World Health Organization | Patient Safety — A World Alliance for Safer Health Care | SAVE LIVES Clean Your Hands

The burden of surgical site infections worldwide

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Outline

- Burden of SSI in high-income countries
- Burden of SSI in low- & middle-income countries (LMICs)
- Gaps in SSI surveillance with focus on LMICs

HAI burden in USA - 2002

- Incidence: **5–6%; 1,7 million** affected patients
  - Urinary Tract Infection: 36%; 561,667 episodes, 13,088 deaths
  - Surgical Site Infection: 20%; 274,098 episodes (1.98%)
  - Catheter Related Bloodstream Infections: 11%; 250,000 episodes,
    28,000 deaths
  - Ventilator Associated Pneumonia: 11%; 5.4/1000 ventilator-days

- Attributable mortality: **3.6%**, approximately **99,000 deaths**
- Annual economic impact: about **US$ 4,5 billion**

Klevens RM, et al. Public Health Reports 2007

Relative incidence of specific types of HAI in the US

Major site of Infection	Estimated Number of Infections
Healthcare-Associated Infection (all HAI)	1,737,125
Surgical Site Infection (SSI)	290,485
Central Line Associated Bloodstream Infections (CLABSI)*	92,011
Ventilator-associated Pneumonia (VAP)**	52,543
Catheter associated Urinary tract Infection (CAUTI)***	449,334
Clostridium difficile-associated disease (CDI)[17]	178,000

Scott RD. http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf.

Surgical Site Infection Rates in the US: NNIS 1992-2004

Procedure	Risk 0	Risk 1	Risk 2	Risk 3
CABG	1.25	1.5	5.4	9.8
Small bowel	4.97	7.1	8.63	11.6
Abd hyster	1.36	2.3	5.17	---
Hip prosthesis	0.86	1.65	2.52	---
Laminectomy	0.88	1.35	2.46	---
Colorectal	3.98	5.66	8.54	11.25

Am J Infect Control 2004;32:470-85

. Distribution of Rank Order of Selected Pathogens Associated with Healthcare-Associated Infections (HAIs) Reporte Healthcare Safety Network, by Type of HAI, 2009–2010

	Overall		CLABSI		CAUTI		VAP		SS
	No. (%) of pathogens	Rank	No. (%) of pathogens	Rank[a]	No. (%) of pathogens	Rank[a]	No. (%) of pathogens	Rank[a]	No. (%) of pathogens
us aureus	12,635 (15.6)	1	3,735 (12.3)	2	442 (2.1)	...	2,043 (24.1)	1	6,415 (30.4)
coli	9,351 (11.5)	2	1,206 (4.0)	9	5,660 (26.8)	1	504 (5.9)	6	1,981 (9.4)
egative staphylococci	9,261 (11.4)	3	6,245 (20.5)	1	467 (2.2)	...	72 (0.9)	...	2,477 (11.7)
neumoniae/oxytoca)	6,470 (8.0)	4	2,407 (7.9)	5	2,365 (11.2)	3	854 (10.1)	3	844 (4.0)
s aeruginosa	6,111 (7.5)	5	1,166 (3.8)	10	2,381 (11.3)	2	1,408 (16.6)	2	1,156 (5.5)
faecalis	5,484 (6.8)	6	2,680 (8.8)	3	1,519 (7.2)	5	45 (0.5)	...	1,240 (5.9)
icans	4,275 (5.3)	7	1,974 (6.5)	7	1,887 (8.9)	4	147 (1.7)	...	267 (1.3)
spp.	3,821 (4.7)	8	1,365 (4.5)	8	880 (4.2)	8	727 (8.6)	4	849 (4.0)
ida spp. or NOS	3,408 (4.2)	9	2,465 (8.1)	4	811 (3.8)	9	36 (0.4)	...	96 (0.5)
faecium	3,314 (4.1)	10	2,118 (7.0)	6	654 (3.1)	10	25 (0.3)	...	517 (2.5)
spp.	2,409 (3.0)	11	703 (2.3)	12	1,010 (4.8)	7	11 (0.1)	...	685 (3.2)
	2,031 (2.5)	12	232 (0.8)	...	1,013 (4.8)	6	119 (1.4)	...	667 (3.2)
.	1,737 (2.1)	13	762 (2.5)	11	204 (1.0)	...	386 (4.6)	7	385 (1.8)
r baumannii	1,490 (1.8)	14	629 (2.1)	13	185 (0.9)	...	557 (6.6)	5	119 (0.6)
	9,304 (11.5)	...	2,762 (9.1)	...	1,633 (7.7)	...	1,510 (17.8)	...	3,399 (16.1)
	81,139 (100)		30,454 (100)		21,111 (100)		8,474 (100)		21,100 (100)

TABLE 6. Distribution of Selected Pathogens Associated with Surgical Site Infections Reported to the National Healthcare Safety Network, by Type of Surgery, 2009–2010

Pathogen	Overall, *n*	No. (%) of pathogens, by type of surgery[a]									
		Abdominal (*n* = 5,617)	Breast (*n* = 83)	Cardiac (*n* = 4,453)	Neck (*n* = 20)	Neurological (*n* = 433)	Ob/gyn (*n* = 2,124)	Orthopedic (*n* = 7,765)	Transplant (*n* = 250)	Vascular (*n* = 333)	Other (*n* = 22)
Staphylococcus aureus	6,415	648 (11.5)	31 (37.3)	1,368 (30.7)	3 (15.0)	160 (37.0)	418 (19.7)	3,656 (47.1)	17 (6.8)	109 (32.7)	5 (22.7)
Escherichia coli	1,981	1,043 (18.6)	3 (3.6)	283 (6.4)	...	12 (2.8)	274 (12.9)	314 (4.0)	24 (9.6)	25 (7.5)	3 (13.6)
Coagulase-negative staphylococci	2,477	288 (5.1)	16 (19.3)	743 (16.7)	1 (5.0)	99 (22.9)	189 (8.9)	1,073 (13.8)	39 (15.6)	27 (8.1)	2 (9.1)
Klebsiella (pneumoniae/oxytoca)	844	305 (5.4)	4 (4.8)	261 (5.9)	3 (15.0)	15 (3.5)	63 (3.0)	159 (2.0)	18 (7.2)	15 (4.5)	1 (4.5)
Pseudomonas aeruginosa	1,156	316 (5.6)	7 (8.4)	350 (7.9)	2 (10.0)	14 (3.2)	83 (3.9)	341 (4.4)	16 (6.4)	26 (7.8)	1 (4.5)
Enterococcus faecalis	1,240	524 (9.3)	1 (1.2)	136 (3.1)	2 (10.0)	15 (3.5)	176 (8.3)	354 (4.6)	16 (6.4)	15 (4.5)	1 (4.5)
Candida albicans	267	153 (2.7)	1 (1.2)	59 (1.3)	...	7 (1.6)	16 (0.8)	22 (0.3)	8 (3.2)	1 (0.3)	...
Enterobacter spp.	849	254 (4.5)	5 (6.0)	228 (5.1)	1 (5.0)	31 (7.2)	58 (2.7)	238 (3.1)	13 (5.2)	20 (6.0)	1 (4.5)
Other *Candida* spp. or NOS	96	48 (0.9)	...	20 (0.4)	...	2 (0.5)	4 (0.2)	14 (0.2)	6 (2.4)	1 (0.3)	1 (4.5)
Enterococcus faecium	517	313 (5.6)	...	51 (1.1)	...	5 (1.2)	26 (1.2)	76 (1.0)	38 (15.2)	8 (2.4)	...
Enterococcus spp.	685	334 (5.9)	4 (4.8)	76 (1.7)	1 (5.0)	2 (0.5)	87 (4.1)	154 (2.0)	13 (5.2)	11 (3.3)	3 (13.6)
Acinetobacter baumannii	119	16 (0.3)	...	36 (0.8)	...	6 (1.4)	8 (0.4)	51 (0.7)	...	1 (0.3)	1 (4.5)
Streptococcus spp.	1,028	305 (5.4)	1 (1.2)	93 (2.1)	1 (5.0)	12 (2.8)	162 (7.6)	433 (5.6)	9 (3.6)	11 (3.3)	1 (4.5)
Proteus spp.	667	135 (2.4)	5 (6.0)	190 (4.3)	...	4 (0.9)	86 (4.0)	231 (3.0)	4 (1.6)	12 (3.6)	...
Serratia spp.	385	26 (0.5)	1 (1.2)	216 (4.9)	1 (5.0)	9 (2.1)	21 (1.0)	98 (1.3)	3 (1.2)	10 (3.0)	...
Other[b]	2,374	909 (16.2)	4 (4.8)	343 (7.7)	5 (35.0)	40 (9.2)	453 (21.3)	551 (7.1)	26 (10.4)	41 (12.3)	2 (9.1)
Total	21,100	5,617 (100)	83 (100)	4,453 (100)	20 (100)	433 (100)	2,124 (100)	7,765 (100)	250 (100)	333 (100)	22 (100)

Sievert DM, et al. ICHE; 2013;34:1-14

TABLE 12. Changes in Percent Resistance among Pathogens Associated with SSIs Reported to the National Healthcare Safety Network, 2007–2010

Resistant pathogen, antimicrobial agents[a]	Resistance percentage, 2007–2008, % (95% CI)	Resistance percentage, 2009–2010, % (95% CI)	Overall change, %	*P* value
Staphylococcus aureus				
Oxacillins	48.0 (46.5, 49.5)	43.7 (42.5, 44.9)	−9.0	<.0001
Enterococcus species				
E. faecium, vancomycin	65.2 (60.6, 69.7)	62.3 (58.1, 66.5)	−4.4	.36
E. faecalis, vancomycin	4.6 (3.1, 6.2)	6.2 (4.9, 7.6)	34.7	.14
Klebsiella (*pneumoniae/oxytoca*)				
ES cephalosporins 4	19.4 (15.9, 22.9)	13.2 (10.7, 15.7)	−31.7	<.01
Carbapenems	9.6 (6.7, 12.5)	7.9 (5.7, 10.1)	−17.7	.35
Multidrug resistant 1	10.9 (7.9, 13.8)	6.8 (4.8, 8.7)	−37.8	.02
Escherichia coli				
ES cephalosporins 4	9.1 (7.5, 10.7)	10.9 (9.4, 12.5)	20.2	.11
Fluoroquinolones 3	27.2 (24.8, 29.5)	25.3 (23.3, 27.2)	−7.0	.23
Carbapenems	1.5 (0.7, 2.2)	2.0 (1.3, 2.8)	38.2	.31
Multidrug resistant 1	1.1 (0.5, 1.7)	1.6 (0.9, 2.2)	41.8	.33
Enterobacter species				
ES cephalosporins 4	30.6 (26.8, 34.5)	27.7 (24.6, 30.8)	−9.5	.24
Carbapenems	2.8 (1.2, 4.3)	2.4 (1.1, 3.6)	−14.4	.69
Multidrug resistant 1	1.5 (0.4, 2.7)	1.7 (0.7, 2.7)	10.6	.83
Pseudomonas aeruginosa				
Aminoglycosides	4.4 (2.5, 6.3)	6.0 (4.2, 7.8)	37.7	.23
ES cephalosporins 2	13.6 (11.1, 16.0)	10.2 (8.4, 12.0)	−24.8	.03
Fluoroquinolones 2	15.8 (13.2, 18.4)	16.9 (14.7, 19.1)	7.2	.51
Carbapenems	11.2 (8.7, 13.8)	11.0 (8.9, 13.1)	−2.1	.89
Piperacillin/tazobactam	6.8 (4.7, 8.8)	6.8 (5.1, 8.6)	1.3	.95
Multidrug resistant 2	4.9 (3.3, 6.5)	5.3 (4.0, 6.7)	8.4	.70
Acinetobacter baumannii				
Carbapenems	38.6 (28.5, 48.8)	37.3 (27.9, 46.6)	−3.6	.85
Multidrug resistant 3	49.5 (39.6, 59.3)	43.9 (34.8, 53.0)	−11.4	.41

