



Implementing international guidelines to reduce the spread of
MDR Gram-negatives at national level

How to measure success of implementing guidelines

Petra Gastmeier

Conflict of interest: none to disclose

How to measure success of implementing guidelines?

Various endpoints

- Structures
- Process quality
- Incidence/prevalence of MDRO

A surveillance system for MDRO should be established

- Proportions (e.g. ESBL *E.coli* per *E.coli* in %)
- Incidence rates
 - MDR gram negative bacteria in case of HCAI
- all MDR gram negatives (infections and colonization)
- Outbreaks with MDR gram negatives



ITS
KISS

OP
KISS

NEO
KISS

ONKO
KISS

STATIONS
KISS

HAND
KISS

MRSA
KISS

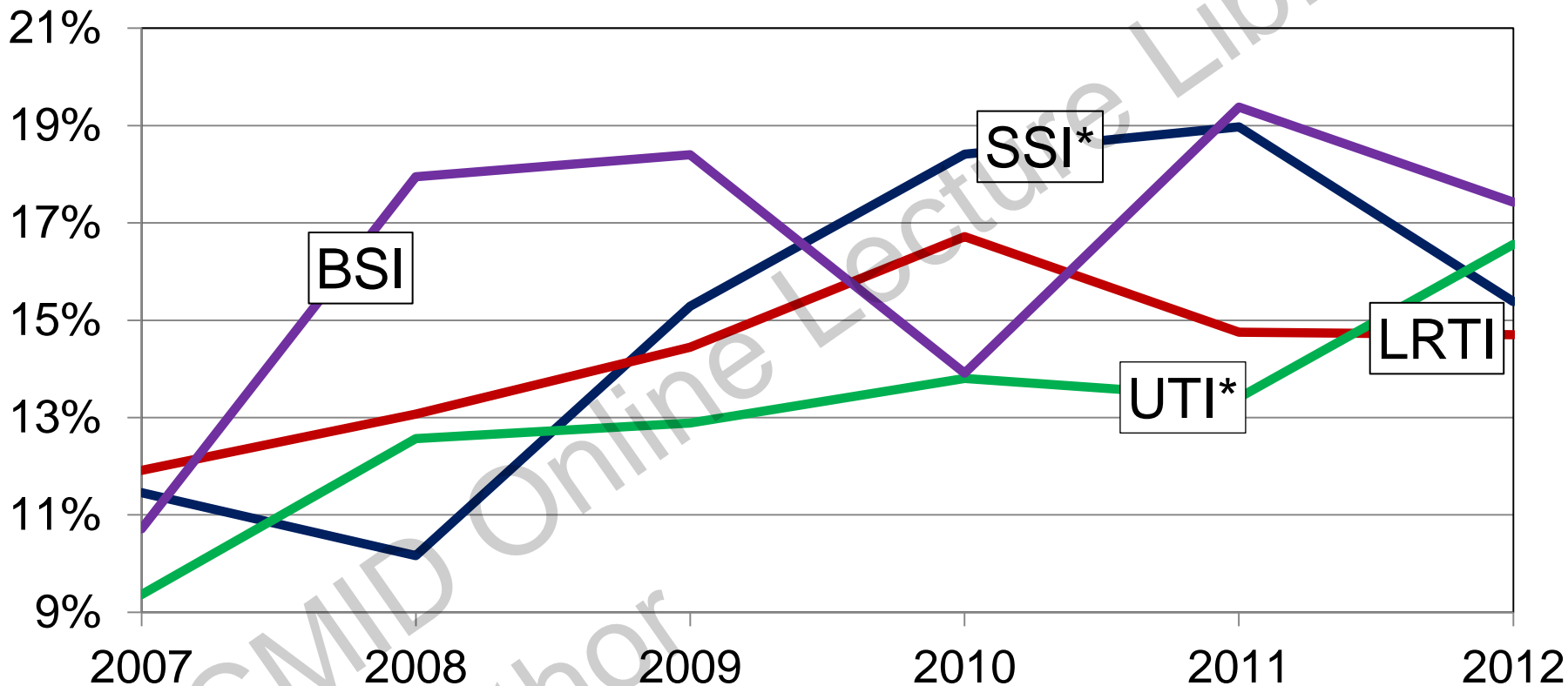
AMBU
KISS

CDAD
KISS

Data from 645 ICUs and 681 surgical departments

ESCMID Online Lecture
© by author

ESBL resistance proportion (%) of nosocomial infections due to *Enterobacteriaceae*



*Statistically significant (Cochrane-Armitage-Test).

SSI=surgical site infection, LRTI= lower respiratory tract infection, UTI= urinary tract infection. BSI= blood stream infection.

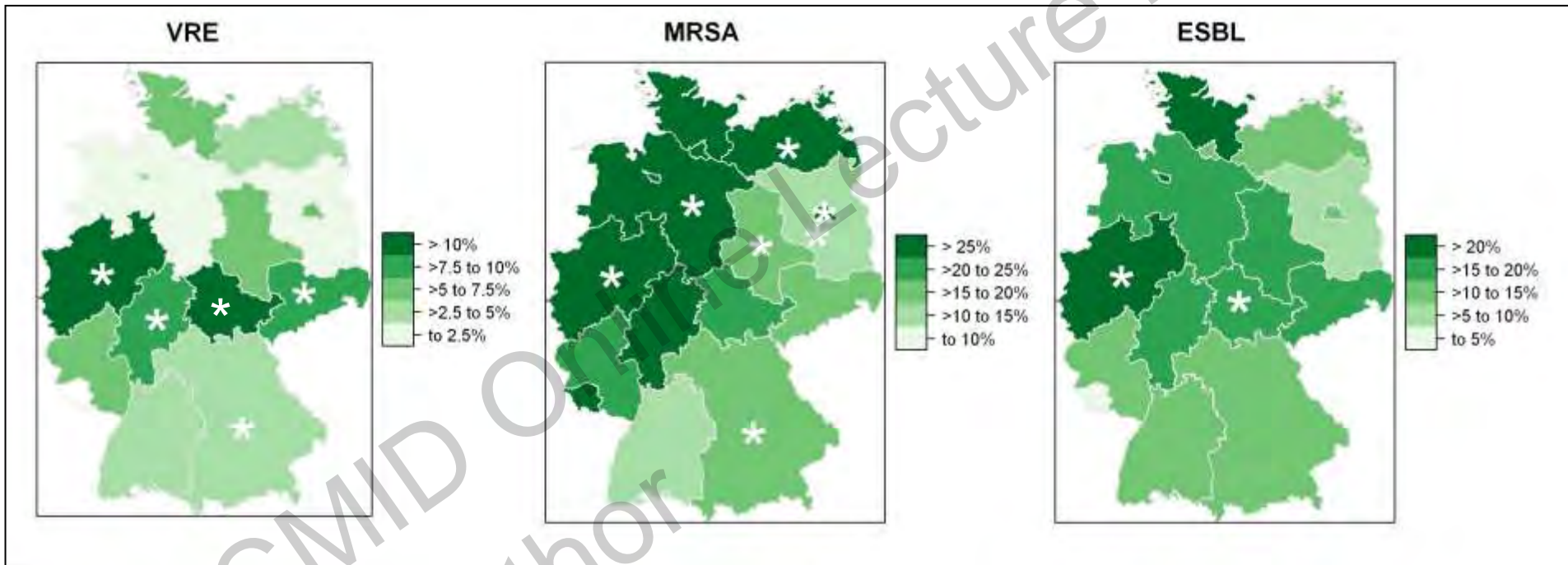
Geographical distribution of MDRO

2011/12



ESCMID Online Lecture Library
© by author

Resistance proportion (%) of nosocomial infections due to *S.aureus*, Enterococci and *Enterobacteriaceae* 2011/12



Data from 645 ICUs and 681 surgical departments

New definitions for **MRGN** in Germany for giving infection control recommendation

According to phenotypes (not genotypes)

Antibiotic group	3MRGN	4MRGN
Acylureidopenicillins	R	R
3rd/4th Gen Cephalosporins	R	R
Carbapemems	S	R
Fluorchinolones	R	R

