Erfahrungen mit einem Computer-gestützten System zur automatischen Überwachung und Erfassung von nosokomialen Infektionen an Intensivstationen – MONI

Alexander Blacky[1], Walter Koller[2], Andrea Rappelsberger[3], and Klaus-Peter Adlassnig[3,4]

[1] ***VAMED-KMB***, *Accredited Inspection Unit for Sterilisation and Disinfection, Vienna*

[2] ***Department of Hospital Epidemiology and Infection Control***, *Medical University of Vienna and Vienna General Hospital*

[3] ***Section for Medical Expert and Knowledge-Based Systems***, *Center for Medical Statistics, Informatics, and Intelligent Systems, Medical University of Vienna*

[4] ***Medexter Healthcare GmbH***, *Vienna, Austria*

ICU Wards at the Vienna General Hospital

- 13B1
- 13B2
- 13C1
- 13C2
- 13C3
- 13H1
- 13H3
- 13I1
- 13I2
- 13I3
- transplant ICU
- neurosurgery ICU
- NICU 9C
- NICU E10
- NICU E12

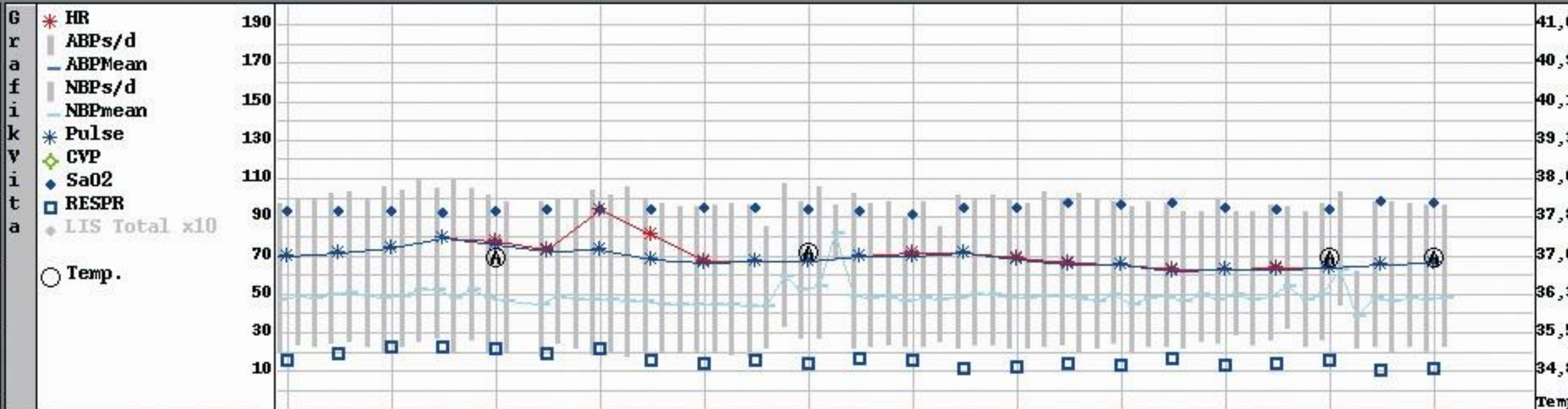
MED Intensiv : PatientenNameNummer 1,70m2 62,00kg

Hauptmenü | Aktionen | Anzeige | Bericht | DATENEINGABE

GRAFIK
ÜBER-SICHT
NEURO/STATUS
ATMUNG
MED./BILANZ
SPEZ. THERAP
PFLEGE
SPEZ. PFLEGE
KATH./SONDEN
OP-WU/DRAIN
LABOR1
LABOR2
NIERE
HÄMODY-NAMIK
SCORES

Zeit: 1 h
Autom. Dokument. @30mi

	07Juli05 0400	0500	0600	0700	07Juli05 0800	0900	1000	1100	07Juli05 1200	1300	1400	1500



Vitalparameter		0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500
HR	(bpm)	70	74	77	94	67	67	71	69	65	63	64	66
Pulse	(bpm)	70	74	76	73	66	67	70	68	65	63	64	66
SaO2	(%)	93	93	93	94	95	94	91	95	96	95	94	97
Atemfrequenz	(/min)	15	22	21	21	14	14	15	12	13	13	15	11
ABP s/d	(mmHg)												
ABP mean	(mmHg)												
NBP s/d	(mmHg)	101/ 23	105/ 22	99/ 20	102/ 20	97/ 20	107/ 27	99/ 22	98/ 21	96/ 19	94/ 28	104/ 44	97/ 22
NBP mean	(mmHg)	49	49	46	47	45	54	48	48	45	50	63	48
CVP mean	(mmHg)												
Temperatur	(°C)			A 37,0			A 37,1					A 37,0	A 37,0
Ereignisse													
Zeitpunkte													
Diagnostik													
Eingriff													
Konsiliar													
OP Tag I/II						40/	40/	40/				40/	40/
Bakteriologie													
Kontrolle													
Monitor:Alarm/Nullen													
DruckSyst:letzt.Wech						6 Juli		6 Juli				6 Juli	
Infusionssystem													
ClaveSteg:letzt.Wech						6 Juli		6 Juli				6 Juli	
Hygieneprogramm													
Resp.1: Alarm/System													
Resp.1:Temp/Befeucht													
RespSyst.1:letzt.We.													
O2-Insuff:letzt.Wech						6 Juli		6 Juli				6 Juli	
Ü BZ Stat.	(mg/dl)				85		218		246				

07 Juli 05 1510

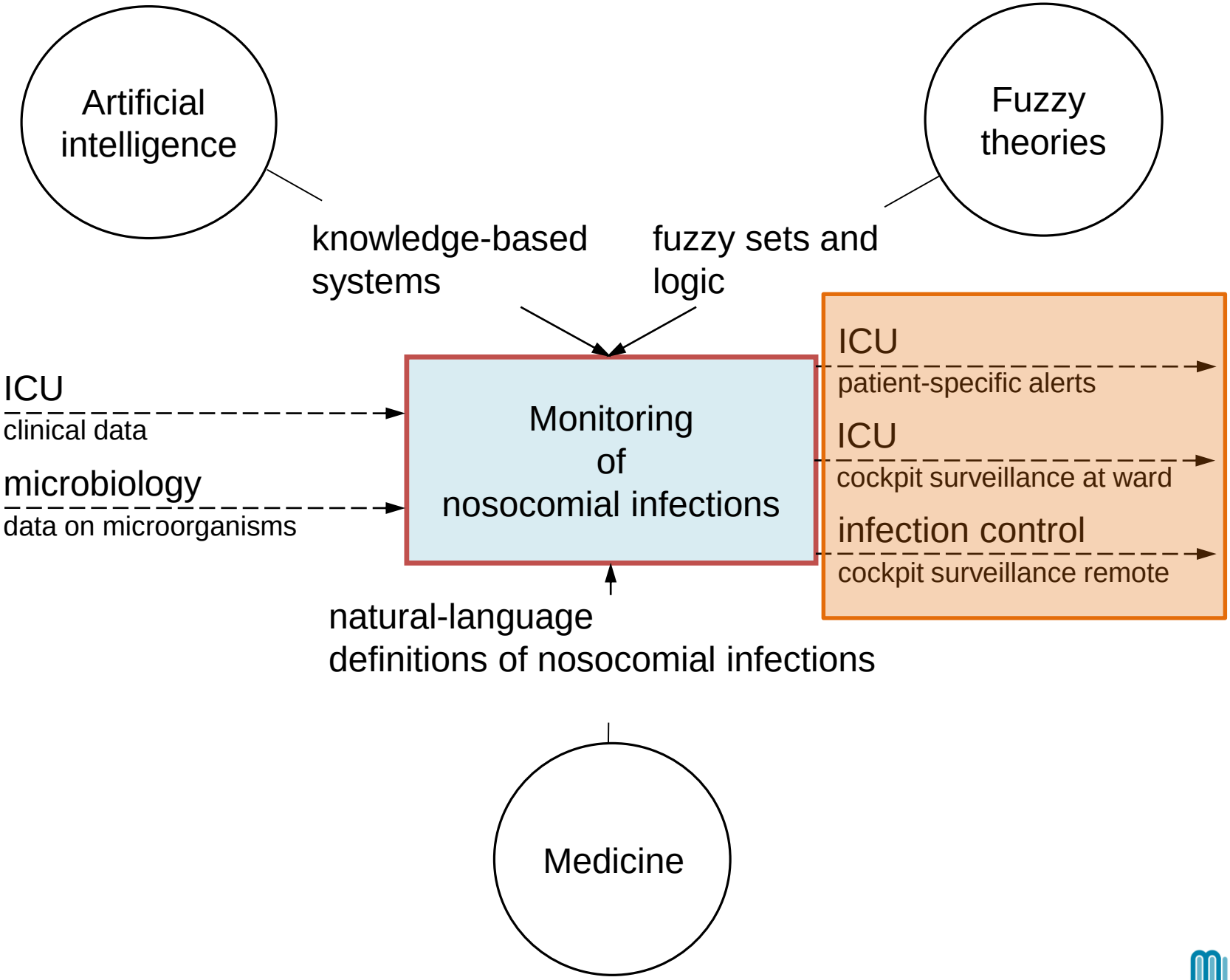
MED Intensiv : PatientenNameNummer 1,70m2 62,00kg

