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Sub-Saharan Africa ConsorTium for the Advancement of Innovative Research and Care in Sepsis

# IPC and surveillance of nosocomial infections

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STAIRS Sepsis Lectures Online Webinar Series 2025

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# Disclosures

„Context-Driven Infection Control Interventions“ – CoDe-ICI
Funded by the Berlin University Alliance in the framework of the Oxford Berlin Research Partnership, OX | BUA Center for Advanced Studies, 822_CAS_OX-BER

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# Learning Objectives

1. What is surveillance (purpose, definitions and principles)
2. Hospital-acquired infections (brief introduction)
3. Surveillance methods (general overview)

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NRZ
National Reference Centre for Nosocomial Infections

# IPC and surveillance of nosocomial infections

## Institute of Hygiene and Environmental Medicine

Pathogen Surveillance
Molecular Epidemiology

Friederike Maechler

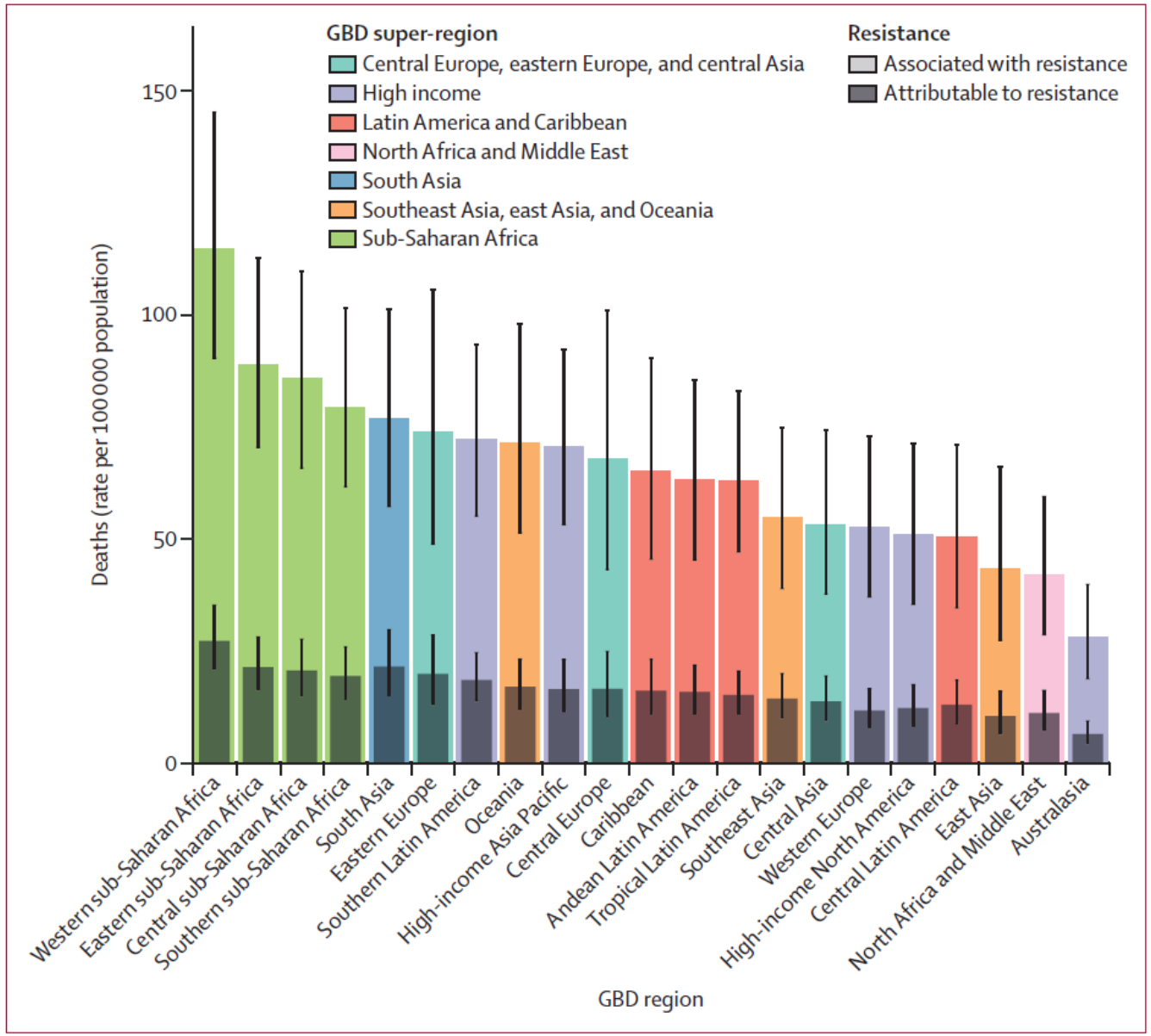


***Figure 2:*** **All-age rate of deaths attributable to and associated with bacterial antimicrobial resistance by GBD region, 2019**

Estimates were aggregated across drugs, accounting for the co-occurrence of resistance to multiple drugs. Error bars show 95% uncertainty intervals. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.

Is this surprising given the overall consumption of antimicrobials?

Murray CJ, et al. The Lancet. 2022.

# Subsahara-Africa highest death rate attributable to and associated with AMR **DESPITE** low AMR percentage among infection deaths (Appendix p. 97)

**Table S11: Decomposition of fatal BD region, 2019**

| GBD region | All-cause death rate per 100 000 | Death rate per 100 000 involving infection | Death rate per 100 000 associated with resistance | Death rate per 100 000 attributable to resistance | Fraction of deaths involving infection that are associated with resistance | Fraction of deaths involving infection that are attributable to resistance |
|---|---|---|---|---|---|---|
| Central Asia | 681.5 (628.0–744.7) | 109.5 (79.3–150.1) | 53.3 (37.7–74.3) | 13.8 (9.5–19.5) | 48.6% (46.7%–50.2%) | 12.6% (11.1%–14.3%) |
| Central Europe | 1201.3 (1074.6–1329.3) | 137.8 (92.5–198.7) | 68.0 (43.2–100.9) | 16.6 (10.5–25.0) | 49.1% (46.6%–51.5%) | 12.0% (10.7%–13.4%) |
| Eastern Europe | 1300.9 (1202.0–1415.4) | 150.0 (103.5–206.6) | 74.0 (48.8–105.6) | 19.9 (13.1–28.5) | 49.2% (46.7%–51.6%) | 13.3% (11.7%–15.0%) |
| Australasia | 706.6 (695.7–717.7) | 90.0 (63.2–124.4) | 28.0 (18.8–39.9) | 6.5 (4.3–9.4) | 31.0% (29.2%–32.8%) | 7.2% (6.2%–8.2%) |
| High-income Asia Pacific | 931.0 (921.9–940.3) | 170.2 (132.5–216.0) | 70.7 (53.2–92.3) | 16.5 (11.6–23.1) | 41.5% (39.6%–43.4%) | 9.7% (7.9%–11.5%) |
| High-income North America | 887.4 (881.1–893.8) | 122.8 (88.7–167.9) | 51.0 (35.4–71.5) | 12.3 (8.3–17.5) | 41.4% (39.5%–43.2%) | 10.0% (8.6%–11.5%) |
| Southern Latin America | 742.7 (726.9–760.0) | 168.3 (134.5–210.8) | 72.3 (55.1–93.4) | 18.6 (13.9–24.7) | 42.8% (40.9%–44.9%) | 11.0% (9.5%–12.6%) |
| Western Europe | 979.9 (970.7–989.4) | 140.5 (104.7–186.9) | 52.5 (37.0–73.0) | 11.7 (8.0–16.6) | 37.2% (34.9%–39.6%) | 8.3% (7.3%–9.4%) |
| Andean Latin America | 504.6 (423.9–599.2) | 137.6 (101.7–182.1) | 63.2 (45.4–85.4) | 15.9 (11.1–21.9) | 45.9% (43.3%–48.0%) | 11.5% (10.1%–13.2%) |
| Caribbean | 804.0 (709.5–905.2) | 180.6 (135.5–237.8) | 65.1 (45.5–90.5) | 16.2 (11.0–23.2) | 35.9% (32.9%–38.8%) | 8.9% (7.7%–10.2%) |
| Central Latin America | 573.2 (503.8–651.2) | 113.9 (81.4–156.2) | 50.6 (34.7–70.9) | 13.0 (8.8–18.5) | 44.3% (42.0%–46.3%) | 11.4% (10.0%–13.0%) |
| Tropical Latin America | 646.3 (629.1–664.3) | 142.2 (111.5–180.6) | 63.0 (47.1–83.1) | 15.2 (11.1–20.6) | 44.2% (42.3%–46.1%) | 10.7% (9.6%–11.9%) |
| North Africa and Middle East | 509.7 (462.6–561.1) | 92.5 (66.0–127.1) | 42.0 (28.7–59.5) | 11.2 (7.5–16.3) | 45.3% (42.6%–47.7%) | 12.1% (10.7%–13.5%) |
| South Asia | 661.3 (604.0–721.0) | 210.6 (168.3–262.2) | 76.8 (57.2–101.2) | 21.5 (15.1–29.8) | 36.4% (30.8%–41.4%) | 10.2% (8.1%–12.7%) |
| East Asia | 752.3 (661.0–848.3) | 91.6 (61.2–135.8) | 43.3 (27.4–66.1) | 10.5 (6.5–16.0) | 47.1% (44.6%–49.2%) | 11.4% (9.9%–13.0%) |
| Oceania | 732.4 (602.3–891.7) | 242.6 (175.7–323.3) | 71.6 (51.4–98.0) | 17.0 (12.1–23.2) | 29.5% (24.9%–33.0%) | 7.0% (5.7%–8.3%) |
| Southeast Asia | 651.3 (595.7–704.9) | 168.2 (133.4–213.[illegible]) | 54.8 (38.9–74.9) | 14.4 (10.0–20.0) | 32.4% (28.8%–35.7%) | [illegible] (7.3%–9.[illegible]) |
| Central Sub-Saharan Africa | 662.8 (568.6–769.2) | 317.7 (254.9–395.6) | 86.0 (65.9–109.8) | 20.7 (14.9–27.7) | 27.0% (24.3%–30.1%) | 6.5% (5.3%–8.1%) |
| Eastern Sub-Saharan Africa | 628.3 (568.1–703.1) | 318.9 (261.3–390.1) | 89.0 (70.5–112.6) | 21.4 (16.3–28.1) | 27.9% (25.6%–30.1%) | 6.7% (5.7%–7.9%) |
| Southern Sub-Saharan Africa | 932.2 (875.3–1002.1) | 425.4 (351.5–507.4) | 79.4 (61.7–101.6) | 19.4 (14.3–25.9) | 18.6% (16.6%–20.9%) | 4.6% (3.7%–5.7%) |
| Western Sub-Saharan Africa | 757.8 (672.5–864.4) | 405.5 (331.6–497.6) | 114.8 (90.4–145.3) | 27.3 (20.9–35.3) | 28.3% (25.4%–30.8%) | 6.7% (5.7%–7.7%) |

