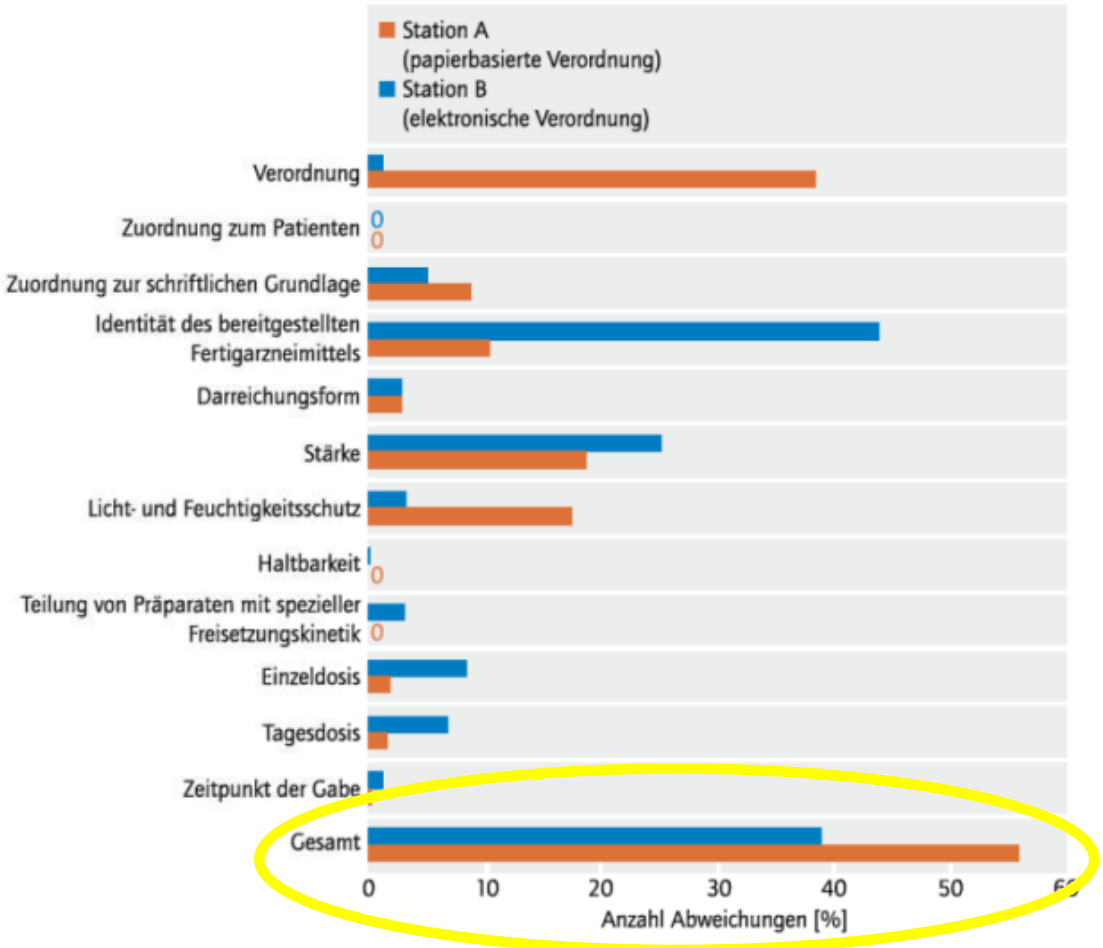
