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SURVEILLANCE REPORT

Surveillance of healthcare-associated infections in Europe

2007

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Abbreviations

ASA	American Society of Anaesthesiology
ATC	Anatomical Therapeutic Chemical Classification System
BSI	Bloodstream infection
C3	Third-generation cephalosporins
CA-BSI	Catheter-associated bloodstream infection
CABG	Coronary artery bypass grafting
CBGB	Coronary artery bypass grafting with both chest and donor site incisions
CBGC	Coronary artery bypass grafting with chest incision only
CHOL	Cholecystectomy
CI	Confidence interval
COLO	Colon surgery
CNS	Coagulase-negative staphylococci
CR-BSI	Catheter-related bloodstream infection
CSEC	Caesarean section
DIG	Digestive tract infection
ECDC	European Centre for Disease Prevention and Control
ENZ. INH.	Enzyme inhibitor
EU	European Union
HAI	Healthcare-associated infection
HELICS	Hospitals in Europe Link for Infection Control through Surveillance
IAP	Intubation-associated pneumonia
IPSE	Improving Patient Safety in Europe
HPRO	Hip prosthesis
ICU	Intensive care unit
ITS-KISS	ICU module of the KISS surveillance
KISS	Krankenhaus Infektions Surveillance System (Germany)
KPRO	Knee prosthesis
LAM	Laminectomy
LOS	Length of stay
MRSA	Meticillin-resistant *Staphylococcus aureus*
MRSE	Meticillin-resistant *Staphylococcus epidermidis*
NHSN	National Healthcare Safety Network (formerly NNIS)
NNIS	National Nosocomial Infections Surveillance
NSIH	National Surveillance of Infections in Hospitals
OTH	Other
P	Percentile
PN	Pneumonia
POD	Postoperative days
PT DAYS	Patient-days
PUL	Pulmonary tract infection
Q	Quartile
SAPS	Simplified Acute Physiology Score
SSI	Surgical site infection
SST, Skin/ST	Skin and soft tissue infection
Unk.	Unknown
Unsp.	Unspecified
UTI	Urinary tract infection

Country codes

AT	Austria	LT	Lithuania
BE	Belgium	LU	Luxembourg
DE	Germany	NL	The Netherlands
ES	Spain	NO	Norway
FI	Finland	PT	Portugal
FR	France	RO	Romania
HR	Croatia	SK	Slovakia
HU	Hungary	UK	United Kingdom
IT	Italy		

Executive summary

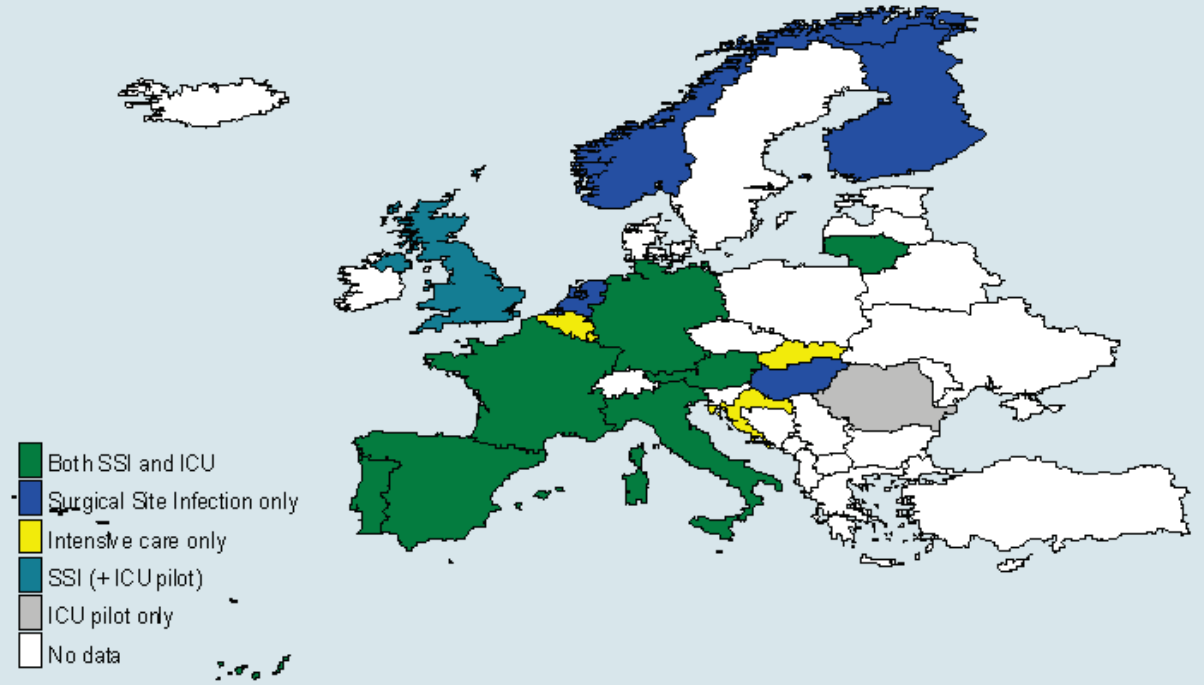
Key points:

- Each year in the European Union (EU), approximately 4 million patients acquire a healthcare-associated infection (HAI) and approximately 37 000 of them die as the direct result of the infection [1]. The most frequent HAI types are urinary tract infections, pneumonia, surgical site infections, bloodstream infections and gastrointestinal infections. The most frequently isolated microorganisms in HAI overall are *Escherichea coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterococcus* species, coagulase-negative staphylococci and *Candida species*. The most frequent cause of healthcare-associated diarrhoea is *Clostridium difficile*.
- National networks for the surveillance of healthcare-associated infections provide participating hospitals with a standardised methodology and reference data to make risk-adjusted comparisons of HAI rates and follow up the effect of infection control measures. Healthcare-associated infection surveillance protocols target specific infection types, e.g. surgical site infections or high-risk patients, e.g. patients admitted to intensive care units (ICU).
- Since 2000, the surveillance of surgical site infections and ICU-acquired infections has been coordinated at the EU level by the HELICS project (Hospitals in Europe Link for Infection Control through Surveillance) [2,3], funded by the European Commission Directorate-General for Health and Consumers, and later, from 2005 to June 2008, as part of the IPSE (Improving Patient Safety in Europe) network [4]. The objectives of HAI surveillance at the EU level are to gradually improve data quality and comparability through intercountry comparisons; to follow up trends of HAI rates, microorganisms and antimicrobial resistance for specific infection types; to set up reference figures for inter-hospital comparisons at the EU level; to exchange information and expertise; and to support Member States in setting up or reinforcing surveillance networks using standardised surveillance tools and through on-site courses.
- In July 2008, the coordination of the IPSE network was transferred to the European Centre for Disease Prevention and Control (ECDC). Some of the previous activities of the IPSE network were outsourced, such as the surveillance of healthcare-associated infections in long-term care facilities and the needs assessment for infection control training in EU Member States. Other activities coordinated by ECDC beside the two surveillance modules mentioned above are the harmonisation of methods for point prevalence surveys of HAI and antimicrobial use in European hospitals, for the surveillance of infection control structure and process indicators and for the surveillance of *C. difficile* infections.

The main results from the data collected by ECDC in February 2009 for the surveillance of surgical site infections and the surveillance of ICU-acquired infections are summarised below:

- Surgical site surveillance data for 2007 with follow-up data until December 2008 were received from 11 EU Member States (15 surveillance networks) and one EEA/EFTA country (Norway) on 260 414 operations from 1 156 hospitals. Twelve Member States and one candidate country (Croatia) contributed data on ICU-acquired infections from 721 hospitals (889 ICUs), two of which were pilot data. In total 17 countries participated in at least one of the HAI surveillance modules (Figure 1). Compared with 2006, there were two new networks (SSI network in Italy and ICU network in Croatia), but unlike in previous years, Belgium and Poland did not submit SSI data for 2007.
- Hip and knee prostheses (HPRO and KPRO) accounted for nearly 60% of the surveyed operations because of the high surveillance coverage in the UK, where the surgical site infection (SSI) surveillance is mandatory for these surgical procedure categories.
- In 2007, a total of 5 478 SSI were reported; of those SSIs, 5 366 SSIs occurred within the defined period of 30 days after the intervention or one year for HPRO and KPRO. Overall 59.6% of SSIs were superficial, 24.8% deep and 15.6% organ/space.
- The intensity of post-discharge surveillance varied considerably between countries and operation categories. The overall percentage of SSI detected after discharge from the hospital was 40.6% and ranged from 17% in Lithuania and Hungary to 77% in Norway and 86% in Finland when discharge date was known. The discharge date, essential for the calculation of the in-hospital incidence density, was however missing in 13.3% of interventions overall, in particular in Germany (decrease from 64.8% missing dates in 2004–2006 to 37.9% in 2007) and Finland (increase from 45.5% in 2004–2006 to 59.8% in 2007).
- Information about results of microbiological analyses was available only in one third (1 962) of SSIs detected. *Staphylococcus aureus* was isolated from SSIs in coronary artery bypass grafts (CABG, 34.5%), HPRO (33.6%) and KPRO (46.3%); of SSIs caused by *Staphylococcus aureus*, with available results on antibiotic susceptibility, 30.7% were meticillin-resistant (MRSA).
- The overall cumulative surgical site incidence in 2007 was 0.4% in laminectomy, 0.8% in knee prosthesis, 1.2% in hip prosthesis, 1.4% in cholecystectomy, 2.8% in coronary artery bypass graft, 2.8% in caesarean section and 9.5% in colon surgery.

Figure 1: Participation in EU surveillance of healthcare-associated infections, status in 2007



- Surgical site infection rates (both incidence density and cumulative incidence) in hip prosthesis decreased markedly from 2004 to 2007 ($p < 0.001$). Risk-adjusted trend analysis also showed significant decreases in SSI incidence density in knee prosthesis since 2005.
- The European surveillance of ICU-acquired infections showed that, in 2007, 7% of patients staying more than two days in intensive care units acquired pneumonia, 3.9% acquired a bloodstream infection and 6.8% a urinary tract infection. The overall incidence density was 7.9 pneumonia episodes per 1 000 patient-days and 4.2 bloodstream infections per 1 000 patient-days, varying strongly according to the percentage of intubated patients, the case-mix severity marker in unit-based surveillance.
- The mean device-adjusted pneumonia rate was 13.2 intubation-associated pneumonia per 1 000 intubation-days, varying from 7.2 in Luxembourg to 22 in Slovakia. The overall catheter-associated bloodstream infection rate (CA-BSI) was 3.2 per 1 000 central-line-days and the catheter-related bloodstream infection rate (CR-BSI) was 1.9 per 1 000 central-line-days.
- Inter-unit and intercountry comparisons of indicators of ICU-acquired infections depended strongly on risk-adjustment, and thus on the type of ICU surveillance performed (unit-based, the minimal data set, or patient-based). The risk-adjusted analysis in patient-based surveillance also showed the incomplete risk adjustment by device-days only (CDC/NHSN methodology [5]).
- The most frequently isolated microorganisms in ICU-acquired pneumonia were *P. aeruginosa*, *S. aureus*, *E. coli*, *Klebsiella* spp. and *Enterobacter* spp. There were large variations between countries, especially for *Acinetobacter* spp., which represented more than 10% of reported microorganisms in Croatia, Italy, Lithuania, Portugal, Slovakia and Spain and and less than 3% in other countries. Gram-negative microorganisms increased significantly since 2004 while gram-positives decreased.
- Resistance to oxacillin in *S. aureus* isolated from ICU-acquired infections decreased significantly between 2004 and 2007. Most markers of antimicrobial resistance in gram-negatives, however, increased during the same period. In 2007, worrying percentages of carbapenem resistance and colistin resistance were reported in *Acinetobacter* spp. (e.g. 73% carbapenem resistance and 3.6% colistin resistance) and *P. aeruginosa*. The frequent use of 'last-resort' antimicrobials, such as colistin, also confirmed the high incidence of life-threatening ICU-acquired infections with multiresistant bacteria.