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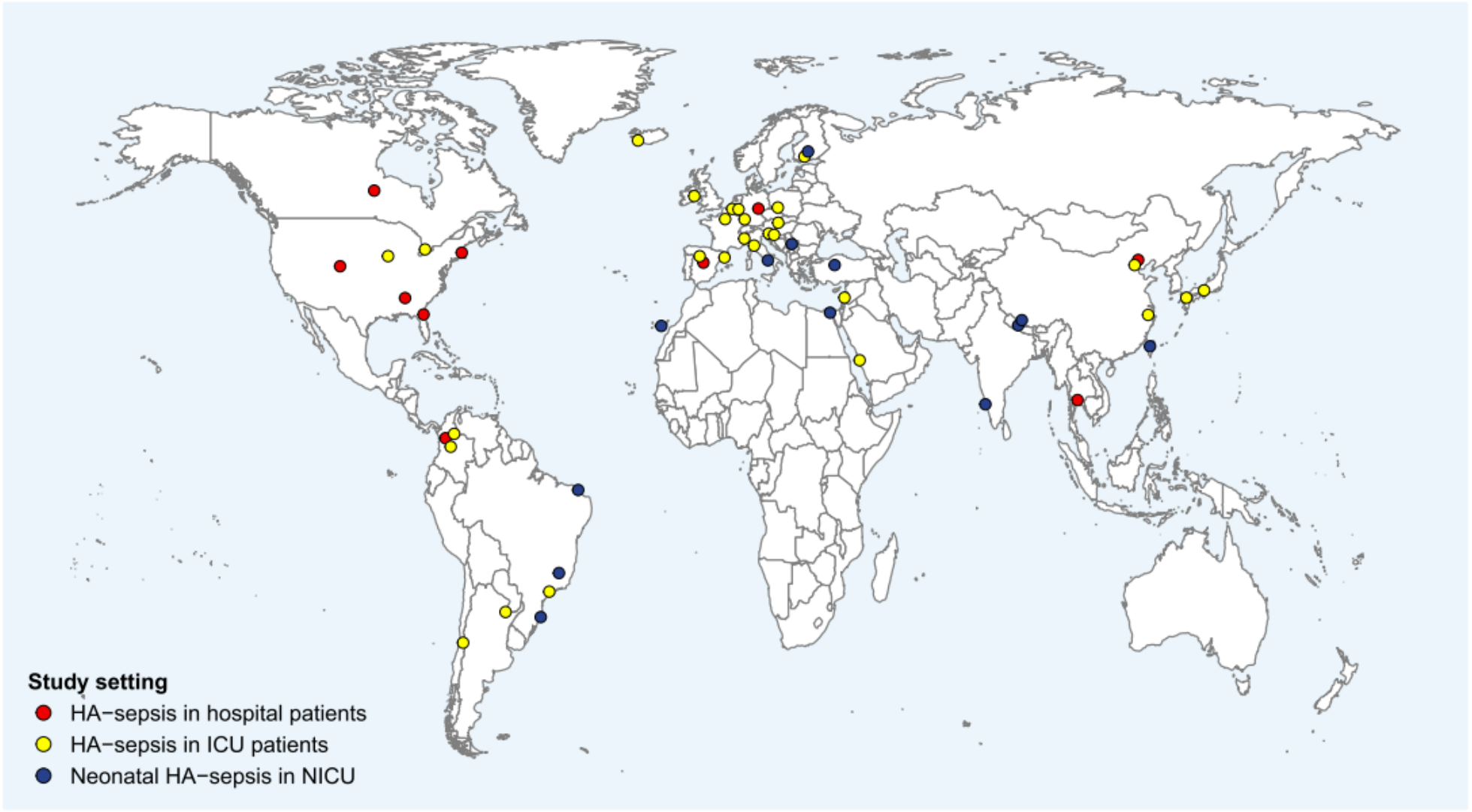



**Fig. 2** Location and type of studies reporting hospital-acquired sepsis



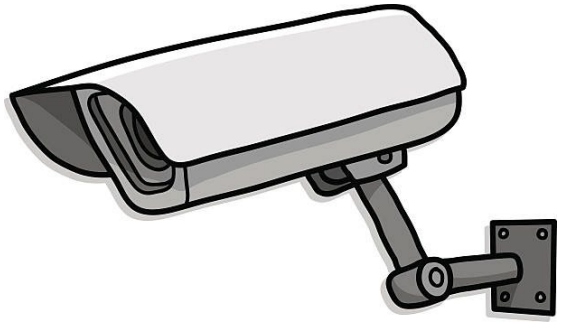
Markwart et al., Intensive Care Med 2020

# 1 What is HAI surveillance?

## Purpose, definition and principles

# PREVENT (REDUCE) INFECTIONS AND MDRO

# Surveillance



1. **Definition:** systematic & continuous surveillance of pathogens / infections (in healthcare facilities)

2. **Aims:**

    1. Determining the status quo

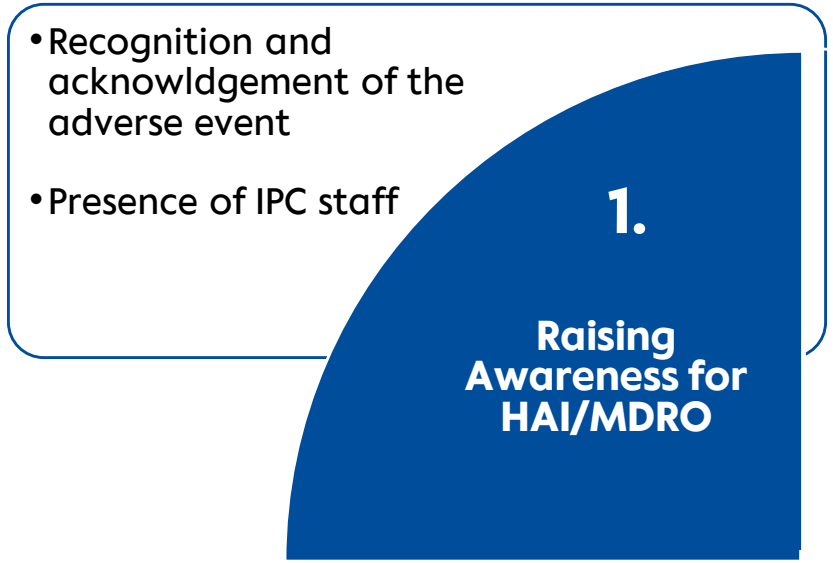
    2. Benchmarking

# Aims of infection/MDRO surveillance?

**To answer the questions whether infection/MDRO frequencies are...**

| | |
|---|---|
| low | decreasing |
| normal | constant |
| high | increasing |
| in comparison with others | over time |