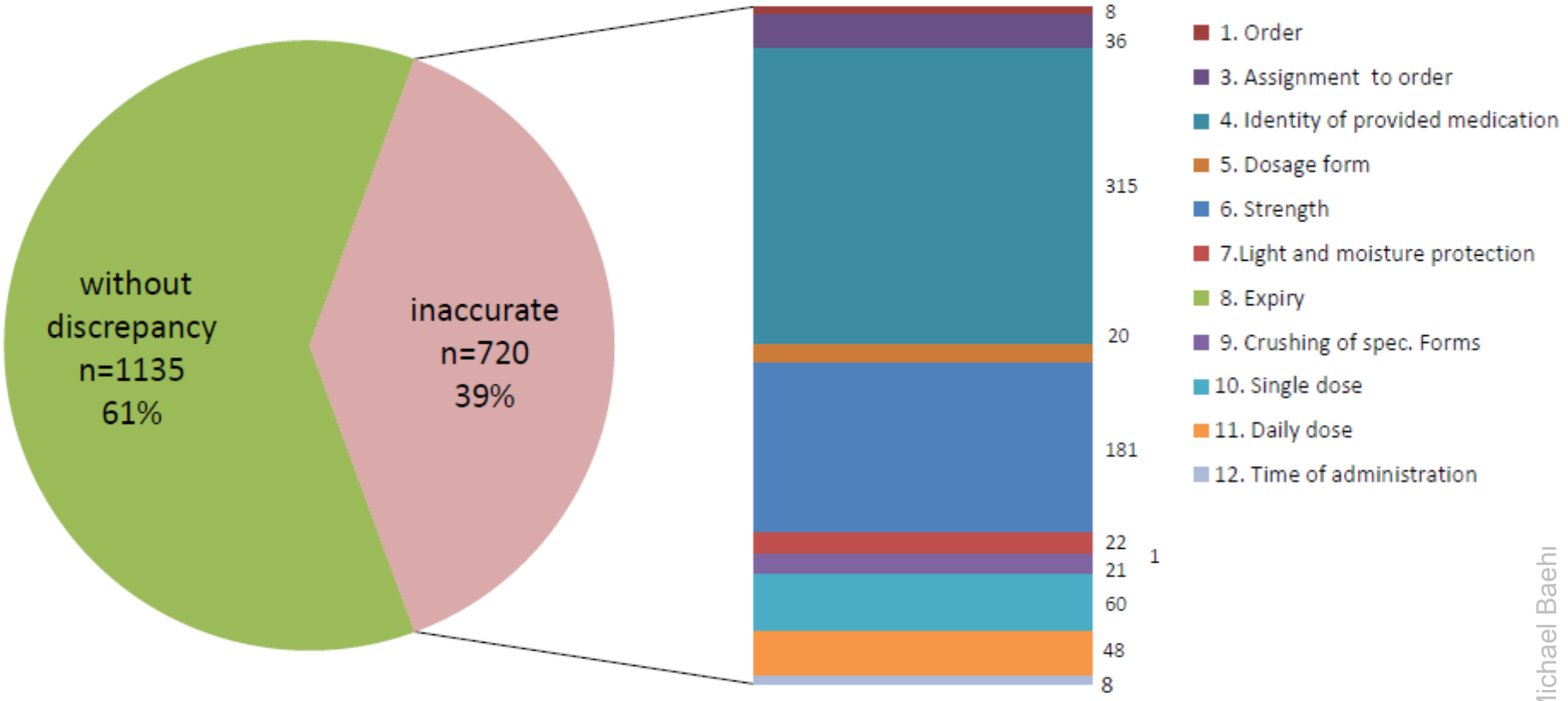


