Surveillance of nosocomial infections
My experience from the last 10 years

Petra Gastmeier
Hanover Medical School, Germany
Situation in Germany 1993

A lot of infection control people wanted to start with surveillance, but

• no agreement about the definitions for NI (too difficult?)

• no agreement about surveillance methods
  - active or passive surveillance?
  - hospital wide or concentration on patients at risk?
  - number of risk factors to record
  - methods for standardization and stratification

• no structures to establish a national database
German national prevalence survey
NI DEP 1 (1994)

- National point-prevalence survey of nosocomial infections in 72 random selected acute care hospitals (14,966 patients)
- Overall prevalence of nosocomial infections 3.5%

NI DEP 1 conclusions

• CDC definitions are useful, but it is necessary to train people diagnosing NI according to CDC criteria
• It is not useful to perform surveillance in all hospital departments, it makes sense to concentrate on high risk areas and high risk infections
NI DEP 2 (1996-98): Quality management project in 8 hospitals

1st Incidence study

Intervention period 1996

2nd Incidence study

Intervention period 1997

3rd Incidence study

Gastmeier P et al. ICHE 202; 23:91-97
NI DEP 2 conclusions

- It is possible to decrease nosocomial infection rates significantly by introducing surveillance and using surveillance data in quality circles to improve infection control measures.
1996: Robert Koch-Institute

Network of National Reference Centres

Staphylococci

Streptococci

Meningococci

...........

...........

nosocomial infections
Reference data for nosocomial infections
Krankenhaus-Infektions-Surveillance System (KI SS)
1. Steps of the development of the surveillance system
2. Workload for surveillance
3. Reduction of infection rates
National Nosocomial Infections Surveillance (NNIS) System

NNIS System Surveillance Components

- Hosp Wide
- Intensive Care Unit
- High Risk Nursery
- Surgical Patient

ICARE
Intensive Care Antimicrobial Resistance Epidemiology

DISC Study
Detailed ICU Surveillance Component (DISC) Study

>30 years
<table>
<thead>
<tr>
<th>ICU KISS</th>
<th>OP KISS</th>
<th>NEO KISS</th>
<th>ONKO KISS</th>
<th>DEVICE KISS</th>
<th>AMBU KISS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For ICUs</strong></td>
<td><strong>For operated patients</strong></td>
<td><strong>For neonatal ICU patients</strong></td>
<td><strong>For BMPSCT patients</strong></td>
<td><strong>For Non-ICU patients</strong></td>
<td><strong>For outpatient surgery</strong></td>
</tr>
<tr>
<td>289 ICUs</td>
<td>285 departments</td>
<td>39 NICUS</td>
<td>17 centres</td>
<td>95 units</td>
<td>105 centres</td>
</tr>
</tbody>
</table>
Uniform definitions

- Translation of CDC definitions
- Training of diagnosing according to CDC definitions
  (a two day introductory course is mandatory)
Appropriate methods for the various patient groups

- Considering the most important risk factors
- Considering cost effectiveness
Method (ICU-KI SS)

Concentration on:
Ventilator associated pneumonia
CVC associated Bloodstream infections
Urinary catheter associated urinary tract infections
Method (ICU-KISS)

**Standardisation:**

Pneumonias in ventilated patients

VAP rate = \( \frac{\text{Pneumonias in ventilated patients}}{\text{ventilator days}} \)

**Stratification:**

separate data for different types of ICUs
**STANDARDIZATION: VAP pneumonia rates**

<table>
<thead>
<tr>
<th></th>
<th>Days on ventilation</th>
<th>Mean</th>
<th>Median</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ICUs (n=289)</td>
<td>989,259</td>
<td>8.5</td>
<td>7.0</td>
<td>11.8</td>
</tr>
</tbody>
</table>

**KISS 6/ 2003**
# STRATIFICATION: VAP pneumonia rates

<table>
<thead>
<tr>
<th></th>
<th>Days on ventilation</th>
<th>Mean</th>
<th>Median</th>
<th>75th percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical ICUs (n=59)</td>
<td>156,427</td>
<td>7.5</td>
<td>6.0</td>
<td>9.4</td>
</tr>
<tr>
<td>Surgical ICUs (n=73)</td>
<td>279,237</td>
<td>10.2</td>
<td>8.2</td>
<td>13.1</td>
</tr>
<tr>
<td>Neurosurgical ICUs (n=10)</td>
<td>46,119</td>
<td>10.7</td>
<td>9.1</td>
<td>12.9</td>
</tr>
</tbody>
</table>
DISTRIBUTION of VAP rate

Ventilator associated pneumonia rate / 1000 ventilator days

Number of ICU

25th percentile (3,3)
median (8,0)
75th percentile (14,8)
Development of nosocomial MRSA-infections in KISS ICUs