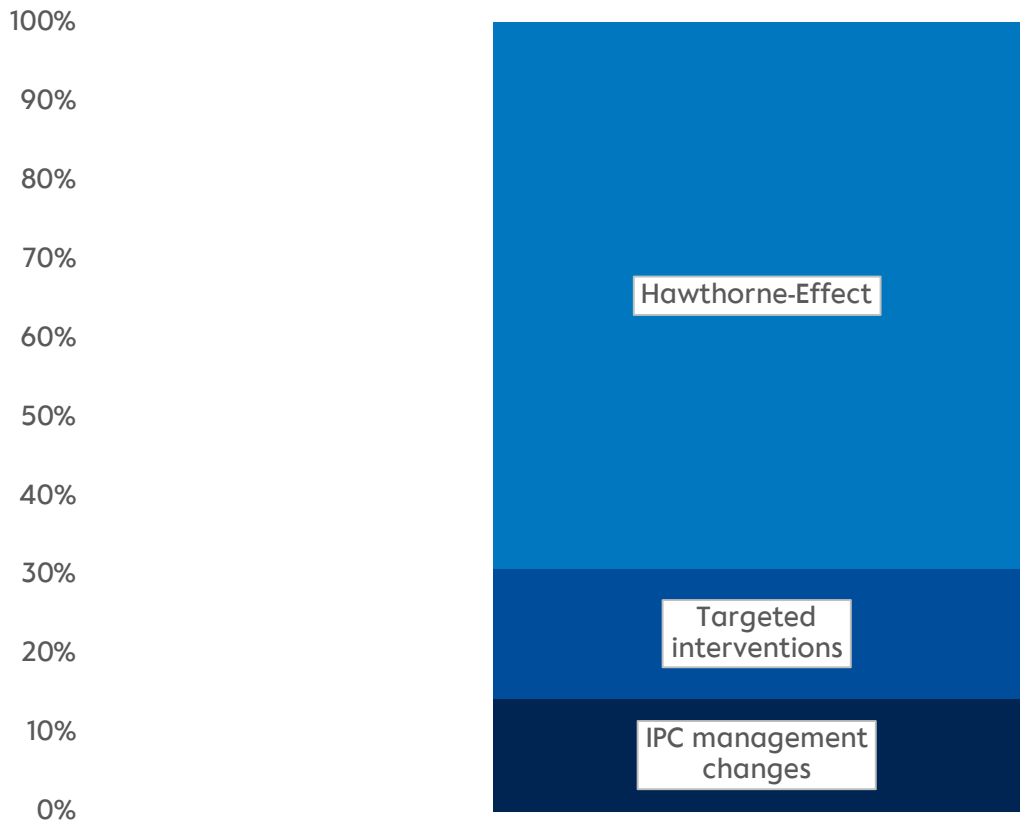
# Surveillance principles



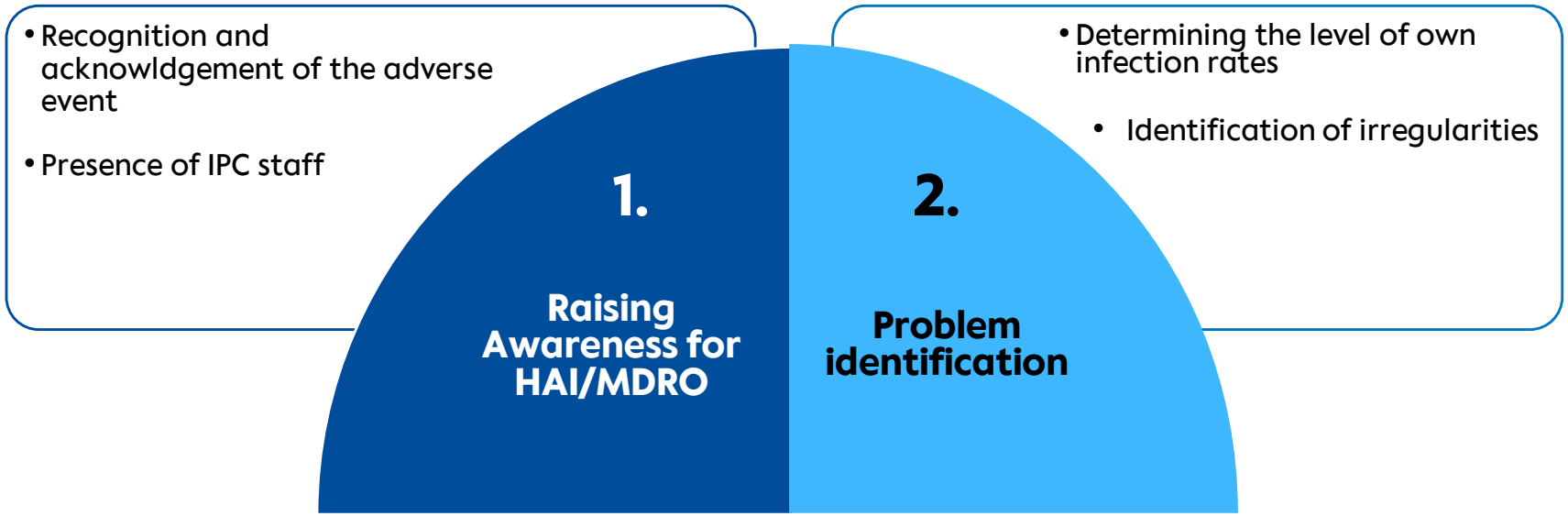

**Hawthorne Effect**

"Individuals who are knowingly observed (as part of a research project) **behave differently** than they would without observation.

# Reasons given by surveillance participants for successful reductions in CVC-associated sepsis



# Surveillance principles



# What do the measured infection rates/frequencies imply?

- Surgical site infection rate: **1.2** per 100 surgeries
- **1.4** CVC-associated sepsis cases per 1,000 CVC days
- VAP rate: **3.0** (ventilator-associated pneumonias per 1,000 ventilation days)
- MRSA incidence density: **1.0** (hospital acquired MRSA = first detection per 1,000 patient days)

**Which of the infection rates/frequencies indicate a problem wi infection transmission?**

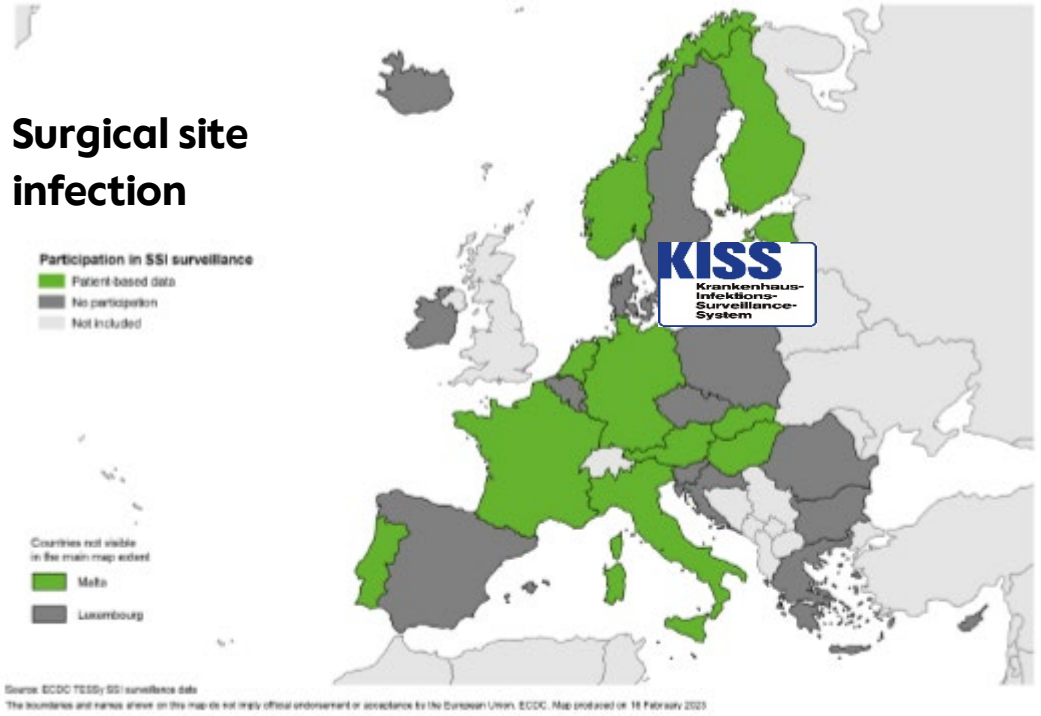
**Multiple answers possible**

# Benchmark values are necessary for analysis and interpretation

# ECDC Surveillance

**Surgical site infection**

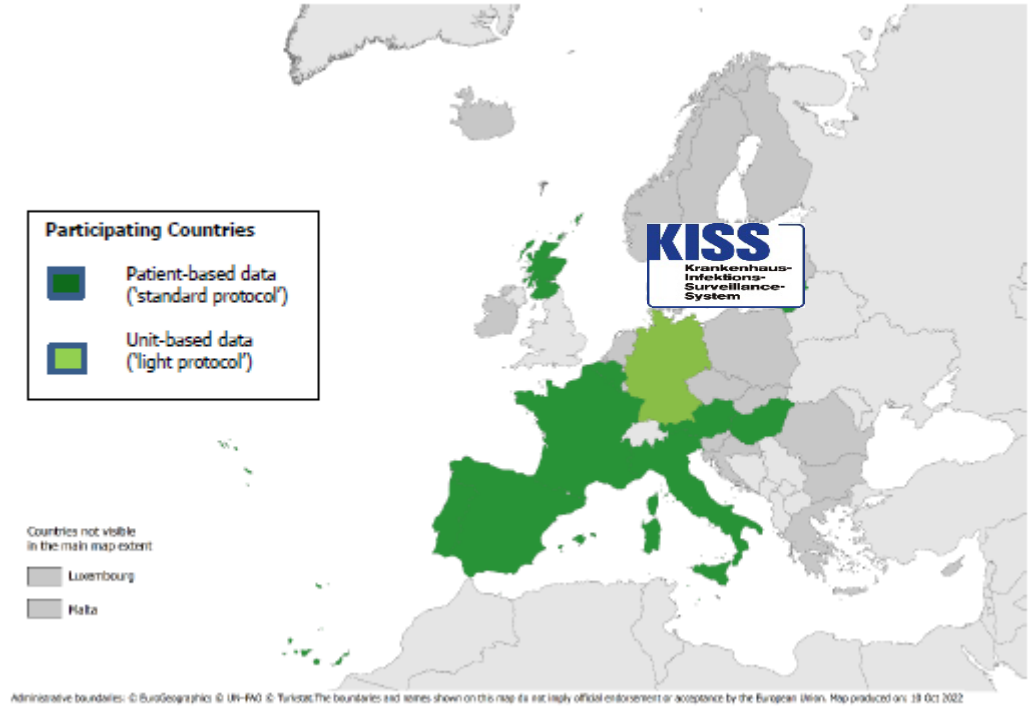
Figure 1. Participation in the surveillance of surgical site infections (SSIs), EU/EEA, 2018–2020




*Source: ECDC. HAI-Net. 2018-2020*

**Hospital associated infections in ICUs**

Figure 1. Participation in surveillance of healthcare-associated infections in intensive care units, EU/EEA, 2019




*Source: ECDC, HAI-Net, 2022.*

Participating countries in the components for postoperative wound infections (2018–2020) and intensive care units (2019)

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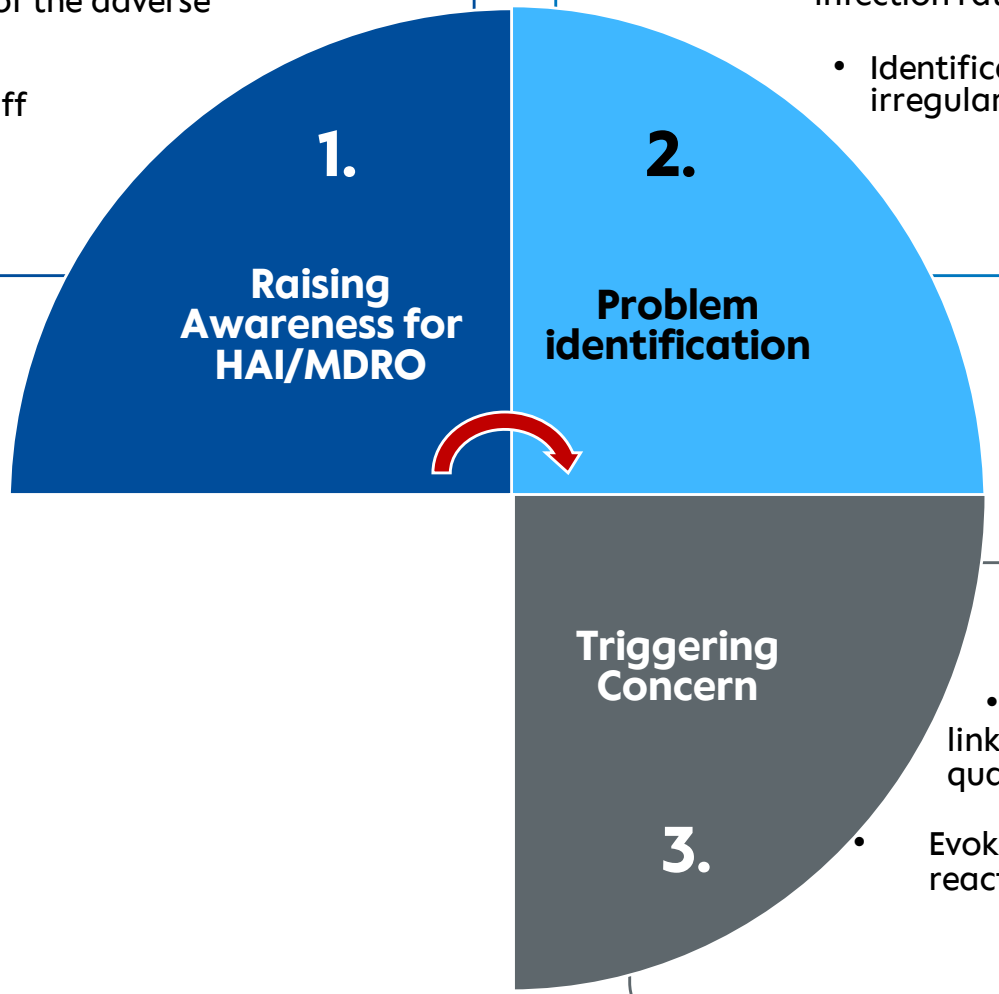
# Krankenhaus Infektions Surveillance System