Introduction

Healthcare-associated infections (HAI) are infections occurring after exposure to healthcare, often, but not always, as a consequence of this exposure. Surveillance of healthcare-associated infections has mainly focused on infections associated with acute care hospital stay (also referred to as nosocomial infections), with surveillance of surgical site infections and nosocomial infections in intensive care units as the most commonly implemented types of HAI surveillance in European Union (EU) Member States [1]. In July 2008, the coordination of the network for the surveillance of healthcare-associated infections (HELICS – Hospitals in Europe Link for Infection Control through Surveillance) in Europe was transferred from the IPSE (Improving Patient Safety in Europe) project to the European Centre for Disease Prevention and Control (ECDC) in Stockholm.

The surveillance of surgical site infections (HELICS-SSI) and of nosocomial infections in intensive care units (HELICS-ICU) continued without changes to the surveillance protocols as in the HELICS network, collecting data from the national surveillance networks for HAI based on common protocols agreed on in 2002–2003 [2,3].

ECDC also continues to provide support to Member States to set up such hospital surveillance networks in their countries by making available free software for hospitals and network coordination centres, and by organising training courses on HAI surveillance.

Other elements of the IPSE transition plan and the activities of ECDC include the surveillance of healthcare-associated infections in long-term care facilities and the European point prevalence survey of healthcare-associated infections and antimicrobial use in acute care hospitals. The former of these activities is outsourced to the HALT project (Healthcare-associated infection surveillance in long-term care facilities), a consortium under the coordination of the former IPSE hub (Claude Bernard University Lyon). The main objective of the EU-wide prevalence survey is to estimate the total burden of all types of healthcare-associated infections in all Member States of the EU in 2011–2012, something that is clearly not the objective of the two risk-oriented surveillance systems on which we report here. Surgical site infection (SSI) surveillance and surveillance of infections acquired in intensive care units (ICUs) specifically target infections in high-risk groups, which are responsible for a high proportion of the burden of HAI in terms of morbidity and mortality. The primary objective for a hospital or ICU to participate in such a national surveillance network is to compare its own infection rates with those of other hospitals/ICUs as a measure of its own performance and to follow up the effect of infection control measures. In order for these comparisons to be meaningful, infection rates have to be risk-adjusted so that variations due to differences in case-mix are eliminated as far as possible. Since HAI are relatively rare events, surveillance also has to be carried out over longer periods to stabilise confidence intervals of infection rates. Moreover, patients have to be followed up (up to one year for surgical site infections in hip prosthesis and knee prosthesis) before final infection rates can be reported. For these reasons, these risk-oriented surveillance systems are rather slow and are certainly not designed for rapid detection of nosocomial outbreaks.

The main objectives of the European HAI surveillance are to analyse intercountry differences, to work towards comparable surveillance methods, to draw up European reference tables for inter-hospital comparisons of risk-adjusted HAI rates (useful for smaller countries that do not have sufficient national reference figures), to contribute to the extension of HAI surveillance in the EU and to follow up and report on long-term trends in HAI rates in the EU and within Member States, as well as trends in the occurrence of different healthcare-associated pathogens, including trends of antimicrobial resistance markers.

The primary aim of this report is to present the results of the 2007 surveillance of surgical site infections (with follow-up data until December 2008) and ICU-acquired infections (with ICU stays until March 2008), and to compare these data with those obtained from 2004 until 2006. The collection of the data included in this report was carried out in February 2009. A summary of the results was published earlier in ECDC's Annual Epidemiological Report on Communicable Diseases in Europe, 2009 [6].

Part I – Surveillance of surgical site infections

1 Methods

In accordance with the current HELICS-SSI protocol [2], the SSI surveillance is patient-based with eight surgical procedure categories of the National Healthcare Safety Network of the Centres for Disease Control [5] (former National Nosocomial Infections Surveillance System, NNIS) under surveillance: CBGB (coronary artery bypass graft with both chest and donor site incisions) and CBGC (coronary artery bypass graft with chest incision only), CHOL (cholecystectomy), COLO (colon surgery), CSEC (caesarean section), HPRO (hip prosthesis), KPRO (knee prosthesis) and LAM (laminectomy).

The approach taken to SSI surveillance by HELICS is to enhance the comparability of data by targeting clearly the above-mentioned categories of surgical procedures and collecting data that enable adjustment for variation in case-mix. Adjustment for case-mix is based on the NHSN risk index [7,8]. This is based on three factors: the wound contamination class [8] (1 point if > 2: contaminated or dirty/infected wounds), the ASA (American Society of Anaesthesiology) physical status classification [10] (1 point if > 2: severe systemic disease to moribund patient) and the duration of the operation (greater than the time at the NHSN 75th percentile time for that group of procedures). Each factor is equivalent to zero or one point and each operation is therefore allocated a risk index score of between zero and three depending on how many of the factors are present.