Hauptmenü | Aktionen | Anzeige | Bericht | DATENEINGABE

GRAFIK | ÜBER-SICHT | NEURO/ STATUS | ATMUNG | MED./ BILANZ | SPEZ. THERAP | PFLEGE | SPEZ. PFLEGE | KATH./ SONDEN | OP-WU/ DRAIN | LABOR1 | LABOR2 | NIERE | HÄMODY-NAMIK | SCORES

	Zeit: 4 h Autom. Dokument. @30mi	1800	2200	06Juli05 0200	0600	1000	06Juli05 1400	1800	2200	07Juli05 0200	0600	1000	07Juli05 1400
Allerzvk	Katheter/Sonde					* ZVK 1							
	Ereignis: Was?					* gelegt							
	Ereignis: Wer?					* kos.							
	ZVK 1: Zugang					▷re Scl.	re Scl.	re Scl.		re Scl.	▷re Scl.	re Scl.	re Scl.
	ZVK 1: Tag/Lumen					▷ 1 4-lu	1 4-lu	1 4-lu		1 4-lu	▷ 2 4-lu	2 4-lu	2 4-lu
	ZVK 1: Befund												
	ZVK 1: Rein./Desinf.					▷0,9/ SH							
	ZVK 1: Versorgung					▷ Stand.	Stand.	Stand.		Stand.	▷ Stand.	Folie	Folie
	ZVK 1: Versorg. seit					▷ 6 Juli	6 Juli	6 Juli		6 Juli	▷ 6 Juli	7 Juli	7 Juli
	ZVK 1: Kontrolle												
	ZVK 2: Zugang	*li Scl.		li Scl.	*li Scl.	li Scl.							
	ZVK 2: Tag/Lumen	*14 3-lu		14 3-lu	*14 3-lu	15 3-lu							
	ZVK 2: Befund			gerötet	gerötet	gerötet							
	ZVK 2: Rein./Desinf.												
	ZVK 2: Versorgung	* Folie		Folie	* Folie	* Folie	Druckvb	Druckvb		Druckvb	▷Druckvb		
	ZVK 2: Versorg. seit	*28 Juni		28 Juni	*28 Juni	*28 Juni	6 Juli	6 Juli		6 Juli	▷ 6 Juli		
	ZVK 2: Kontrolle				▷Röntgen								
Arterie	Art.2: Zugang	*li fem.		li fem.	*li fem.	li fem.							
	Art.2: Tag/Typ	*22 G16L		22 G16L	*22 G16L	23 G16L							
	Art.2: Befund				gerötet	gerötet							
	Art.2: Rein./Desinf.												
	Art.2: Versorgung	* Folie		Folie	* Folie	* Folie	Druckvb	Druckvb		Druckvb	▷Druckvb		
	Art.2: Versorg. seit	* 2 Juli		2 Juli	* 2 Juli	* 2 Juli	6 Juli	6 Juli		6 Juli	▷ 6 Juli		
Harnableitung	Harnabl.2: Tag/Typ	* 9 DK		9 DK	* 9 DK	9 DK	9 DK	9 DK		9 DK	▷10 DK	10 DK	10 DK
	HarnK.2: Ch/Material	*16 Sili		16 Sili	*16 Sili	17 Sili	17 Sili	17 Sili		17 Sili	▷17 Sili	17 Sili	17 Sili
	HarnK.2: Befund					oB.							
	HarnK.2: Rein/Desinf					Std/							
	HarnK.2: Versorgung	* Schutz		Schutz	* Schutz		Schutz	Schutz		Schutz	▷ Schutz	Schutz	Schutz
	HarnK.2:Versorg.seit	*30 Juni		30 Juni	*30 Juni	30 Juni	30 Juni	30 Juni		30 Juni	▷30 Juni	30 Juni	30 Juni
Enteral	EntSonde2: Tag/Lokal	*25 nasL		25 nasL	*25 nasL	26 nasL	26 nasL	26 nasL		26 nasL	▷27 nasL	27 nasL	27 nasL
	EntSonde2: Ch/Typ	*15 MaSi		15 MaSi	*15 MaSi	15 MaSi	15 MaSi	15 MaSi		15 MaSi	▷15 MaSi	15 MaSi	15 MaSi
	EntSonde2: Kontrolle												
	EntSonde2: Befund				oB.								
	EntSonde2: Fixation	*Pfl+Pol		Pfl+Pol	*Pfl+Pol	Pfl+Pol	Pfl+Pol	Pfl+Pol		Pfl+Pol	▷Pfl+Pol	Pfl+Pol	Pfl+Pol
PM	PM: Tag/Zugang	*40 Vent		40 Vent	40 Vent			▷41 Vent		41 Vent	▷42 Vent	42 Vent	42 Vent
	PM: Befund												
	PM: Rein/Desinf.												
	PM: Versorgung	* Stand.		Stand.	Stand.			▷ Stand.		Stand.	▷ Stand.	Stand.	Stand.
	PM: Versorg. seit	* 5 Juli		5 Juli	5 Juli			▷ 5 Juli		5 Juli	▷ 5 Juli	5 Juli	5 Juli

07 Juli 05 1513


Artificial intelligence
Fuzzy theories
knowledge-based systems
fuzzy sets and logic
ICU
clinical data
microbiology
data on microorganisms
Monitoring of nosocomial infections
ICU
patient-specific alerts
ICU
cockpit surveillance at ward
infection control
cockpit surveillance remote
natural-language definitions of nosocomial infections
Medicine

HELICS

Hospital in Europe
Link for Infection Control through
Surveillance

Surveillance of Nosocomial Infections in Intensive Care Units

Protocol
Version 6.1
(Based on Version 5.0 including technical amendments)

SEPTEMBER 2004

Project commissioned by the EC / DG SANCO/ F/ 4
Agreement Reference number: VS/1999/5235 (99CVF4-025)

ecdc

TECHNICAL DOCUMENT

Surveillance of surgical site infections in European hospitals – HAISSI protocol

Protocol version 1.02

www.ecdc.europa.eu

INFECTION SITE: Symptomatic urinary tract infection

CODE: UTI-SUTI

DEFINITION: A symptomatic urinary tract infection must meet at least one of the following criteria:

Criterion 1: Patient has at least *one* of the following signs or symptoms with no other recognized cause: fever (>38° C), urgency, frequency, dysuria, or suprapubic tenderness
and
patient has a positive urine culture, that is, $\geq 10^5$ microorganisms per cm^3 or urine with no more than two species of microorganisms.

Criterion 2: Patient has at least *two* of the following signs or symptoms with no other recognized cause: fever (>38° C), urgency, frequency, dysuria, or suprapubic tenderness
and
at least *one* of the following:

a. positive dipstick for leukocyte esterase and/or nitrate
b. pyuria (urine specimen with ≥ 10 wbc/mm^3 or ≥ 3 wbc/high power field of unspun urine)
c. organisms seen on Gram stain of unspun urine
d. at least *two* urine cultures with repeated isolation of the same uropathogen (gram-negative bacteria or *S. saprophyticus*) with $\geq 10^2$ colonies/ml in nonvoided specimens
e. $\leq 10^5$ colonies/ml of a single uropathogen (gram-negative bacteria or *S. saprophyticus*) in a patient being treated with an effective antimicrobial agent for a urinary tract infection
f. physician diagnosis of a urinary tract infection
g. physician institutes appropriate therapy for a urinary tract infection.