(Hospital Infection Surveillance System)

- Provision of risk-adapted **surveillance methods** for relevant areas and populations to collect data on:
  - → **hospital-acquired infections**, including CDI
  - → the occurrence of relevant multi-drug resistant pathogens (e.g. MRSA, VRE, MRGN)
  - → infection-related parameters in hospitals (e.g. hand disinfectant consumption, hand hygiene compliance, antibiotic consumption)
- Provision of the **software and support** necessary for data management
- Provision of **reference data** for benchmarking
- Used in ~1500 hospitals across Germany (HAI surveillance mandatory)

# Surveillance principles



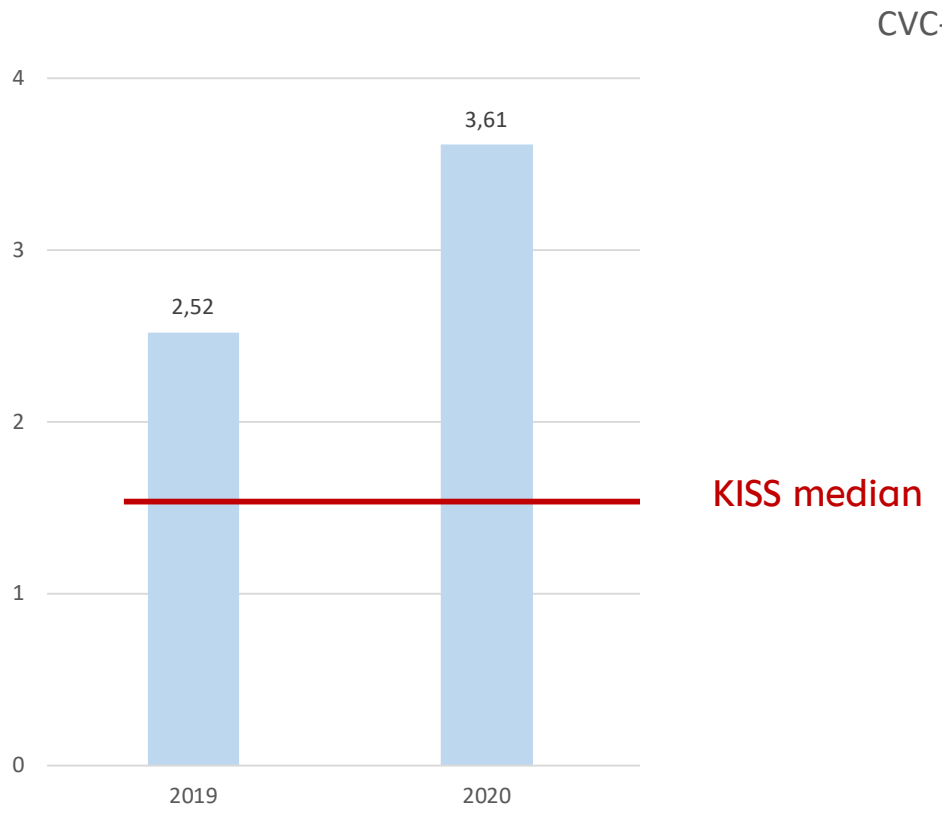

- Recognition and acknowldgement of the adverse event
- Presence of IPC staff

- Determining the level of own infection rates
- Identification of irregularities

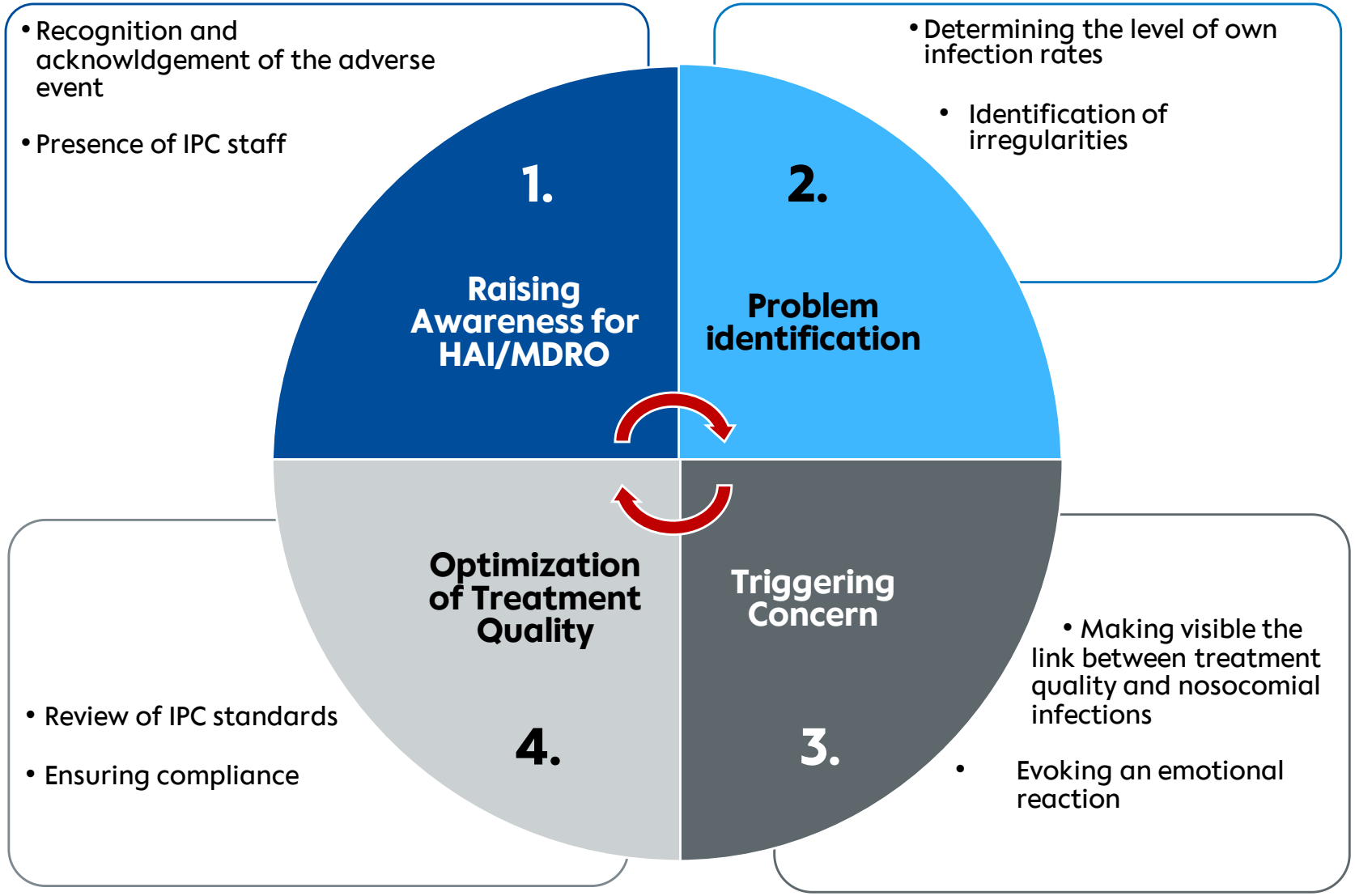
- Making visible the link between treatment quality and HAIs
- Evoking an emotional reaction

# Surveillance participant's report

# Surveillance participant's report from ICU



# Surveillance principles



# Surveillance helps ask the right questions!

- How frequently are patients affected by infections / MDROs?
- What could be the reasons for unusually high infection / MDRO rates?
- Are our measures effective in preventing such infections / MDROs?

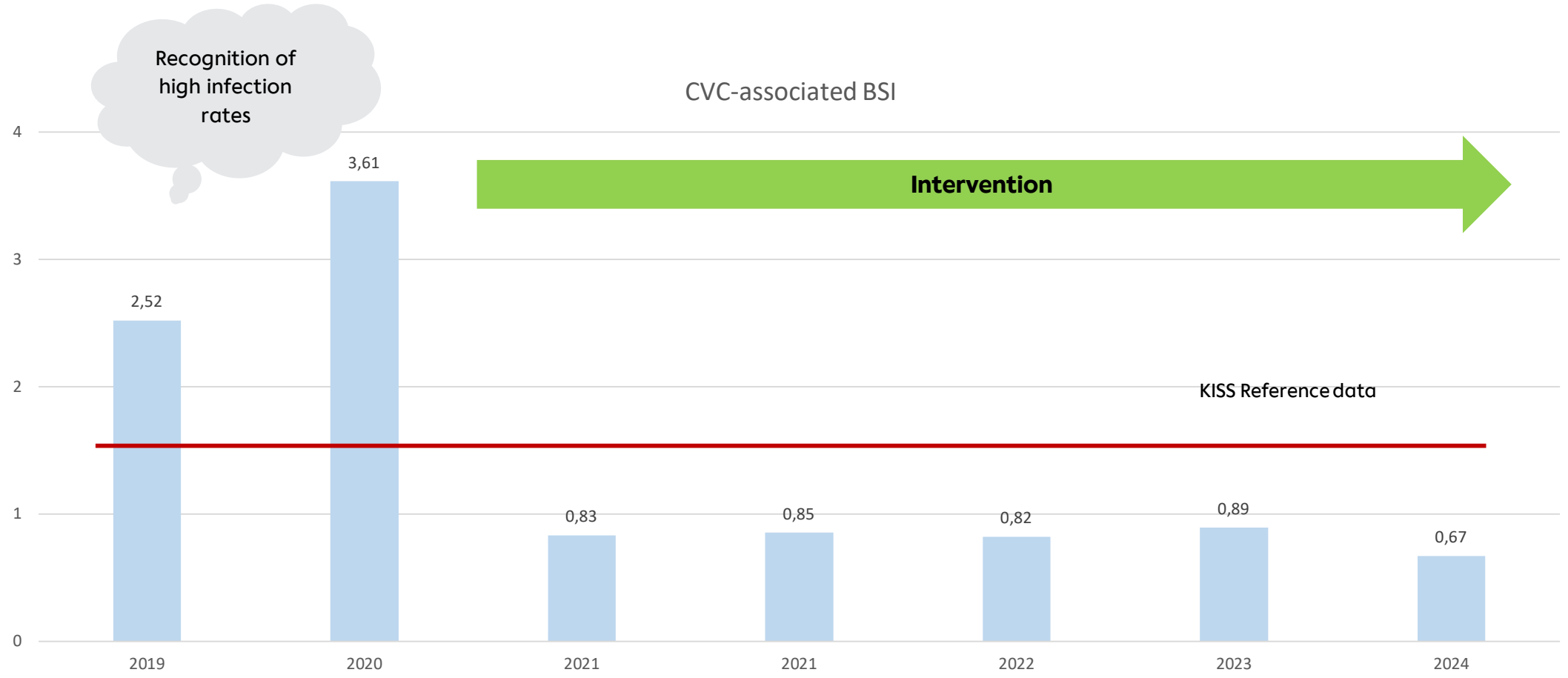
# How to deal with the results?