Abb. 1. Prozentualer Anteil der Abweichungen bei den einzelnen Qualitätsmerkmalen des Prüfkatalogs (Tab. 1) auf der Station mit papierbasierter Verordnung (A) bzw. elektronischer Verordnung (B).

Increased medication safety

CPOE without unit-dose supply
University Medical Center Freiburg



according to Groth-Tonberge C, Häckh G, Strehl E, Hug M Krankenhauspharmazie 33:476-479 (2012)

Increased medication safety

Their conclusions:

CPOE does generally decrease the number of medication errors caused by inaccurate prescription. The medication safety is not decreased necessarily.

The more vulnerabilities, violations of rules or neglectfulness occur in a process, the greater the probability of the occurrence of serious incidents.

Increased medication safety

Significant improvement of medication safety by coupling of electronic prescription and unit-dose drug distribution*

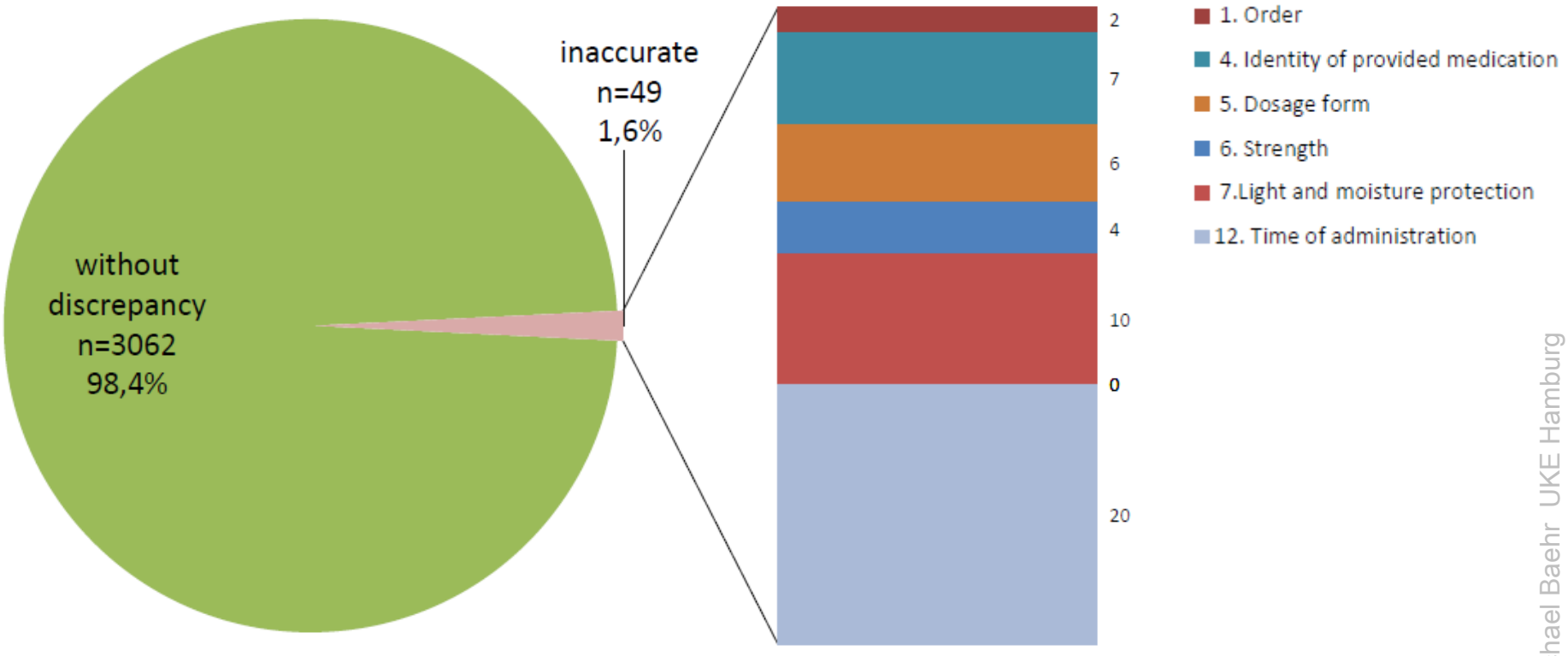
The purpose of this study was to evaluate the efficacy of a paperless closed loop medication administration (CLMA) process including CPOE, pharmacy validation, and unit-dose distribution to increase medication safety.
3,111 medications for oral use were checked short before administration on two different wards.

We used exactly the same design like Groth-Tonberge et al in their first study.

*Baehr M, van der Linde A, König R, Melzer S, Langebrake C, Groth-Tonberge C, Hug MJ. **In press**

Increased medication safety

CPOE combined with unit-dose supply
University Medical Center Hamburg Eppendorf



Baehr M, van der Linde A, König R, Melzer S, Langebrake C, Hug M submitted to KHP 2013

Increased medication safety

Our conclusions:

These results show that the paperless CLMA process is significantly superior to a traditional paper based ward stock supply, and that the unit-dose supply plays an important role in the prevention of medication errors.

The *less* vulnerabilities, violations of rules or neglectfulness occur in a process, the *lower* the probability of the occurrence of serious incidents.

Dose dispensing is the best option for the CLMA-Process!