For each surgical procedure category two indicators have been used to express the SSI risk:

- the cumulative incidence, which is the crude percentage of operations resulting in a SSI (the numerator is the number of SSIs detected within 30 days after the operation or one year for HPRO and KPRO, the denominator is the total number of operations of the respective operation category);
- the incidence density, which is the number of SSIs with onset before hospital discharge per 1 000 postoperative patient days in the hospital.

The incidence density is the preferred measure for the comparison of incidence between countries as it uses only observations during the hospital stay in both numerator and denominator and comparisons are therefore less affected by variation in length of postoperative stay in hospital (LOS) or intensity of case-finding post-discharge. However, the incidence density can only be calculated when the discharge date is known. A third indicator was added in 2008: the cumulative incidence excluding post-discharge SSIs.

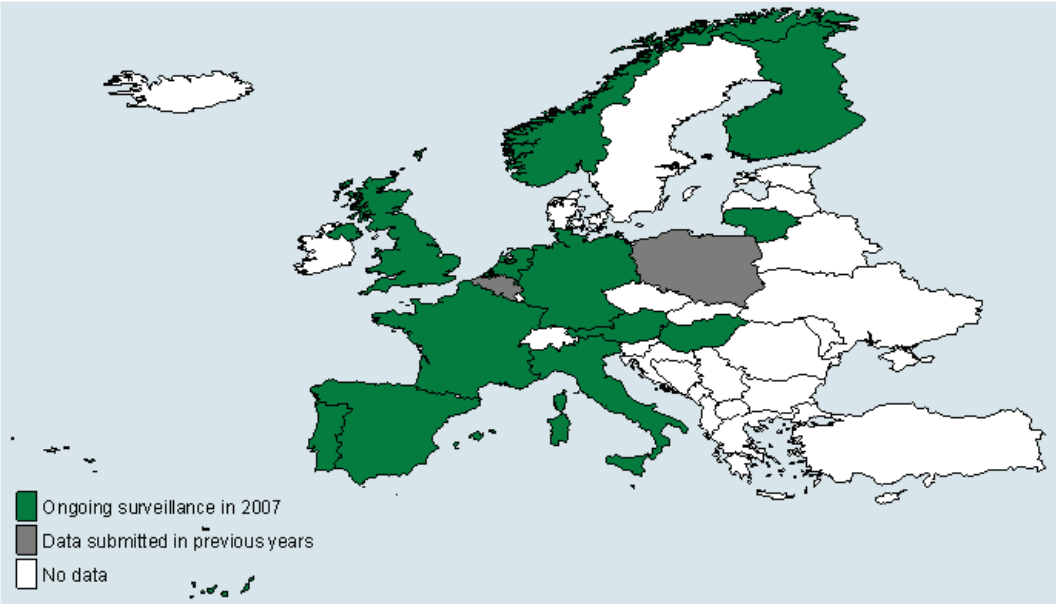
Trend analyses were performed using Poisson regression adjusting for case-mix (NHSN risk-index). Poisson exact 95% confidence intervals were calculated around infection rates.

2 Participation

Surgical site surveillance data for 2007 with follow-up until December 2008 were received from 15 networks present in 12 countries (Austria, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, Norway, Portugal, Spain and the United Kingdom) (Figure 2); these data concerned 260 414 operations from 1 156 hospitals (compared with 238 550 from 1 033 hospitals in 2006, 162 427 from 806 hospitals in 2005 and 120 209 from 655 hospitals in 2004). Figures may slightly differ from earlier published data because of data updates from Member States.

Italy submitted data for the first time in 2009 (2007 data), while two countries who had previously submitted data, Belgium and Poland, did not submit for 2007. Other EU countries either did not yet have a national network for the SSI surveillance at the time of the data collection (February–March 2009) or did not submit data in time to be included in this report.

Figure 2: Participation in EU surveillance of surgical site infections, status in 2007



The numbers of hospitals and of operations by country and by surgical procedure category are shown in Table 1.

Table 1: Number of hospitals and operations included in the European surveillance of surgical site infections according to the HELICS-SSI protocol, by country and by surgical procedure category, 2007

Country	Number of hospitals	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM	Total
AT	30	296	152	170	2 200	3 946	318	133	7 215
DE	186	7 569	8 961	5 333	11 997	20 935	11 927	2 136	68 858
ES	26	571	963	851	719	982	444	242	4 772
FI	13	0	0	0	0	5 441	4 134	0	9 575
FR	508	744	10 020	5 832	17 791	12 545	8 109	844	55 885
HU	18	0	1 509	185	1 664	639	108	0	4 105
IT	52	381	955	654	1 461	618	770	94	4 933
LT	6	517	816	194	0	230	157	0	1 914
NL	31	0	420	836	1 282	3 099	1 816	0	7 453
NO	49	681	343	0	1 672	1 374	0	0	4 070
PT	13	0	1 037	438	789	215	0	10	2 489
UK	224	3 810	0	2 162	12 241	34 262	36 670	0	89 145
Total	**1 156**	**14 569**	**25 176**	**16 655**	**51 816**	**84 286**	**64 453**	**3 459**	**260 414**

CABG = coronary artery bypass graft (=NHSN codes CBGB+CBGC), CHOL = cholecystectomy, COLO = colon surgery, CSEC = caesarian section, HPRO = hip prosthesis, KPRO = knee prosthesis, LAM = laminectomy.

The category of surgical procedures transmitted to the EU database depended on whether these procedures were included in the national surveillance protocol or not. Several countries allow the participating hospitals to select freely the category of surgical procedures to be surveyed as a function of local needs or interests. Therefore, the number of hospitals included in the database does not necessarily represent the total number of hospitals participating in the SSI surveillance network as some networks register surgical procedures other than the ones used in the HELICS protocol [11].