Identification of high infection rates compared to reference data →

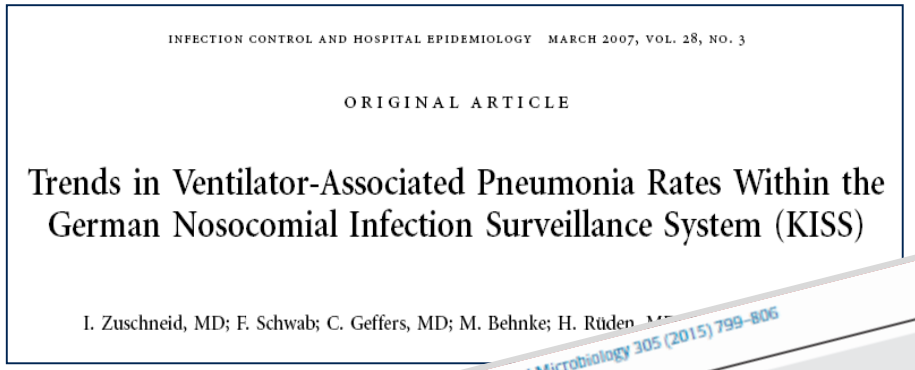
**Implementation of a bundle of interventions**

1. Presentation of surveillance results to healthcare workers
2. Revision/creation of written IPC standards based on national/international recommendations (e.g. insertion of CVCs, replacement of arterial pressure systems, measures during initial care)
3. Improvement of nurse-to-patient ratio
4. Hand hygiene workshops
5. Written information for patients and relatives on IPC measures

# Surveillance participant's report from ICU



# Success stories


INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY MARCH 2007, VOL. 28, NO. 3

ORIGINAL ARTICLE

Trends in Ventilator-Associated Pneumonia Rates Within the German Nosocomial Infection Surveillance System (KISS)

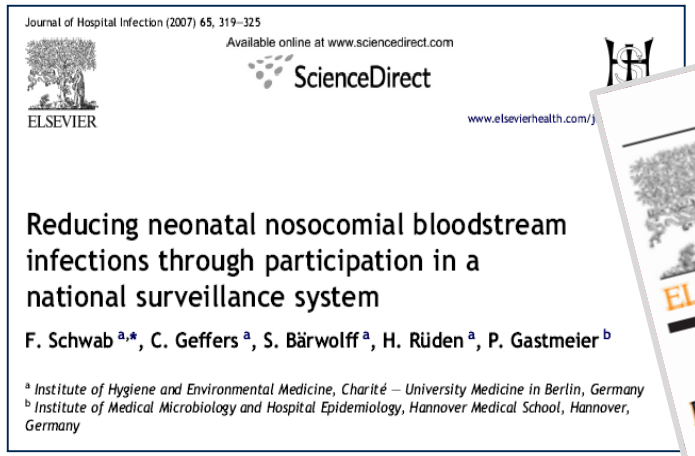
I. Zuschneid, MD; F. Schwab; C. Geffers, MD; M. Behnke; H. Rüden, M


INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY DECEMBER 2006, VOL. 27, NO. 12

ORIGINAL ARTICLE

Reduction of Surgical Site Infection Rates Associated With Active Surveillance

t, MD; D. Sohr, PhD; M. Behnke; F. Daschner, MD; H. Rüden, MD; P. Gastmeier, MD


Journal of Hospital Infection (2007) 65, 319–325

Available online at www.sciencedirect.com

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ELSEVIER

Reducing neonatal nosocomial bloodstream infections through participation in a national surveillance system

F. Schwab [a,*], C. Geffers [a], S. Bärwolff [a], H. Rüden [a], P. Gastmeier [b]

[a] Institute of Hygiene and Environmental Medicine, Charité – University Medicine in Berlin, Germany
[b] Institute of Medical Microbiology and Hospital Epidemiology, Hannover Medical School, Hannover, Germany


International Journal of Medical Microbiology 305 (2015) 799–806

Contents lists available at ScienceDirect

International Journal of Medical Microbiology

journal homepage: www.elsevier.com/locate/ijmm

ELSEVIER

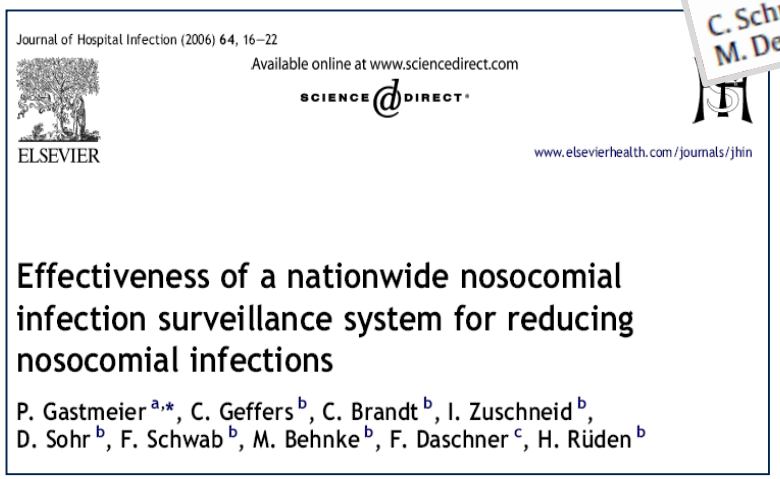
Epidemiology of healthcare associated infections in Germany: Nearly 20 years of surveillance

C. Schröder [a,*], F. Schwab [a], M. Behnke [a], A.-C. Breier [a], F. Maechler [a], B. Piening [a], M. Dettenkofer [b], C. Geffers [a], P. Gastmeier [a]


Brandt · T. Eckmanns

Rüden

Reduction of orthopaedic wound infections in 21 hospitals


Journal of Hospital Infection (2006) 64, 16–22

Available online at www.sciencedirect.com

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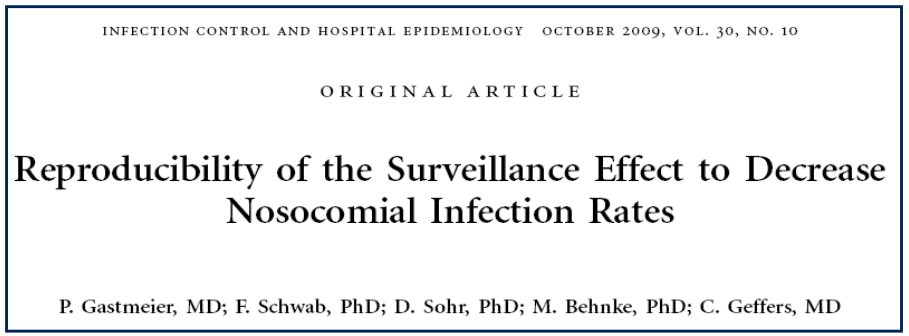
Effectiveness of a nationwide nosocomial infection surveillance system for reducing nosocomial infections

P. Gastmeier [a,*], C. Geffers [b], C. Brandt [b], I. Zuschneid [b], D. Sohr [b], F. Schwab [b], M. Behnke [b], F. Daschner [c], H. Rüden [b]


INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY OCTOBER 2009, VOL. 30, NO. 10

ORIGINAL ARTICLE

Reproducibility of the Surveillance Effect to Decrease Nosocomial Infection Rates

P. Gastmeier, MD; F. Schwab, PhD; D. Sohr, PhD; M. Behnke, PhD; C. Geffers, MD


Journal of Hospital Infection (2006) 64, 156–161

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Reduction of surgical site infections after Caesarean delivery using surveillance

S. Bärwolff [a,d,*], D. Sohr [a,d], C. Geffers [a,d], C. Brandt [a,d], R.-P. Vonberg [b,d], H. Halle [c], H. Rüden [a,d], P. Gastmeier [b,d]

[a] Institute of Hygiene and Environmental Medicine, Charité – University Medicine Berlin, Germany
[b] Institute for Medical Microbiology and Hospital Epidemiology, Medical School Hannover, Germany
[c] Department of Obstetrics and Gynaecology, Charité – University Medicine Berlin, Germany
[d] German National Reference Centre for the Surveillance of Nosocomial Infections

# After adjusting for other influencing factors, the year of participation remains a protective factor

International Journal of Medical Microbiology 305 (2015) 799–806

Contents lists available at ScienceDirect

International Journal of Medical Microbiology

journal homepage: www.elsevier.com/locate/ijmm

Epidemiology of healthcare associated infections in Germany: Nearly 20 years of surveillance

C. Schröder[a,*], F. Schwab[a], M. Behnke[a], A.-C. Breier[a], F. Maechler[a], B. Piening[a], M. Dettenkofer[b], C. Geffers[a], P. Gastmeier[a]

Risk factors for HAI in ICU-KISS 2006–2013; 622 ICUs starting in ICU-KISS later or equal year 2006 with 1,761,997 patients were considered in this analysis.

| Parameter | Primary blood stream infection (PBSI) IRR (95%CI), *p*-value | Lower respiratory tract infection (LRTI) |
|---|---|---|
| YP = 2 | 0.77 (0.68–0.87), <0.001 | 0.80 (0.75–0.86), <0.001 |
| YP = 3 | 0.77 (0.67–0.88), <0.001 | 0.71 (0.65–0.77), <0.001 |
| YP = 4 | 0.67 (0.57–0.79), <0.001 | 0.66 (0.60–0.74), <0.001 |
| YP ≥ 5 | 0.60 (0.50–0.72), <0.001 | 0.61 (0.52–0.71), <0.001 |
| Length of stay (per day) | 1.01 (1.00–1.02), 0.003 | |
| CVC use (per 10% increase) | 1.09 (1.04–1.14), <0.001 | 1.07 (1.04–1.09), <0.001 |
| Tubus use (per 10% increase) | 1.10 (1.05–1.14), <0.001 | 1.13 (1.10–1.15), <0.001 |
| Season (Mar–May) | 1.18 (1.06–1.31), 0.002 | 1.06 (1.01–1.12), 0.014 |
| Season (Jun–Aug) | 1.34 (1.21–1.48), <0.001 | 1.14 (1.08–1.20), <0.001 |
| Season (Sep–Nov) | 1.16 (1.05–1.28), 0.003 | 1.09 (1.03–1.14), 0.002 |
| Size of hospital (≥600 beds) | | 1.16 (1.00–1.34), 0.043 |
| Type of ICU (=surgical) | | 1.21 (1.03–1.41), 0.018 |
| Type of hospital (=university) | 1.34 (1.07–1.67), 0.012 | |

ITS KISS

# Preventive potential is always relative to the starting conditions

- Facilities with **inconspicuous/low infection rates** may have already implemented all possible preventive measures.
- Facilities with **high baseline rates** may have implemented preventive measures inadequately.