Criterion 3: Patient ≤1 year of age has at least *one* of the following signs or symptoms with no other recognized cause: fever (>38° C), hypothermia (<37° C), apnea, bradycardia, dysuria, lethargy, or vomiting
and
patient has a positive urine culture, that is, $\geq 10^5$ microorganisms per cm^3 of urine with no more than two species of microorganisms.

Criterion 4: Patient ≤1 year of age has at least *one* of the following signs or symptoms with no other recognized cause: fever (>38° C), hypothermia (<37° C), apnea, bradycardia, dysuria, lethargy, or vomiting
and
at least *one* of the following:

a. positive dipstick for leukocyte esterase and/or nitrate
b. pyuria (urine specimen with ≥ 10 wbc/mm^3 or >3 wbc/high power field of unspun urine)
c. organisms seen on gram stain or unspun urine
d. at least *two* urine cultures with repeated isolation of the same uropathogen (gram-negative bacteria or *S. saprophyticus*) with $\geq 10^2$ colonies/ml in nonvoided specimens
e. $\leq 10^5$ colonies/ml of a single uropathogen (gram-negative bacteria or *S. saprophyticus*) in a patient being treated with an effective antimicrobial agent for a urinary tract infection
f. physician diagnosis of a urinary tract infection
g. physician institutes appropriate therapy for a urinary tract infection.

COMMENTS:

- A positive culture of a urinary catheter tip is *not* an acceptable laboratory test to diagnose a urinary tract infection.
- Urine cultures must be obtained using appropriate technique, such as clean catch collection or catheterization.
- In infants, a urine culture should be obtained by bladder catheterization or suprapubic aspiration; a positive urine culture from a bag specimen is unreliable and should be confirmed by a specimen aseptically obtained by catheterization or suprapubic aspiration.

Reprinted from: Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections. In: Olmsted RN, ed.: APIC Infection Control and Applied Epidemiology: Principles and Practice. St. Louis: Mosby; 1996: pp. A-1--A-20.

Bloodstream Infections (BSI)

CODE: BSI

BSI-A:
- 1 positive blood culture for a recognised pathogen

or

- Patient has at least one of the following signs or symptoms: fever (>38°C.), chills, or hypotension and 2 positive blood cultures for a common skin contaminant (from 2 separate blood samples drawn within 48 hours).

skin contaminants = coagulase-negative staphylococci, *Micrococcus sp., Propionibacterium acnes, Bacillus sp., Corynebacterium sp.*

BSI-B: Patient has at least one of the following signs or symptoms: fever (>38°C.), chills, or hypotension

And either

- 1 positive blood culture with a skin contaminant in patient with an intravascular line in place and in whom the physician instituted appropriate antimicrobial therapy.

or

- positive blood Antigen test (e.g. *H.influenzae, S.pneumoniae, N. meningitidis* or Group B *Streptococcus*)

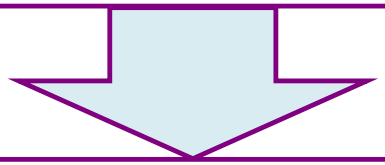
Comment:
BSI-A is the definition used by the majority of NI surveillance networks in Europe. BSI-B extents this definition to the CDC definition of laboratory-confirmed bloodstream infection. Networks should specify in the network data (table **icu_net**, see 6.3.1) whether only BSI A or both BSI B and BSI A are included in the surveillance (i.e. networks using CDC definition of laboratory confirmed bloodstream infection [CDC_{LCBI}=BSI-A+B]). If this is the case, then BSI A and BSI B categories should be specified in the data collection.

- bloodstream infection with
  - recognized pathogen
  - clinical signs and growth of same skin contaminant from two separate blood samples
  - clinical signs and growth skin contaminant from blood and intravascular line in place and AB Therapy
  - clinical signs and positive antigen test from blood

Bloodstream infection with clinical signs and growth of same skin contaminant from two separate blood samples

- Patient has at least one of the following signs or symptoms: fever (>38°C.), chills, or hypotension and 2 positive blood cultures for a common skin contaminant (from 2 separate blood samples drawn within 48 hours).

skin contaminants = coagulase-negative staphylococci, *Micrococcus sp., Propionibacterium acnes, Bacillus sp., Corynebacterium sp.*



BSI-A2

1

$\Leftarrow$

clinical_signs_of_BSI (t-1d, t, t+1d)

$\wedge$

same_skin_contaminant_from_two_separate_blood_samples

Decomposition—clinical signs

clinical_signs_of_BSI (t-1d, t, t+1d)[yesterday, today, tomorrow]

=

clinical_signs_of_BSI (t-1d) = fever (t-1d) ∨ hypotension (t-1d) ∨ leucopenia (t-1d) ∨ leucocytosis (t-1d) ∨ CRP increased (t-1d)

∨

clinical_signs_of_BSI (t) = fever (t) ∨ hypotension (t) ∨ leucopenia (t) ∨ leucocytosis (t) ∨ CRP increased (t)

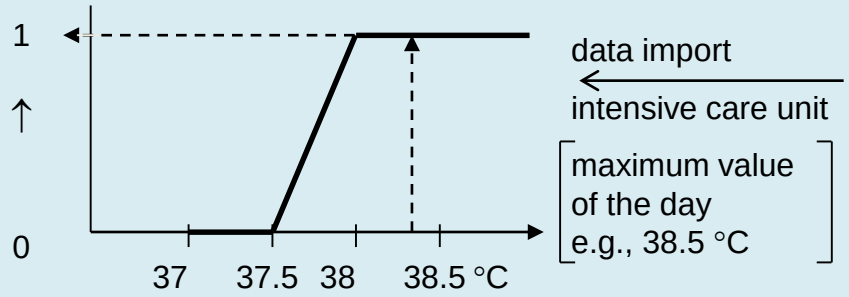
∨

clinical_signs_of_BSI (t+1d) = fever (t+1d) ∨ hypotension (t+1d) ∨ leucopenia (t+1d) ∨ leucocytosis (t+1d) ∨ CRP increased (t+1d)

Clinical signs—fever

fever (t-1d) ⇐ ...

fever (t) ⇐ body temperature ↑ v thermoregulation applied

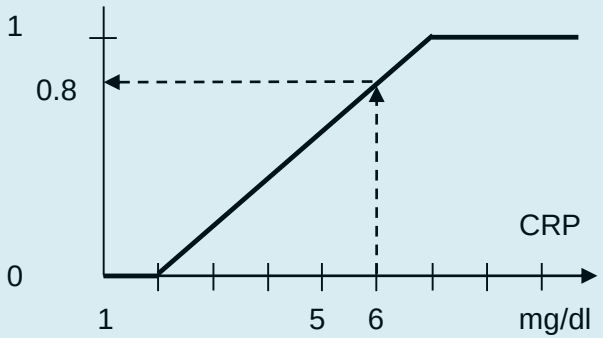


fever (t+1d) ⇐ ...

Clinical Signs—CRP Increased

CRP increased (t-1d) ⇐ ...