In Table 2, a SSI surveillance coverage estimate is given by surgical procedure category and by country. Overall, the estimated SSI surveillance coverage was 9.1% (total number of performed operations = 2 888 711). Considering the different surveillance strategies, the coverage varies between countries. In some countries participation in SSI surveillance is continuous, while in other countries SSI surveillance is only performed for a few months, e.g. three or six months. Another difference is that while in most cases surveillance is encouraged but not mandatory, surveillance for specific surgical procedures is mandatory in some networks. For example, the high coverage in the United Kingdom for CSEC, HPRO and KPRO is explained by the mandatory participation in the following surveillance networks: UK-Scotland and UK-Wales for CSEC; UK-England, UK-Northern Ireland, UK-Scotland and UK-Wales for HPRO and KPRO.

Table 2: Number of surveyed operations and coverage of total number of performed operations by surgical procedure category and by country, 2007

Country	AT	DE	ES	FI	FR	HU	IT[2]	LT[3]	NL[4]	NO[5]	PT	UK
CABG												
N. surveyed op.	296	7 569	571	0	744	0	381	517	0	681	0	3 810
N. performed op.[1]	3 546	106 408	12 015		19 887		12 169	3 476		3 000		23 484
Coverage %	**8.3**	**7.1**	**4.8**		**3.7**		**3.1**	**14.9**		**22.7**		**16.2**
CHOL												
N. surveyed op.	152	8 961	963	0	10 020	1 509	955	816	420	343	1 037	0
N. performed op.[1]	2 920	177 554	54 179		114 842	22 705	50 066	6 667	19 391	3 500	16 254	
Coverage %	**5.2**	**5.0**	**1.8**		**8.7**	**6.6**	**1.9**	**12.2**	**2.2**	**9.8**	**6.4**	
COLO												
N. surveyed op.	170	5 333	851	0	5 832	185	654	194	836	0	438	2 162
N. performed op.[1]	3 269	93 471	48 633		88 337	7 599	25 860	1 305	3 188		11 911	42 287
Coverage %	**5.2**	**5.7**	**1.7**		**6.6**	**2.4**	**2.5**	**14.9**	**26.2**		**3.7**	**5.1**
CSEC												
N. surveyed op.	2 200	11 997	719	0	17 791	1 664	1 461	0	1 282	1 672	789	12 241
N. performed op.[1]	20 214	239 270	87 402		163 718	27 775	106 049		20 636	9 000	27 347	21 215
Coverage %	**10.9**	**5.0**	**0.8**		**10.9**	**6.0**	**1.4**		**6.2**	**18.6**	**2.9**	**57.7**
HPRO												
N. surveyed op.	3 946	20 935	982	5 441	12 545	639	618	230	3 099	1 374	215	34 262
N. performed op.[1]	15 694	203 855	39 501	9 056	122 410	9 095	42 366	3 340	25 735	6 000	8 576	97 582
Coverage %	**25.1**	**10.3**	**2.5**	**60.1**	**10.2**	**7.0**	**1.5**	**6.9**	**12.0**	**22.9**	**2.5**	**35.1**
KPRO												
N. surveyed op.	318	11 927	444	4 134	8 109	108	770	157	1 816	0	0	36 670
N. performed op.[1]	14 701	138 476	40 600	10 359	69 434	4 215	36 102	2 130	13 266			93 336
Coverage %	**2.2**	**8.6**	**1.1**	**39.9**	**11.7**	**2.6**	**2.1**	**7.4**	**13.7**			**39.3**
LAM												
N. surveyed op.	133[2]	2 136	242	0	844	0	94	0	0	0	10	0
N. performed op.[1]		122 787	17 753		14 274		22 878				4 641	
Coverage %		**1.7**	**1.4**		**5.9**		**0.4**				**0.2**	

[1] Number of performed operations (op.): source: personal communications from national surveillance networks, reference year 2007.
[2] Number of performed operations, reference year 2005 (second half).
[3] Number of performed operations not available.
[4] Number of performed operations, reference year 2004.
[5] Estimated number of performed operations.

3 Results

3.1 Characteristics of patients and surgical procedures

3.1.1 Age and gender by NHSN category

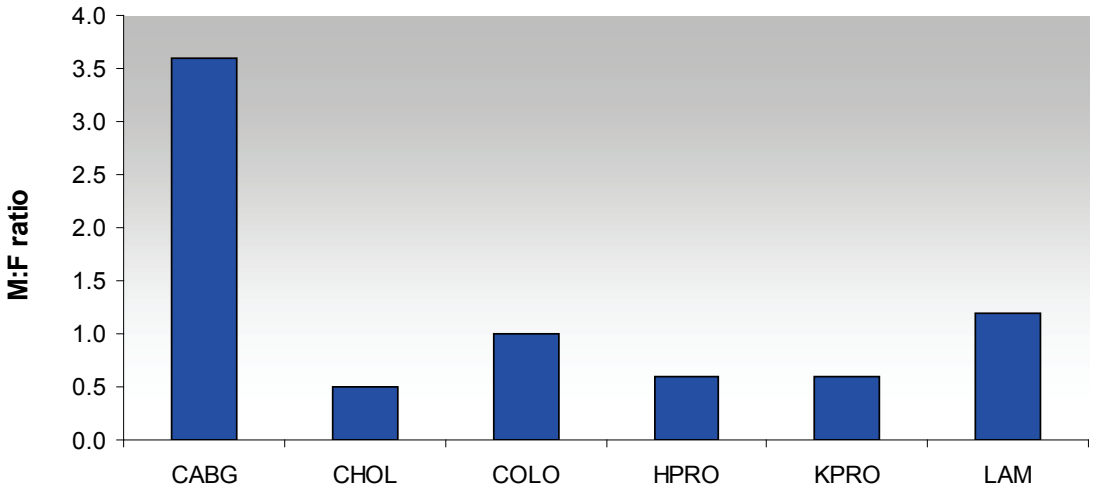
The age of the patients was known for almost all the surgical procedures (96.9%); overall the median age was 66 years. Table 3 shows the median age by country and by surgical procedure category. As would be expected, age was lowest for CSEC and highest for HPRO and KPRO. These results are very similar to those for previous years.