# Percentage of ICUs with VAP reduction after three years of surveillance

| | VAP-Rate reduction between year 1 and 3 of participation |
|---|---|
| | % ICUs with reduction |
| **Total** | **55%** |

# 2 What are hospital-acquired infections?

# When does a set of signs and symptoms indicate an „Hospital Associated Infection (HAI)“?

# HAI

# ≠ Treatment Error

→ Infection that was not present on admission to the facility, regardless of its origin

# Whether the infection could have been prevented …

…is **irrelevant** for the documentation as an HAI!

# HAI vs. Non-HAI

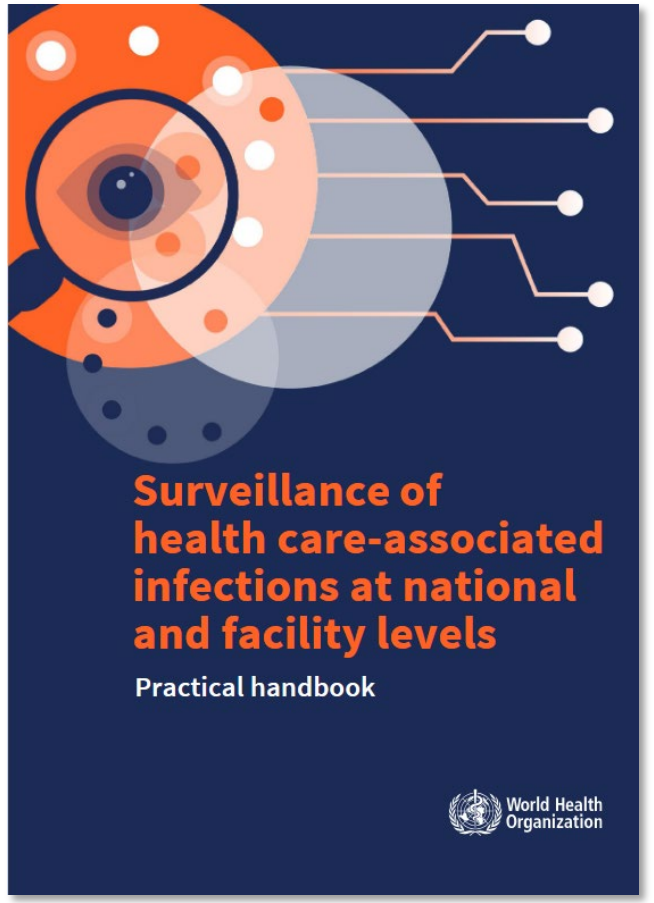
The classification of an infection as HAI is made by means of the length of time from the admission of a patient to the ward until the first symptoms appear.

(except for Surgical Site Infection, there is a different definition)

# Specific signs or symptoms for infections

...depend on surveillance system used

- Results from a **laboratory sample*** for the diagnosis of a pathogen (e.g. urine culture, blood culture, microbiological examination of tracheal secretions).
- Results from **imaging procedures** (e.g. chest X-ray, CT, MRI, ultrasound)
- Procedure or **examination results** (direct examination, auscultation, histopathology etc.)
- (Diagnosis of the doctor)
- (Start of specific AB therapy)




*Surveillance of health care-associated infections: a practical handbook

Annex 1. WHO health care-associated infection case definitions for use in settings with limited resources

https://iris.who.int/bitstream/handle/10665/379248/9789240101456-eng.pdf?sequence=1

# What infections are we looking at?

- Lower respiratory tract infections
  - →pneumonia + bronchitis
- Blood stream infections
- Urinary tract infections
- Surgical site infections

**80% of all hospital associated infections in ICUs**

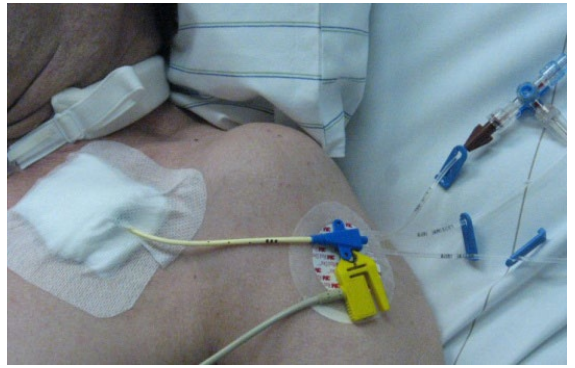
- Low resource setting → „Treated unidentified severe infection“

# Devices as risk factors for HAIs

Mechanical Ventilation for Pneumonia

Urinary Catheter for Urinary Tract Infection

Venous Catheters for Primary Blood Stream Infection and



# Device-associated infection rates

What is device-associated?

→Definition via temporal association

→Temporal relation between day of infection and device and a minimum duration of device use

| | HAI surveillance case definitions | Clinical diagnosis |
|---|---|---|
| Purpose | For surveillance and public health purposes. | To guide patient care. |
| Objective versus subjective | Aims to apply objective criteria. | Applies all available subjective and objective criteria. |
| Population versus individual | Population level. | Individual level. |
| Consistency versus accuracy | Consistent. | Accurate. |
| Temporal aspect | May include a temporal aspect. | Focuses on the current clinical presentation of the patient. |

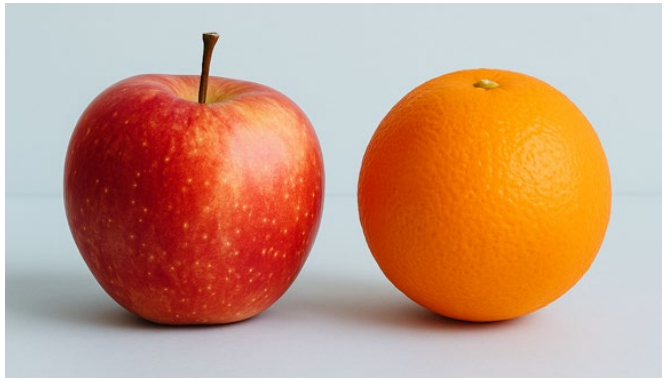
https://iris.who.int/bitstream/handle/10665/379248/9789240101456-eng.pdf?sequence=1

## How to compare the HAI over time and across wards?

Standardization e.g. by

- Number of patients *(per 100 patients)*
- Number of patient days *(per 1000 patient days)*
- Number of days at risk *(per 100 catheter days)*
- Number of surgeries by type *(per 100 surgeries)*

## How to compare the HAI over time and across wards?



Stratification, e.g. by

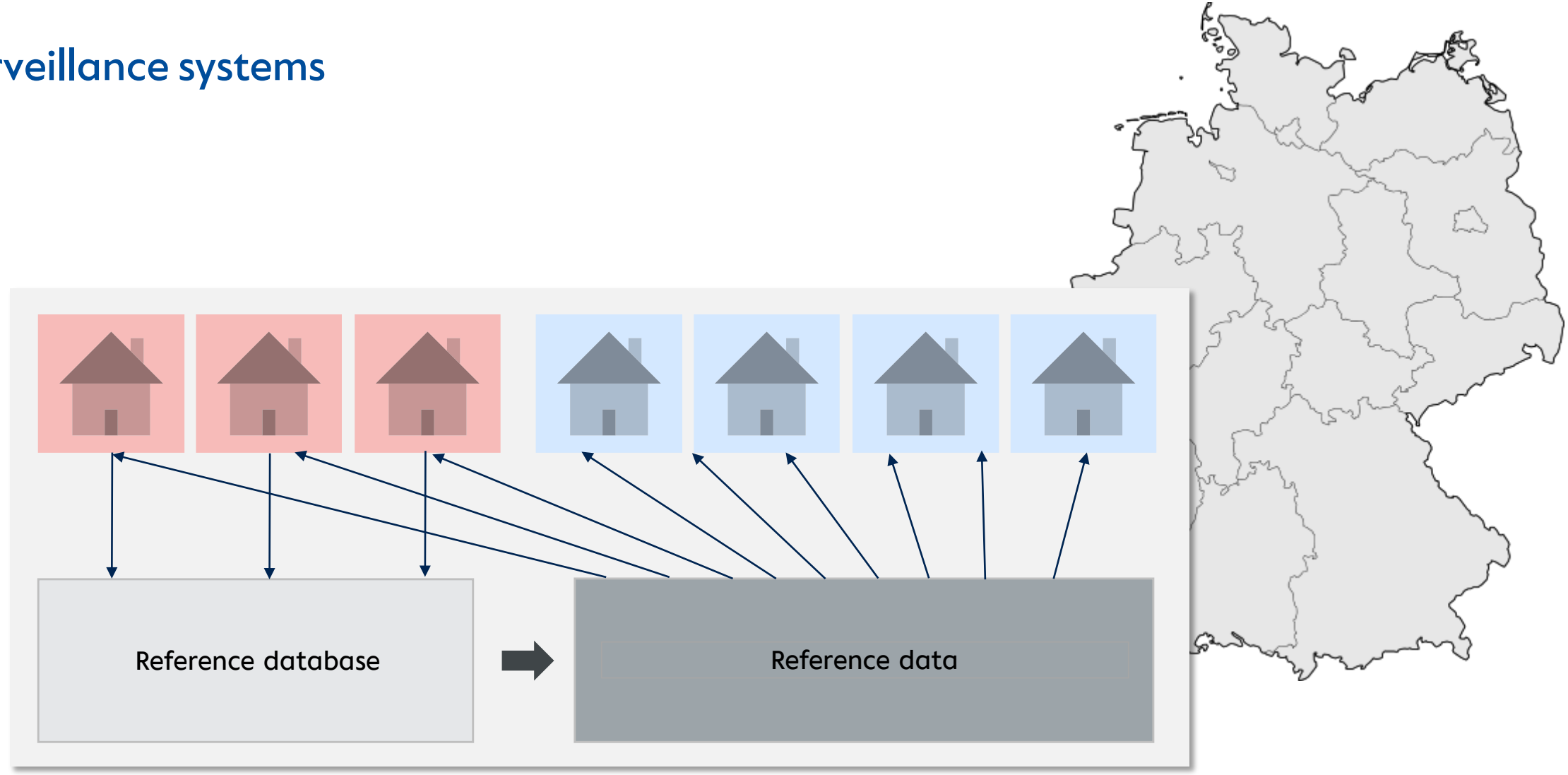
- Type of hospital/ward
- SSI – ASA-Score, duration of surgery, contaminated vs. clean
- MDRO – extent of screening