CRP increased (t) ⇐

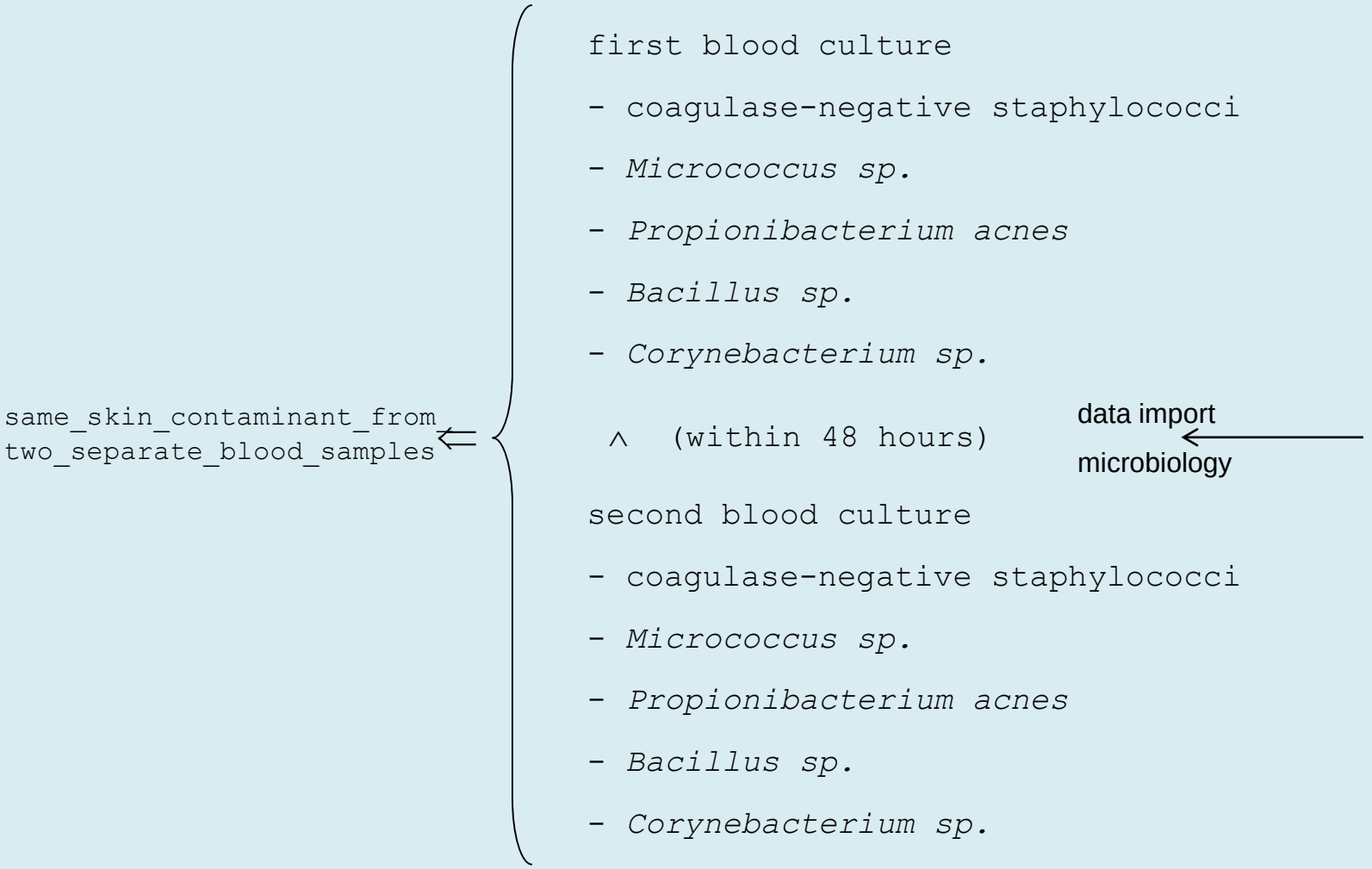


data import ←
intensive care unit

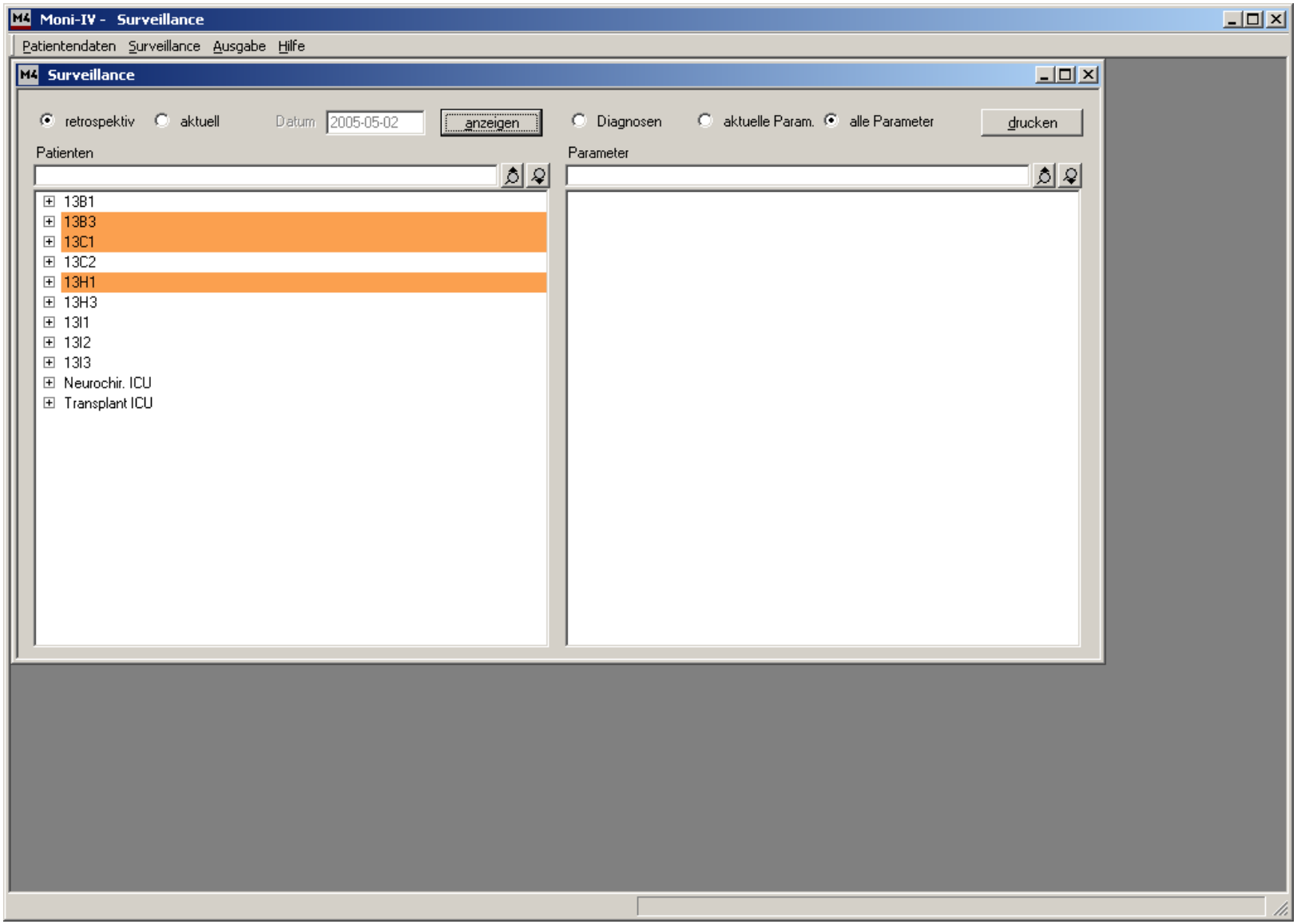
maximum value
of the day
e.g., 5 mg/dl

CRP increased (t+1d) ⇐ ...