Pathogen, antimicrobial[a]	SSI		
	No. of isolates reported	No. (%) of isolates tested	Resistance, %
Staphylococcus aureus	6,415		
OX/METH		6,304 (98.3)	43.7
Enterococcus spp.			
E. faecium	517		
VAN		509 (98.5)	62.3
E. faecalis	1,240		
VAN		1,187 (95.7)	6.2
Klebsiella (*pneumoniae/oxytoca*)	844		
ESC4		710 (84.1)	13.2
Carbapenems		582 (69.0)	7.9
MDR1		621 (73.6)	6.8
Escherichia coli	1,981		
ESC4		1,627 (82.1)	10.9
FQ3		1,876 (94.7)	25.3
Carbapenems		1,330 (67.1)	2.0
MDR1		1,390 (70.2)	1.6
Enterobacter spp.	849		
ESC4		816 (96.1)	27.7
Carbapenems		594 (70.0)	2.4
MDR1		648 (76.3)	1.7
Pseudomonas aeruginosa	1,156		
AMINOS		664 (57.4)	6.0
ESC2		1,097 (94.9)	10.2
FQ2		1,111 (96.1)	16.9
Carbapenems		872 (75.4)	11.0
PIP/PIPTAZ		818 (70.8)	6.8
MDR2		1,053 (91.1)	5.3
Acinetobacter baumannii	119		
Carbapenems		102 (85.7)	37.3
MDR3		114 (95.8)	43.9

Costs of specific types of HAI in the US

	# of infections	Range of $ estimates based on 2007 CPI for all urban consumers	Range of $ estimates based on 2007 CPI for Inpatient hospital services	Range of estimate using CPI for all urban consumers (billions)	Range of estimate using CPI for Inpatient hospital services (billions)
SSI	290,485	$11,087 - $29,443	$11,874 - $34,670	$3.22 - $8.55	$3.45 - $10.07
CLABSI	92,011	$ 6,461 - $25,849	$ 7,288- $29,156	$0.59 - $2.38	$0.67 - $2.68
VAP	52,543	$14,806 - $27,520	$19,633 - $28,508	$0.78 - $1.45	$1.03 - $1.50
CAUTI	449,334	$ 749 - $ 832	$ 862 - $ 1,007	$0.34 - $0.37	$0.39 - $0.45
CDI	178,000	$ 5,682 - $ 8,090	$ 6,408 - $ 9,124	$1.01 - $1.44	$1.14 - $1.62

$11,874 - $34,670

$3.45 - $10.07

Scott RD. http://www.cdc.gov/ncidod/dhqp/pdf/Scott_CostPaper.pdf.

HAI burden in Europe

- **Prevalence:** 3.5–14.8% (average: 7.1%)
- 4 131 000 affected patients
- 4 544 100 episodes of HAI every year
- 16 million extra days of hospital stay
- 37 000 attributable deaths (and contribution to an additional 110 000)
- **Annual economic impact:** about EUR 7 billion per year (including direct costs only)

(ECDC, Comm Dis Report 2008)

Country	N° of cases/year	N° of deaths/year	Costs/year
UK	100,000	5,000	UK£ 1 billion
Scotland	/	/	UK£ 183 mio
Switzerland	70,000	/	CHF 230-300 mio

HAI prevalence and burden in Europe

Prevalence: 5.7% (95%CI, 4.5–7.4%)

- **3 529 778** (95% CI, 1 941 962-8 250 382) HAI episodes per year
- **87 539** HAI episodes at any given day
  - Respiratory tract infection: 23.4% (pneumonia: 19.4%; LRTI: 4.1%)
  - **Surgical Site Infection: 19.6%; 17 399 episodes per day (1.22%)**
  - Urinary Tract Infection: 19%
  - Gastro-intestinal infections: 7.7%
  - Bloodstream Infections: 10.7%

(ECDC, Point Prev Report 2011-12)

- **16 million** extra days of hospital stay
- **37 000** attributable deaths (and contribution to an additional 110 000)
- **Annual economic impact:** about **EUR 7 billion** per year (including direct costs only)

(ECDC, Comm Dis Report 2008)

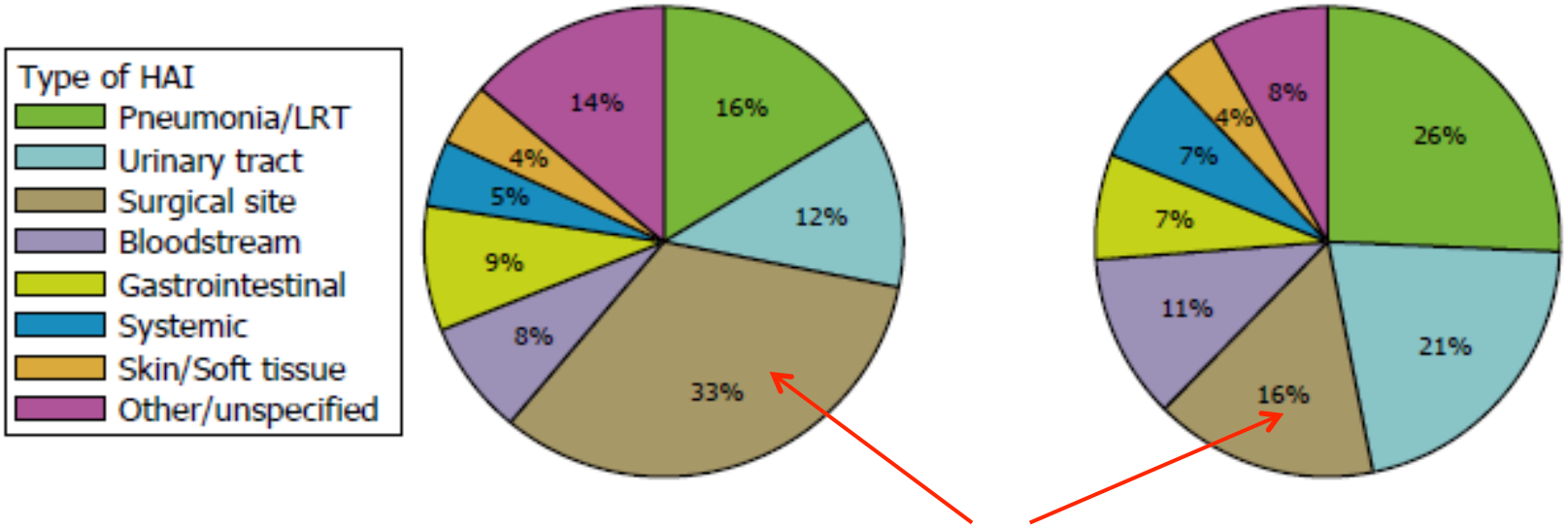
HAI episodes per year in Europe

HAI type	LN-INT	P50 (LN-INT)	HAI inc.%	(95% CI)	N HAIs /year	(95% CI)	% of total HAIs	(95% CI)
Total HAIs [a]					3 529 778	(1 941 962-8 250 382)		

N HAIs /year	(95% CI)
543 149	(298 167-1 062 673)

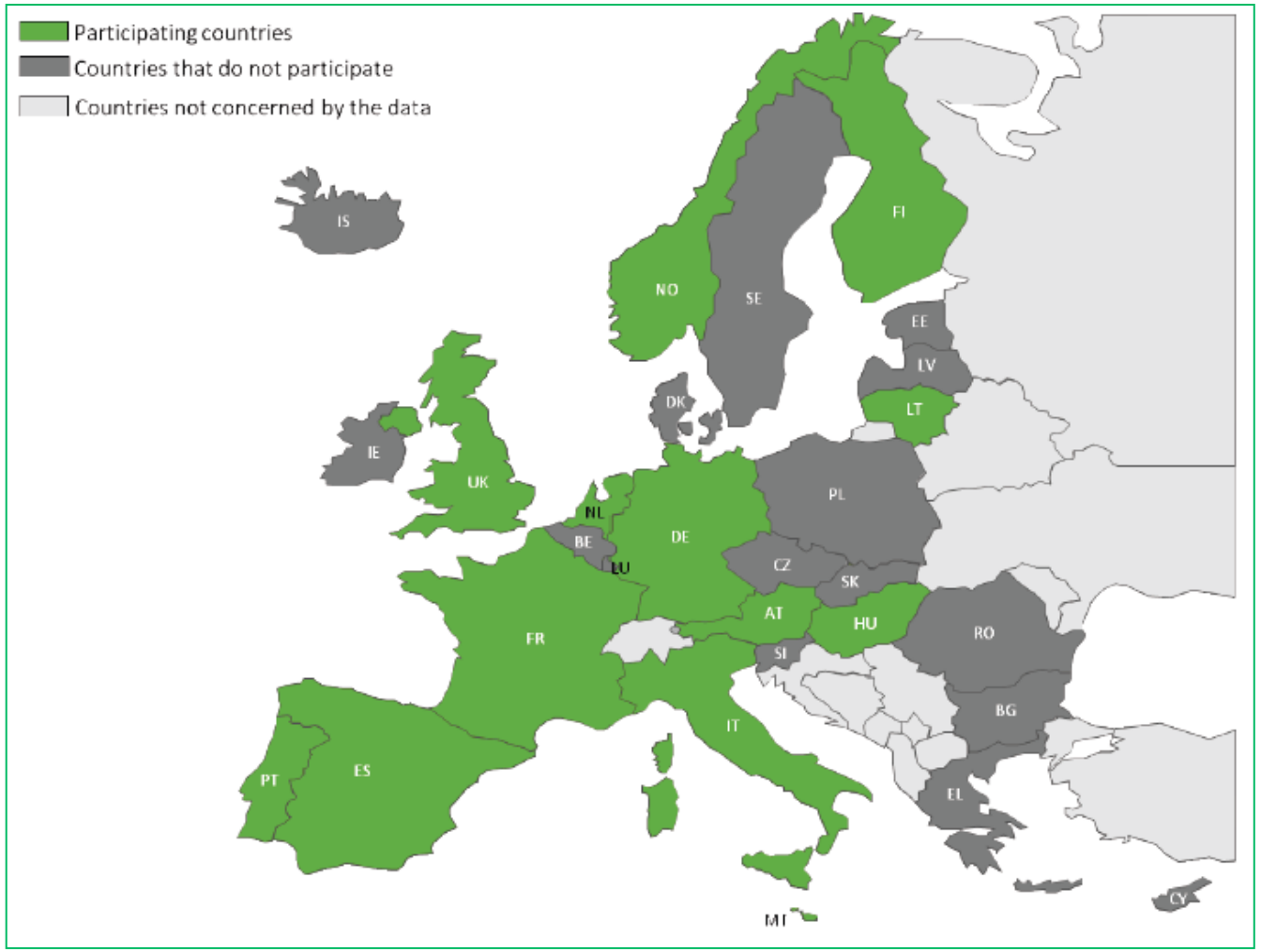
(ECDC, Point Prev Report 2011-12)

Figure 1. Distribution of HAI types by presence of HAI on admission, HAI present on admission (left) HAI onset during hospitalisation (right)



Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals. ECDC Report 2013

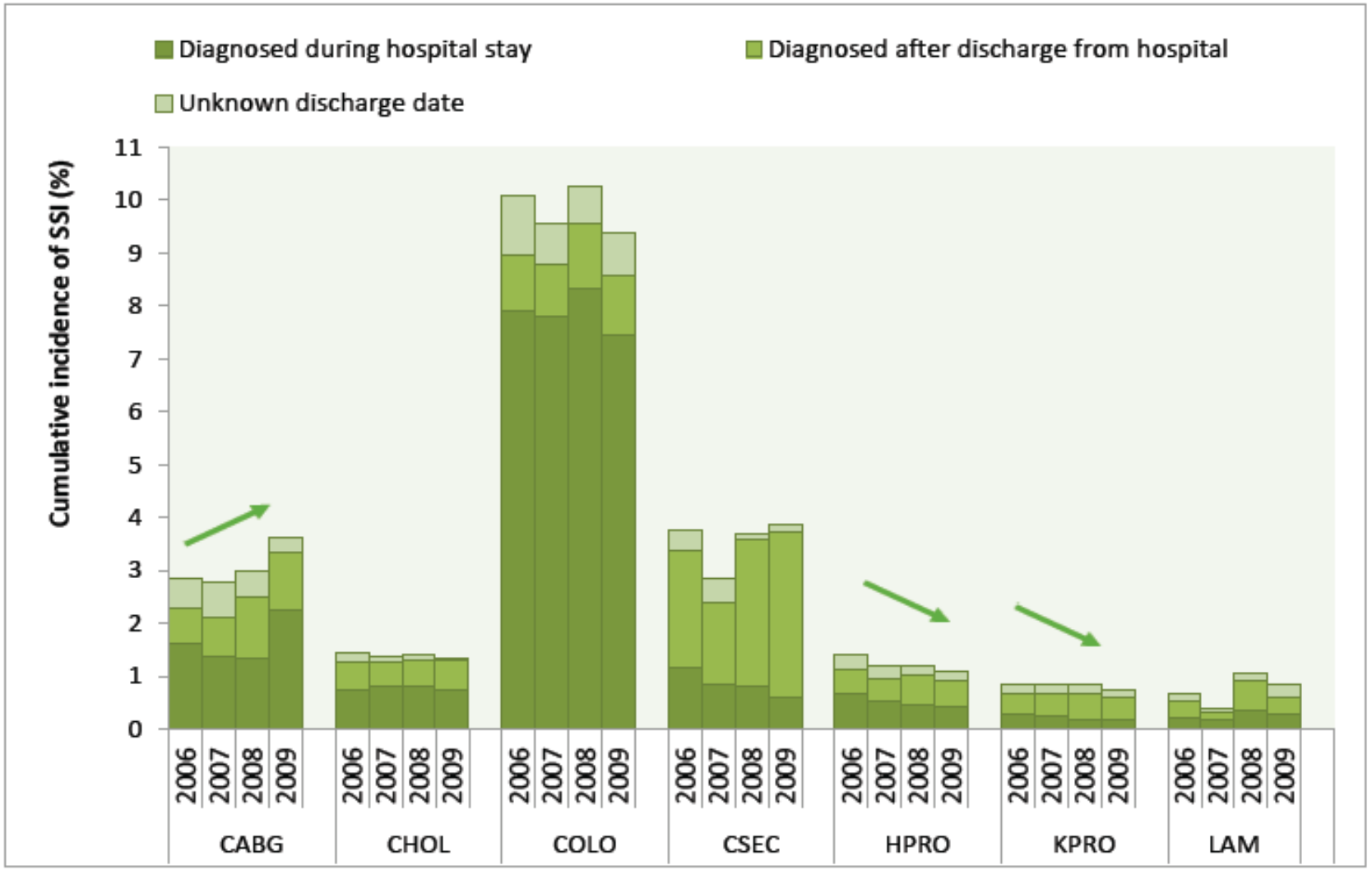
SSI surveillance in Europe 2008-2009



ECDC Surveillance Report, 2008-2009

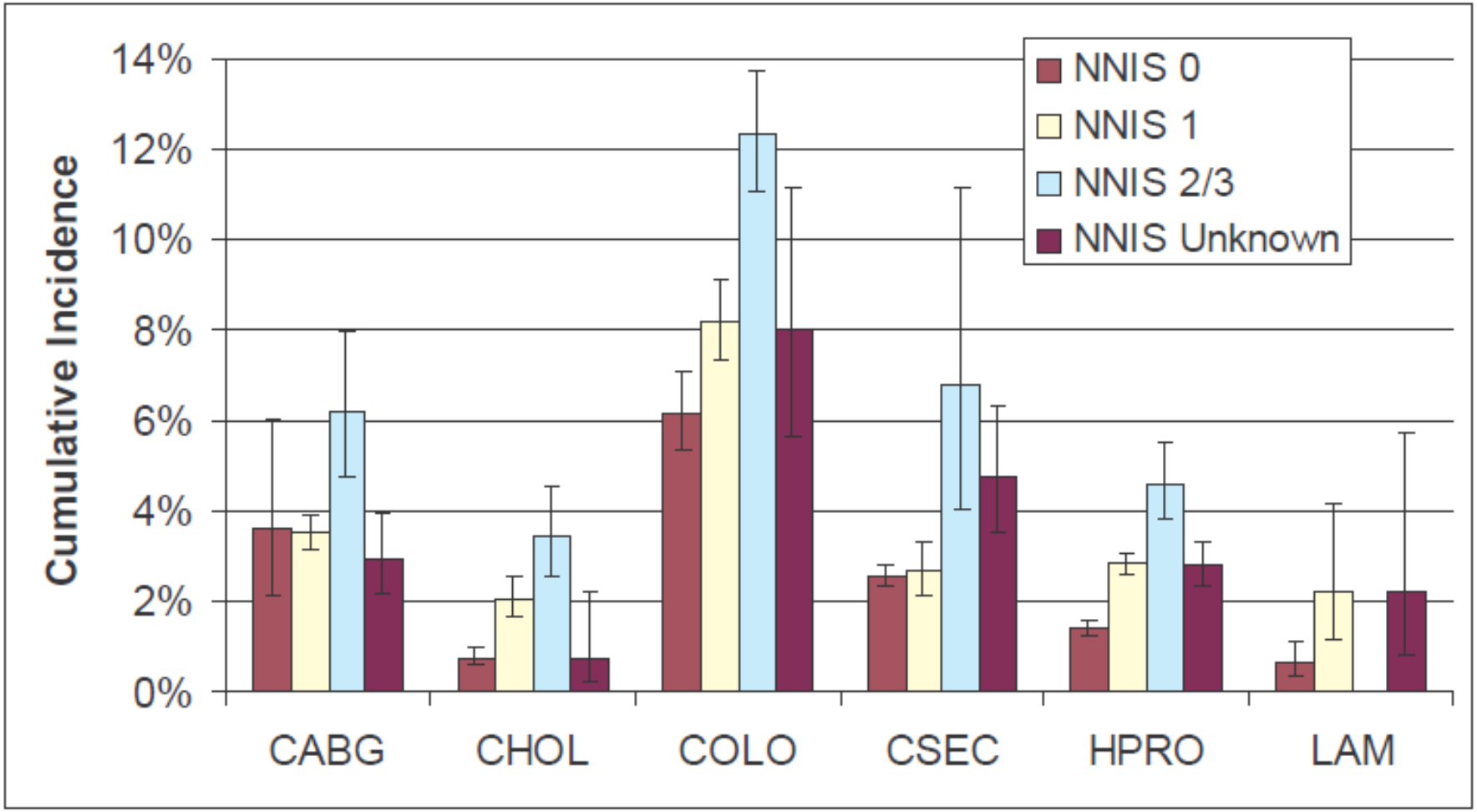
- 13 countries
- 1 785 hospitals
- 655 637 surgical operations

SSI cumulative incidence by operation type – 2006-2009



ECDC SSI surveillance report 2008-2009

SSI cumulative incidence by NNIS index and by procedure in Europe

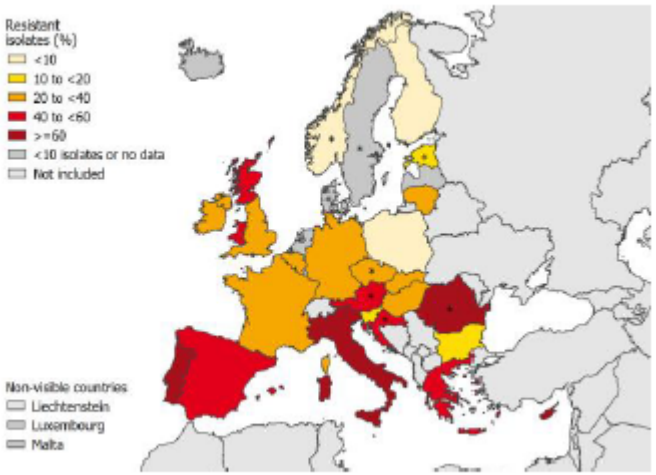


HELICS, SSI statistical report 2004

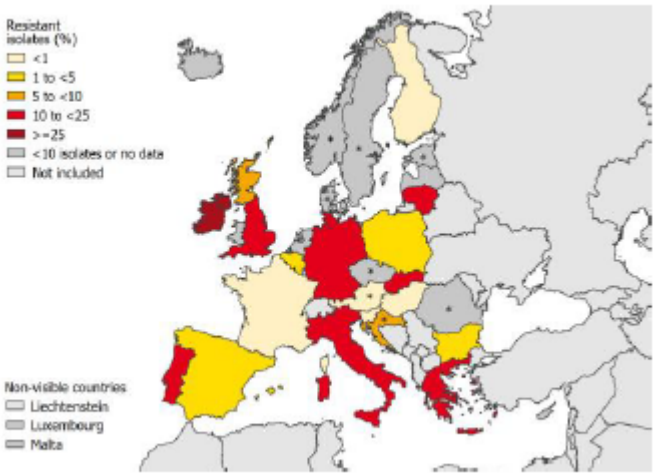
Overall SSI incidence: 3/100 surg. proc.

Resistance patterns in HA-pathogens in Europe

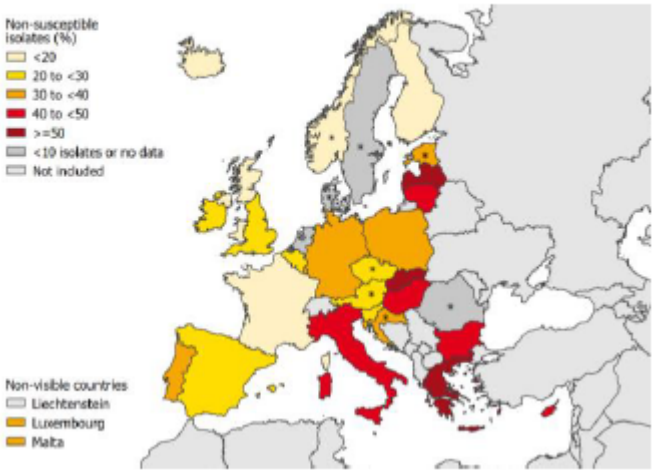
a. Meticillin-resistant *Staphylococcus aureus* (MRSA)



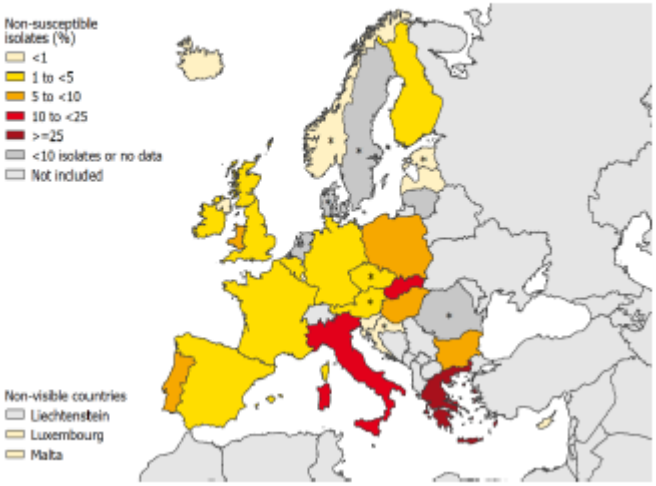
b. Vancomycin-resistant *Enterococcus species* (VRE)



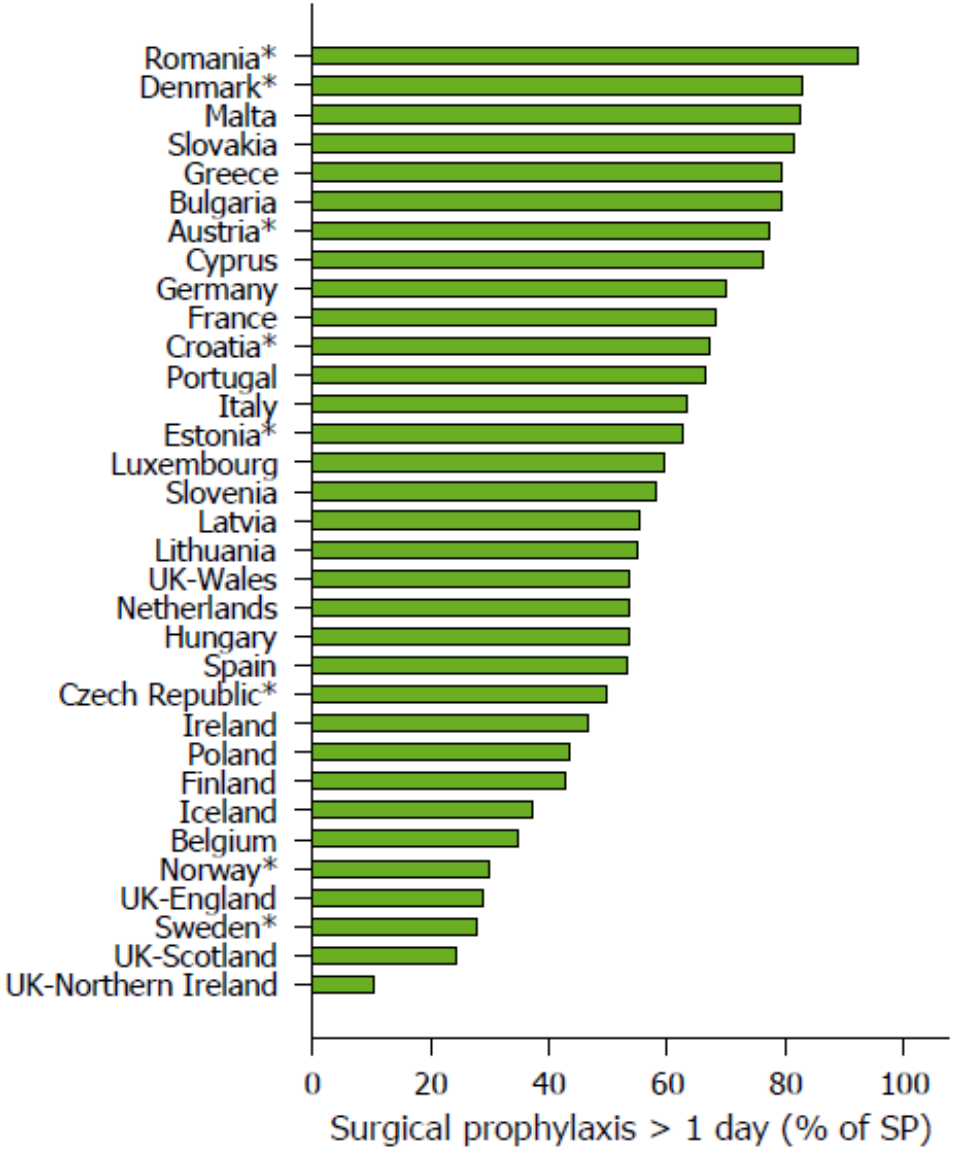
c. Third-generation cephalosporin-non-susceptible *Enterobacteriaceae*