# Which of the following is correct?

3

# What are common methods for HAI/MDRO surveillance

# Surveillance systems



# Considerations for surveillance methods

Resources and research question

## Point- / period-surveys - prevalence

- Quick and easy
- Across several areas/populations of interest
- Cross-sectional studies (repeated?)
- Determine patient populations/areas at risk

https://www.ecdc.europa.eu/en/search?s=Point+prevalence+survey

## Longitudinal surveillance - incidence

- Higher workload, resource intensive
- Focused = smaller target area/population
- Longitudinal and **prospective surveillance** preferable in order to adapt IPC protocols

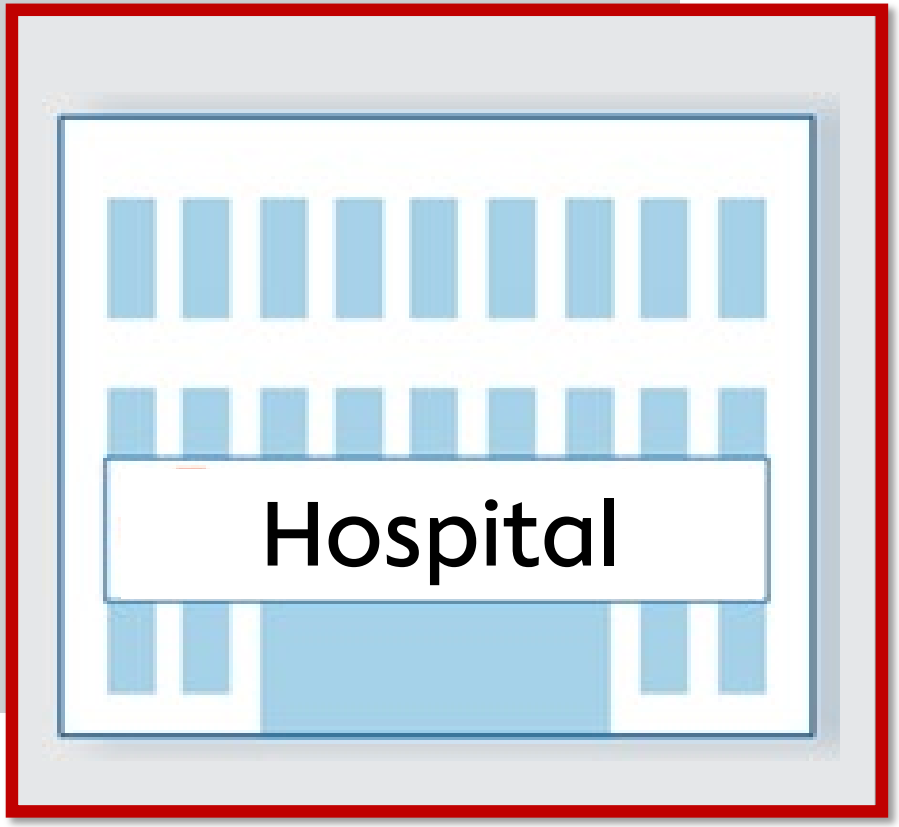
https://www.ecdc.europa.eu/en/publications-data/protocol-surveillance-healthcare-associated-infections-and-prevention-indicators



https://iris.who.int/bitstream/handle/10665/379248/9789240101456-eng.pdf?sequence=1

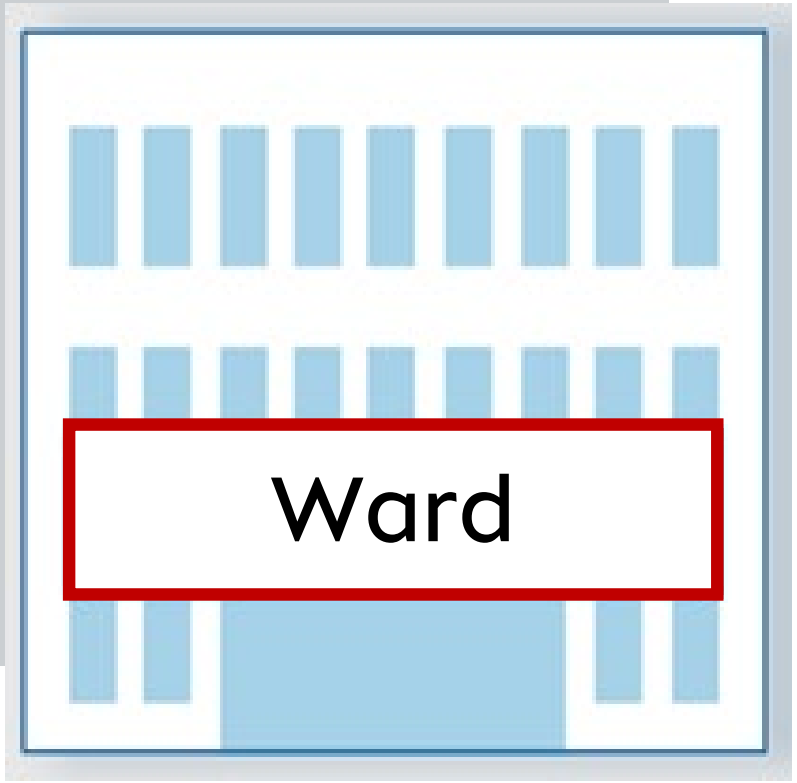
| Aspect | Point prevalence | Incidence |
|---|---|---|
| Definition | Proportion of patients with active HAI at a specific point in time expressed as a percentage. | Rate or ratio of new HAI occurring over a specified period of time. |
| Timeframe | Snapshot at a specific time point. | Cumulative over a specific period of time. |
| Measurement | Percentage or proportion of patients with HAI. | Rate per unit of population or patient exposure days. |
| Monitoring frequency | Often periodic may be annual or biannual. | Continuous or periodic surveillance. |
| Purpose/focus | Describes the magnitude of infections at a given time. | Emphasizes the rate of new infections over time and their dynamics reflecting their occurrence. |
| Limitations | • Does not capture the dynamics of infections.<br>• Limited utility for outbreak detection.<br>• Dependency on diagnostic practices. | • Resource intensive.<br>• Selection bias in the case of limited populations selected.<br>• Dependency of diagnostic practices. |

https://iris.who.int/bitstream/handle/10665/379248/9789240101456-eng.pdf?sequence=1




## Hospital-based

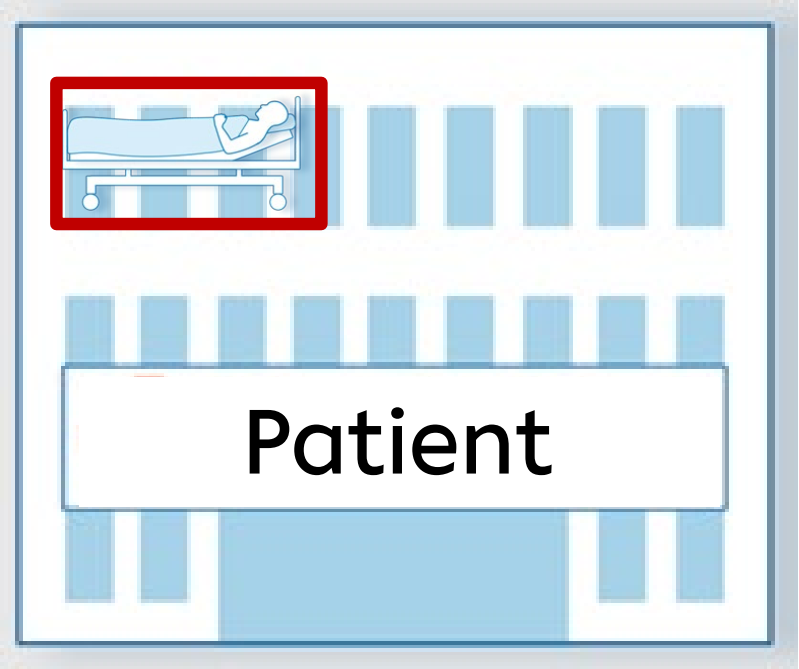
- Overview of the entire (own) hospital
- Relatively simple, aggregated data
- Indicative data