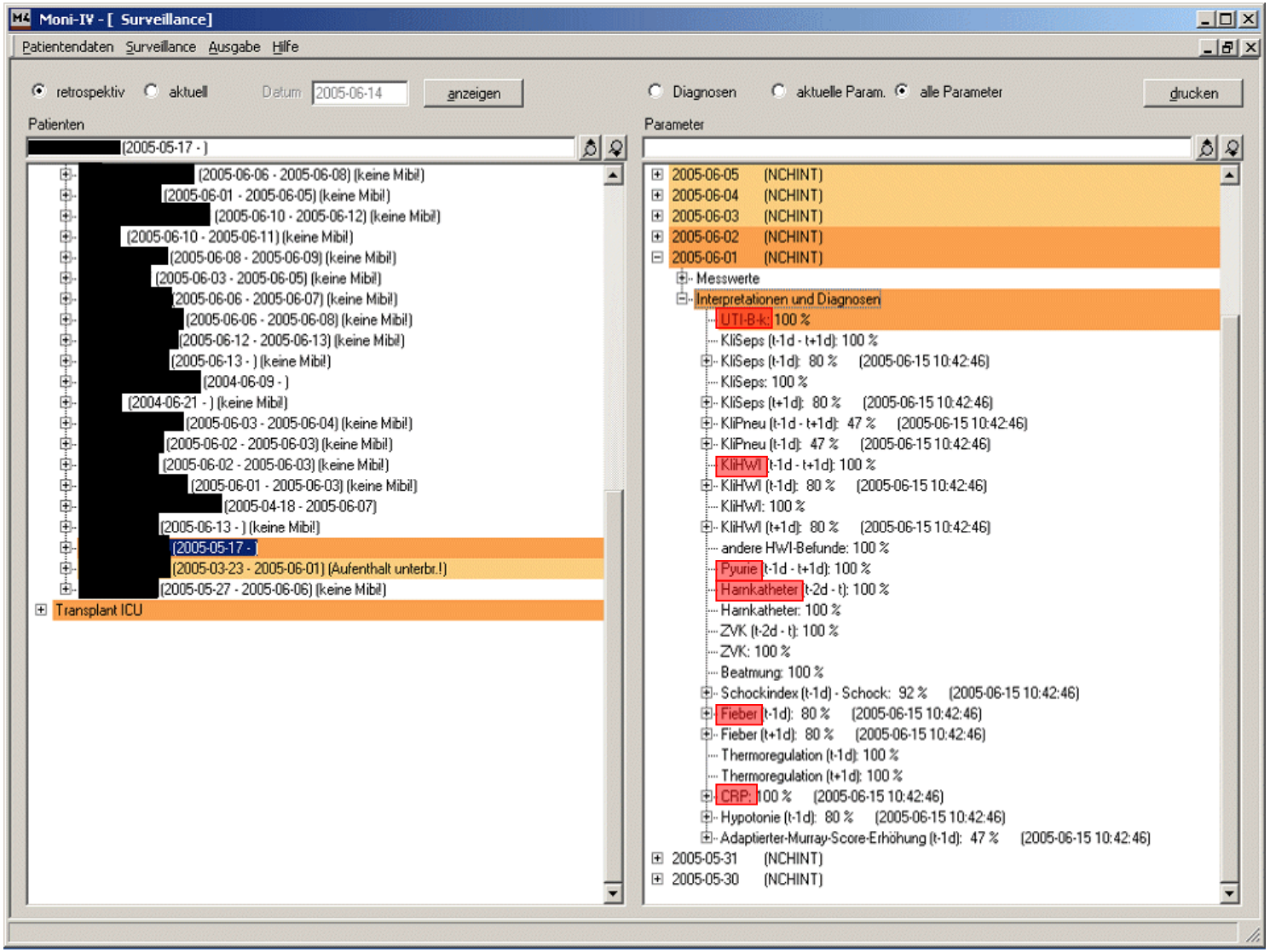
Decomposition—skin contaminant



Cockpit Surveillance
at the infection control unit

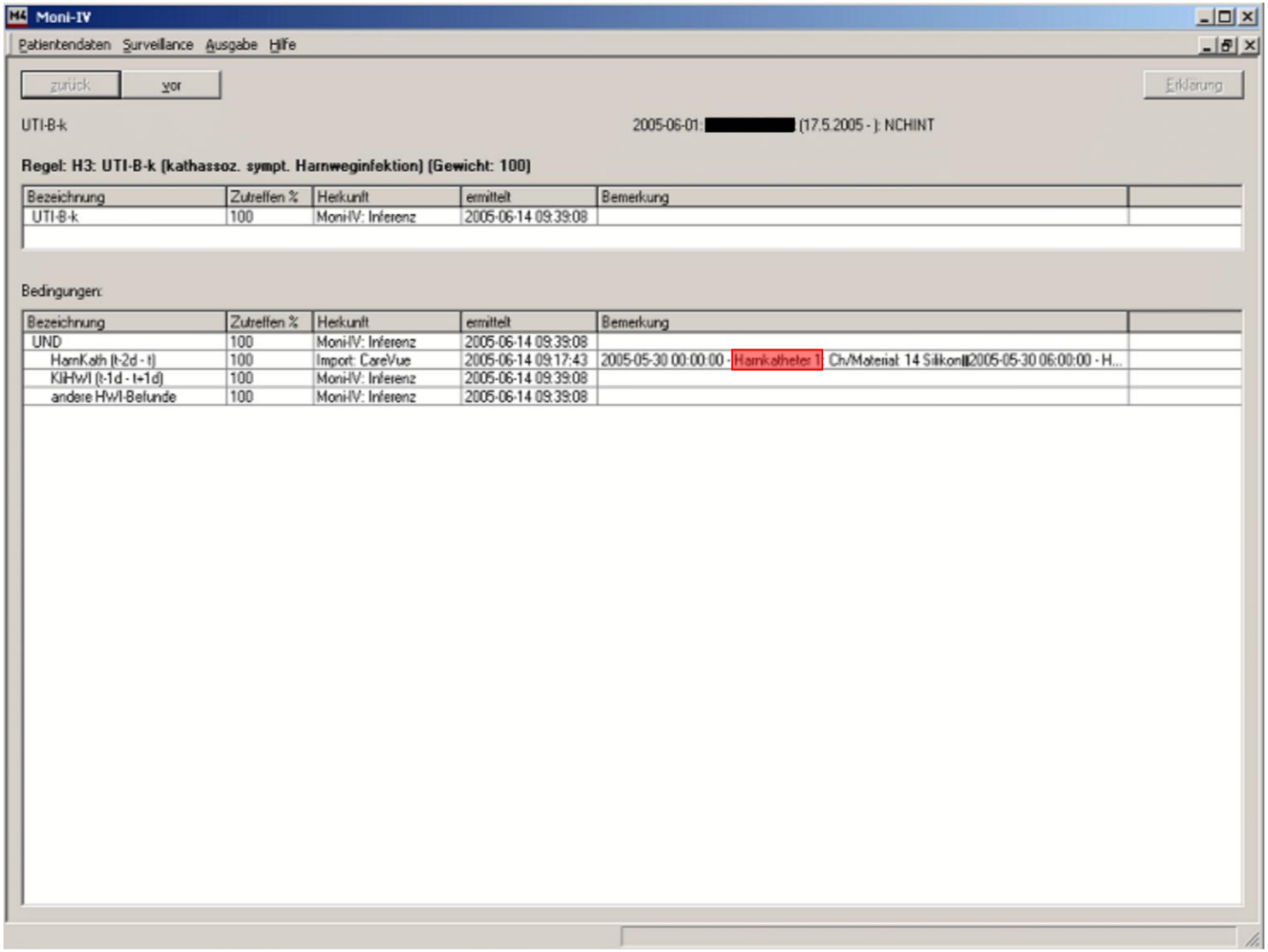


Catheter-Associated Symptomatic Urinary Tract Infection completely fulfilled (100%)