e.g. ESBL

Enterobacteriaceae

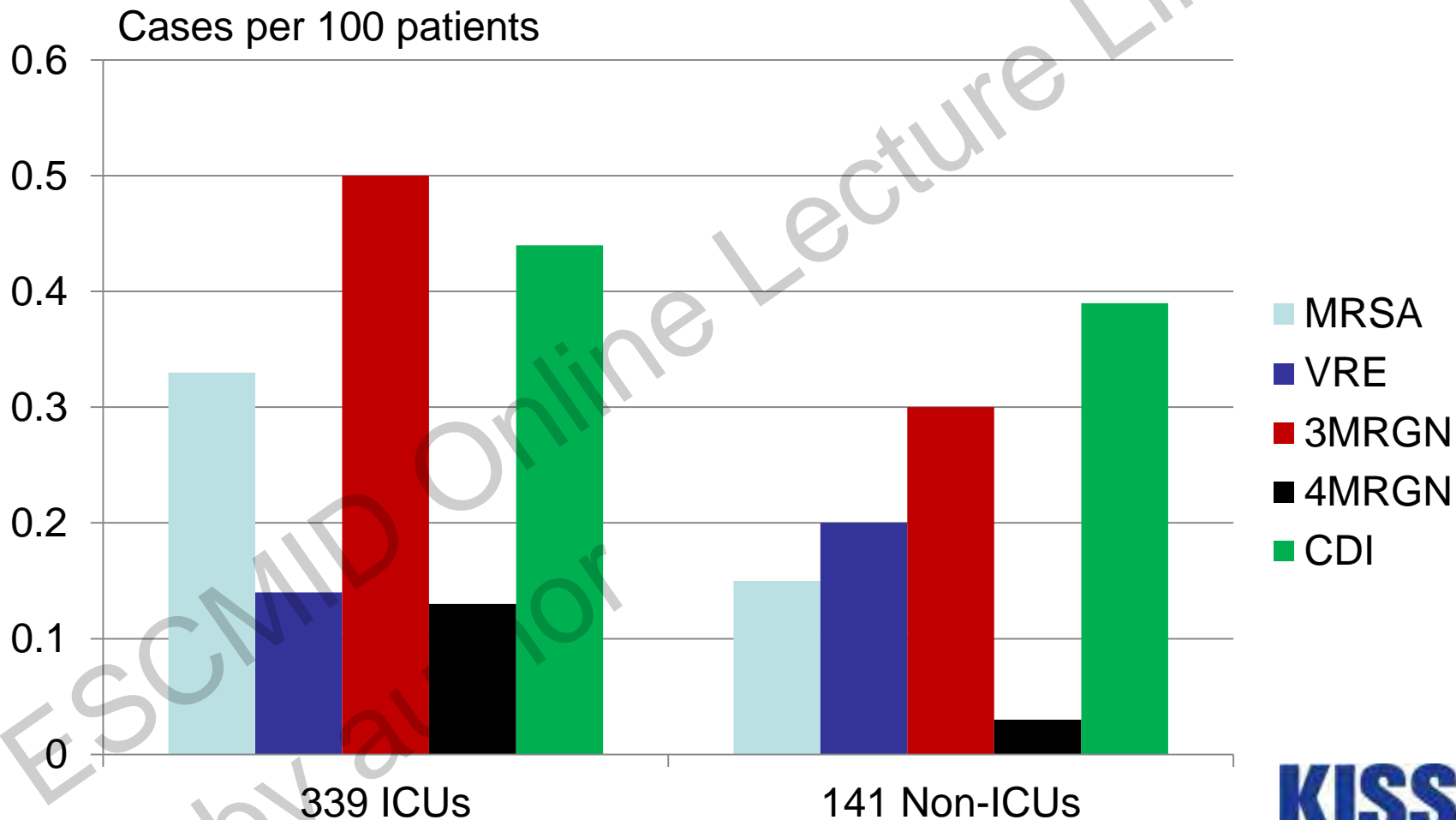
e.g. CPE

New start of the national surveillance system January 2013

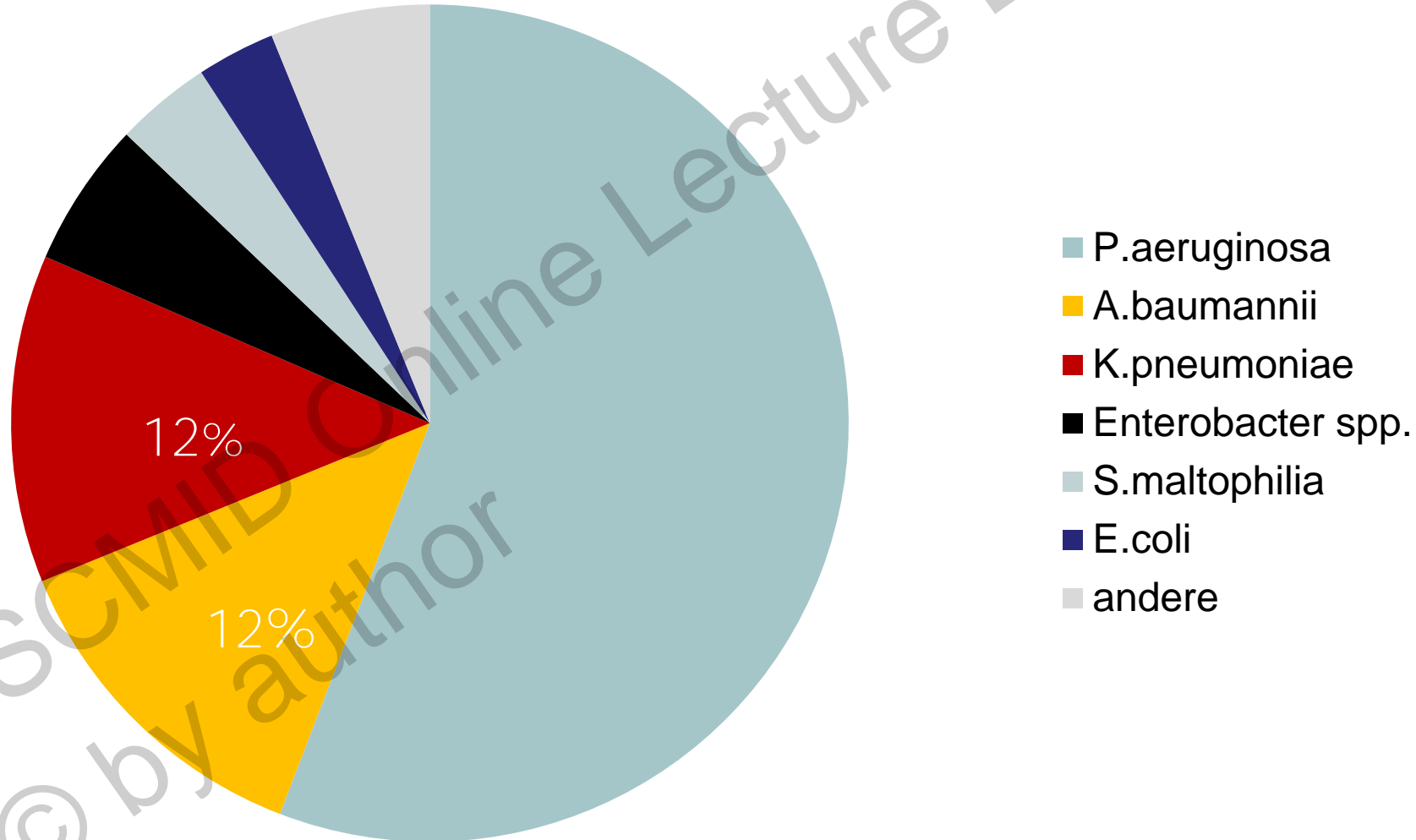
Endpoints:

- Overall incidence of $\frac{3}{4}$ MRGN
(not shown- overwhelming effect of screening activities)
- Prevalence of MRGN infections
(per 100 patients)
- Incidence density of unit-acquired MRGN infections (per 1000 patient days)

Prevalence of MDRO infections in ICUs and Non-ICUs 2013



Distribution of 4MRGN according to species in 339 ICUs 2013 (n=892)



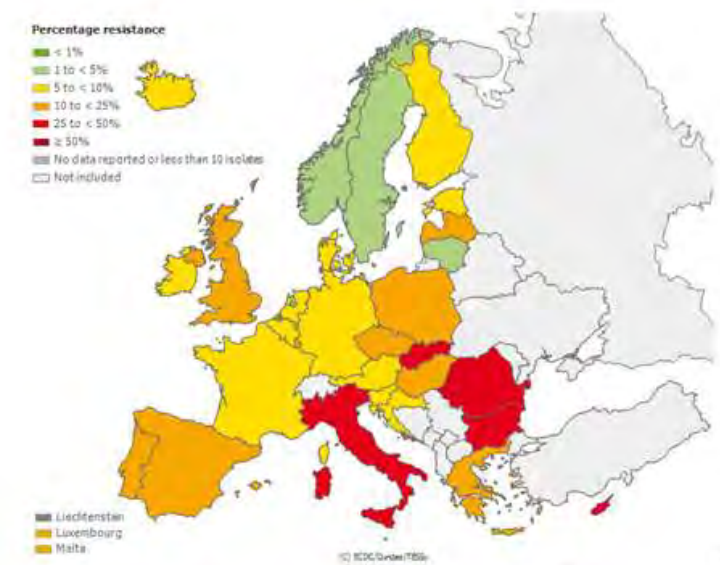
Notification of nosocomial outbreaks



Notified nosocomial outbreaks in Germany 2013 (42% by multiresistant bacteria)

Pathogen	Number of outbreaks	Cases
ALL BACTERIA	151	
Among them caused by Enterobacteria	52	347
- <i>Klebsiella</i> spp.	19	173
- <i>Acinetobacter</i> spp.	14	67
- <i>E. coli</i>	6	39
- <i>Serratia</i> spp.	4	22
- <i>P. aeruginosa</i>	6	29
- <i>Enterobacter</i> spp.	3	17

Figure EC1: *Escherichia coli*: percentage (%) of invasive isolates with resistance to third-generation cephalosporins, by country, EU and EEA countries, 2012



Comparison with other European countries

Figure KP1: *Klebsiella pneumoniae*: percentage (%) of invasive isolates with resistance to third-generation cephalosporins, by country, EU and EEA countries, 2012

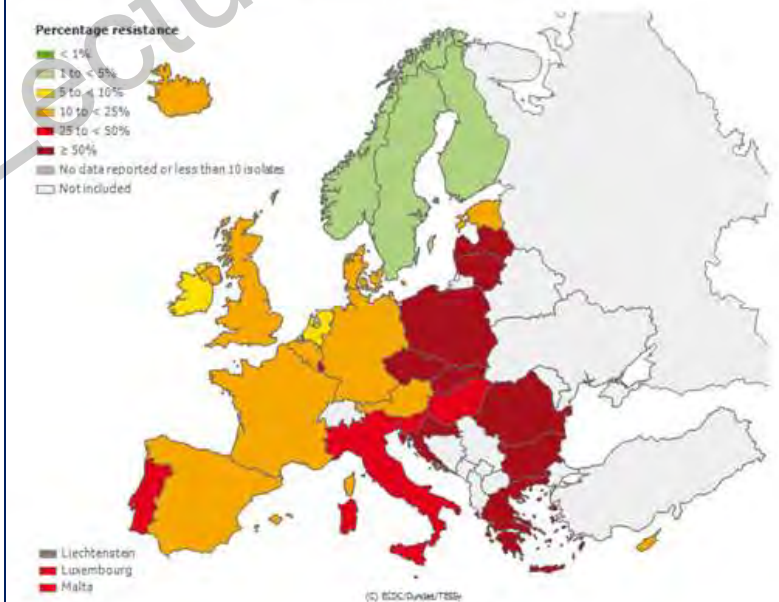
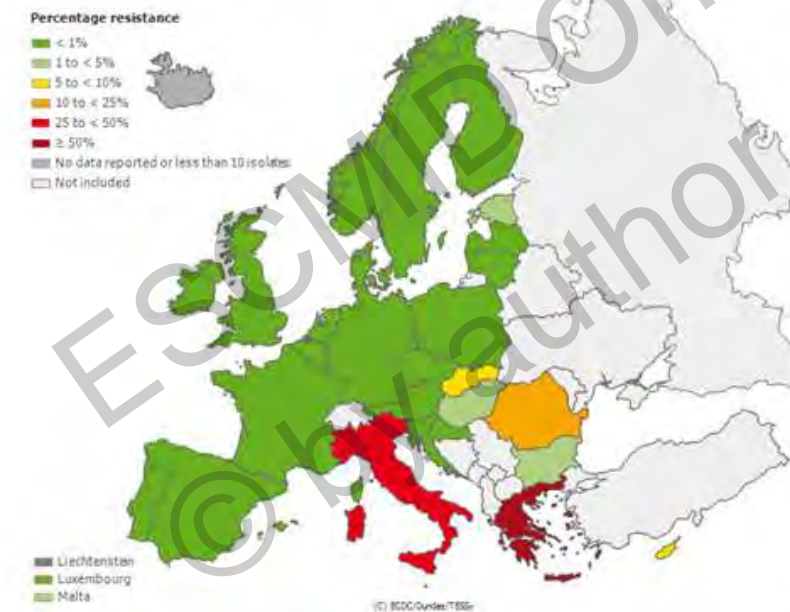


Figure KP4: *Klebsiella pneumoniae*: percentage (%) of invasive isolates with resistance to carbapenems, by country, EU and EEA countries, 2012



EARS-net:
MDR gramnegative bacteria

How to measure success of implementing guidelines?

Various endpoints

- Structures
- Process quality
- Incidence/prevalence of MDRO

ESCMID guidelines for multiresistant gram negative MDRO

TABLE 4. Quality of studies by intervention. Basic measures to reduce the spread of multidrug-resistant (MDR)-*Klebsiella pneumoniae* and extended-spectrum β -lactamase (ESBL)-producing Enterobacteriaceae in hospitalized adult patients: recommended for all acute-care facilities in endemic setting

Microorganism	MDR-K. pneumoniae			Overall quality of evidence	ESBL-producing Enterobacteriaceae			Overall quality of evidence
	Quality of studies [ref.]				Quality of studies [ref.]			
Intervention	Moderate	Low	Very low		Moderate	Low	Very low	
Hand hygiene	2 [122,265]	–	–	Moderate	2 [137,266]	1 [267]	–	Moderate
Education	1 [122]	–	–	Moderate	1 [266]	1 [267]	–	Moderate
Contact precautions	2 [122,265]	–	–	Moderate	3 [136,137,266]	1 [267]	–	Moderate
Isolation room	1 [265]	–	–	Moderate	1 [137]	1 [267]	–	Moderate
Environmental cleaning	2 [122,265]	–	–	Moderate	1 [137]	–	–	Moderate
Antimicrobial stewardship	1 [268]	1 [269]	–	Moderate	4 [136,268,270,271]	2 [267,272]	1 [273]	Moderate

How to measure success of implementing hand hygiene?



**World Health
Organization**

Evidence of hand hygiene to reduce transmission and infections by multi-drug resistant organisms in health-care settings

INTRODUCTION

Infections by multidrug-resistant organisms (MDROs) are increasing worldwide (1).

Prevention of spread and control of MDROs in health-care settings are critical and urgent as the number of antibiotics available to treat these infections is extremely limited and development of new antibiotics is not forthcoming in the foreseeable future. Worldwide, the most common bacteria causing health-care associated infections (HAIs) are:

- **MRSA** Methicillin resistant *Staphylococcus aureus*
- **VRE** Vancomycin resistant *Enterococci* spp.
- **ESBL** Extended-spectrum beta (β)-lactamase gram-negative organisms
- **CRE** Carbapenems resistant *Enterobacteriaceae*
- **MRAB** Multi-resistant *Acinetobacter baumannii*

Two 2 principles of hand hygiene surveillance

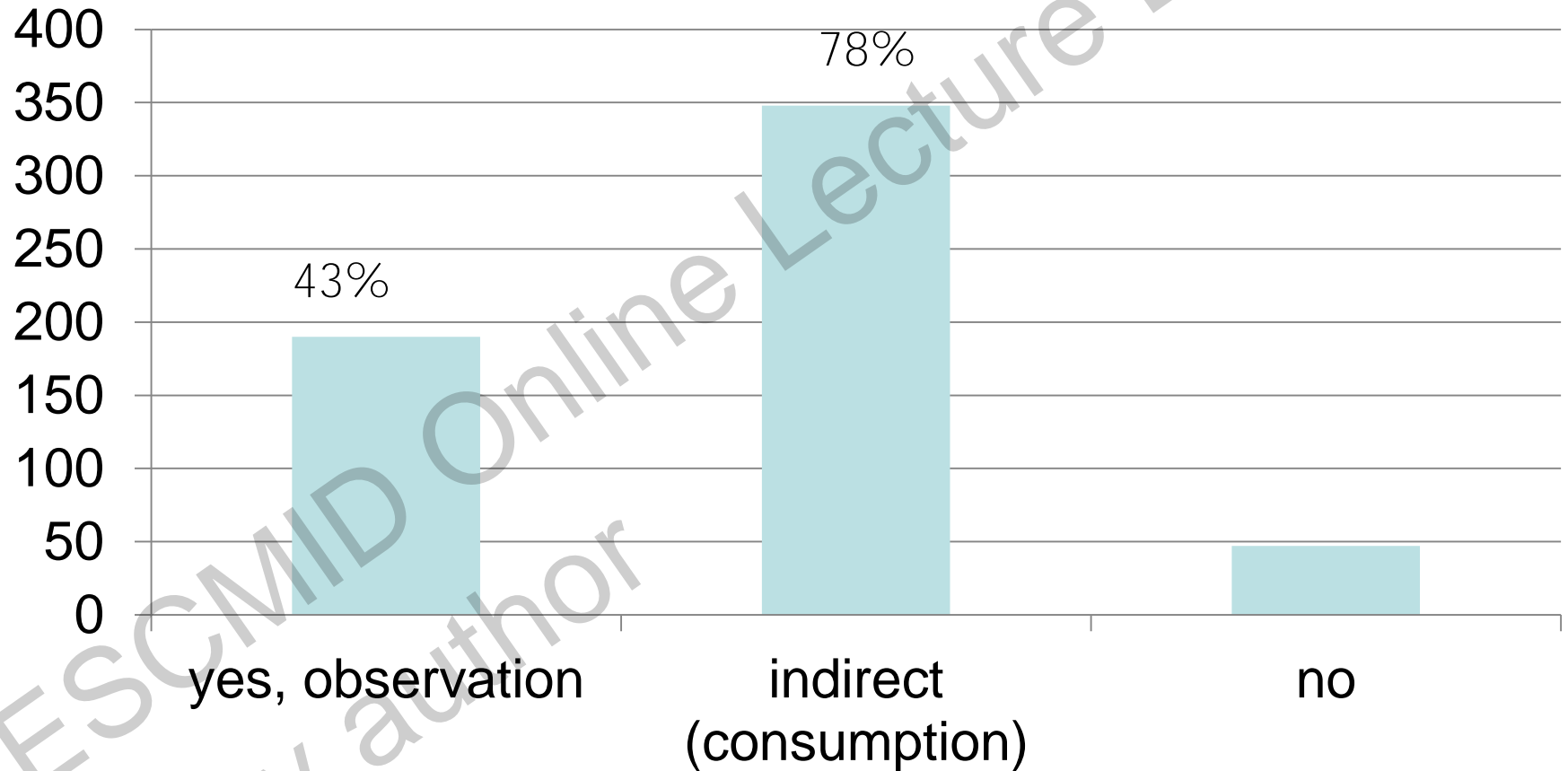
Compliance
observations

Hand rub
consumption



Questionnaire to KISS ICUs 2011

Do you evaluate hand hygiene on your ICU? (n=355)