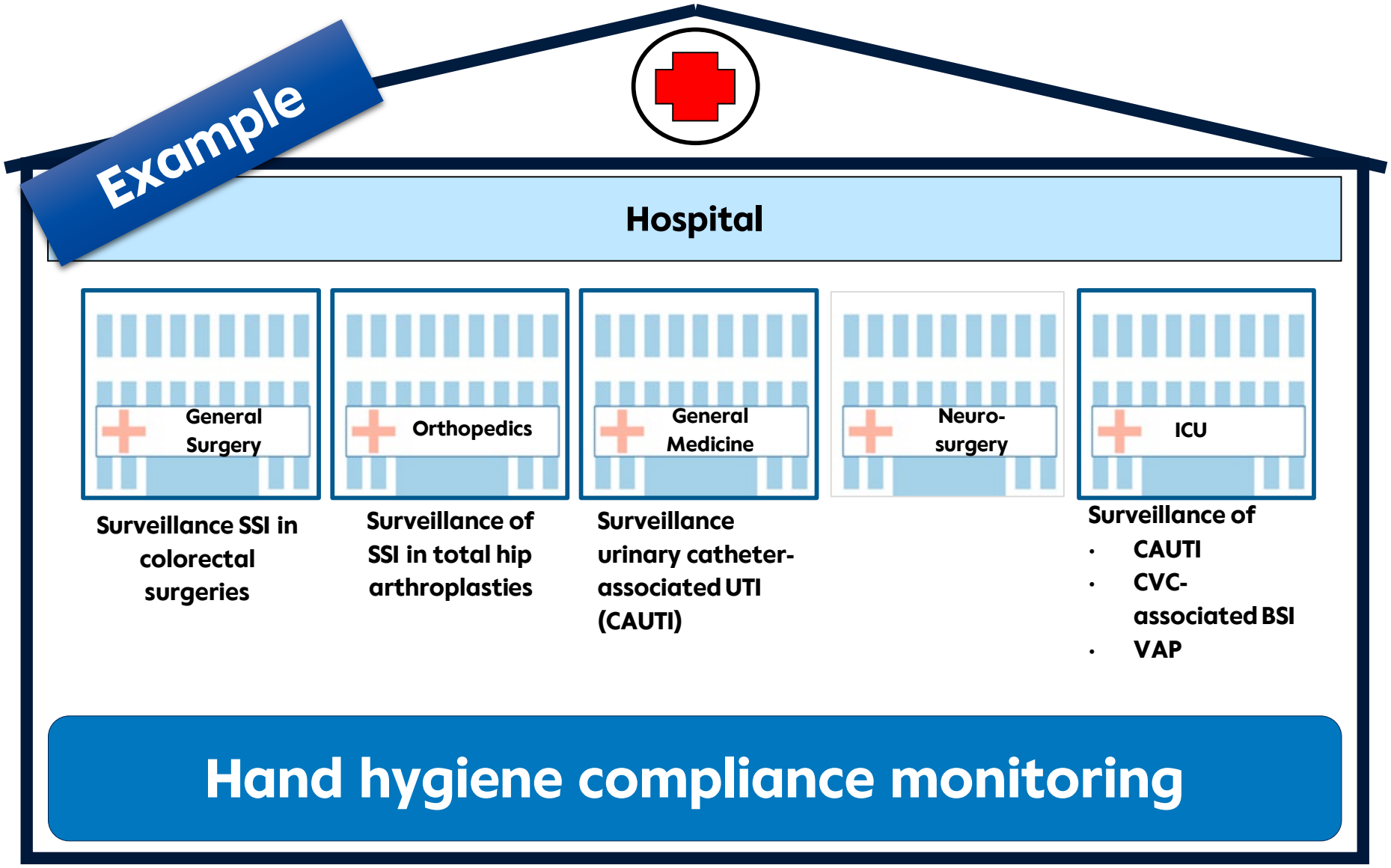

## Ward-based

- **High-risk / problem wards**
- Labor-intensive, case-related data
- Detailed data from a single ward
- Well-suited for interventions

## Patient-based

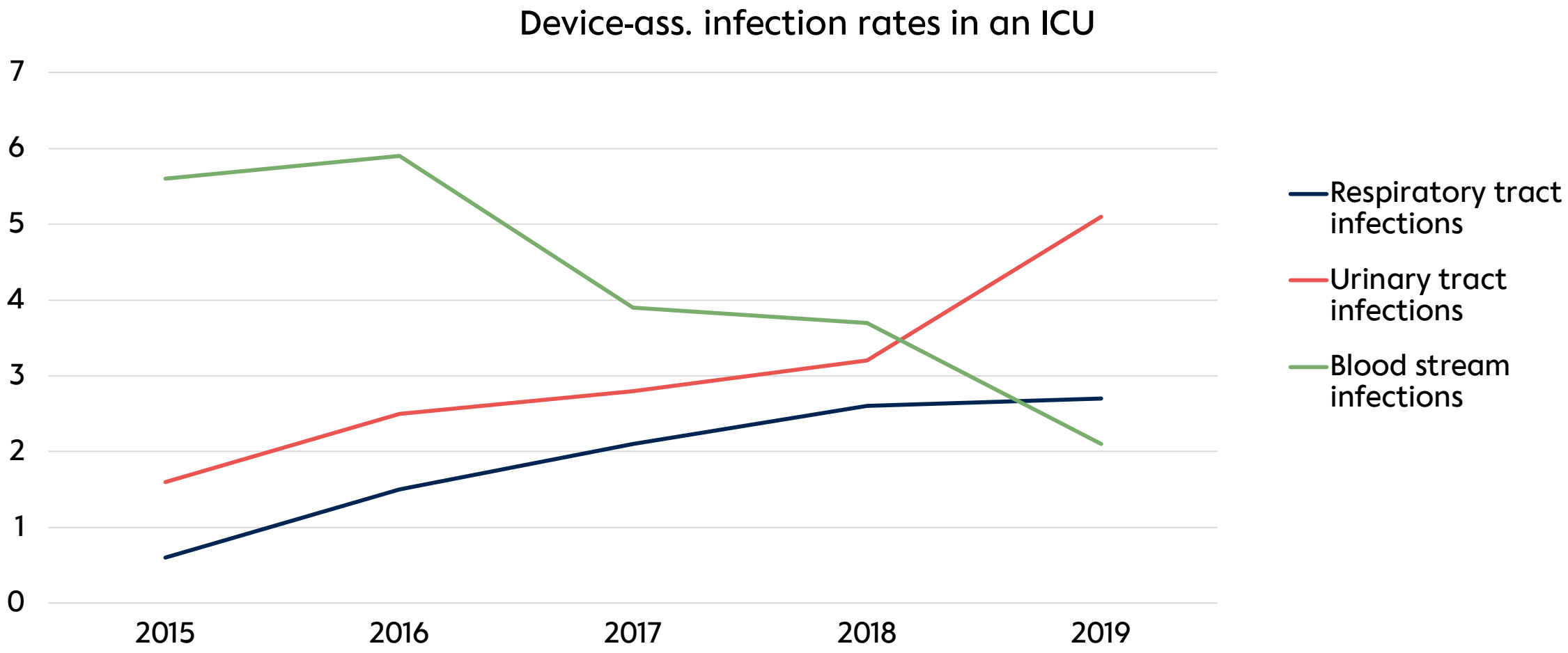



- **High-risk patients**
- Labor-intensive, case-related data
- Detailed data from specific patients
- Well-suited for interventions




**Extent of surveillance efforts depends on areas at risk and resources**

# Monitor the trends of your infection rates over time



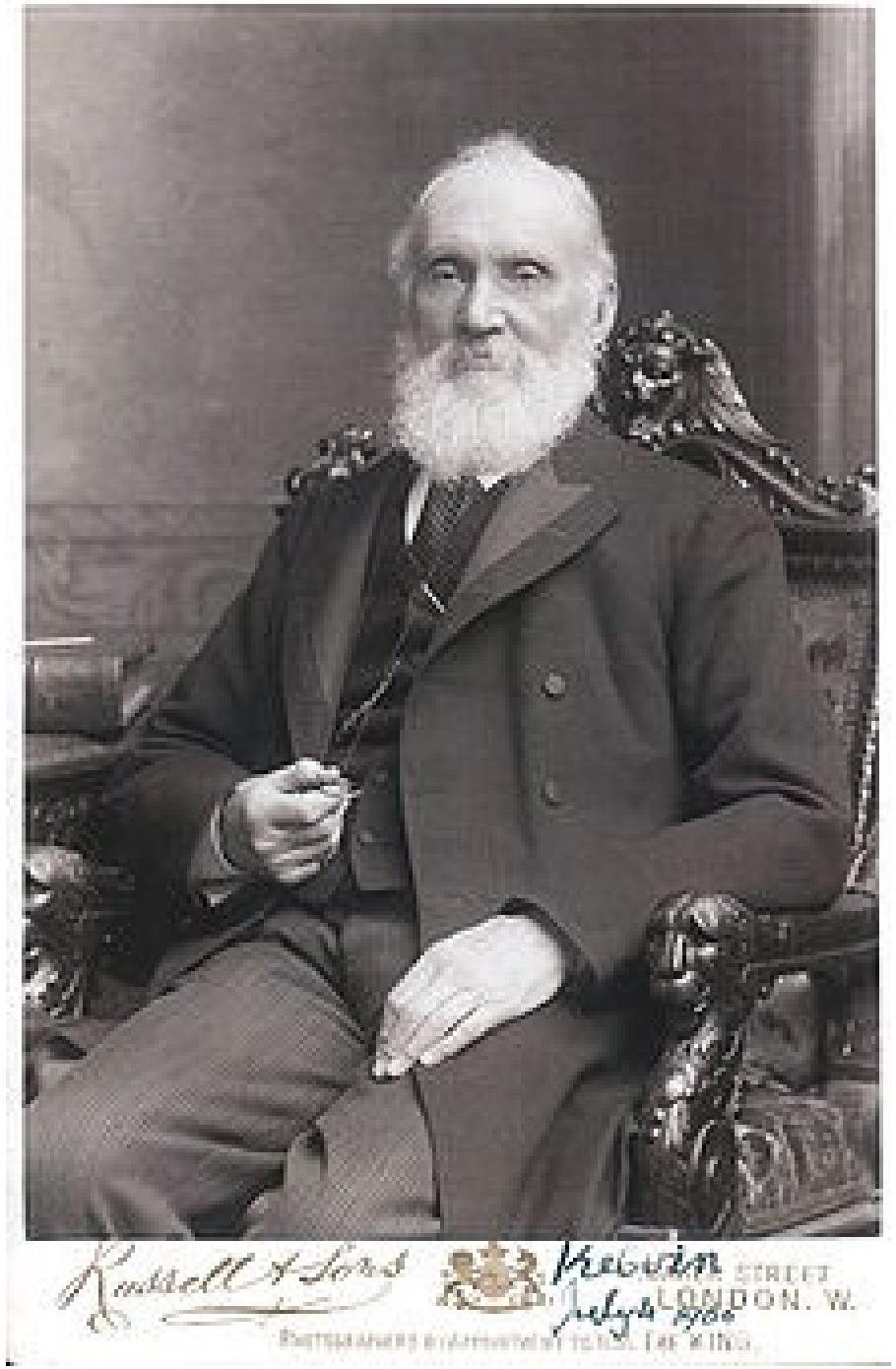
# Which of the following is correct?

# Summary IPC and surveillance I

- Prevention success is not determined solely by targeted measures in response to high infection rates
- Awareness of the issue of HAI / MDRO
- Unconscious behavior change (presence of IPC staff on the ward)

# Summary IPC and surveillance II

- Methods and extent depend on resources and target HAI/population
- Not all HAIs can be avoided, mostly caused by endogenous flora or pathogens of patients that have already been present on admission to the ward
- Uniform definitions, standardization and stratification for comparison over time and with others




"

„If you can't measure it,

you can't improve it."

William Thomson aka Lord Kelvin
British Physicist

https://www.nrz-hygiene.de/ https://www.code-ici.com/

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- **Abdulrazaq Olagoke Usman**
- **Abdul Fattah Afolabi Sulaiman**


# THANK YOU!

Oxford University
- **Christiane Dolecek**
- **Ben Cooper**

Freie Universität Berlin
- **Pourang Zarif Karimi**
- **Joachim Trebbe**

Robert Koch-Institute
- **Sara Tomczyk**
- **Muna Abu Sin**
- **Anja von Laer**
- **Flora Haderer**
- **Ute Zocher**
- **Idesbald Boone**

Charité – Universitätsmedizin Berlin
- **Luisa Anna Denkel**
- **Carolin Hackmann**
- **Solvy Wolke**
- **Sarah Hackinger**
- **Andreas Hetey** (REDCap)
- **Rubèn Serral Gracià**
- **Nora Anton**

WITOS
- **Amanda Wichert**

Berlin University Alliance
- **Nehle Frerick**
- **Gerrit Rößler**

CHARITÉ