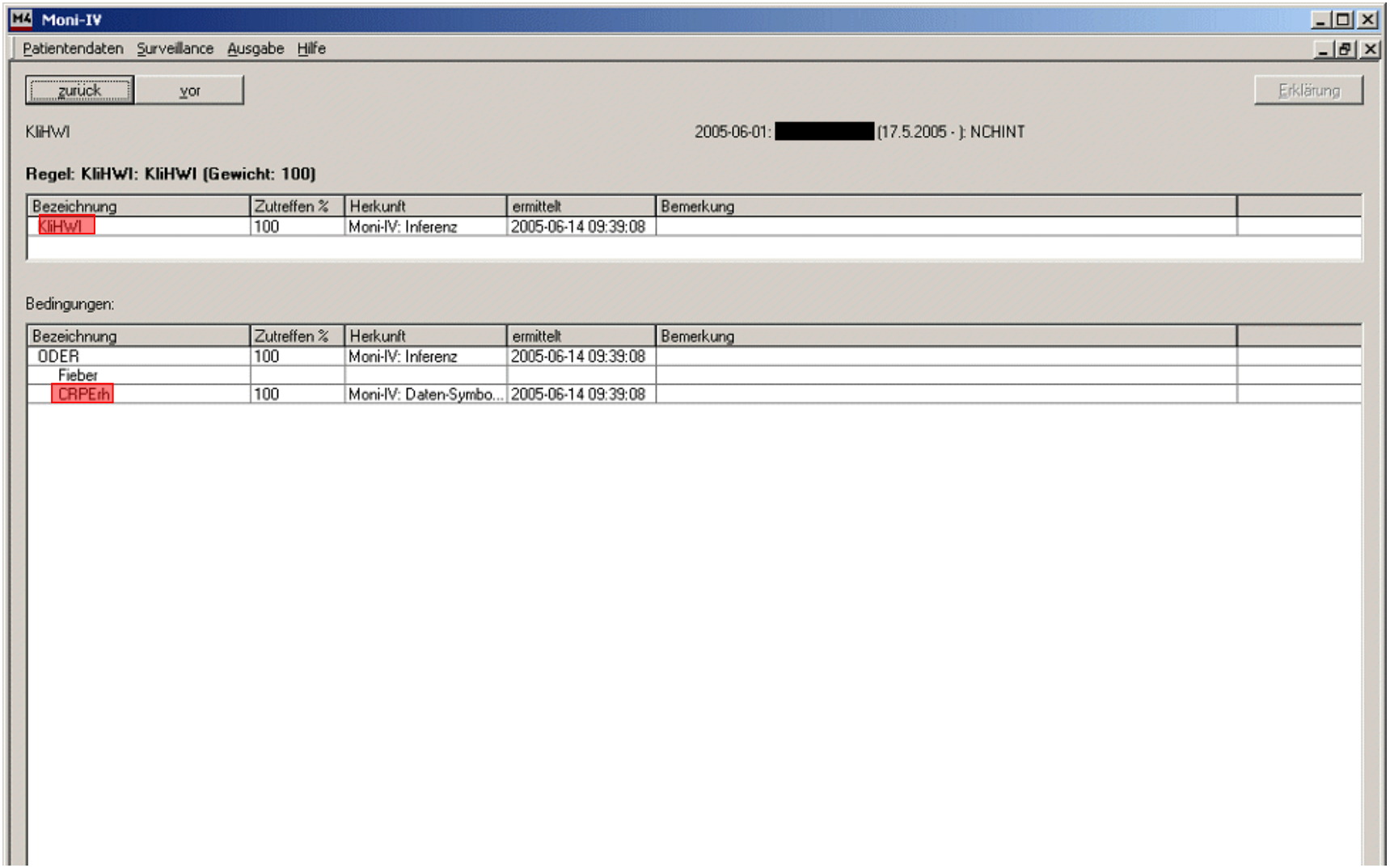


MEDIZINISCHE UNIVERSITÄT WIEN

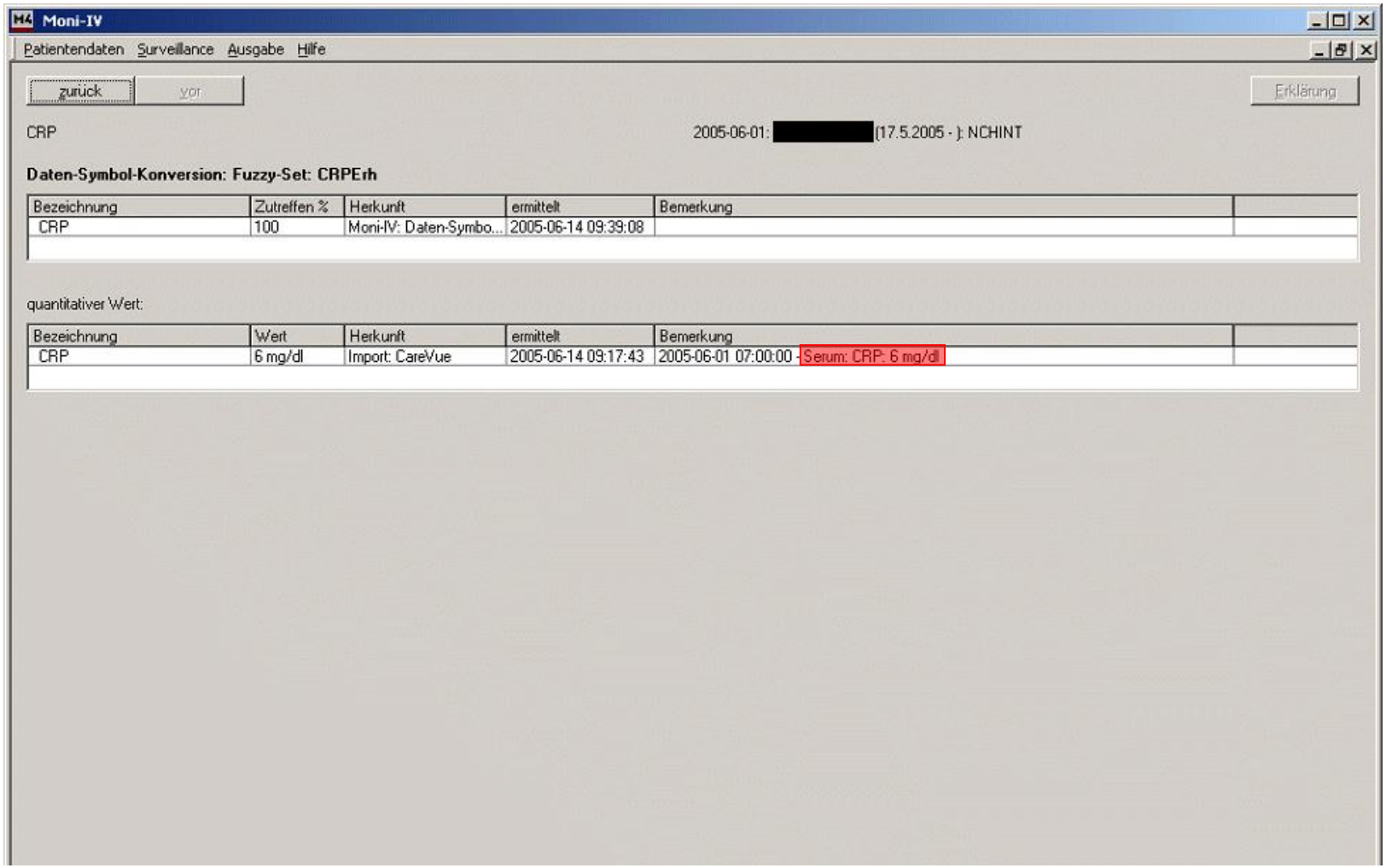
Backtracking of the Logical Chain of Reasoning patient has urinary catheter



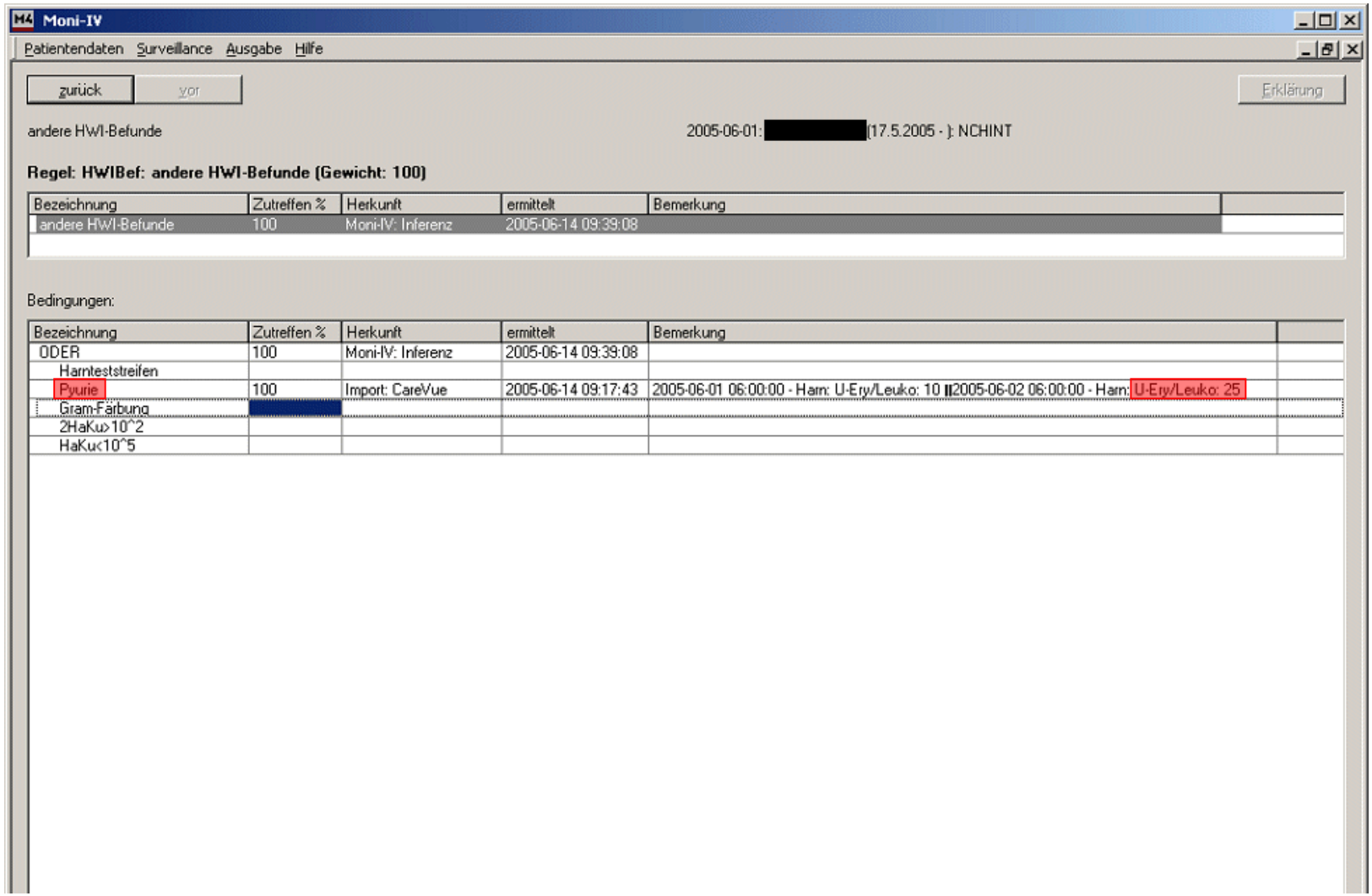
Elevated CRP as a Clinical Sign present (100%)