d. Carbapenem-non-susceptible *Enterobacteriaceae*



Surgical ATB prophylaxis prolongation > 24h



Average, 59.2%, range 10.7% (UK/N Ireland) - 92.3% (Romania)

SSI rates

USA:	2.6/100 surg. proc.	*Gaines RP et al, CID 2001*
Europe:	3/100 surg. proc.	*HELICS, SSI statistical report 2004*

General surgery

3.1%	*Haridas et al, Surgery 2008*
4.5%	*Misteli et al, Arch Surg 2009*
4.7%	*Hawn et al, J Am Coll Surg '08*

Abdominal surgery

23%	*Duttaroy et al, Surg Infect 2009*
11%	*Greif et al, NEJM 2000*

Frequency and impact by type of HAI *(USA and EU)*

HAI Type	Average attributable mortality	Average increased LOS	Attributable Costs in US Dollars		Range	
	(%)	(days)	Mean	SD	Min	Max
BSI	20	8.5	36,441	37,078	1,822	107,156
SSI	**4.3**	**6.5**	**25,546**	**39,875**	**1,783**	**134,602**
VAP	27	5	9,969	2,920	7,904	12,034
UTI	/	/	1,006	503	650	1,361

What about low and middle income countries ?

Allegranzi B et al.
Lancet 2011;377:228-41

Articles

Burden of endemic health-care-associated infection
developing countries: systematic review and meta-

Summary

Background Health-care-associated infection is the most frequent result of unsafe patient care w
data are available from the developing world. We aimed to assess the epidemiology of endemic heal
infection in developing countries.

Methods We searched electronic databases and reference lists of relevant papers for articles publ
Studies containing full or partial data from developing countries related to infectio
incidence—including overall health-care-associated infection and major infection sites, and thei
cause—were selected. We classified studies as low-quality or high-quality according to predefi
were pooled for analysis.

Findings Of 271 selected articles, 220 were included in the final analysis. Limited data were rep
regions and many countries were not represented. 118 (54%) studies were low quality. In general, infe
reported in high-quality studies were greater than those from low-quality studies. Prevalence of heal
infection (pooled prevalence in high-quality studies, 15·5 per 100 patients [95% CI 12·6–18·9]) was
proportions reported from Europe and the USA. Pooled overall health-care-associated infection
intensive-care units was 47·9 per 1000 patient-days (95% CI 36·7–59·1), at least three times as
reported from the USA. Surgical-site infection was the leading infection in hospitals (pooled cum
5·6 per 100 surgical procedures), strikingly higher than proportions recorded in developed countri
bacilli represented the most common nosocomial isolates. Apart from meticillin resistance, noted in
Staphylococcus aureus isolates (in eight studies), very few articles reported antimicrobial resistance.

Interpretation The burden of health-care-associated infection in developing countries is high. Our f
need to improve surveillance and infection-control practices.

Funding World Health Organization.

Introduction

Health-care-associated infections are deemed the most frequent adverse event threatening patients' safety worldwide.[1,2] However, reliable estimates of the global burden are hampered by a paucity of data adequately describing endemic infections at national and regional levels, particularly in resource-limited settings.[4] In countries where less than 5% of the gross national product is spent on health care, and workforce density is less than five per 1000 population,[3] other emerging health problems and diseases take priority.[5] The epidemiological gap leading to the absence of reliable estimates of the global burden is mainly because surveillance of health-care-associated infection expends time and resources and needs expertise in study design, data collection, analysis, and interpretation. Very few countries of low and middle income have national surveillance systems for health-care-associated infections. Data from the International Nosocomial Infection Control Consortium,[7] and findings of two systematic reviews on hospital-acquired neonatal infections[8] and ventilator-associated pneumonia,[9] suggested not only that risks of health-care-associated infection are significantly higher in developing countries but also that the effect on patients systems is severe and greatly underest

The aim of this systematic review a is to assess the burden of endemic healt infection in developing countries available data from published studies We also aim to investigate consis surveillance of health-care-associat resource-limited settings and iden for improvement.

Methods

Search strategy and selection criteria

We undertook a literature search an according to a protocol designed befor We aimed to identify studies on the health-care-associated infection in deve with a particular focus on the most infections—urinary-tract infection, surg bloodstream infection, hospital-acquire ventilator-associated pneumonia. We for reports published between Jan December, 2008, with no language rest comprehensive list of terms (panel 1).

www.thelancet.com Published online December 30, 2010 DOI:10.1016/S0140-6736(10)61458-4

World Health Organization | Patient Safety

Published on 5 May 2011
http://www.who.int/gpsc/en/

Report on the Burden of Endemic Health Care-Associated I Worldwide

Clean Care is Safer Care

Systematic reviews

Health-care-associated infection in Africa: a systematic review

Sepideh Bagheri Nejad,[a] Benedetta Allegranzi,[a] Shamsuzzoha B Syed,[b] Benjamin Ellis[c] & Didier Pittet[c]

Objective To assess the epidemiology of endemic health-care-associated infection (HAI) in Africa.
Methods Three databases (PubMed, the Cochrane Library, and the WHO regional medical database for Africa) were searched to identify studies published from 1995 to 2009 on the epidemiology of HAI in African countries. No language restriction was applied. Available abstract books of leading international infection control conferences were also searched from 2004 to 2009.
Findings The eligibility criteria for inclusion in the review were met by 19 articles, only 2 of which met the criterion of high quality. Four relevant abstracts were retrieved from the international conference literature. The hospital-wide prevalence of HAI varied between 2.5% and 14.8%; in surgical wards, the cumulative incidence ranged from 5.7% to 45.8%. The largest number of studies focused on surgical site infection, whose cumulative incidence ranged from 2.5% to 30.9%. Data on causative pathogens were available from a few studies only and highlighted the importance of Gram-negative rods, particularly in surgical site infection and ventilator-associated pneumonia.
Conclusion Limited information is available on the endemic burden of HAI in Africa, but our review reveals that its frequency is much higher than in developed countries. There is an urgent need to identify and implement feasible and sustainable approaches to strengthen HAI prevention, surveillance and control in Africa.

Abstracts in العربية, 中文, Français, Русский and Español at the end of each article.

Introduction

Health-care-associated infection (HAI) is a major global safety concern for both patients and health-care professionals.[1–3] HAI is defined as an infection occurring in a patient during the process of care in a hospital or other health-care facility that was not manifest or incubating at the time of admission. This includes infections acquired in the hospital and any other setting where patients receive health care and may appear even after discharge. HAI also includes occupational infections among facility staff.[1] These infections, often caused by multiresistant pathogens, take a heavy toll on patients and their families by causing illness, prolonged hospital stay, potential disability, excess costs and sometimes death.[4–6]

The burden of HAI is already substantial in developed countries, where it affects from 5% to 15% of hospitalized patients in regular wards and as many as 50% or more of patients in intensive care units (ICUs).[7,8] In developing countries, the magnitude of the problem remains underestimated or even unknown largely because HAI diagnosis is complex and surveillance activities to guide interventions require expertise and resources.[4] Surveillance systems exist in some developed countries and provide regular reports on national trends of endemic HAI,[9] such as the National Healthcare Safety Network of the United States of America or

This review provides a general overview of the endemic burden of HAI in Africa based on the information available in the scientific literature. It also identifies information gaps, examines differences in HAI epidemiology between developed and developing countries and highlights the possible role of the World Health Organization (WHO) in preventing HAI.

Methods

Search strategy and selection criteria

A literature search was performed from January 1995 to December 2009 with no language restriction to retrieve publications on the epidemiology of the most common HAIs in African countries: health-care-associated urinary tract infection (HA-UTI), surgical site infection (SSI), hospital-acquired pneumonia/ventilator-associated pneumonia and health-care-associated bloodstream infection. PubMed was searched using a combination of the following keywords, including "cross-infection" as the MeSH term: "nosocomial infection", "hospital-acquired", "incidence", "prevalence" and "rate" together with the individual country names. The Cochrane Library was searched for any relevant review papers. Reference lists of retrieved articles were hand searched for additional studies.

A separate search was run in the WHO regional medical database for Africa. African Index Medicus, using a shorter list of es-

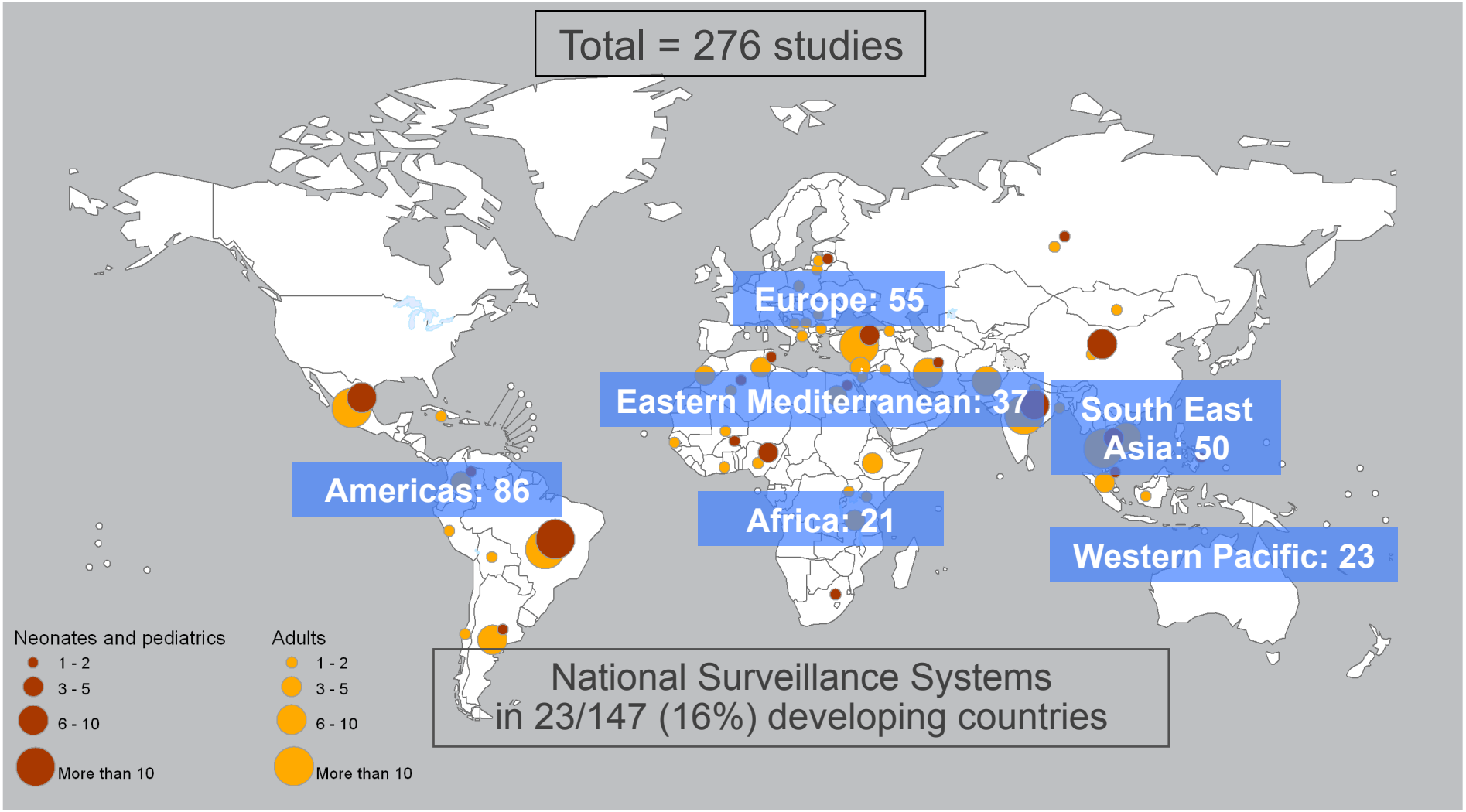
[a] Clean Care is Safer Care, World Health Organization Patient Safety, Geneva, Switzerland.
[b] African Partnerships for Patient Safety, World Health Organization Patient Safety, Geneva, Switzerland.