Hand hygiene compliance observations



advantages

Not only quantitative information, also quality (indications)

Information about various staff groups

disadvantages

High workload

Training necessary

Subjective

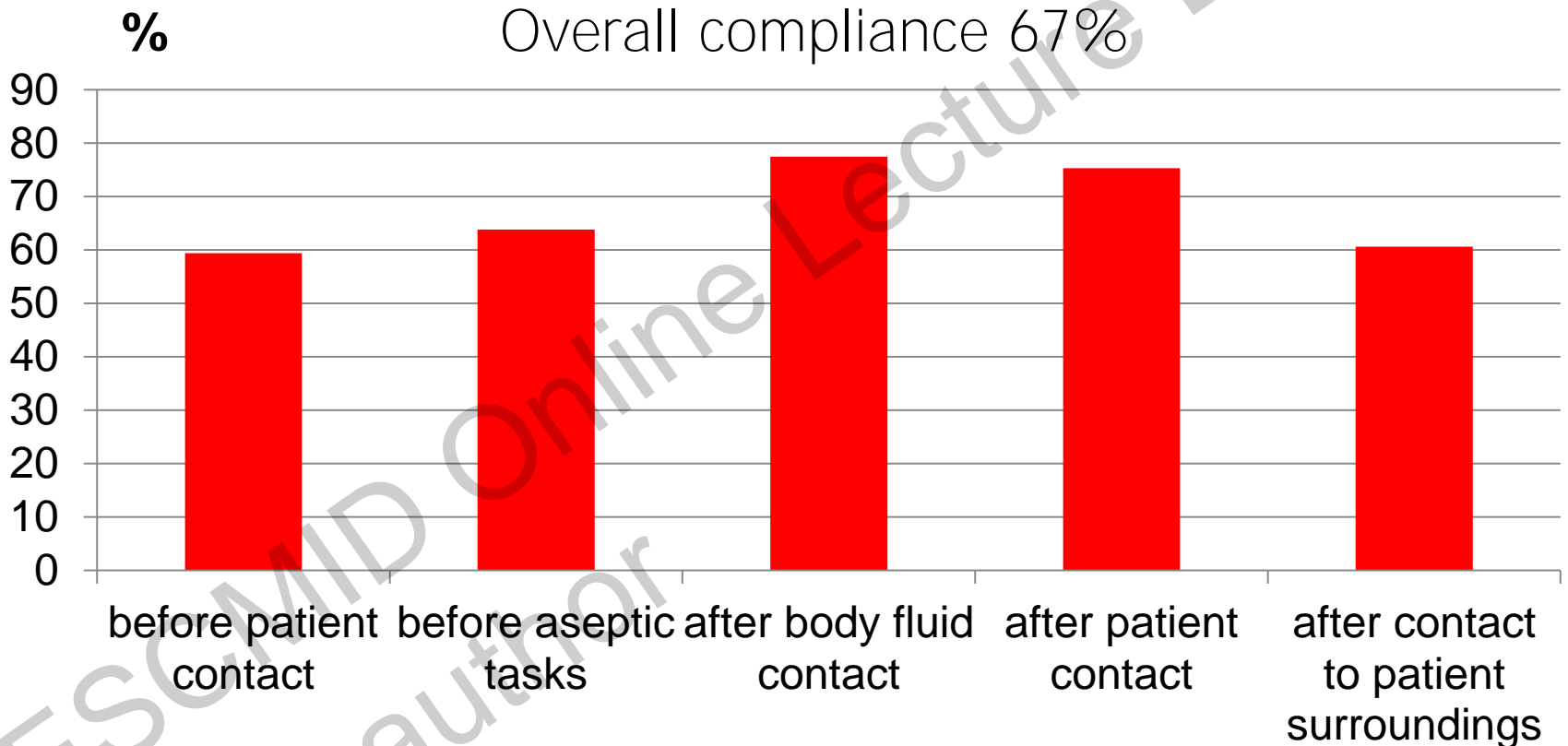
Snap shot character

HAWTHORNE effect

National hand hygiene campaign



Hand hygiene compliance observations according to observation periods in %



487,482 observations from 243 hospitals with 875 wards included
(from 2008 to 2012)

Results of logistic analysis

Factor	Odd ratio	CI95	P value
Physicians	0,54	0,49-0,58	<0,001
Medical students	0,63	0,55-0,73	<0,001
Nurses	Reference		
Nurse trainees	1,13	1,03-1,24	0,01
Other	0,48	0,45-0,52	<0,001
Last observation period	1,64	1,54-1,74	<0,001
First observation period	Baseline		
WHO indication 5	0,47	0,44-0,50	<0,001
WHO indications 1+2	0,48	0,45-0,50	<0,001
WHO indications 3+4	Reference		

Hand rub consumption



advantages

Overview about 24 h a day, 365 days a year

Less workload

Widely available
(EU PPS)

disadvantages

Storage effects, misuse of hand rub for other purposes

Adjustment according to the extent of procedures requiring hand hygiene

No information which target should be achieved?

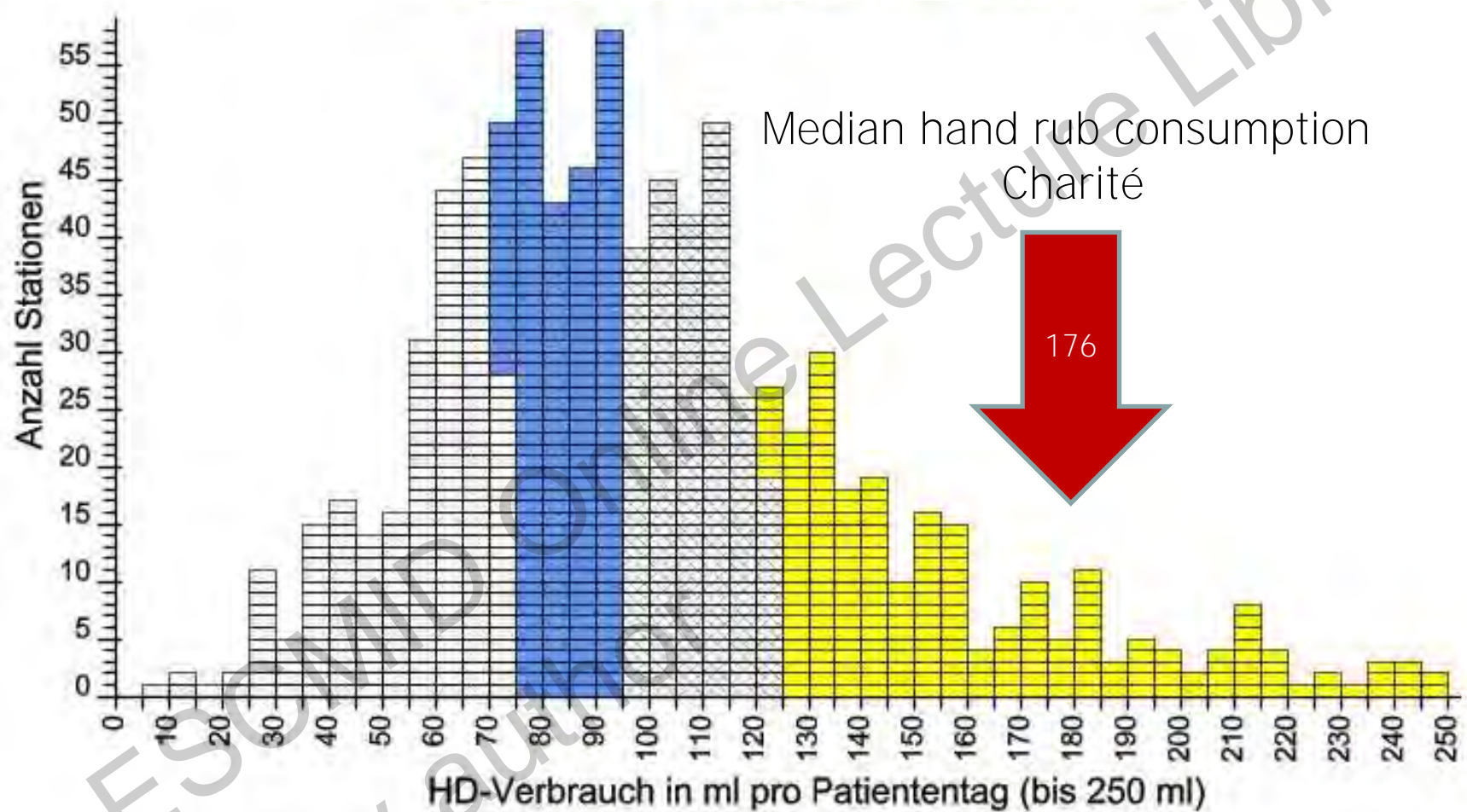


HAND-KISS

Distribution of hand rub consumption in ICUs 2013 (ml/patient day)

Type of ICU	Number of hospitals	Number of ICUs	10. Percentile	Median	90. Percentile
Internal	121	136	59	97	159
Interdisciplinary	459	522	56	93	145
Surgery	86	115	66	116	176
Pediatrics	42	44	69	138	247
Neonatology	98	103	58	113	230
TOTAL	581	995	57	98	167

Distribution of hand rub consumption in German ICUs



Q1: 73,00 Median: 95,00 Q3: 123,00

Legende

□ bedeutet Krh mit einem HD-Verbrauch in ml pro Pat.-Tag \leq Q1, ■ \leq Median, ▨ \leq Q3 und ■ $>$ Q3.



Nationales Referenzzentrum für Surveillance von nosokomialen Infektionen



NRZ

SURVEILLANCE

SUPPORT

KONTAKT

[-> SURVEILLANCE / KISS / HAND-KISS](#)

Suchbegriff



KISS

Teilnahme
Modulfinder
Fragen & Antworten
CDC-Definitionen
KISS-Zertifikat
Import

Antibiotikverbrauch
AMBU-KISS
CDAD-KISS
DEVICE-KISS

HAND-KISS

ITS-KISS
MRSA-KISS
NEO-KISS
ONKO-KISS
OP-KISS
STATIONS-KISS
SART

Kurzbeschreibung des Moduls

Modul: HAND-KISS und HAND-KISS-AMBU

Surveillance-Ziel: Verbrauchs-Surveillance

Surveillance-Prinzip: Stations-, Funktionsbereichs- oder Altenpflegeheimbezogen

Patientenkollektiv: Stationäre Patienten, ambulante Patienten, Bewohner in Altenpflegeheimen

Beschreibung:

HAND-KISS: Surveillance des Händedesinfektionsmittelverbrauchs (HDMV) auf Stationsebene oder in Funktionsbereichen (z.B. Dialyse, Endoskopie) sowie Altenpflegeheimen

HAND-KISS-AMBU: Surveillance des HDMV in ambulanten Einrichtungen (Arztpraxen, ambulante Dialysezentren, radiologisches Zentrum, Rettungsstelle etc.) sowie in der Ambulanten Hauskrankenpflege

Für HAND-KISS-AMBU brauchen Sie **keinen** webKess-Zugang!

Modul HAND-KISS

Die Durchführung der hygienischen Händedesinfektionen ist auch heute noch eine der effektivsten Methoden der Prävention nosokomialer Infektionen und gehört zu den Standardmaßnahmen bei der Versorgung von Patienten im Krankenhaus, ambulanten Einrichtungen und Altenpflegeheimen.