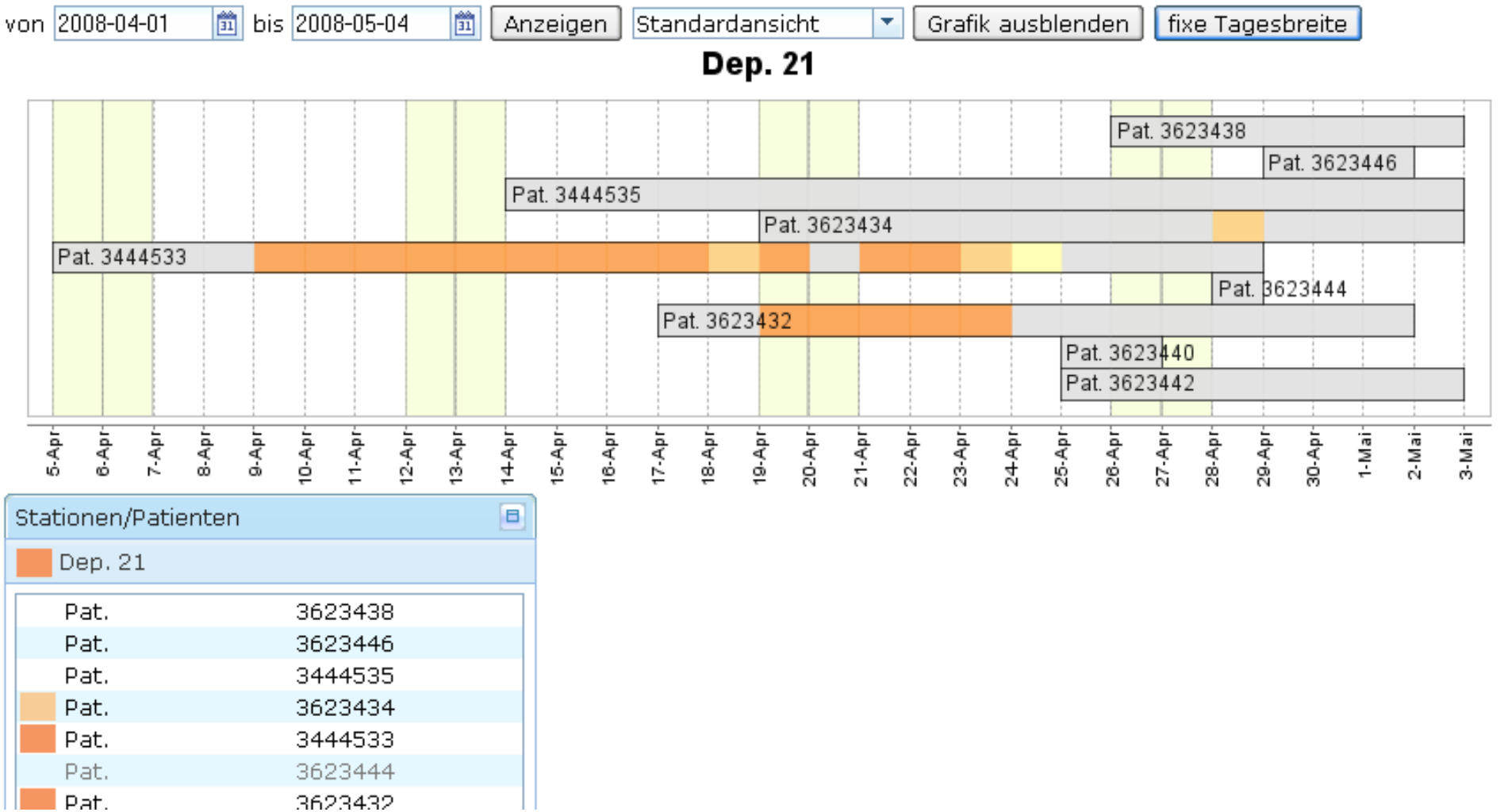
Elevated CRP is Present
6 mg/dl is measured



Other Signs of Urinary Tract Infection
Pyurie

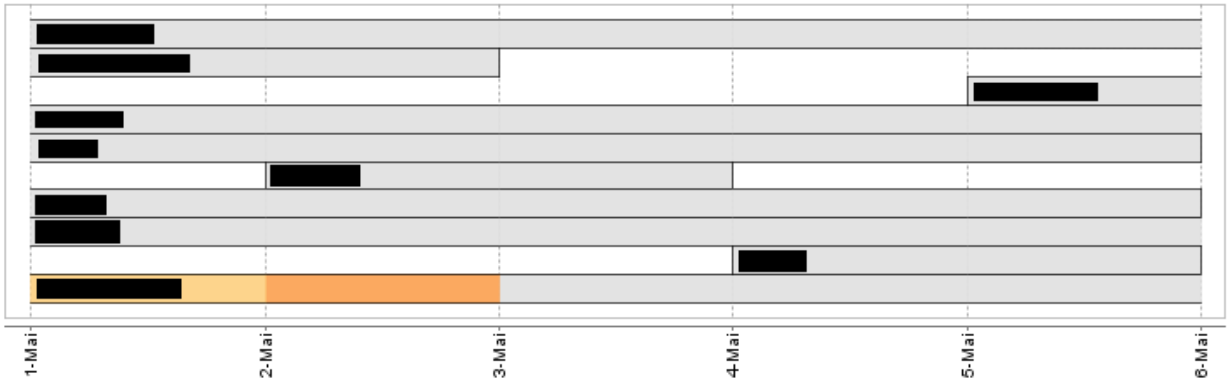


Neues MONI : MONI ICU und MONI N-ICU
„The Next Generation“



von 2008-05-01 bis 2008-05-05 Anzeigen Standardansicht Grafik ausblenden fixe Tabellenbreite

13c3



Stationen/Patienten

- 13b1
- 13b3
- 13c1
- 13c2
- 13c3

- 13h1
- 13h3
- 13i1

[redacted]

- **2008-05-10**
- **2008-05-09**
- **2008-05-08**
- **2008-05-07**
- **2008-05-06**
- **2008-05-05**
- **2008-05-04**
- **2008-05-03**
- **2008-05-02**
- **2008-05-01**
  - **Messwerte**
  - **Interpretationen und Diagnosen**

CRI2 (generalisierte ZVK-assoz. Infektion)	80 %
Fieber	80 %
Hypotonie	80 %
klin. Anzeichen für Entzündung bei HWI	80 %
klin. Anzeichen für Entzündung bei Sepsis	80 %
CRP erhöht	37 %
Schock	100 %
max. Körpertemperatur	37,4 °C
Blutdruck-Profil (unterer Grenzwert)	86 mmHg
Blutdruck-Profil (oberer Grenzwert)	88,33 mmH...
Blutdruck-Profil (21:00 (Vortag) bis 3:00)	86,11 mmH...
Blutdruck-Profil (0:00 bis 6:00)	85,89 mmH...
Blutdruck-Profil (3:00 bis 9:00)	89,67 mmH...
Blutdruck-Profil (6:00 bis 12:00)	93,83 mmH...