Universitätsklinikum Hamburg-Eppendorf

UKE Press release dated May 29, 2015

Innovation Award 2015

German Association of Hospital Pharmacists

Head of UKE Hospital Pharmacy Receives Innovation Award 2015

Dr. Michael Baehr, Director of Pharmacy at the University Hospital Hamburg-Eppendorf (UKE), has been awarded the Innovation Prize of the German Association of Hospital Pharmacists (ADKA). The award is endowed with 7,500 euros and Dr. Baehr was awarded on the occasion of the 40th Scientific Congress of the Association.

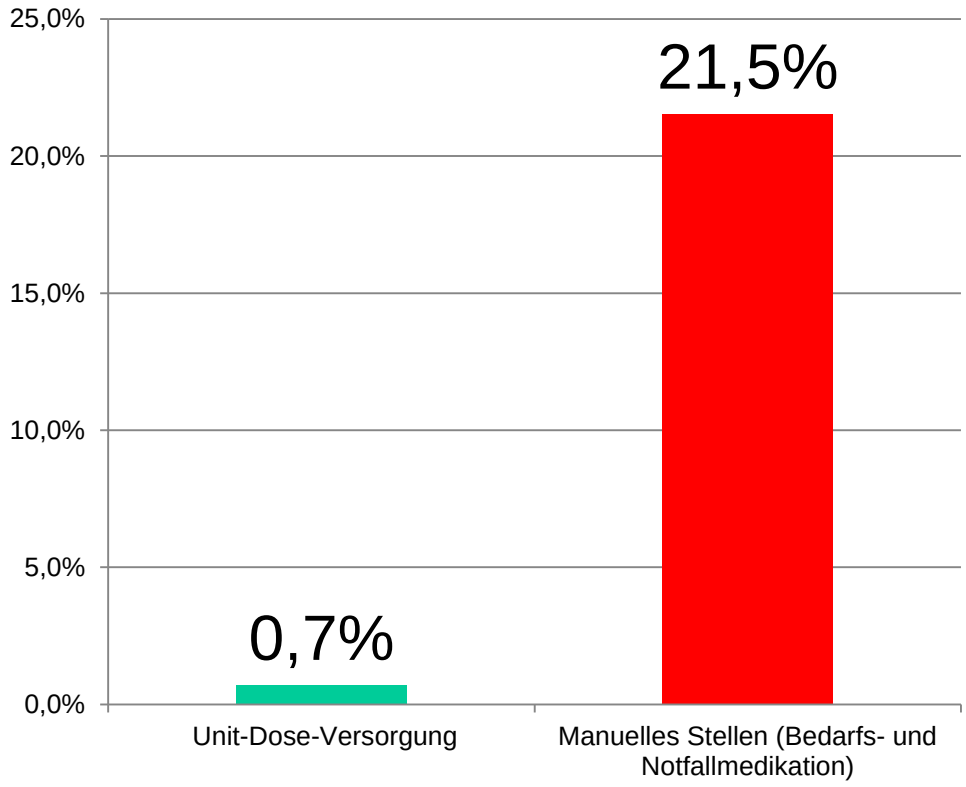
In his publication "Closed Loop of Medication Administration (CLMA) - Basis for an increased drug safety in an inpatient setting" Dr. Baehr has proven that the introduction of a closed medication process contributes significantly to the prevention of medication errors in the hospital. This could only be achieved by the introduction of a Patient Specific Unit Dose Dispensing System by the pharmacy, in connection with a comprehensive Electronic Patient Record System by the IT-department.
Today 12,000 individual doses are produced respectively dispensed on a daily basis in the UKE-hospital pharmacy.
Dr. Baehr: "The award recognizes the work of my staff and the large interdisciplinary teams. Together and according to the latest scientific findings we have made the medication process more safely and efficiently for our patients."

Michael Baehr UKE Hamburg


Greetings from Hamburg

Increased medication safety

95.6% of all administrations referred to unit-doses delivered by the pharmacy, 4.4% were manually dispensed by nursing staff (PRN medication etc).



Rate of discrepancies

Unit-doses delivered by pharmacy

Medication dispensed manually by nursing staff

Increased medication safety

Distribution of discrepancies in administrations referring to unit-doses delivered by pharmacy