Vor infektionsrelevanten Tätigkeiten durchgeführt, ist die Händedesinfektion in der Lage, das Infektionsrisiko für den Patienten zu senken. Nach kontaminationsträchtigen Tätigkeiten durchgeführt, kann die Händedesinfektion das Transmissionstrisiko von

Protokolle und Anleitung

- [HAND-KISS_S, HAND-KISS_F Protokoll](#)
- [HAND-KISS_P Protokoll \(Stand 04/2010\)](#)
- [Änderung im HAND-KISS_P Protokoll \(Stand 04/2010\)](#)
- [HAND-KISS-AMBU Protokoll](#)
- [HAND-KISS Anleitung webKess](#)

Referenzdaten

- [HAND-KISS_S Referenzdaten 2012](#)
- [HAND-KISS_F Referenzdaten 2012](#)
- [HAND-KISS_P Referenzdaten 2012](#)



Median hand rub consumption from 2007 to 2013 (ml/patient day)

Year	Hospitals	ICUs	Median	Hospitals	Non-ICUs	Median
2007	177	341	70	192	2048	14
2008	333	615	73	377	3837	16
2009	427	792	80	481	4778	18
2010	540	948	84	617	5820	19
2011	612	1075	90	705	6628	21
2012	643	1125	95	774	7078	22
2013	581	995	98	712	6178	23

40 %

64 %

Formula for calculation

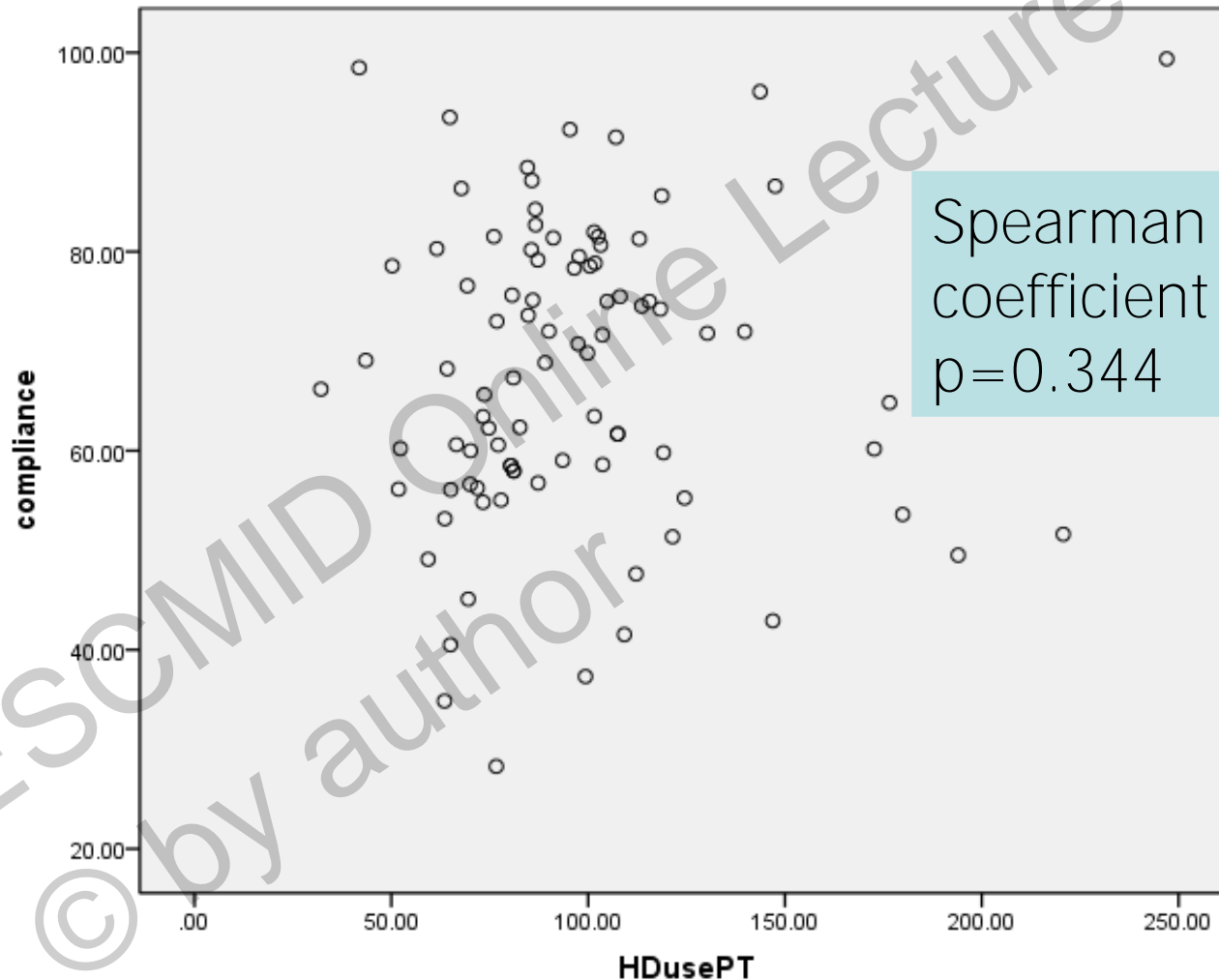
Handrub consumption = Number of opportunities x compliance



This factor varies with intensity of care

Correlation between hand rub consumption and compliance data

(90 observations from 52 ICUs)



Spearman correlation coefficient = 0.101, $p=0.344$

www.ecdc.europa.eu/en/publications/healthcare-associated-infections-antimicrobial-use-PPS.pdf

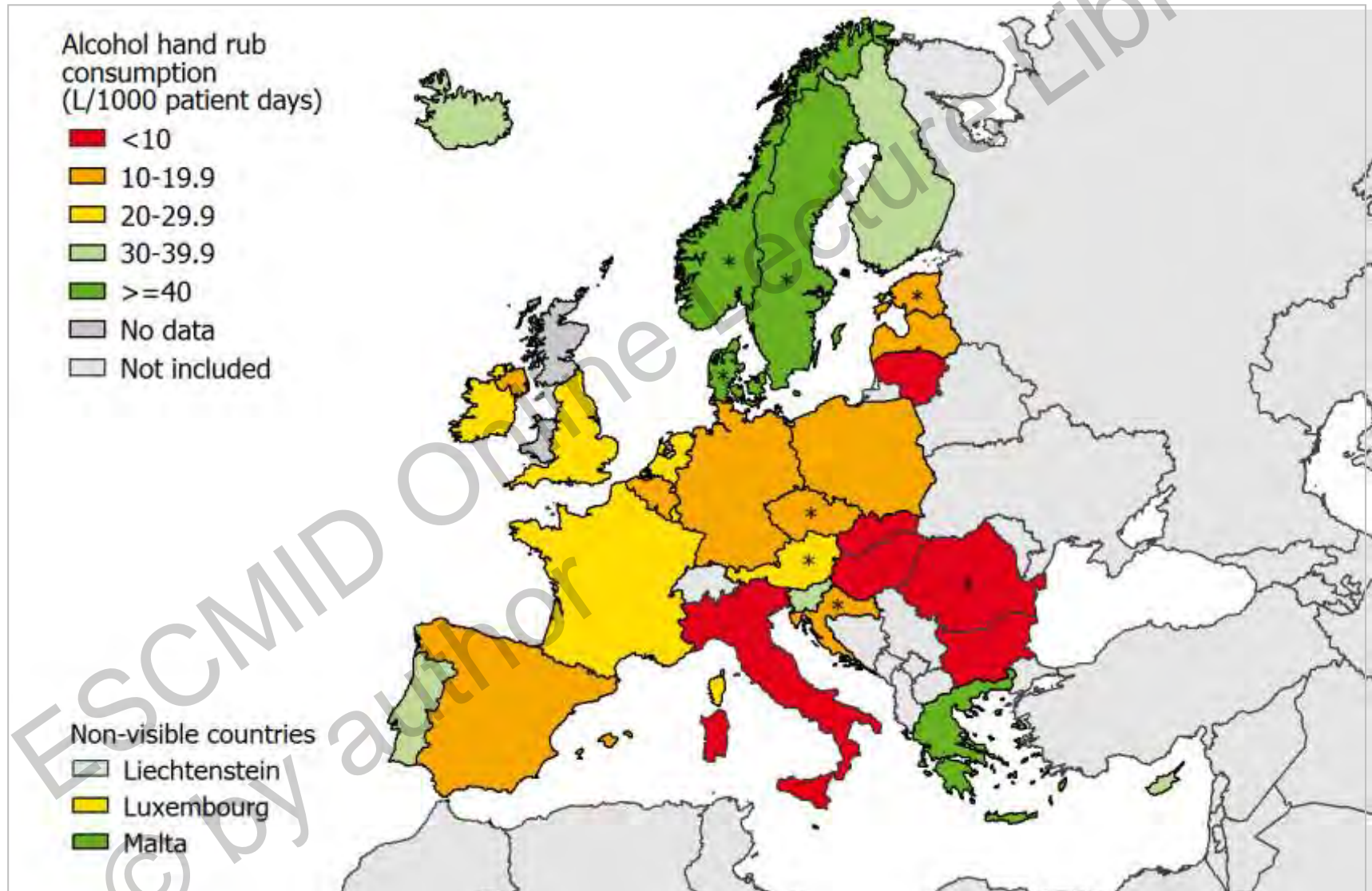
SURVEILLANCE REPORT



Point prevalence survey of
healthcare-associated infections
and antimicrobial use in European
acute care hospitals

2011–2012

Comparison of alcoholic hand rub consumption (l/1000 PD) European prevalence study 2011-2012



How to measure success of implementing education?

National E-learning systems ?

e.g. provided by national public health institutions



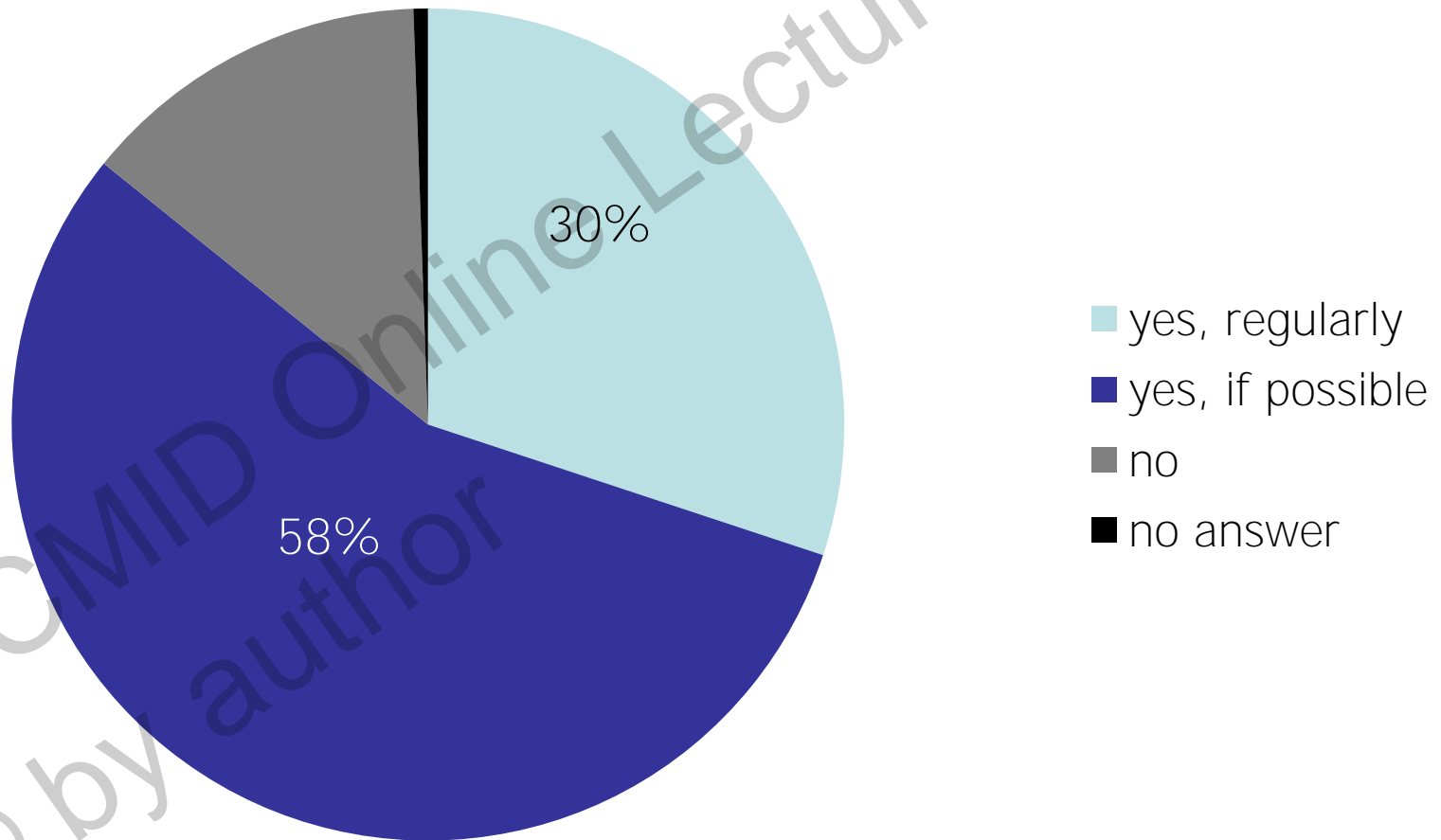
How to measure success of implementing contact isolation and isolation in single rooms?