Table 3: Median age (years) by surgical procedure category and by country, 2007

	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	Overall
CABG	67	69	69		69		67	67		67		69	**68**
CHOL	58	58	60		57	56	58	58	53	47	58		**57**
COLO	67	69	70		68	66	68	70	70		67	69	**69**
CSEC	31	31	33		31	29	33		32	31	30	30	**31**
HPRO	69	71	75	71	74	68	77	70	72	73	72	70	**71**
KPRO	71	71	73	69	73	69	72	69	69			70	**71**
LAM	54	53	47		59		51				40.5		**54**

The overall male-to-female (M:F) ratio was 0.5 (CSEC included); the M:F ratio by surgical procedure category (CSEC excluded) is given in Figure 3. CABG is more frequently performed on men; COLO and LAM equally for both sexes; CHOL, HPRO and KPRO more frequently on women. Those data are very similar to the SSI surveillance in previous years and small differences are detected between countries.

Figure 3: Male-to-female ratio by surgical procedure category, 2007



3.1.2 Length of postoperative stay in hospital

A major factor influencing the detection of SSIs is the duration of the postoperative stay in hospital. After discharge, the detection of SSIs is entirely dependent on the intensity and effectiveness of the post-discharge surveillance organised by the hospital. Artificial differences in SSI rates due to different or non-existent post-discharge surveillance are more likely to occur for surgical procedures with a shorter average length of stay.

Overall the median length of stay was seven days; the length of stay by surgical procedure category and by country is given in Table 4, and, as in previous years, is the shortest for CHOL, followed by LAM and CSEC.

Table 4: Median postoperative length of hospital stay (days) by surgical procedure category and by country, 2007

	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	Overall
CABG	10	10	10		10		9	13		7		8	**9**
CHOL	5	5	3		4	4	4	5	2	2	3		**4**
COLO	12	12	11		11	11	10	13	10		9	10	**11**
CSEC	7	6	5		7	6	5		5	5	4	4	**6**
HPRO	12	13	8	4	10	10	11	11	6	8	11	7	**8**
KPRO	13	14	8	4	10	11	10	11	6			6	**7**
LAM	6	6	5		6		4				4.5		**6**

For operations without SSIs, the average length of stay was significantly lower (8.7 days, 95% CI 8.6–8.7) than for operations with SSIs (15.8 days, 95% CI 15.4–16.3).

As shown in Table 5, the average and the median length of stay differ between superficial SSIs and deep/organ SSIs, with significantly lower values for superficial SSIs. This difference may be due to a number of reasons: patients with deep and organ SSIs are likely to have a longer stay in hospital because of the infection; deep and organ SSIs are more likely to be detected in patients with a longer hospital stay; or a combination of both these reasons.

Table 5: Mean and median postoperative length of hospital stay (days) by type of surgical site infections, 2007

Type of SSI	Postoperative length of hospital stay (days)	
	Mean (95% CI)	**Median (q1–q3)***
Superficial (n = 2 744)	12.75 (12.26–13.23)	9 (5–16)
Deep (n = 1 157)	23.71 (22.49–24.93)	17 (9–31)
Organ (n = 703)	25.70 (24.01–27.38)	18 (10–34)

**q1: First quartile, percentile 25; q3: third quartile, percentile 75.*

3.1.3 Patient/surgical procedure-related risk factors

Patient/surgical procedure-related risk factors included in the NHSN risk index are wound contamination class, ASA physical status classification, duration of operation (for information on the availability of these variables, see Annex 1 and Table 65) and whether or not the entire operation was performed using an endoscope.

Table 6 shows the percentage of CHOL and COLO performed using an endoscopy. Overall the reported use of an endoscope was higher than for 2004–2006: 18.7% (up from 7.5% previously) for COLO, and 80.1% for CHOL (77.6% in 2004–2006).

Endoscope use, however, was not consistently reported in all countries, and some networks (UK-England) excluded endoscopic operations. Therefore, the basic NHSN risk index was used for further analyses, disregarding information about endoscopy use.

Table 6: Percentage of operations carried out using an endoscope, by surgical procedure category and by country, 2007

	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	Overall	% missing values
CHOL	84.2	86.8	80.8		82.3	85.2	66.4	96.3	NR[1]	91	21.8		**80.1**	**4.3**
COLO	28.2	19.1	17.5		29.5	1.1	8.4	4.6	11.4		2.3	NR[2]	**18.7**	**3.2**

[1] *Not reported.*
[2] *UK-England not reported; missing values were included in the denominator, i.e. counted as non-endoscopic.*

For the duration (in minutes) of the operation, the 75th percentiles (T-times) from the USA NHSN were used as a threshold [5]. The analysis shows that this threshold was similar for European hospitals in 2007 (see Table 7) as well as in previous years (2004–2006).

Table 8 shows the percentage of operations with a duration longer than T-time. This percentage differed somewhat by country and the highest proportion was reported for COLO and LAM, which is consistent with previous years (2004–2006).