World Health Organization

Patient Safet
A World Alliance for Safer Health

Bagheri Nejad S, et al. Bull OMS 2011;89:757-765

Figure 4.1: Number of studies* reporting health care-associated infection in low- and middle-income countries, 1995-2010



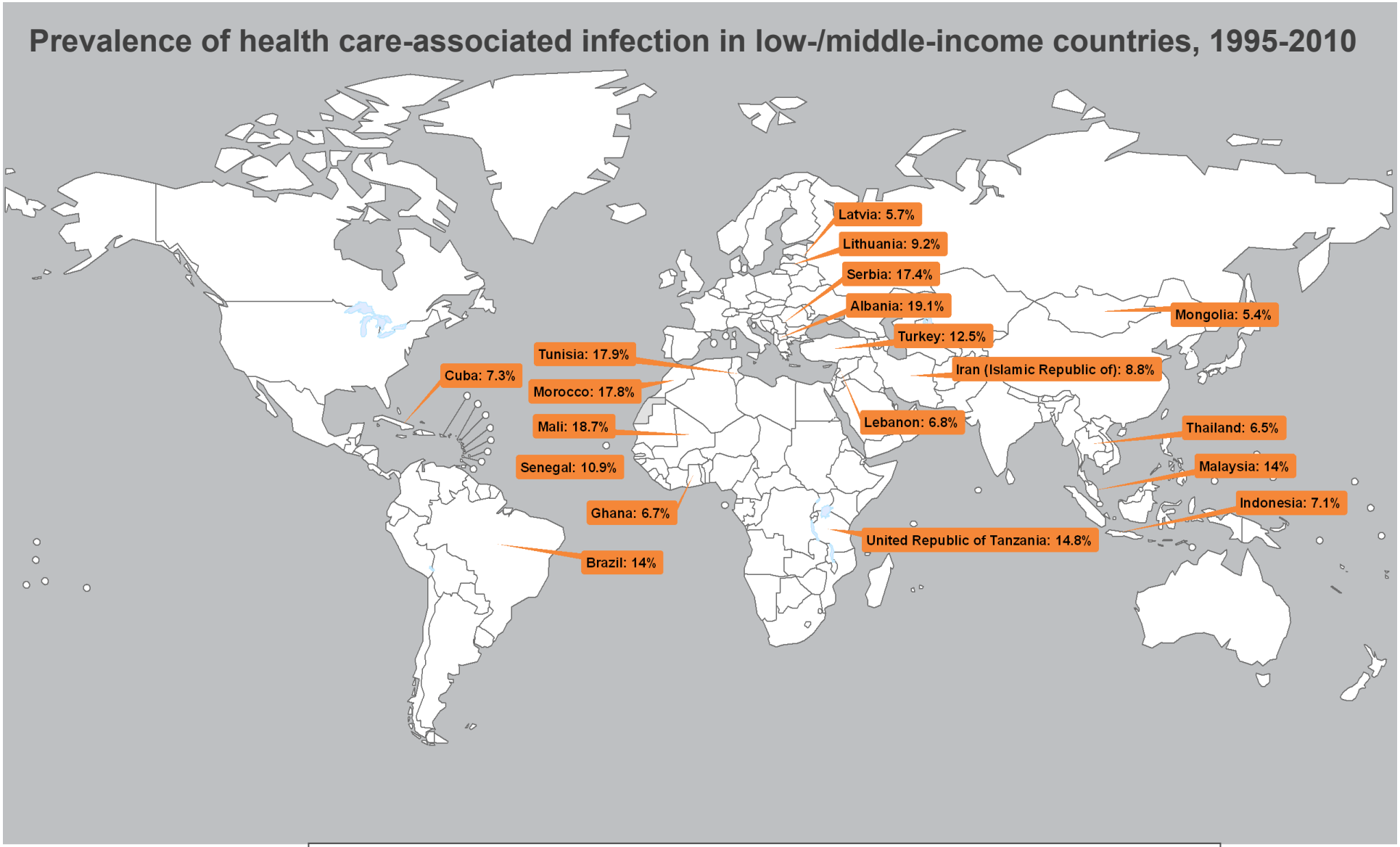
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

World Health Organization

* Studies with any scope (i.e. conducted at the unit, facility, multicenter, or national level) are included

Prevalence of health care-associated infection in low-/middle-income countries, 1995-2010



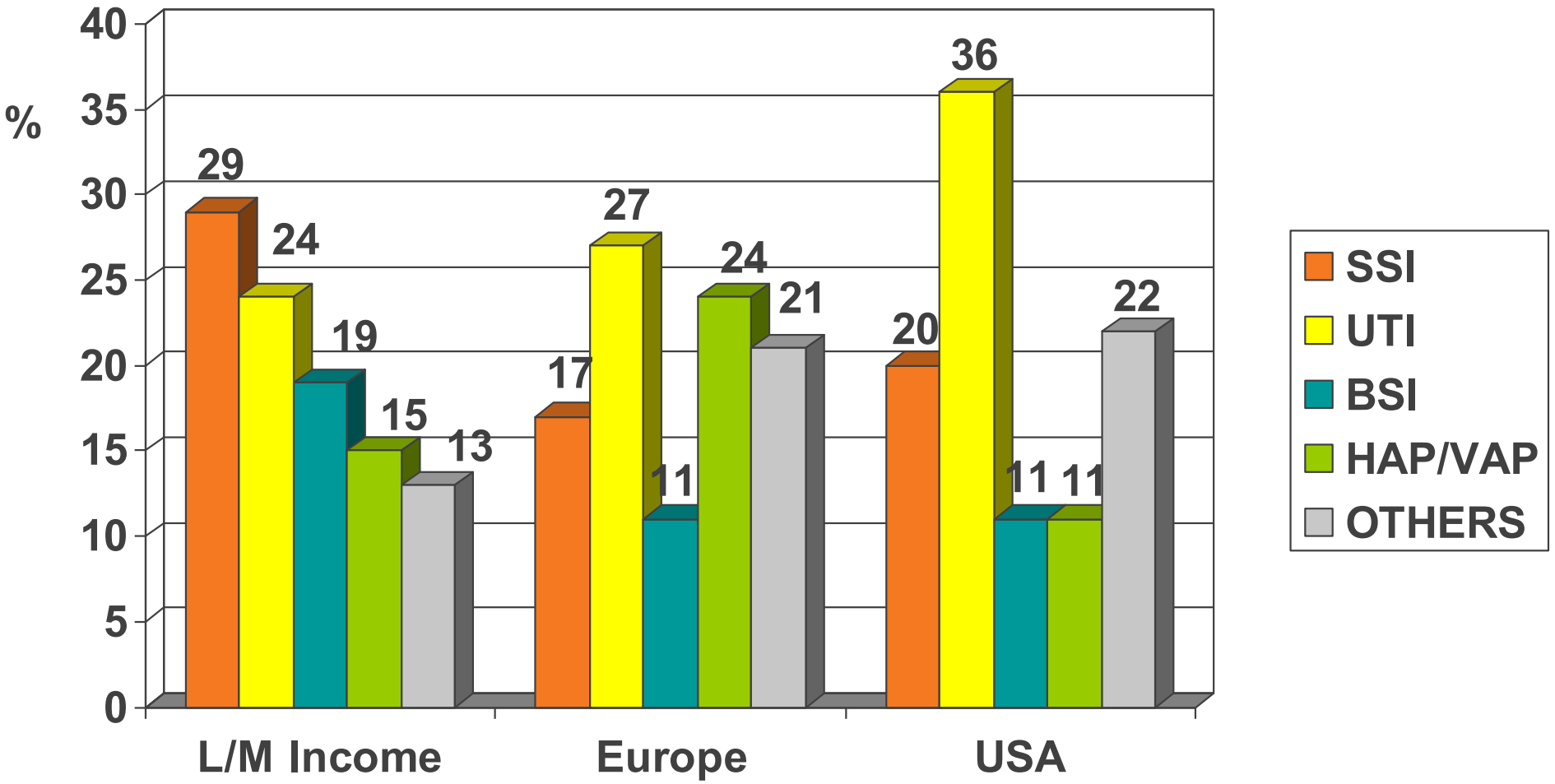
Range: 5.7-19.1%
Pooled prevalence: 10.1% (95% CI 8.4-12.2)
In high-quality papers: 15.5% (95% CI 12.6-18.9)