“The patient in the next bed is highly infectious. Thank God for these curtains.”

Questionnaire to KISS ICUs 2011

Do you require single room isolation for ESBL patients in your ICU? (n=355)

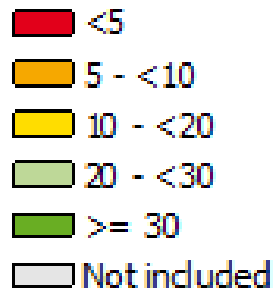


How to measure success of implementing contact isolation and isolation in single rooms?

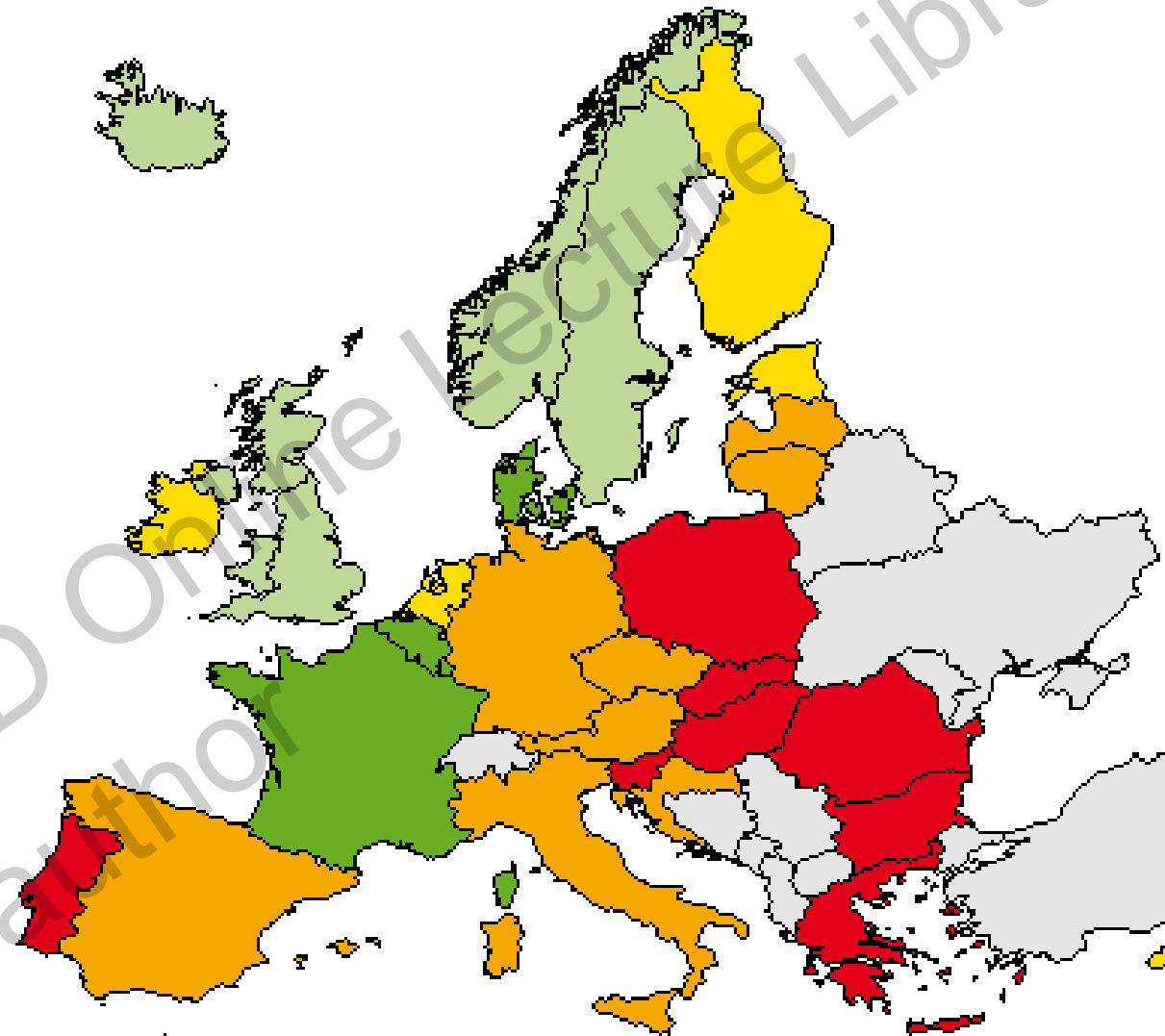
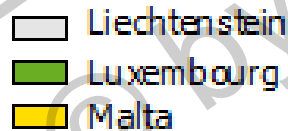
- Most hospitals:
no regular evaluation of contact isolation
(exception: outbreaks , special pathogens)
- No formal checklist
- Only possible by observation (workload)
- Barrier: availability of single rooms

Median percentage of single room beds among total number of hospital beds

Single room beds (%)



Non-visible countries



How to measure success of implementing environmental cleaning?

ORIGINAL ARTICLE

Risk of Acquiring Extended-Spectrum β -Lactamase–Producing *Klebsiella* Species and *Escherichia coli* from Prior Room Occupants in the Intensive Care Unit

Adebola O. Ajao, PhD;¹ J. Kristie Johnson, PhD;^{1,2} Anthony D. Harris, MD, MPH;¹ Min Zhan, PhD;¹ Jessina C. McGregor, PhD;³ Kerri A. Thom, MD, MS;¹ Jon P. Furuno, PhD^{1,3}

Ajao et al. ICHE 2013;34:453-458

How to measure success of implementing antibiotic stewardship?

Infection (2014) 42:119–125
DOI 10.1007/s15010-013-0531-y

CLINICAL AND EPIDEMIOLOGICAL STUDY

Antibiotic stewardship in Germany: a cross-sectional questionnaire survey of 355 intensive care units

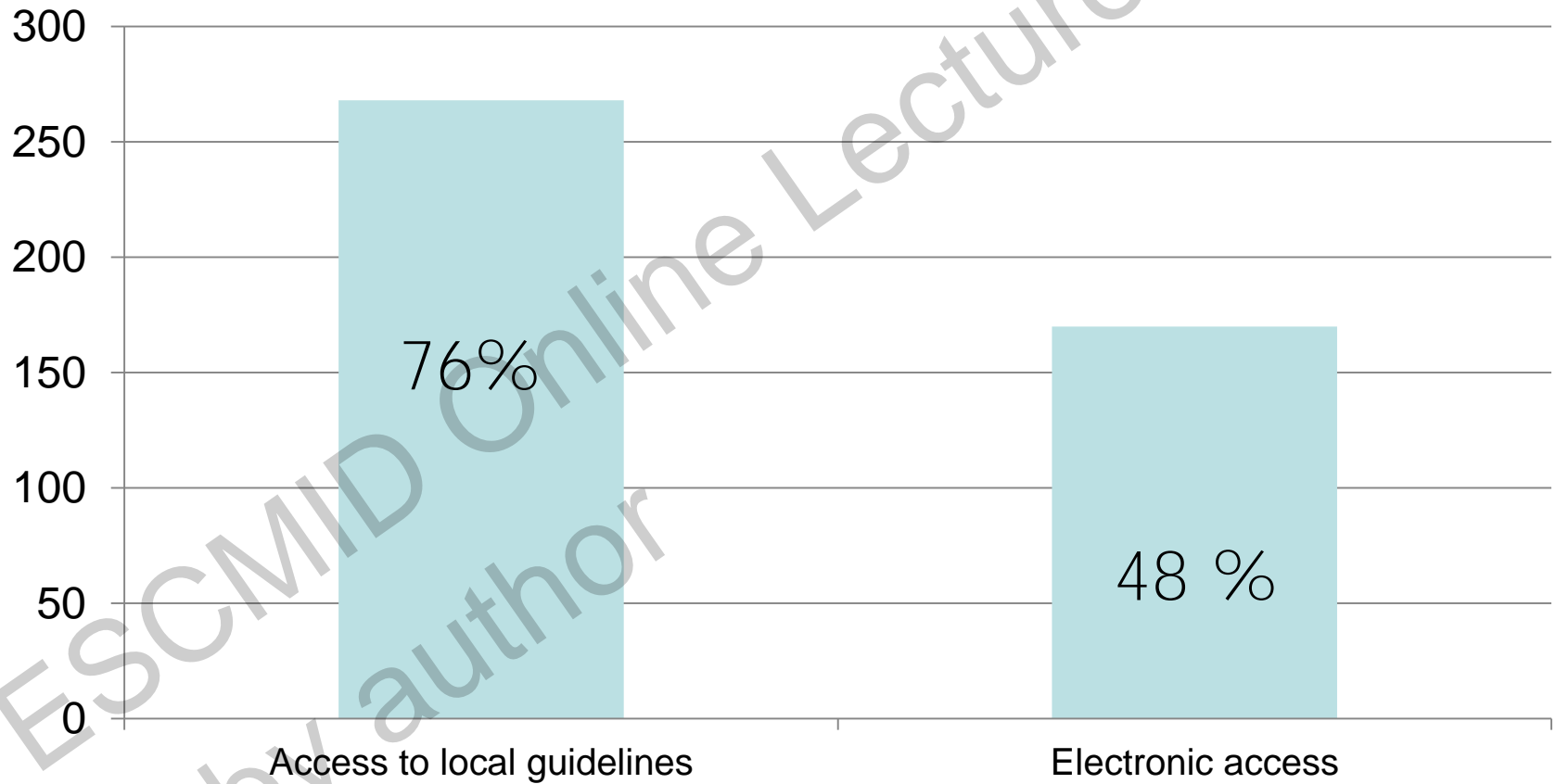
**F. Maechler · F. Schwab · C. Geffers ·
E. Meyer · R. Leistner · P. Gastmeier**

Response rate 61 %

Maechler et al. Infection 2014; 42:119-25

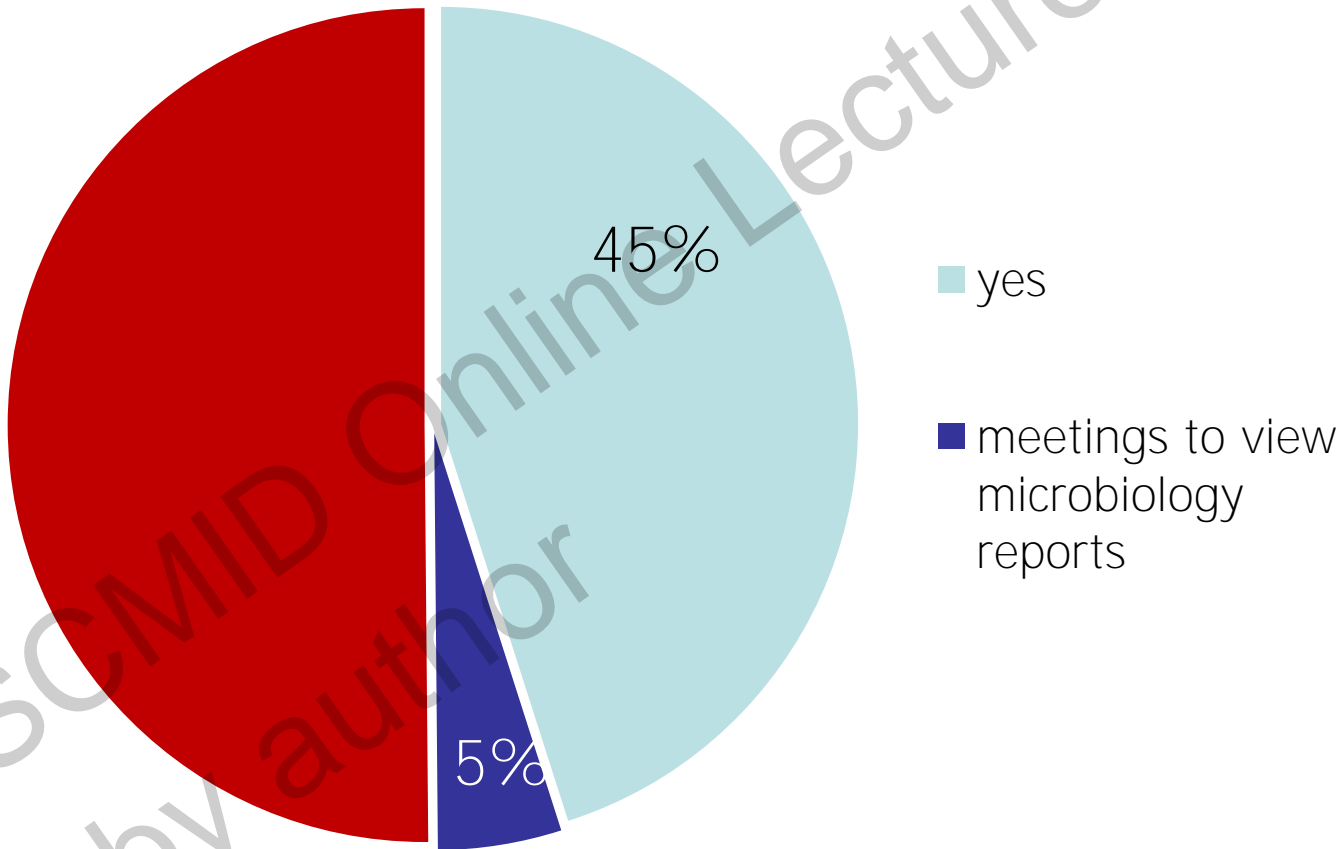
Questionnaire to KISS ICUs 2011

Do you have individual antibiotic guidelines in your ICU? (n=355)