Table 7: Percentiles of the distribution of duration of operation (in minutes), 2007

	Mean	p10	p25	p50	p75	p90
CABG	208	130	163	196	**240**	295
CHOL	70	30	44	60	**85**	120
COLO	150	60	95	135	**189**	250
CSEC	44	24	30	37	**47**	60
HPRO	87	50	60	80	**104**	130
KPRO	87	54	65	80	**101**	125
LAM	82	40	55	71	**100**	134

Table 8: Percentage of operations with duration > T-time[1] by surgical procedure category and by country, 2007

	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	Overall	% missing values
CABG	13.2	5.2	35.4		28.8		13.7	3.9		1.2		9.4	**8.9**	**1.2**
CHOL	11.8	7.1	13.8		12.8	3.4	16.8	5.3	1.7	12.0	0		**9.4**	**0.7**
COLO	36.2	23.5	30.8		32.1	26.5	29.8	18.6	12.9		0	29.7	**26.9**	**1.5**
CSEC	4.7	7.2	18.1		8.3	10.2	10.3		4.2	5.9	0	9.1	**8.7**	**1.6**
HPRO	6.8	11.3	25.7	25.5	6.7	8.3	9.7	3.5	5.3	19.4	0	15.4	**13.1**	**2.4**
KPRO	11.6	10.8	36.7	31.8	15.2	25.9	10.3	14.0	7.5			8.5	**11.5**	**3.6**
LAM	25.6	9.6	35.1		17.5		20.2				0		**14.2**	**0.7**

[1] *T-time: cut-off based on the 75th percentile of operation duration as in CDC/NHSN system: CBGB 300 minutes (m), CBGC 240 m, CHOL 120 m, COLO 180 m, CSEC 60 m, HPRO 120 m, KPRO 120 m, LAM 120 m; missing values incuded in the denominator.*

3.1.4 NHSN risk index

The NHSN risk index (see Annex 1, section b) was computed from the wound contamination class, the ASA physical status classification and the duration of the operation. Missing values for one of the three components resulted in a missing NHSN risk index, which occurred for only 7.1% of records (see also Table 65). However, some networks excluded records for which the NHSN risk index was missing before transmission of the data and therefore this proportion is underestimated.

Overall the NHSN risk index 0 was assigned to 56.8% of operations (n = 260 414), the NHSN risk index 1 to 30.3%, and the highest NHSN risk indexes (2 and 3) to 5.8%.

As in previous years, the comparison of the NHSN risk index by surgical procedure category and by country (Figures 4–10; only hospitals with ≥ 20 surgical procedures in each NHSN category included) shows the expected differences between the frequency of risk factors according to the category of surgical procedure, but it also shows important variations between countries within the same NHSN category.

In HPRO for example (Figure 8), the proportion of operations with the lowest risk index (index 0) varied from 30.5% in Finland up to more than 70% in Hungary (76.1%), Lithuania (72.2%) and the Netherlands (72.1%). Large variations were again seen for KPRO (Figure 9) with more than 55% of operations with NHSN risk index 1 in Lithuania (57.3%) and less than 20% in the Netherlands (19.7%). Whereas, for CSEC, the NHSN risk index is consistently low in all countries with only some slight variation between countries, apart from Spain, where a relatively high percentage (24.9%) of missing values was reported (Figure 7).

The differences between countries may be due to a number of reasons: difference of severity of illness of the patients, different types of surgical procedures within the same NHSN category, different applications of the definitions of the risk index components, the proportion of missing values, or a combination of all of these reasons.