WHO Report on the Burden of Endemic Health Care-associated Infection Worldwide

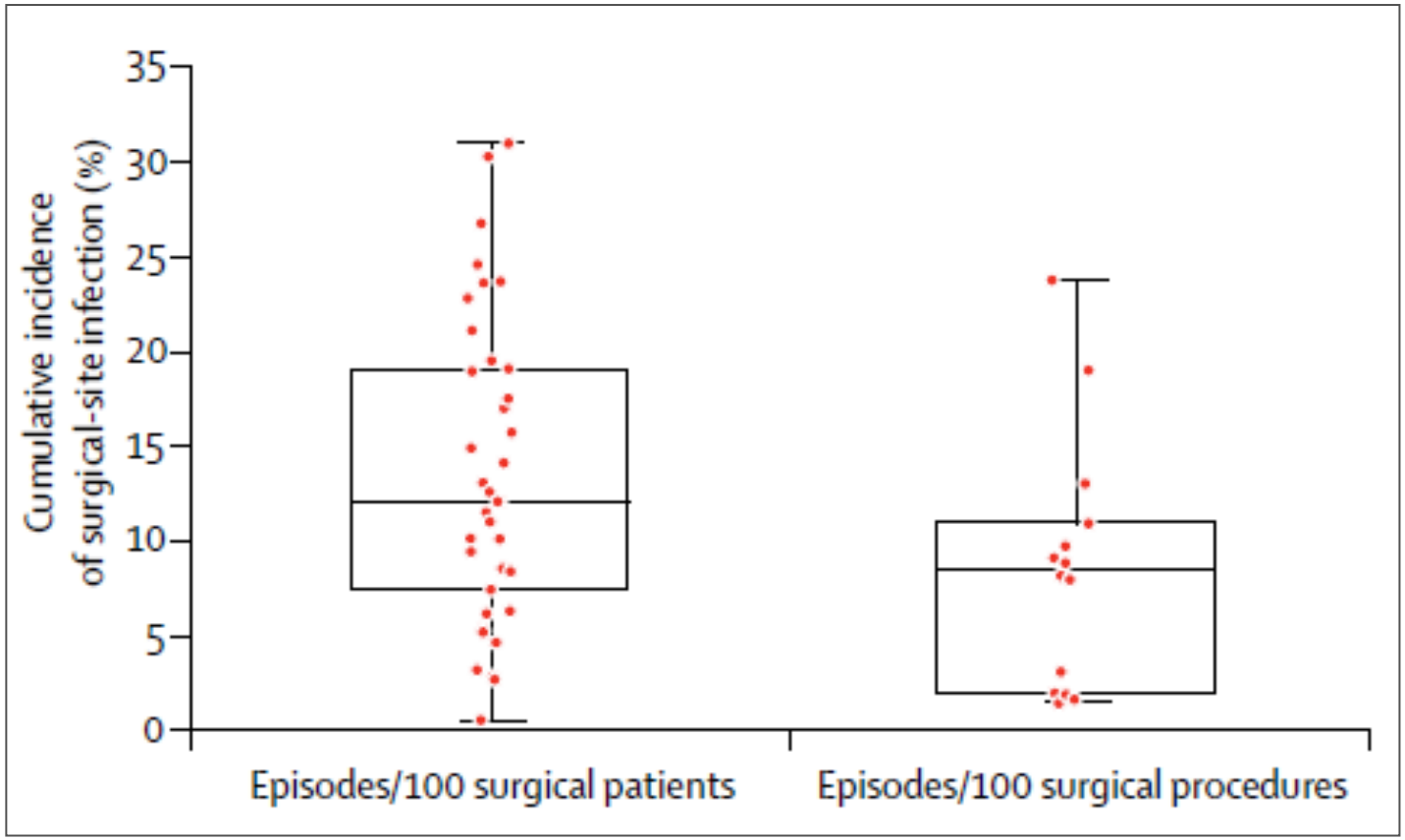
Type of study by region

	Africa		Americas		Eastern Med.		Europe		South-East Asia		West Pacific		Internat.		Total		
Type of infection	*Adult*	*Ped*	*Adult*	*Ped*	*Adult*	*Ped*	*Adult*	*Ped*	*Adult*	*Ped*	*Adult*	*Ped*	*Adult*	*Ped*	*Adult*	*Ped*	***All***
HAI general	6	1	31	20	14	3	29	4	15	5	7	6	4	0	*106*	*39*	***145***
SSI	7	3	16	3	8	0	8	0	12	0	5	0	0	0	*56*	*6*	***62***
VAP	1	1	5	0	8	0	4	1	6	2	1	1	0	0	*25*	*5*	***30***
BSI	0	0	5	2	1	1	3	1	3	3	0	2	0	0	*12*	*9*	***21***
HAP	0	1	3	0	0	0	3	0	2	1	0	1	0	0	*8*	*3*	***11***
UTI	1	0	1	0	2	0	2	0	1	0	0	0	0	0	*7*	*0*	***7***
Total	**15**	**6**	**61**	**25**	**33**	**4**	**49**	**6**	**39**	**11**	**13**	**10**	**4**	**0**	**214**	**62**	**276**

Type of hospital-acquired infection



Incidence of surgical site infections (57 studies)

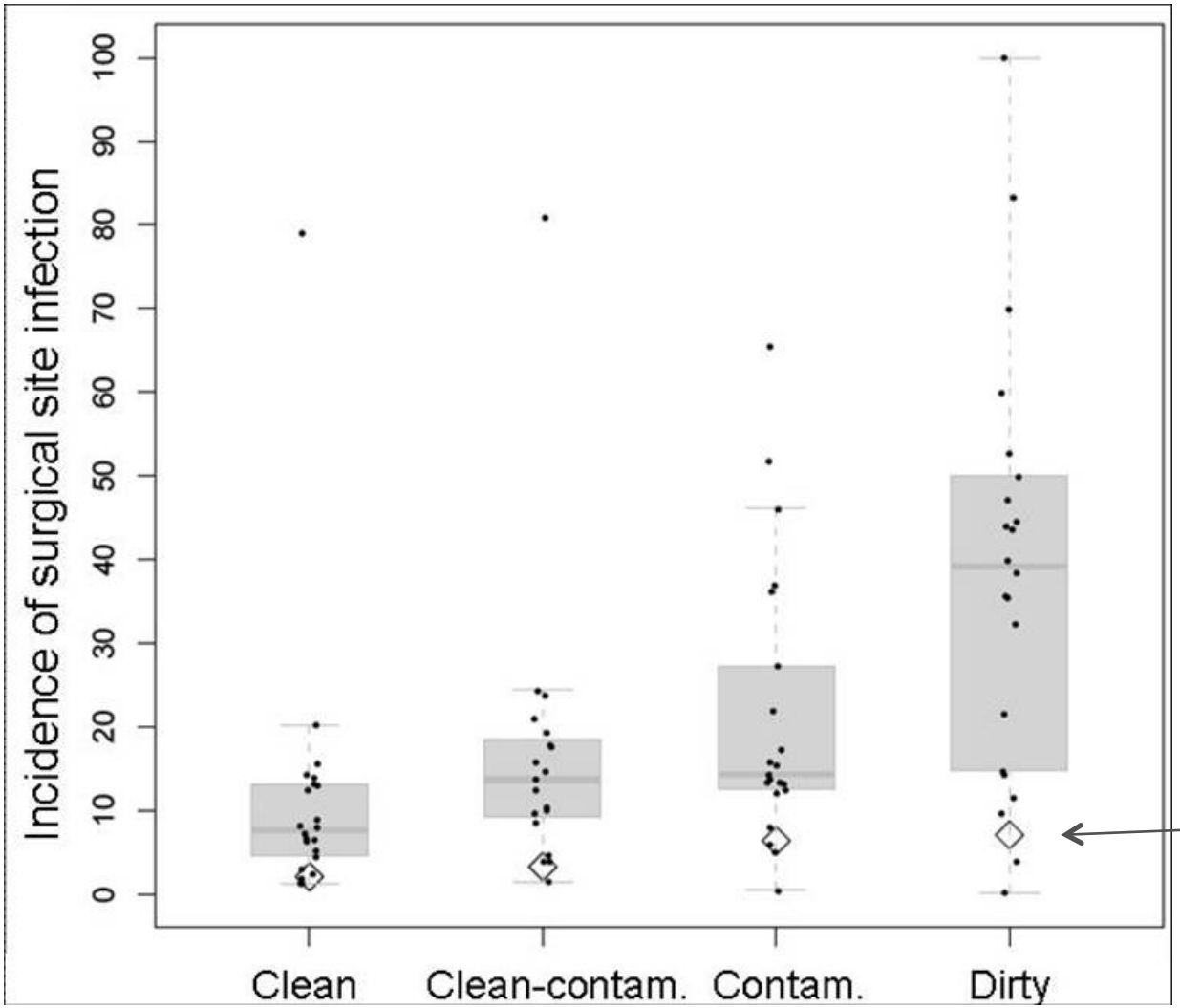


Range: 0.4-30.9 per 100 surg pts
1.2-23.6 per 100 surg procedures

Pooled cumulative incidence: 11.8 per 100 surg pts (95% CI 8.6-16.0)
5.6 per 100 surg procedures (95% CI 2.9-10.5)

Allegranzi B et al. Lancet 2011; 377:228-41

SSI risk in developing countries according to wound classification



SSI pooled means:

11.5, 16.6, 21.3, 38.8

episodes per 100 SP (from clean to dirty wound)

Allegranzi B et al. Lancet 2011;377:228-41

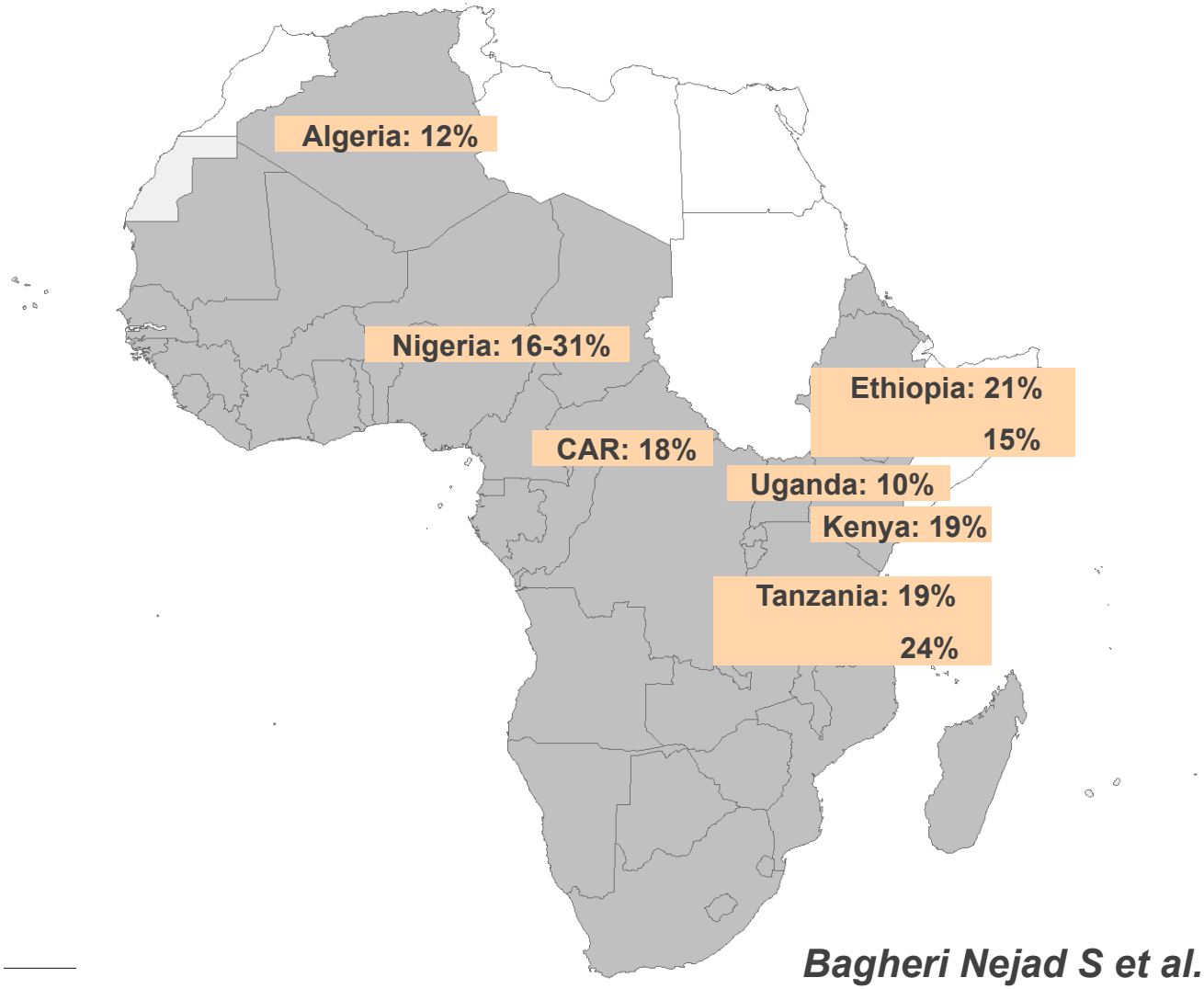
◊ NNIS reports

SSI rates from 30 countries, 4 continents, 2005-2010

CODE	Procedure name	INICC 2005–2010, SSI rate, %	CDC-NHSN 2006–2008 SSI rate (pooled risk categories), %	RR	95% CI	*P*
AAA	Abdominal aortic aneurysm repair	7.7	3.2	2.41	0.33–17.40	.3668
AMP	Limb amputation	2.7	2.3	1.18	0.80–1.74	.4099
APPY	Appendix surgery	2.9	1.4	2.05	1.61–2.59	.0001
BILI	Bile duct, liver or pancreatic surgery	9.2	9.9	0.93	0.70–1.22	.5945
BRST	Breast surgery	1.7	2.3	0.77	0.55–1.06	.1111
CBGB	Coronary bypass with chest and donor incision	4.5	2.9	1.52	1.44–1.61	.0001
CARD	Cardiac surgery	5.6	1.3	4.32	3.81–4.88	.0001
CHOL	Gallbladder surgery	2.5	0.6	3.94	3.10–5.01	.0001
COLO	Colon surgery	9.4	5.6	1.69	1.52–1.87	.0001
CRAN	Craniotomy	4.4	2.6	1.69	1.46–1.96	.0001
CSEC	Cesarean section	0.7	1.8	0.39	0.34–0.43	.0001
FUSN	Spinal fusion	3.2	1.5	2.10	1.48–3.00	.0001
FX	Open reduction of fracture	4.2	1.7	2.44	2.02–2.93	.0001
GAST	Gastric surgery	5.5	2.3	2.41	1.82–3.19	.0001
HER	Herniorrhaphy	1.8	2.3	0.78	0.63–0.96	.0197
HPRO	Hip prosthesis	2.6	1.3	2.06	1.80–2.37	.0001
HYST	Abdominal hysterectomy	2.7	1.6	1.66	1.36–2.03	.0001
KPRO	Knee prosthesis	1.6	0.9	1.84	1.56–2.18	.0001
LAM	Laminectomy	1.7	1.0	1.67	1.33–2.09	.0001