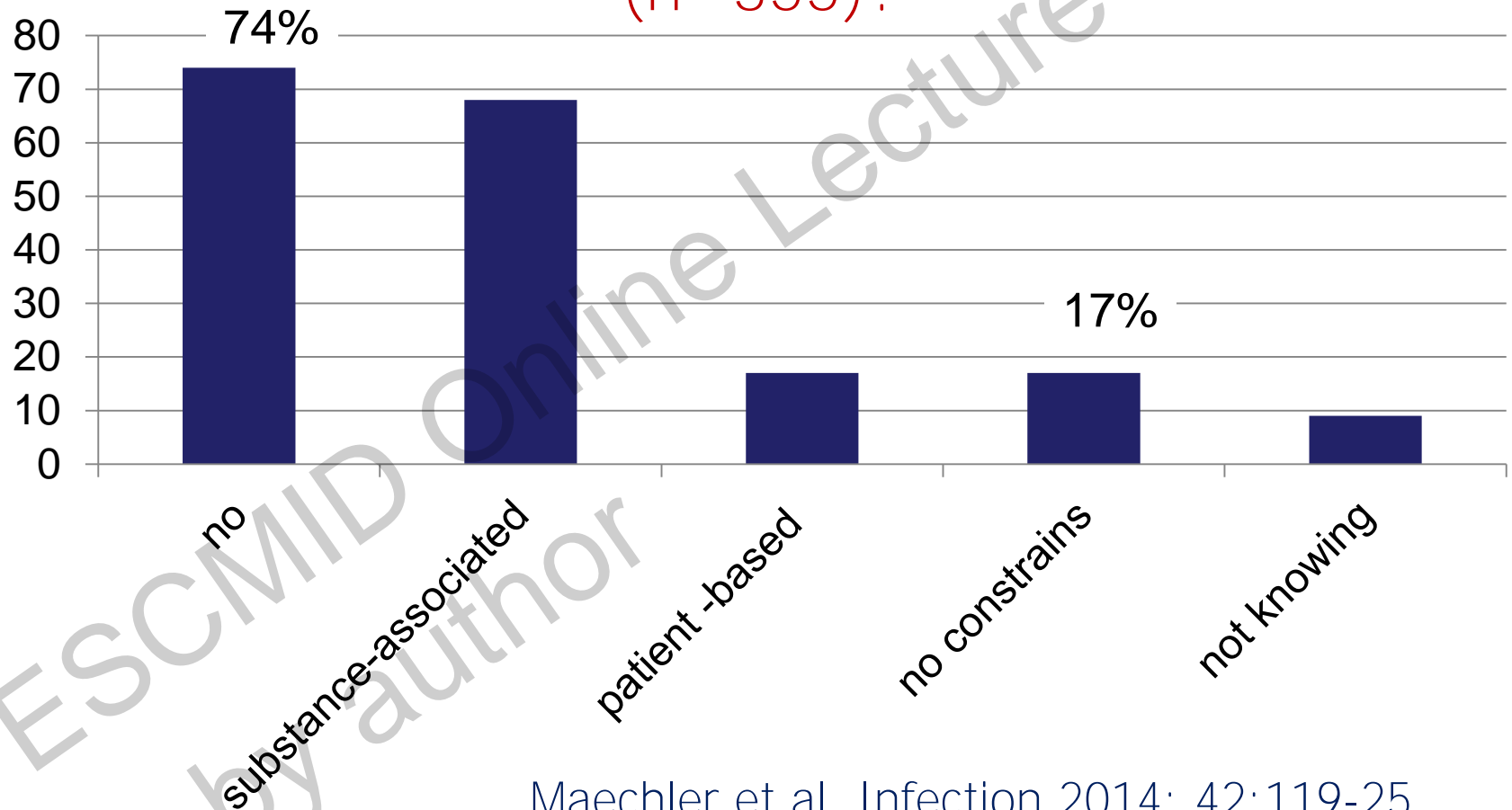
Questionnaire to KISS ICUs 2011

Do you have regular antibiotic rounds on your ICU?
(n=355)



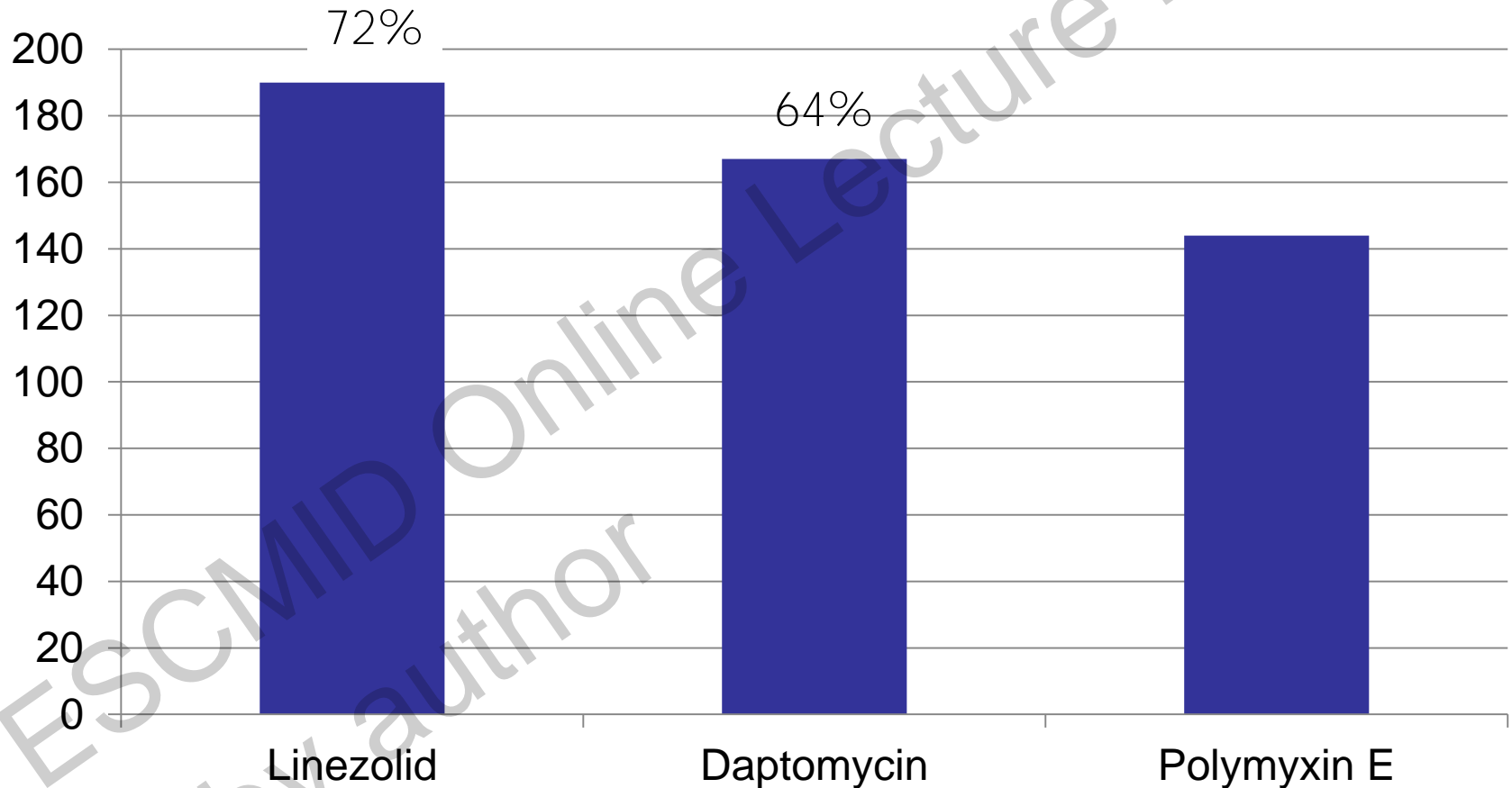
Questionnaire to KISS ICUs 2011

Would your hospital pharmacy dispense certain antimicrobials without the use of pre-authorization forms (n=355)?



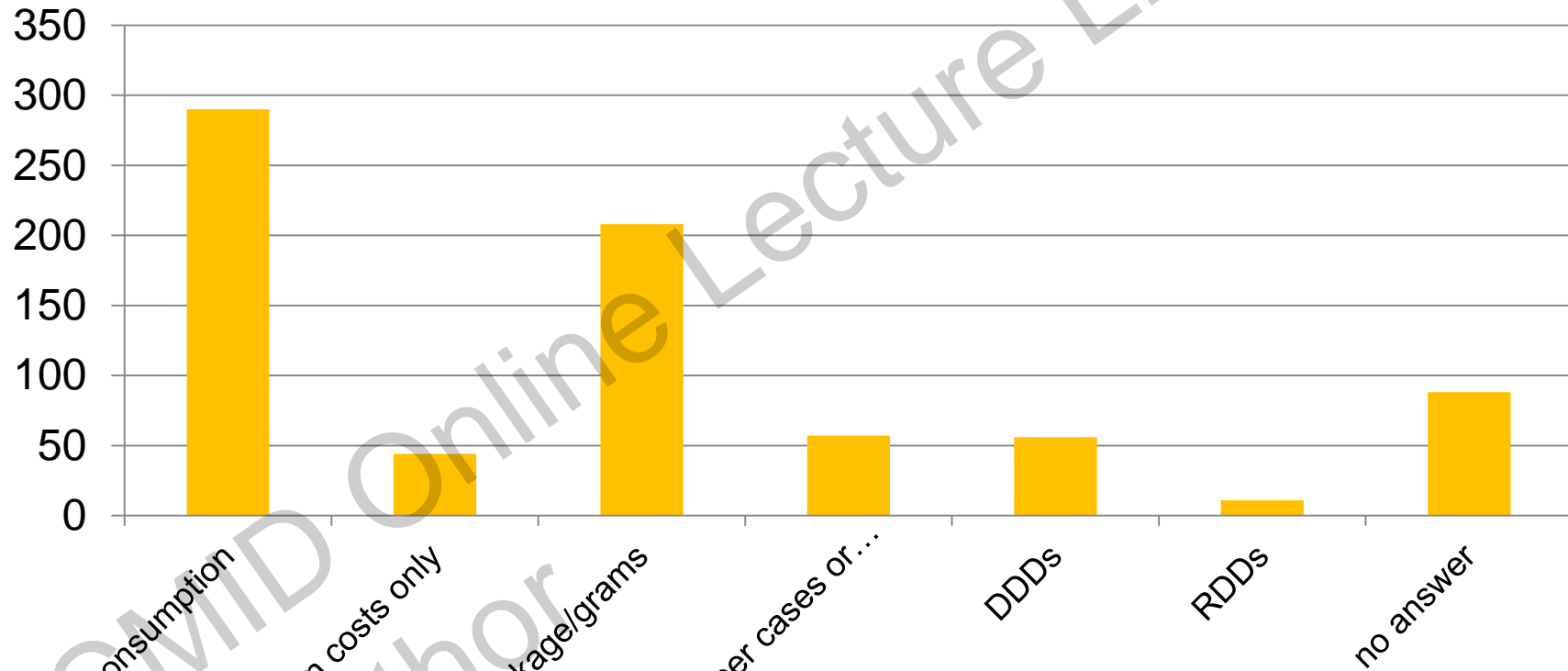
Questionnaire to KISS ICUs 2011

Most frequent antimicrobial agents targeted for restriction by approval (n=355)



Questionnaire to KISS ICUs 2011

Feedback of antibiotic usage data? (n=355)