MRSA/ S.aureus (%)

Distribution of MRSA incidence density in KISS ICUs

Number of ICUs

MRSA/1000 patient days
Correlation between MRSA incidence density and nosocomial MRSA cases in KISS ICUs

MRE—KISS Januar bis Dezember 2003

Inzidenzdichte nosokom. MRSA—Fälle

Inzidenzdichte MRSA—Fälle (pro 1000 Patiententage)
Method (OP-KI SS)

**Stratification:** separate data according to the number of risk points
(Risk points for wound class, ASA score, duration of surgery)

**Standardisation:** calculation of SIR for each department

\[
\text{SIR} = \frac{\text{observed SSI}}{\text{expected SSI}}
\]
STRATIFICATION: Hip prosthesis

SSI rate (%)

Risk points

NNIS: 112,025 operations (12/2002), 153 hospitals
KISS: 47,347 operations (6/2003), 92 hospitals
STANDARDISATION: Colon surgery (2,851 operations)

KISS June 1999
Method (NEO-KISS) for neonates with < 1500g birth weight

• Modified NNIS method and modified definitions
• Concentration on:
  Ventilator associated pneumonia
  CVC associated Bloodstream infections
  NEC
• Stratification according to birth weight categories

• 12/2002: 33 departments with
  < 500 g: 61 Newborns
  500-999 g: 1318 Newborns
  1000-1500 g: 1978 Newborns
ONKO-KISS
Method (ONKO-KISS) for patients with bone marrow and stem cell transplantation

- newly developed
- concentration on blood stream infections and pneumonia
- Standardization according to neutropenia days

- 6/2003: 17 centers with 929 patients with allogen transplantation
  547 patients with autolog transplantation

- mean observation period: 15 days
German Protection Infection Act 2001
§ 23

It requires the ongoing surveillance of nosocomial infections in at least one hospital department with a high risk of these infections, such as intensive care units or surgical departments.

In addition, it also requires the surveillance of surgical site infections in surgical outpatient settings.
Method (DEVl CE-Kl SS) for patients with devices in non-ICUs

- use of the method for ICUs (device associated NI)
- concentration on
  CVC associated BSI and
  urinary catheter associated urinary tract infections
- 6/2003: Data from 63 wards
Data from 63 device-KISS wards
urinary catheter associated UTI 6/2003

CAUTI / 1000 UC days

- Medical: 5
- Surgical: 0
- Neurological: 14
- ICU: 2
- Reha: 2
Method (AMBU-KISS) for SSI in outpatient settings

Calculation of crude SSI rates:

\[
\text{number of SSI for a given indicator operation} = \frac{\text{number of operations of this type}}{100}
\]
### Comparison with hospital data

<table>
<thead>
<tr>
<th>Procedure</th>
<th>OPs</th>
<th>SSI rate (%)</th>
<th>SSI rate (%) NNI S index 0</th>
<th>OPs</th>
<th>SSI rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hernia repair</td>
<td>29 121</td>
<td>1,36</td>
<td>0,78</td>
<td>3 094</td>
<td>0,65</td>
</tr>
<tr>
<td>Varicosis OP</td>
<td>3 878</td>
<td>0,80</td>
<td>0,64</td>
<td>5 020</td>
<td>0,38</td>
</tr>
<tr>
<td>Arthroscopic knee procedures</td>
<td>23 163</td>
<td>0,20</td>
<td>0,11</td>
<td>7 931</td>
<td>0,09</td>
</tr>
</tbody>
</table>

KI SS 6/ 2003
1. Steps of the development of the surveillance system
2. Workload for surveillance
3. Reduction of infection rates
Cost effectiveness of surveillance

Reduction of infection rates

Expenses for surveillance
- Numerator data
- Denominator data
Process of identifying nosocomial infections

- All patients
- Patients with indicators for NI
- Patients with NI according to CDC definitions

Sensitivity

Specificity
## Methods for identification of cases

### Sensitivity of indicators

<table>
<thead>
<tr>
<th>Method</th>
<th>Sensitivity (%)</th>
<th>h per week per 100 beds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory based telefon call</td>
<td>36</td>
<td>1.2</td>
</tr>
<tr>
<td>Laboratory based ward visit</td>
<td>51</td>
<td>3.1</td>
</tr>
<tr>
<td>Ward rounds</td>
<td>62</td>
<td>3.5</td>
</tr>
<tr>
<td>Temperature based chart review</td>
<td>41</td>
<td>3.6</td>
</tr>
<tr>
<td>Temperature +treatment based chart review</td>
<td>65</td>
<td>6.5</td>
</tr>
<tr>
<td>Laboratory based ward rounds</td>
<td>76</td>
<td>6.4</td>
</tr>
</tbody>
</table>