CRI2 (generalisierte ZVK-assoz. Infektion)

UND	80 %
NICHT	100 %
pos. BlutKultur	
klin. Anzeichen für Entzündung bei Sepsis	80 %
ODER	100 %
quant. Kultur Katheterspitze	100 %
semiquant. Kultur Katheterspitze	100 %

klin. Anzeichen für Entzündung bei Sepsis

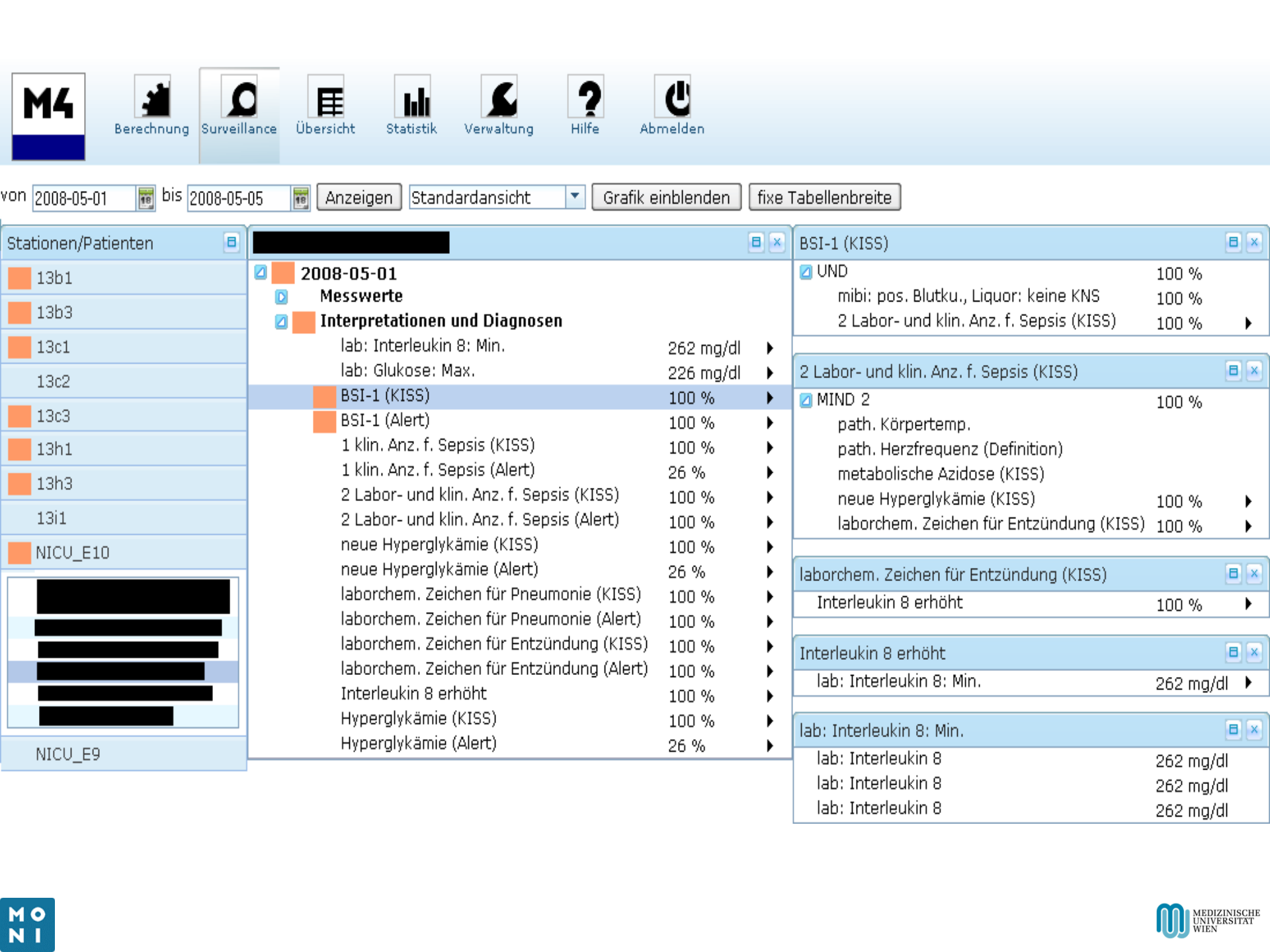
ODER	80 %
Fieber	80 %
Hypotonie	80 %
Leukopenie	
Leukocytose	
CRP erhöht	37 %

Hypotonie

ODER	100 %
Blutdruck-Abfall	
Schock	100 %

Schock

Schockindex	0,8


Berechnung
Surveillance
Übersicht
Statistik
Verwaltung
Hilfe
Abmelden
von 2008-05-01 bis 2008-05-05
Anzeigen
Standardansicht
Grafik einblenden
fixe Tabellenbreite
Stationen/Patienten
13b1
13b3
13c1
13c2
13c3
13h1
13h3
13i1
NICU_E10
NICU_E9
2008-05-01
Messwerte
Interpretationen und Diagnosen
lab: Interleukin 8: Min. 262 mg/dl
lab: Glukose: Max. 226 mg/dl
BSI-1 (KISS) 100 %
BSI-1 (Alert) 100 %
1 klin. Anz. f. Sepsis (KISS) 100 %
1 klin. Anz. f. Sepsis (Alert) 26 %
2 Labor- und klin. Anz. f. Sepsis (KISS) 100 %
2 Labor- und klin. Anz. f. Sepsis (Alert) 100 %
neue Hyperglykämie (KISS) 100 %
neue Hyperglykämie (Alert) 26 %
laborchem. Zeichen für Pneumonie (KISS) 100 %
laborchem. Zeichen für Pneumonie (Alert) 100 %
laborchem. Zeichen für Entzündung (KISS) 100 %
laborchem. Zeichen für Entzündung (Alert) 100 %
Interleukin 8 erhöht 100 %
Hyperglykämie (KISS) 100 %
Hyperglykämie (Alert) 26 %
BSI-1 (KISS)
UND 100 %
mibi: pos. Blutku., Liquor: keine KNS 100 %
2 Labor- und klin. Anz. f. Sepsis (KISS) 100 %
2 Labor- und klin. Anz. f. Sepsis (KISS)
MIND 2 100 %
path. Körpertemp.
path. Herzfrequenz (Definition)
metabolische Azidose (KISS)
neue Hyperglykämie (KISS) 100 %
laborchem. Zeichen für Entzündung (KISS) 100 %
laborchem. Zeichen für Entzündung (KISS)
Interleukin 8 erhöht 100 %
Interleukin 8 erhöht
lab: Interleukin 8: Min. 262 mg/dl
lab: Interleukin 8: Min.
lab: Interleukin 8 262 mg/dl
lab: Interleukin 8 262 mg/dl
lab: Interleukin 8 262 mg/dl

MONI: Evaluierung

2 ICUs:	n	without HCAI	with HCAI
patients	89		
ICU stays	93	75	18*
LOS (days)	median:7 shortest:1 longest:40		
patient days	1005	918	88

* comprising 30 HCAI episodes: 12 with one, 1 with two, 4 with three and 1 with four distinct infection episodes during one stay

MONI

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HCAI condition correctly or falsely identified by MONI and by the human expert

MONI reported:	HCAIs present	HCAIs absent
HCAIs **present**	26 (86.7%)	1* (1.3%)
HCAIs **absent**	4** (13.3%)	75 (98.7%)
human expert reported:		
HCAI **present**	12 (40%)	5*** (6.4%)
HCAI **absent**	18**** (60%)	73 (93.6%)

* A CRI episodes was falsely detected. The underlying cause was elevated CRI as a result of leukemia.
** 3 PN episodes and 1 CRI episode not reported due to missing import of electronic microbiology report
*** human expert misinterpreted or wrongly reported 4 UTI episodes and 1 BSI episode.
**** human expert missed 3 UTI episodes, 3 BSI episodes, 11 CRI episodes and 1 PN episode

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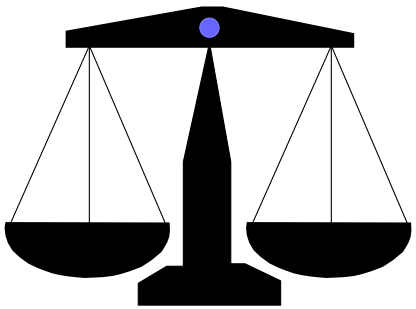
Surveillance - Zeitbedarf

	2 ICUs	alle ICUs
	Conventional surveillance	**MONI-ICU surveillance**
Time spent	82.5 h (100%)	12.5 h (15.2%)

Erfolge bei der Infektions-prävention



Aufwand für die Surveillance

Herzlichen Dank!