Surveillance of antibiotic usage



OP
KISS

ITS
KISS

NEO
KISS

SARI

KISS
Krankenhaus-
Infektions-
Surveillance-
System

ONKO
KISS

STATIONS
KISS

HAND
KISS

MRSA
KISS

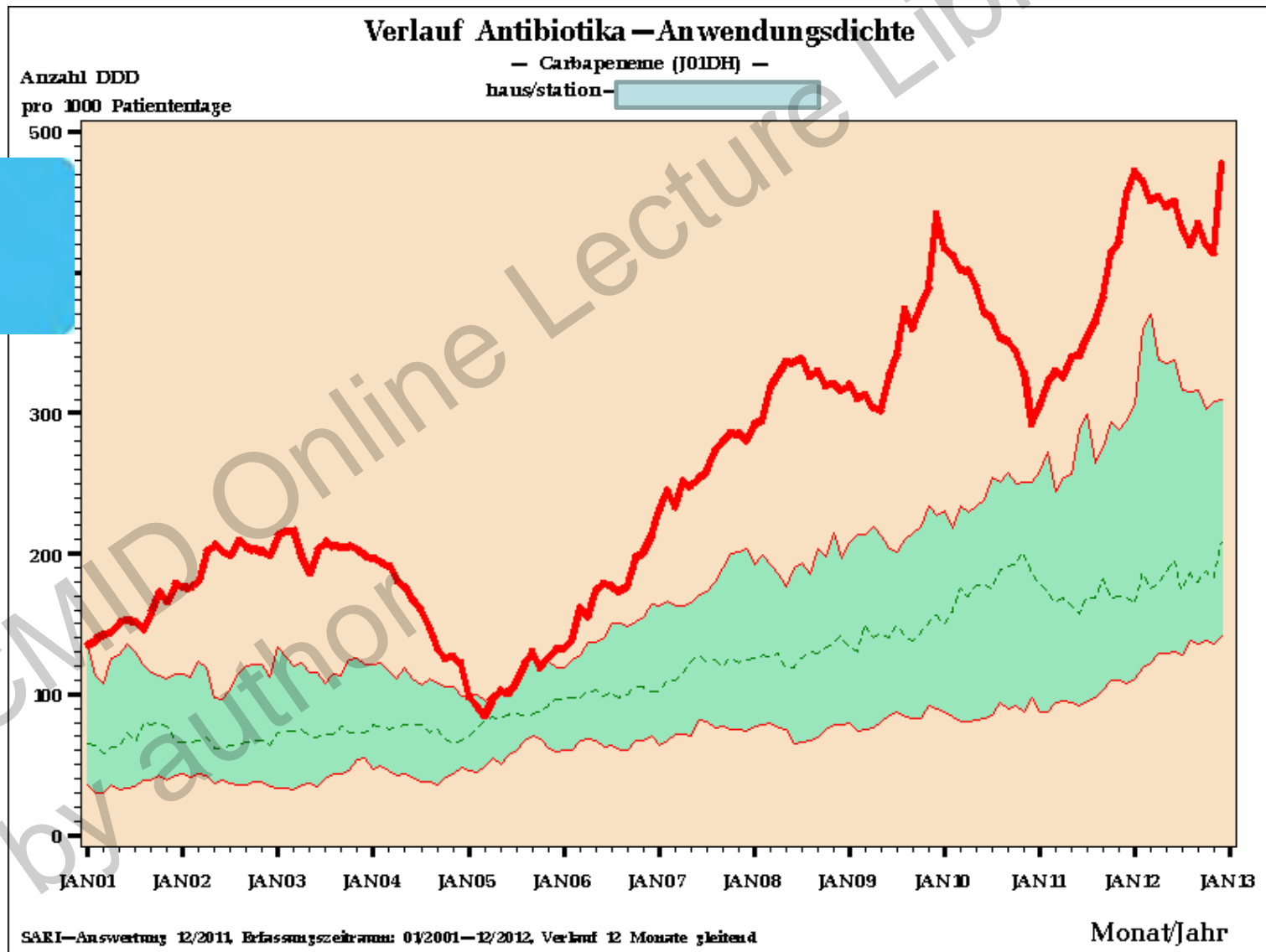
AMBU
KISS

CDAD
KISS

SARI –

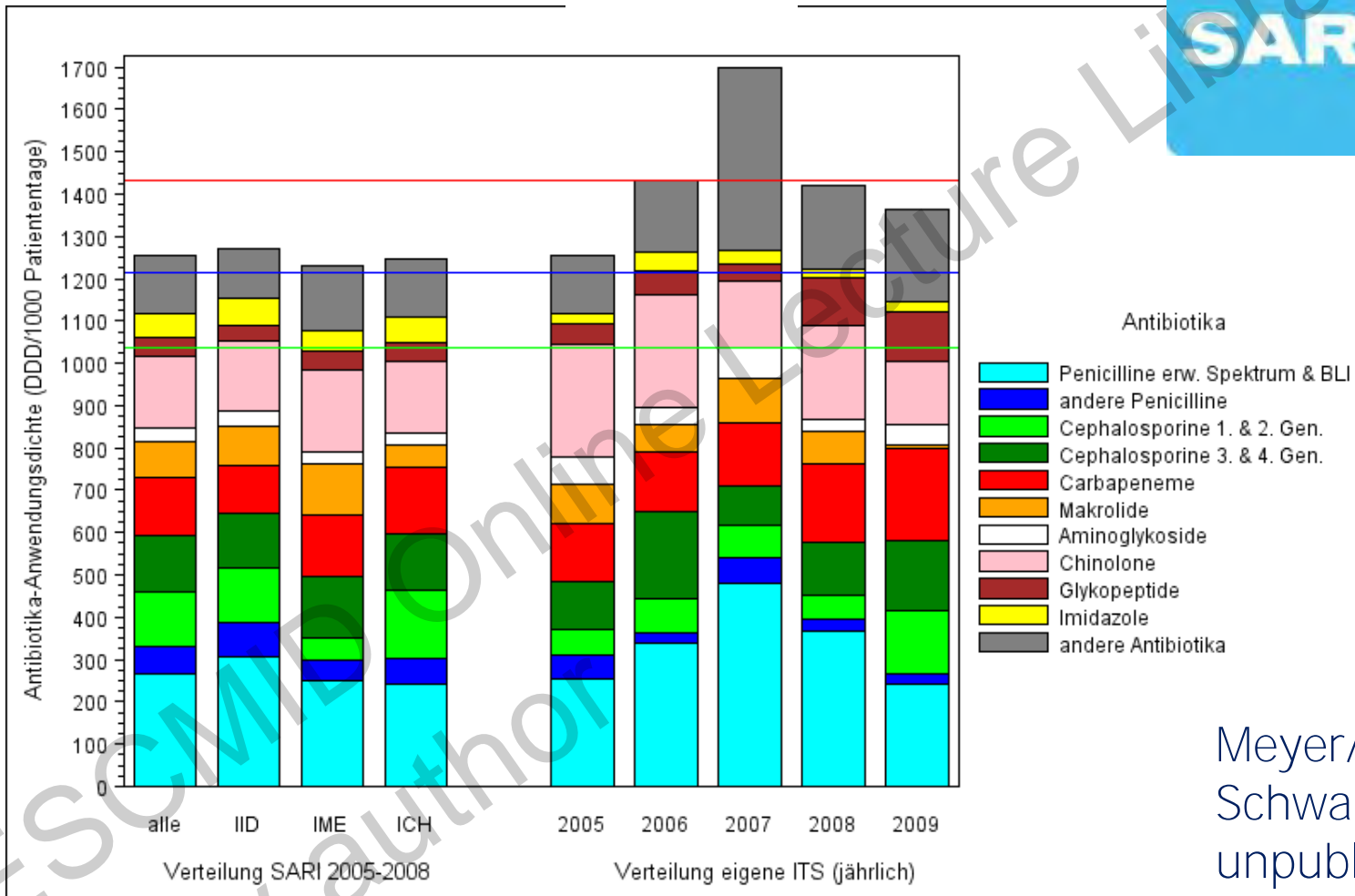
The own ICU (red line) compared with the other ICUs

SARI



Meyer/
Schwab,
unpublished

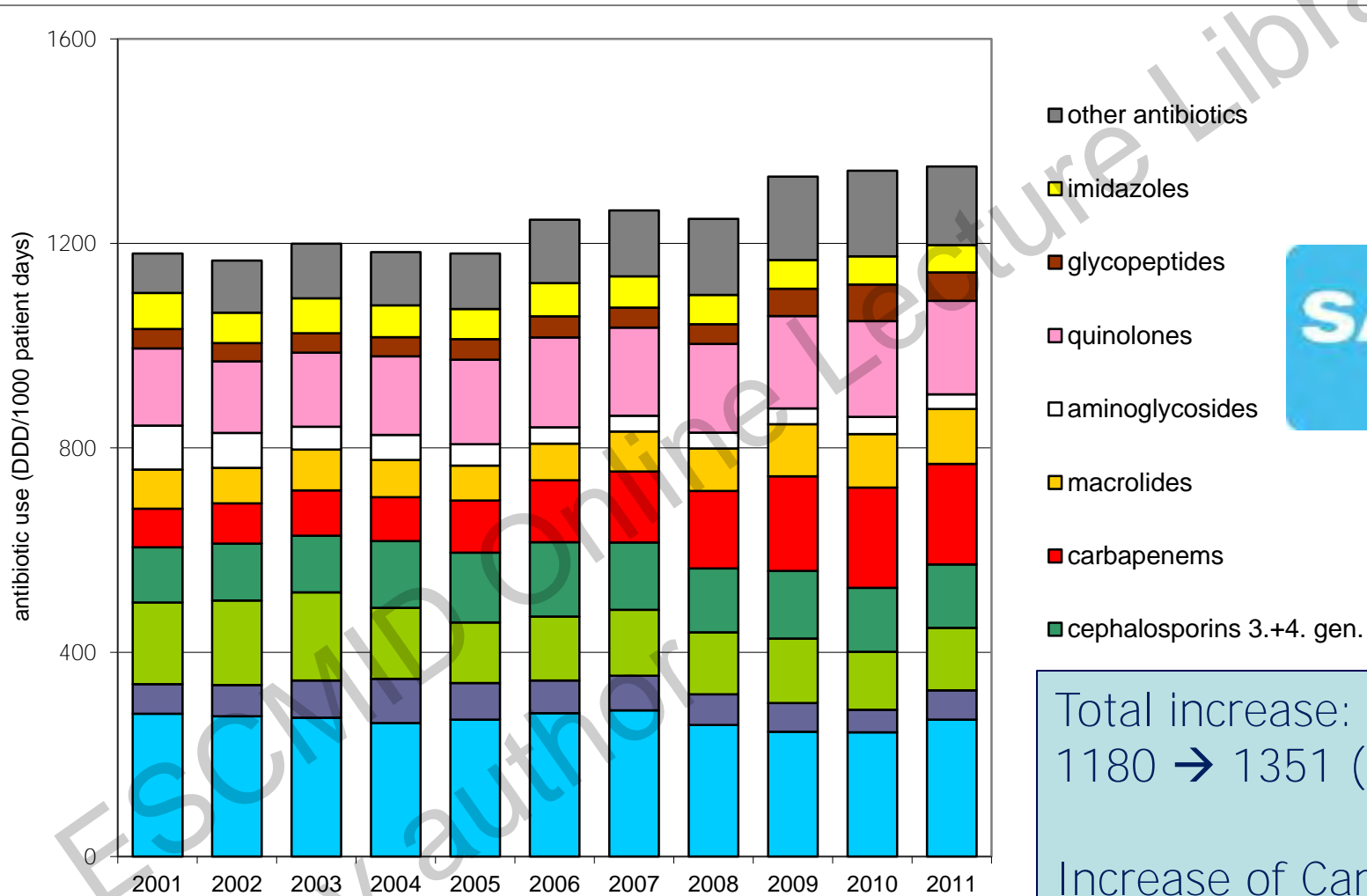
ICU A



Meyer/
Schwab,
unpublished

SARI-Auswertung 12/2009, Erfassungszeitraum: 01/2005-12/2009, DDD defined daily doses (Tagesdosen), erw. erweitertem, BLI beta-Laktamase Inhibitor, alle ITS (N=72), IID interdisziplinäre ITS (N=28), IME medizinische ITS (N=18), ICH chirurgisch/neurochirurgisch ITS (N=26), Referenzlinien: grün 25% Perzentil, blau 50% Perzentil, rot 75% Perzentil aller ITS

Antibiotic usage in SARI ICUs



Total increase:
1180 → 1351 (15%)

Increase of Carbapenems:
76 → 197 (159%)

Antibiotic usage in German hospitals: results of the second national prevalence study

Sonja Hansen^{1,2*}, Dorit Sohr^{1,2}, Brar Piening^{1,2}, Luis Pena Diaz^{1,2}, Alexander Gropmann^{1,2}, Rasmus Leistner^{1,2}, Elisabeth Meyer^{1,2}, Petra Gastmeier^{1,2} and Michael Behnke^{1,2}

¹*Institute of Hygiene, Charité—Universitätsmedizin Berlin, Hindenburgdamm 27, 12203 Berlin, Germany;* ²*German National Reference Centre for Surveillance of Nosocomial Infections (NRZ), Hindenburgdamm 27, 12203 Berlin, Germany*

*Corresponding author. Institute for Hygiene and Environmental Medicine, Charité—Universitätsmedizin Berlin, Campus Benjamin Franklin, Hindenburgdamm 27, D-12203 Berlin, Germany. Tel: +(49)-030-8445-3680; Fax: +(49)-030-8445-4486; E-mail: sonja.hansen@charite.de