Methods for identification of cases
Sensitivity of indicators

Gastmeier et al. ICHE 1999; 20:124-127

14,966

NI

Antimicrobial therapy

31 = 6% von 518

518 (3.5%)

Microbiology reports
Methods for identification of cases
Sensitivity of indicators

Sensitivity in %

Gastmeier et al. ICHE 1999; 20:124-127
Two strategies

To be present on the wards for several hours a week to gather information

To use hospital databases as much as possible to acquire necessary information

Combination of surveillance and infection control activities

Extra stimulation of infection control activities
Active surveillance is preferred

• In most hospitals infection control nurses are responsible for surveillance (about 70%)
• They get support from link nurses in many hospitals.
• In the remaining hospitals the doctors of the ward are doing surveillance.
<table>
<thead>
<tr>
<th></th>
<th>ICU-KI SS</th>
<th>OP-KI SS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Median:</strong></td>
<td>2 h/week</td>
<td>2 h/week</td>
</tr>
<tr>
<td><strong>ICU beds:</strong></td>
<td>4-28</td>
<td>1-12 indikator operations</td>
</tr>
<tr>
<td><strong>On average:</strong></td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
Reporting and Using Surveillance Information

“Surveillance without action should be abandoned.”

Present surveillance information in a manner to stimulate ideas for process improvement.

Perform follow-up surveillance to monitor for improvement following changes (“close the loop”).
ICU-KI SS: Validation study 2001/ 02

Retrospective study in 20 randomly selected ICUs
A total of 1,481 cases
(286 NI cases, 1,195 Non-NI cases)

Positive predictive value 83 %
Negative predictive value 98 %

Median specificity 99.6 %
Median sensitivity 79 %
Reporting and Using Surveillance Information

Use extreme caution when surveillance information is used for external comparisons!
Who gets surveillance information?

CONFIDENCE is the most important principle!

The unit/department itself should decide who gets this information inside and outside the hospital
1. Steps of the development of the surveillance system
2. Workload for surveillance
3. Reduction of infection rates
Reduction of CVC associated BSI rate in KISS ICUs

Data from 84 ICUs participating for at least 2 years, only the data from the first 24 months of participation were considered.

Zuschneid et al. ICHE 2002; 24: 501-05
ZVK-assoziierte Sepsisrate

Anzahl ZVK-assoz. Sepsen pro 1000 ZVK-Tage

Monatliche Lineare Reduktion = 0,026 (sig.)

Lineare Reduktion in 2 Jahren um 28,6 % von 2,09 auf 1,49

Monat der Teilnahme

KISS-Daten 01/97—06/01, 84 Stationen mit mind. 24 Monate Teilnahme
Reduction of ventilator associated pneumonia rates in KISS ICUs

Data from 71 ICUs participating for at least 3 years since 1999, only the first 3 years were considered.
Significant reduction from 10.4 (1) to 8.0 (2) → Reduction of 23.1%
Reduction of surgical site infection rates in KISS

Inclusion criteria:
• Indicator operations with > 15 departments participating and with ≥ 30 procedures of this type and ≥ 3 years participation

Calculation of SSI rates per year of participation
Stratification of departments according to the basic SSI rate (1st year)
# Data used for this analysis

<table>
<thead>
<tr>
<th>Type of procedure</th>
<th>departments</th>
<th>operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHOLECYSTECTOMY</td>
<td>25</td>
<td>14,500</td>
</tr>
<tr>
<td>COLON OPERATION</td>
<td>37</td>
<td>4,924</td>
</tr>
<tr>
<td>HERNIA REPAIR</td>
<td>25</td>
<td>12,092</td>
</tr>
<tr>
<td>HIP PROSTHESIS</td>
<td>37</td>
<td>23,953</td>
</tr>
<tr>
<td>KNEE PROSTHESIS</td>
<td>17</td>
<td>7,842</td>
</tr>
<tr>
<td>SECTIO CAESAREA</td>
<td>16</td>
<td>11,750</td>
</tr>
<tr>
<td><strong>total</strong></td>
<td><strong>79</strong></td>
<td><strong>75,061</strong></td>
</tr>
</tbody>
</table>
SSI rates

SSI (%)  

RR = 0.78 (CI95: <0.69; 0.90>)

pooled  

(n = 75,061 OP from 79 departments)
1. Steps of the development of the surveillance system
2. Workload for surveillance
3. Reduction of infection rates
Aufgaben des NRZ

Das NRZ für Surveillance von nosokomialen Infektionen bietet seinen Partnern, behandelnden Ärzten, medizinischen Einrichtungen, Laboratorien und Gesundheitsbehörden folgende Leistungen an:

1. Ausbau und Optimierung und Pflege der Referenzdatenbank für nosokomiale Infektionen (Krankenhaus-Infektions-Surveillance-System - KISS)
   - Modul OP-KISS (operativ)
   - Modul ITS-KISS (Intensivstationen)
   - Modul NEKISS (für nosokomiale ITS)
   - Modul ONKO-KISS (für Patienten mit Blutsstammzelltransplantationen)

2. Aufbau einer Referenzdatenbank für nosokomiale Infektionen (Krankenhaus-Infektions-Surveillance-System - KISS)
Hanover Medical School
ANALYSIS FOR OUR HOSPITAL DIRECTOR

Four ICUs were included in the analysis:

1. Trauma ICU (T)
2. Neurosurgical ICU (NS)
3. Neonatal ICU (N)
4. Bone marrow transplant ICU (BMT)

For every ICU:
Comparison of the first and the second 12 surveillance months
## Basic situation for VAP rates

<table>
<thead>
<tr>
<th>ICU</th>
<th>VAP rate/ 1000 ventilator days</th>
<th>Median of the corresponding KISS component</th>
<th>KISS: 75th perzentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>11.8</td>
<td>8.2</td>
<td>13.7</td>
</tr>
<tr>
<td>NS</td>
<td>5.0</td>
<td>9.1</td>
<td>12.9</td>
</tr>
<tr>
<td>N (&lt; 1000g)</td>
<td>0</td>
<td>3.9</td>
<td>6.1</td>
</tr>
<tr>
<td>N (&lt; 1500g)</td>
<td>0</td>
<td>0.1</td>
<td>0.7</td>
</tr>
<tr>
<td>BMT</td>
<td>4.8</td>
<td>6.3</td>
<td>8.2</td>
</tr>
</tbody>
</table>
## Basic situation for CVC-BSI rates

<table>
<thead>
<tr>
<th>ICU</th>
<th>CVC-BSI rate/1000 CVC days</th>
<th>Median of the corresponding KISS component</th>
<th>KISS: 75th perzentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>6.6</td>
<td>1.5</td>
<td>2.4</td>
</tr>
<tr>
<td>NS</td>
<td>0</td>
<td>0.7</td>
<td>1.9</td>
</tr>
<tr>
<td>N (&lt; 1000g)</td>
<td>6.6</td>
<td>8.1</td>
<td>10.7</td>
</tr>
<tr>
<td>N (&lt; 1500g)</td>
<td>3.1</td>
<td>3.9</td>
<td>6.1</td>
</tr>
<tr>
<td>BMT</td>
<td>21.0</td>
<td>14.3</td>
<td>20.8</td>
</tr>
<tr>
<td></td>
<td>CVC BSI</td>
<td>VAP</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cases 1st period</td>
<td>Cases 2nd period</td>
<td>Reduction</td>
</tr>
<tr>
<td>T</td>
<td>15</td>
<td>4</td>
<td>-11</td>
</tr>
<tr>
<td>NS</td>
<td>0</td>
<td>1</td>
<td>+1</td>
</tr>
<tr>
<td>N</td>
<td>7</td>
<td>6</td>
<td>-1</td>
</tr>
<tr>
<td>BMT</td>
<td>35</td>
<td>22</td>
<td>-13</td>
</tr>
</tbody>
</table>

-24 BSI cases  - 6 VAP cases
In comparison to patients without NI:

<table>
<thead>
<tr>
<th>Infection Type</th>
<th>Attributable length of stay</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First NI</td>
<td>5.2 d</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>6.1 d</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Urinary tract infections</td>
<td>-0.2 d</td>
<td>0.52</td>
</tr>
<tr>
<td>Primary sepsis</td>
<td>2.8 d</td>
<td>0.118</td>
</tr>
<tr>
<td>Surgical site infections</td>
<td>13.3 d</td>
<td>0.0933</td>
</tr>
</tbody>
</table>

Beyersmann et al. 2004, in press
## Success

<table>
<thead>
<tr>
<th>Reduction</th>
<th>n</th>
<th>Prolongation of stay per case in days</th>
<th>Total days</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSI cases</td>
<td>24</td>
<td>3</td>
<td>72</td>
</tr>
<tr>
<td>Pneumonia cases</td>
<td>6</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td></td>
<td>108</td>
</tr>
</tbody>
</table>

One ICU day: 1,200 €  
108 ICU days: 130,000 €  
Hospital charges for one infection control nurse per year: 30,000 € - 35,000 €
= Hospitals in Europe Link for Infection Control through Surveillance

1994-96
Development of surveillance protocols

1998-99
Inventory in Europe

2000-2002
Harmonisation, Protocols for ICUs, SSI, prevalence

2003-2004
Establishment of 2 surveillance systems

http://helics.univ.lyon1.fr
Uniform protocol for prevalence surveys

Hospitals in Europe Link for Infection Control through Surveillance

A harmonised European protocol for prevalence surveys (Rossello J)