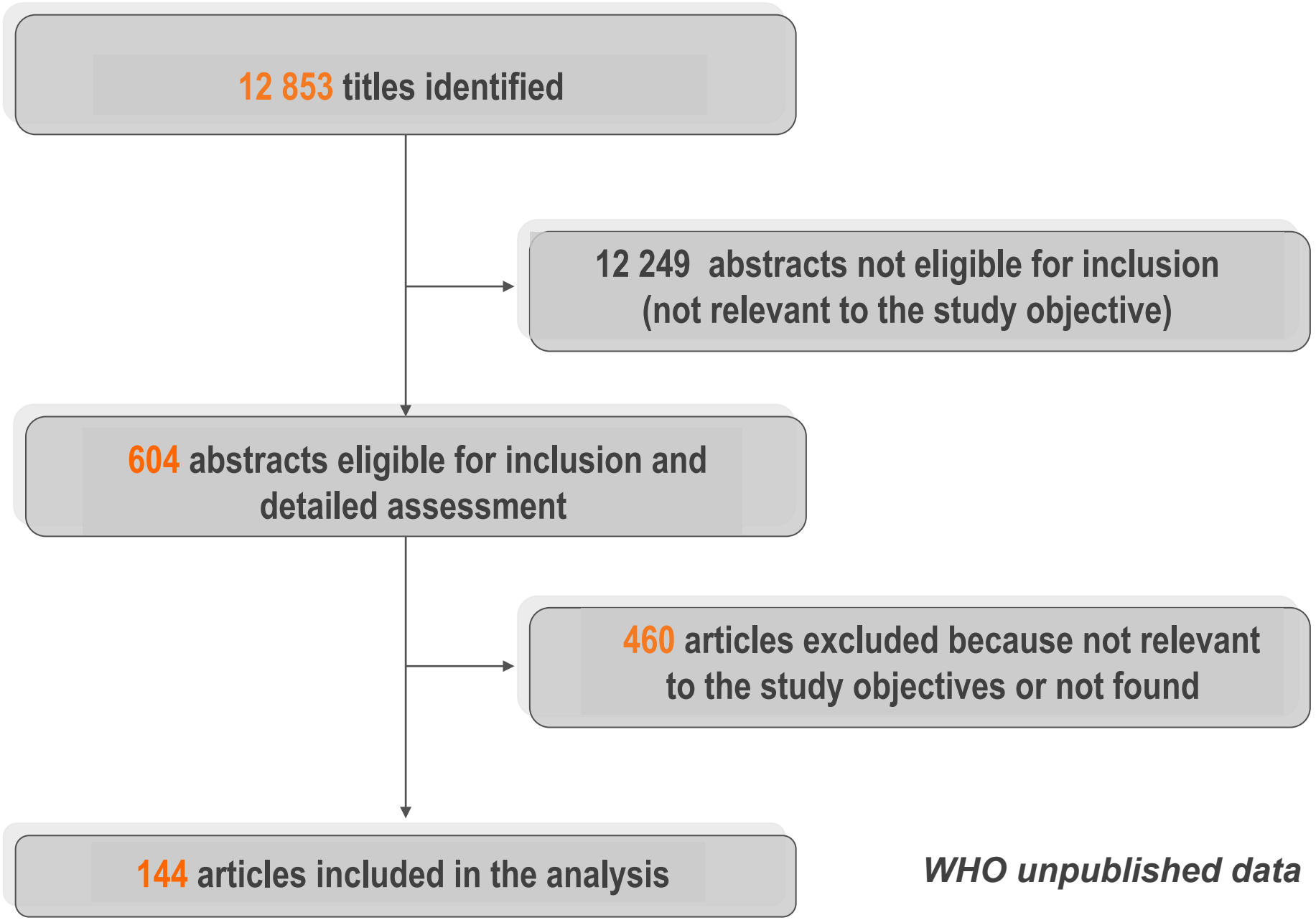
Rosenthal V et al, ICHE 2013

SSI incidence in Africa (studies from1995-2009)



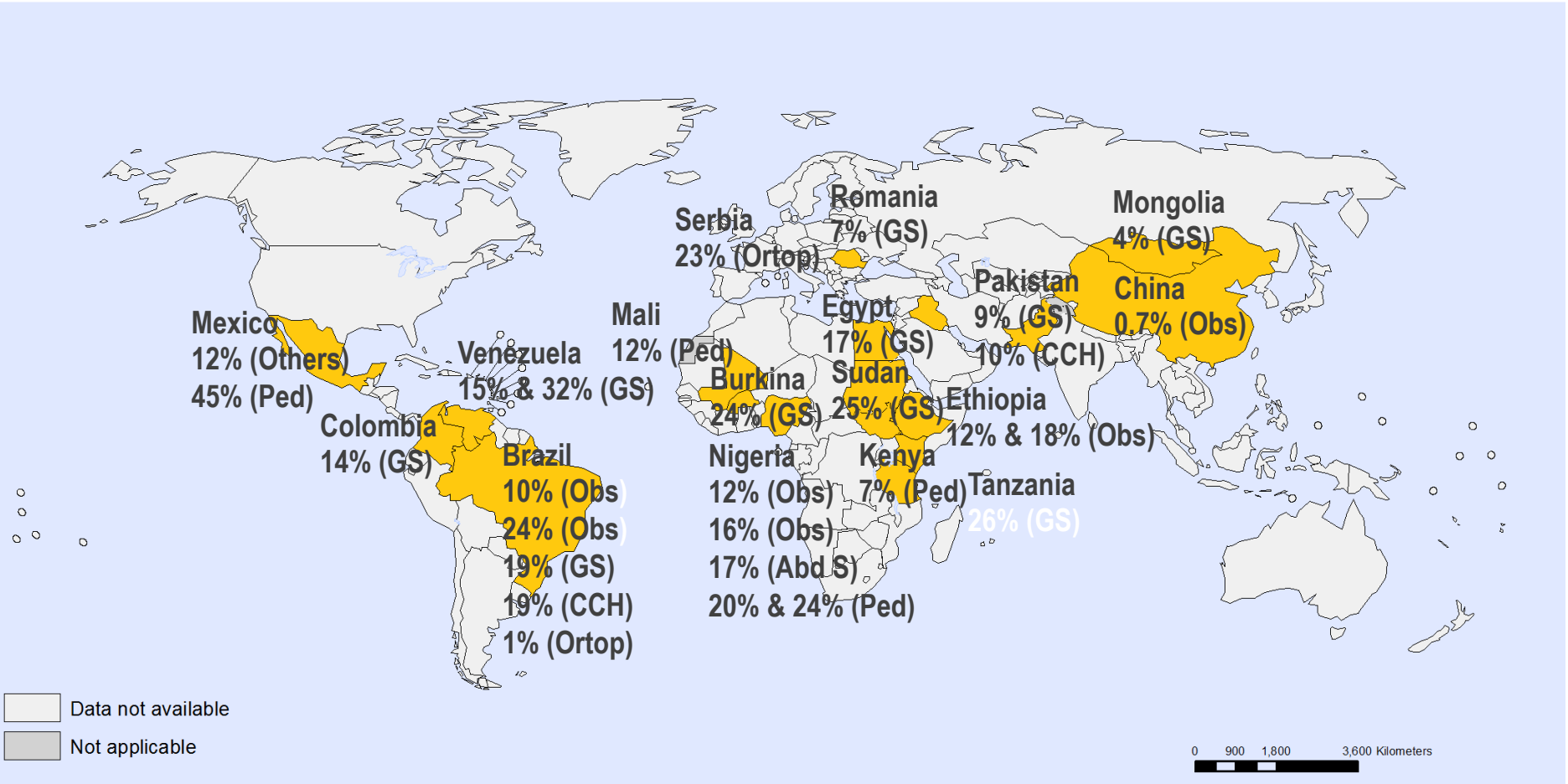
Bagheri Nejad S et al. WHO Bull 2011;89:757–765

Systematic review on SSI epidemiology in LMIC (1995-2014)
PRELIMINARY RESULTS



WHO unpublished data

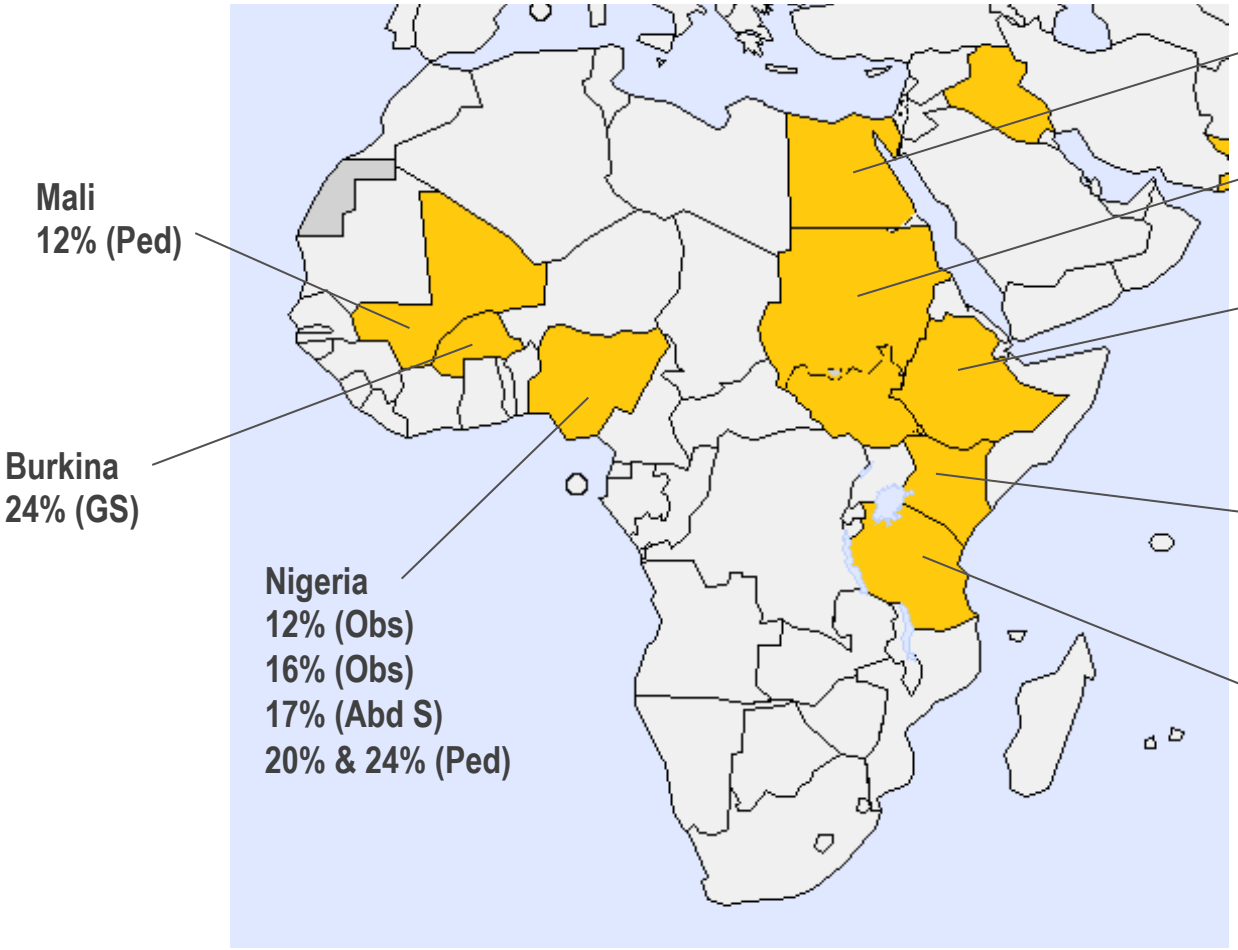
SSI frequency in specific countries (2010-2014)



Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

World Health Organization

SSI frequency in specific African countries (studies from 2010- 2013)