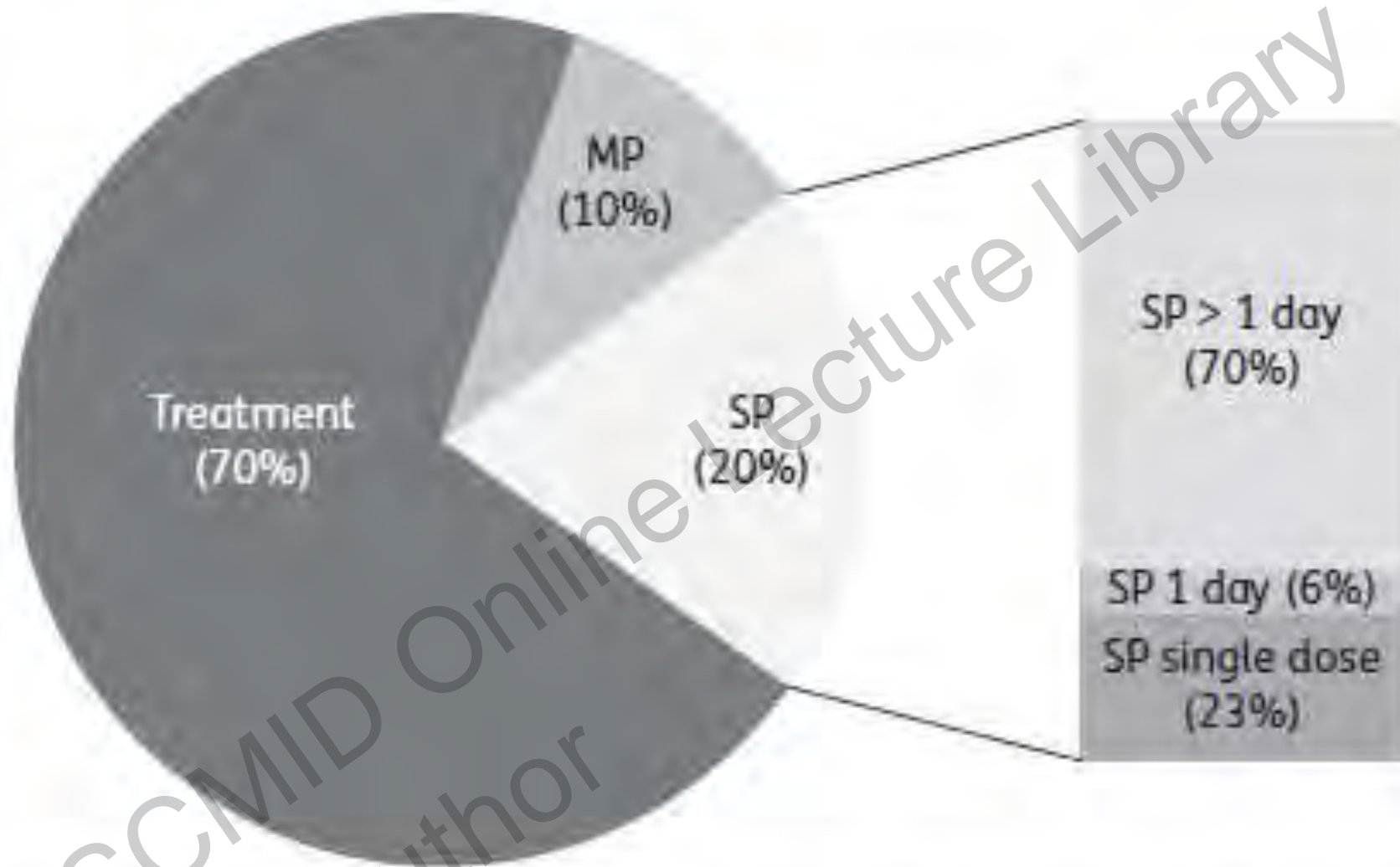


Figure 2. Indications for antibiotic use. MP, medical prophylaxis; SP, surgical prophylaxis.

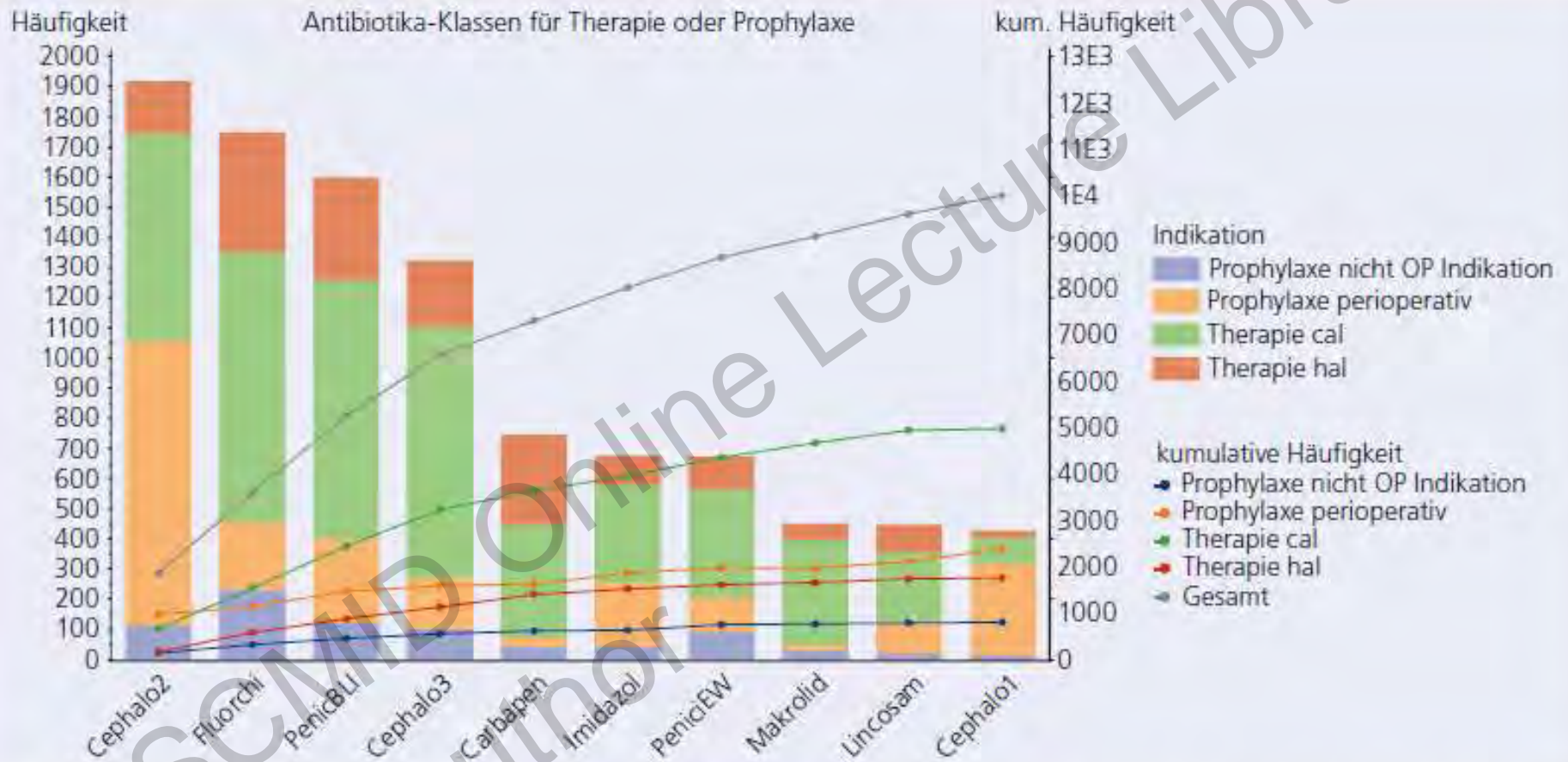


Abb. 1: Kumulative Anwendung der häufigsten Antibiotikaklassen für die Therapie und Prophylaxe (cal= mitgebrachte Infektion, hal = nosokomiale Infektion, Cephalo2= Zweitgenerations-Cephalosporine, PenicBLL= Penicillin- β -Lactamase-Inhibitor-Kombination, Fluorchl= Fluorchinolon, Cephalo3= Drittgenerations-Cephalosporine, Carbapen= Carbapeneme, PeniciEW= Penicilline mit erweiterterem Wirkungsspektrum, Cephalo1= Erstgenerations-Cephalosporine, SulfoTri= Sulfamethoxazol/Trimethoprim, Lincosam= Lincosamine)

How to measure success of implementing guidelines?

Various endpoints

- Structures
- Process quality
- Incidence/prevalence of MDRO

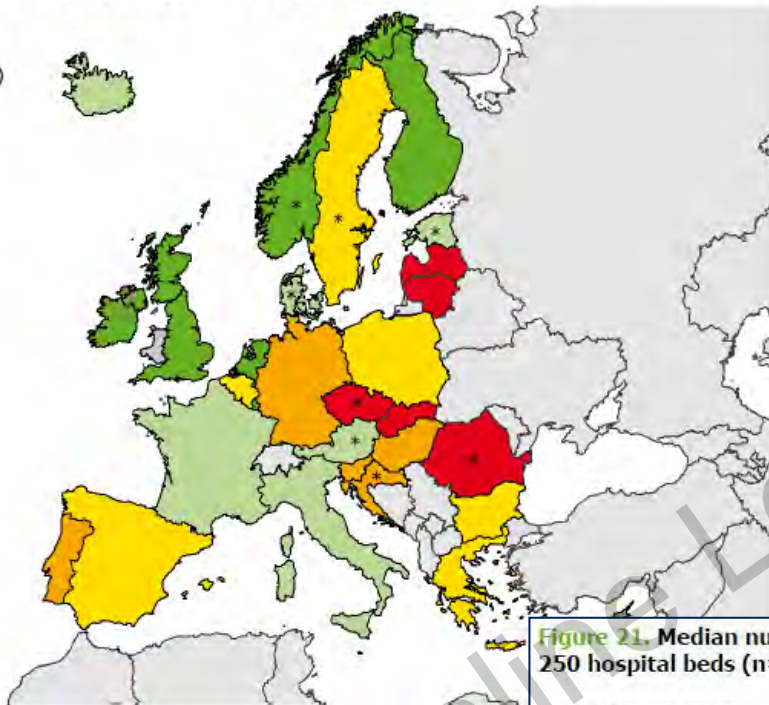
Figure 19. Median number of infection prevention and control nurse full-time equivalents (FTE) per 250 hospital beds (n=866 hospitals), ECDC PPS 2011–2012

Infection prevention and control nurses (Median FTE/250 beds)

- <0.50
- 0.50 to <0.75
- 0.75 to <1.00
- 1.00 to <1.25
- ≥1.25
- No data
- Not included

Non-visible countries

- Liechtenstein
- Luxembourg
- Malta



Infection control nurses

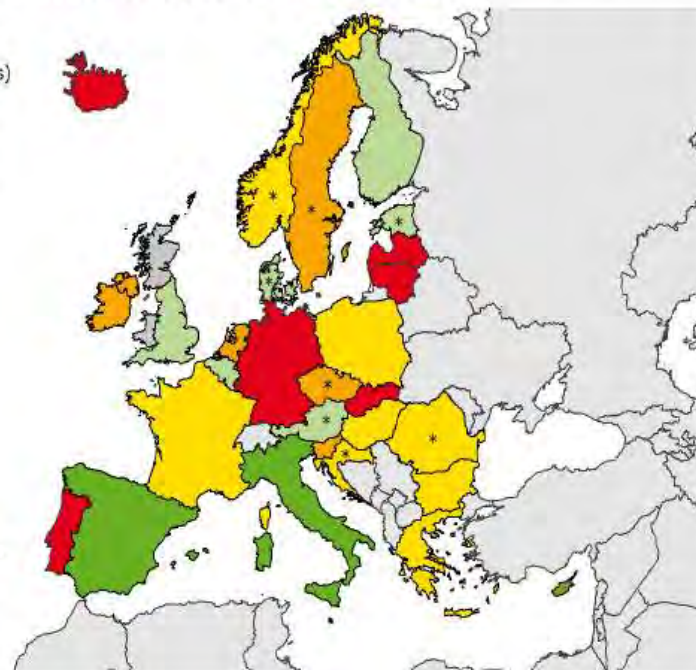
Figure 21. Median number of infection prevention and control doctor full-time equivalents (FTE) per 250 hospital beds (n=779 hospitals), ECDC PPS 2011–2012

Infection prevention and control doctors (Median FTE/250 beds)

- <0.15
- 0.15 to <0.30
- 0.30 to <0.50
- 0.50 to <0.75
- ≥0.75
- No data
- Not included

Non-visible countries

- Liechtenstein
- Luxembourg
- Malta



Infection control doctors

Regional laws for infection prevention in Germany

Employment of Infection control nurses

(adjusted according to the patients' risk)

Risk category	Examples	Employment
High	ICUs, hematology wards	1 per 100 beds
Medium	Surgical or medical units	1 per 200 beds
Low	psychiatry	1 per 500 beds

Each hospital has to calculate the appropriate number of infection control nurses and the infection control committee has to decide about the employment of infection control staff.

New legislation for improvement of infection control in July 2013 in Germany

Additional money for the hospitals for infection control staff until 2016:

- Employment of new infection control nurses: 90 % of salary is covered
- Employment of new infection control doctors: 75 % of salary is covered
- Training of infection control nurses: 10 000 €
- Training of infection control doctors: 30 000 € per year

How to measure success of implementing guidelines? (at a national level)

- National surveillance systems for MDRO should be available (proportions and rates)
- Surveillance systems can also include process quality parameters (antibiotic usage + hand rub consumption)
- Questionnaires may also be useful to identify gaps of implementation
- European surveillance systems and prevalence studies are very helpful for comparison