Pathogens	Number of isolates (%) (total number of studies 36)									
	BSI (5 studies)	%	SSI (20studies)	%	UTI (4 studies)	%	VAP/HAP (7 studies)	%	Total	%
S. aureus	62	14.5	245	20.3	4	1.1	47	10.2	358	14.6
Coagulase Neg Staph	92	21.5	92	7.6	1	0.3	15	3.3	200	8.2
Enterococcus spp	48	11.2	38	3.1	42	12.0	1	0.2	129	5.3
E. coli	25	5.8	245	20.3	55	15.7	6	1.3	331	13.5
Pseudomonas spp	52	12.1	210	17.4	53	15.1	134	29.2	449	18.3
Enterobacteriaceae (excl E coli)	49	11.4	311	25.7	37	10.5	92	20.0	489	20.0
Acinebacter spp	53	12.4	18	1.5	23	6.6	110	24.0	204	8.3
Candida spp	30	7.0	13	1.1	130	37.0	1	0.2	174	7.1
Other	17	4.0	37	3.1	6	1.7	53	11.5	113	4.6
Total	428	100	1209	100	351	100	459	100	2447	100

MRSA: 54.5%*

Allegranzi B et al.
Lancet 2011;377:228-41

Resistance rates in hospitals worldwide

North America

VRE (*E. faecium*)	66.1%
MRSA	50.6%
ESBL-*K. pneumoniae*	9.8%
A. baumannii (IMP-R)	10.9%
P. aeruginosa (IMP-R)	7.7%
Enterobacter spp. (CPE-R)	2.1%

Europe

VRE (*E. faecium*)	14.4%
MRSA	24.8%
ESBL-*K. pneumoniae*	17.0%
A. baumannii (IMP-R)	13.4%
P. aeruginosa (IMP-R)	9.1%
Enterobacter spp. (CPE-R)	6.5%

Latin America

VRE ( )	38.8%
ESBL-	36.2%
A. baumannii (IMP-R)	33.5%
P. aeruginosa (IMP-R)	18.0%
Enterobacter spp. (CPE-R)	13.5%

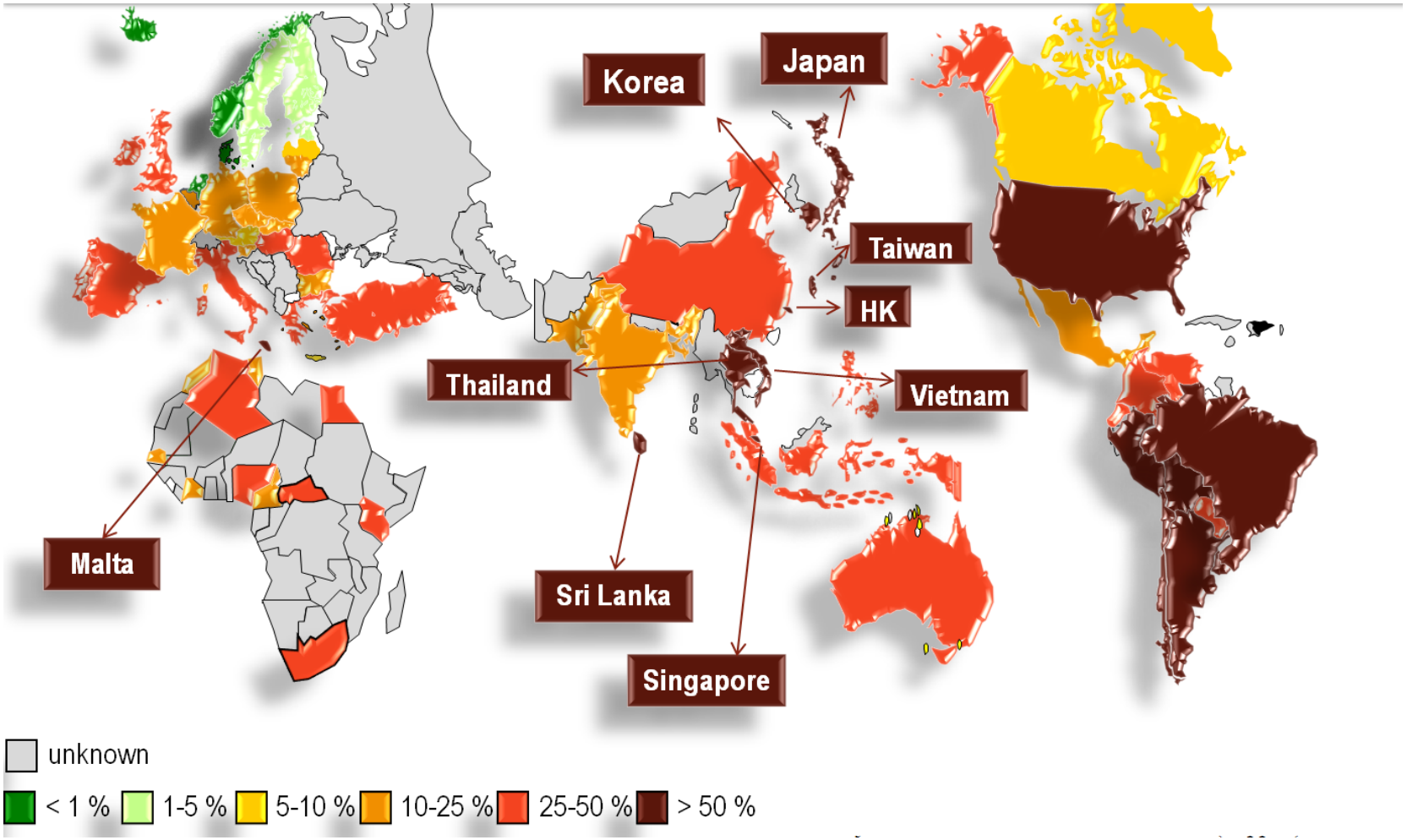
Asia Pacific

VRE (*E. faecium*)	21.7%
MRSA	45.0%
ESBL-*K. pneumoniae*	22.8%
A. baumannii (IMP-R)	24.2%
P. aeruginosa (IMP-R)	9.6%
spp. (CPE-R)	8.4%

www.testsurveillance.com.

Courtesy, Dr Kurup A

MRSA prevalence in hospital settings



Song JH, Chung DR. et al. 2011;66:1061-9
Grundmann H, et al. Lancet 2006;368:874-85
Stefani S, Chung DR, et al. Int J Antimicrob Agents 2012;39:273-82

Courtesy, Chung DR

Independent risk factors for SSI in LMIC

(systematic review 1995-2013)

Risk factors	Number of articles
Duration of surgery	12
Underlying pathology (diabetes)	10
Wound class	9
ASA	7
Age	4
Obesity	4
Duration of admission	3
Drain (use, duration)	3
Malnutrition	2
Sex (female)	2

Author, year, country	Population	LOS, days	Mortality	Costs
Nigeria, 2009, Nigeria	Paediatrics	with vs without 18.0 (1–99) without	vs 4.1%	NA
Bhatia, 2003, India	(CABG) graft (bypass) (CABG)	moderate 20 , severe 25) 20 , severe 25)	No SSI related deaths	in mild, moderate, severe infections severe infections
Raka, 2007, Kosovo	Abdominal surgery	without 4 without	NA	NA
Thailand , 2005, Thailand	Mixed surgery	Mean excess LOS: 21.3		1355 $
Kaya, 2006, Turkey	General surgery	Mean excess LOS: 8	NA	600 $
Le, 2006, Vietnam	Orthopaedics and neurosurgery	Median excess LOS: 18	No mortality difference	NA

Gaps in SSI surveillance in LMIC

No data from many countries

Inconsistent use of

- Definitions and surveillance methodologies

No data from many countries

Inconsistent use of

- Definitions and surveillance methodologies

- Post-discharge surveillance

  Use of N of patients as denominator

Limited data on

- Microbiology and antibiotic resistance

  NNIS index and other risk factors

Many challenges to preventing SSI in Africa

Patient-related

- eg. Co-morbidities inc HIV, malnutrition

- Operation-related
  - eg. Late presentation → contaminated operations
  - eg. Surgeon with poor handwashing technique
- Microbiological factors
  - eg. Colonisation with drug-resistant bacteria
- Institutional factors
  - Construction of building, sterilization services, staffing …

Risk Models are Needed to Monitor Performance

Different patients, different diseases, and different operations create different risks of infection

risk adjustment that accounts for these differences is critical to allow for meaningful comparisons between surgeons or between hospitals

National Nosocomial Infection Surveillance System Risk Index

One point given for each of the following:

1. patient having an **American Society of Anesthesiologists (ASA)** preoperative assessment score of 3, 4, or 5

One point given for each of the following:

1. patient having an **American Society of Anesthesiologists (ASA)** preoperative assessment score of 3, 4, or 5

2. an operation classified as either **contaminated or**

Crude infection rate or risk-adjusted standardised infection ratio?

Does stratifying surgical site infection rates by the National Nosocomial Infection Surveillance risk index influence the rank order of the hospitals in a surveillance system?

S. Brümmer [a,1], C. Brandt [b,1], D. Sohr [a], P. Gastmeier [a,*]

Journal of Hospital Infection (2008) 69, 295e300

The importance of surveillance

Reduction of Surgical Site Infection
Associated With Active Surv

C. Brandt,

Reduction of surg fections after
Caesarean d ng surveillance

Impact of a ontrol programme on
surgica tions in France: results of the
INCIS llance

C.

25-57% reduction

International Jo ality in Health Care 2006; **Volume 18, Number 2:** pp. 127–133 10.1093/int
Advance Acces cation: 16 February 2006

Reduced risk of surgical site infections through surveillance in a network

EVELINE L. P. E. GEUBBELS[1], NICO J. D. NAGELKERKE[2], A. JOKE MINTJES-DE GROOT[3], CHRISTINA M. J. E. VANDENBROUCKE-GRAULS[4], DIEDERICK E. GROBBEE[5] AND ANNETTE S. DE BOER[1]

Journal of Hospital Infection 83 (2013) 140–145

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Evaluation of surveillance for surgical site infections in Thika Hospital, Kenya

A.M. Aiken [a,b,*], A.K. Wanyoro [c,d], J. Mwangi [c], P. Mulingwa [c], J. Wanjohi [c], J. Njoroge [c], F. Juma [c], I.K. Mugoya [e], J.A.G. Scott [b,f], A.J. Hall [a]

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Kenya
Sub-Saharan Africa
Surgical site infection
Surveillance

SUMMARY

Background: In low-income countries, surgical site infections (SSIs) are a very frequent form of hospital-acquired infection. Surveillance is an important method for controlling SSI but it is unclear how this can best be performed in low-income settings.

Aim: To examine the epidemiological characteristics of various components of an SSI surveillance programme in a single Kenyan hospital.

Methods: The study assessed the inter-observer consistency of the surgical wound class (SWC) and American Society of Anesthesiologists (ASA) scores using the kappa statistic. Post-discharge telephone calls were evaluated against an outpatient clinician review 'gold standard'. The predictive value of components of the Centers for Disease Control and Prevention – National Healthcare Safety Network (CDC-NHNS) risk index was examined in patients having major obstetric or gynaecological surgery (O&G) between August 2010 and February 2011.

Findings: After appropriate training, surgeons and anaesthetists were found to be consistent in their use of the SWC and ASA scores respectively. Telephone calls were found

Keywords: ssi, surveillance, Kenya

Telephone calls after discharge

When phone calls and clinical reviews were within 48 hours of each other

		Clinician review = GOLD STANDARD	
		No SSI	SSI
Phone call status	No SSI	66	7
	SSI	0	16

On this basis

Sensitivity of phone call = 69.6% (95%CI 47.1-86.8%)
Specificity of phone call = 100% (95%CI 95-100%)

Why is there so little SSI surveillance in LMIC?

- Lack of dedicated human resources and funds
- Lack of expertise in epidemiology and infection control
- Difficulties in the application of standard definitions:
  - limited expertise
  - lack of reliable microbiological and other diagnostic tools
  - poor-quality information from patient records
  - need to evaluate clinical evidence
- Lack or insufficient microbiology laboratory capacity
- Lack of skills for data interpretation and use
- Existence of different payer sources
- Penalization of hospitals and staff by State Inspection Agency

Allegranzi B et al. Lancet 2011

5 May 2014
Role of hand hygiene to combat antimicrobial resistance
http://www.who.int/gpsc/5may/en/

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5 Moments
to change
the world

Clean your hands, stop the spread of drug-resistant germs!

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A Global Prevalence Survey on Multidrug- Resistant Organisms (MDROs) – to assess and raise awareness of the burden of the five key health case-associated MDROs that have been identified at the global level

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- **Find out how to participate at:**

English http://www.who.int/gpsc/5may/global-surveys/en/

French http://www.who.int/gpsc/5may/global-surveys/fr/

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Thank you

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Find information at www.who.int/gpsc/5may

Send enquiries to savelives@who.int or allegranzib@who.int