Figure 4: CABG: NHSN risk index by country, 2007

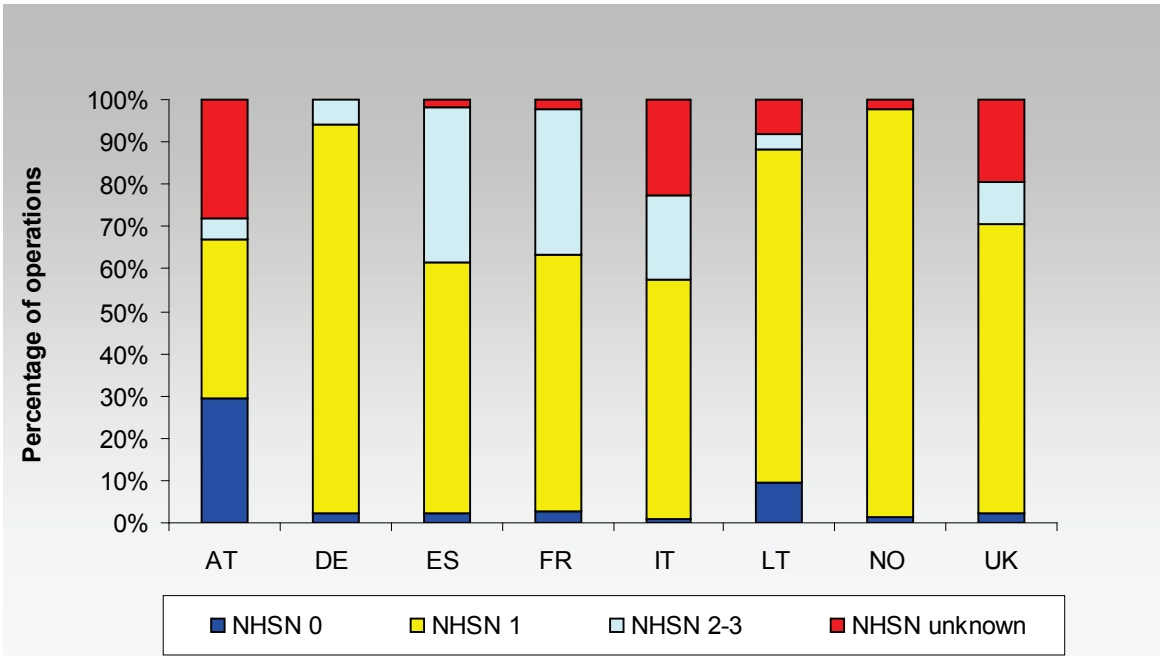


Figure 5: CHOL: NHSN risk index by country, 2007

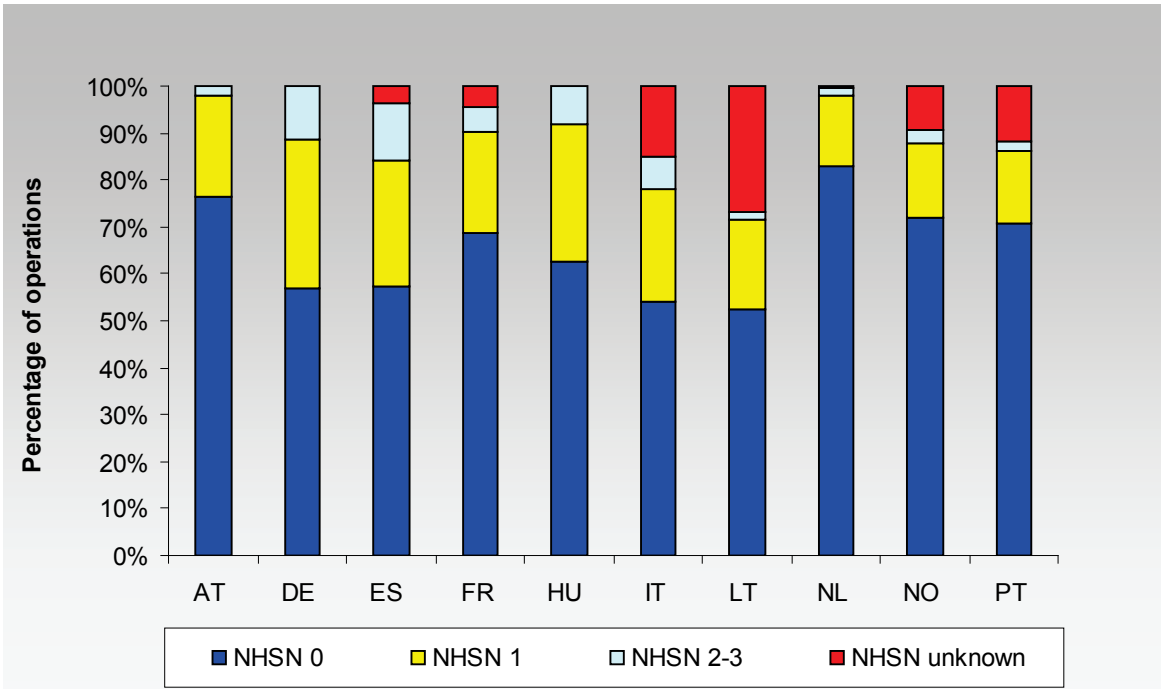


Figure 6: COLO: NHSN risk index by country, 2007

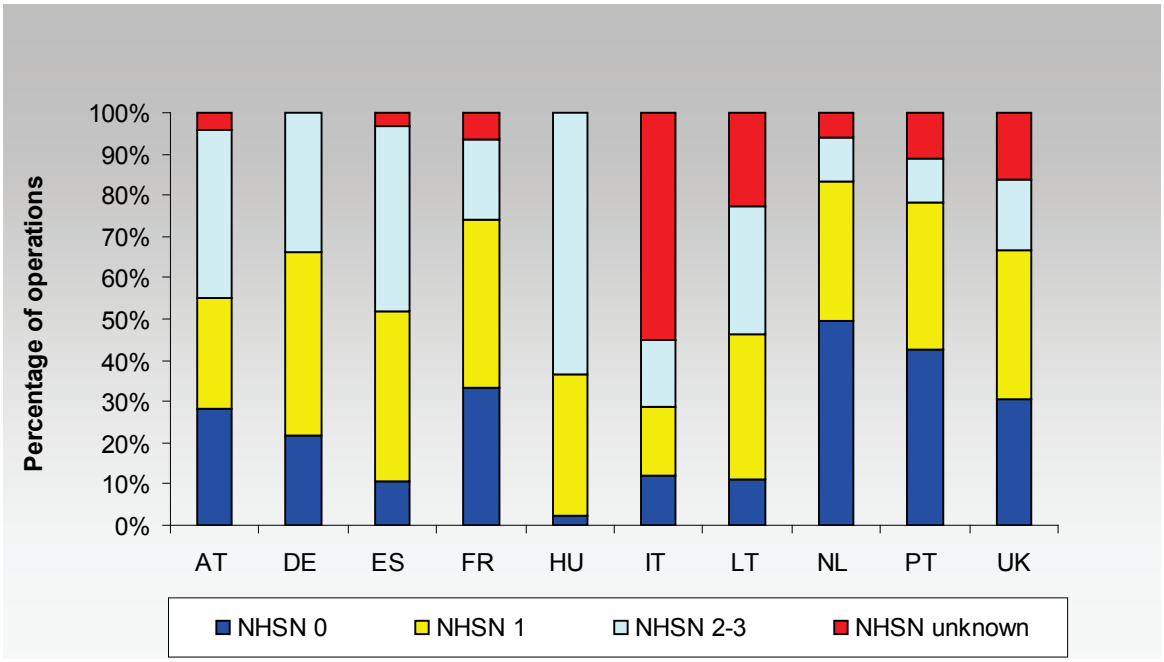


Figure 7: CSEC: NHSN risk index by country, 2007

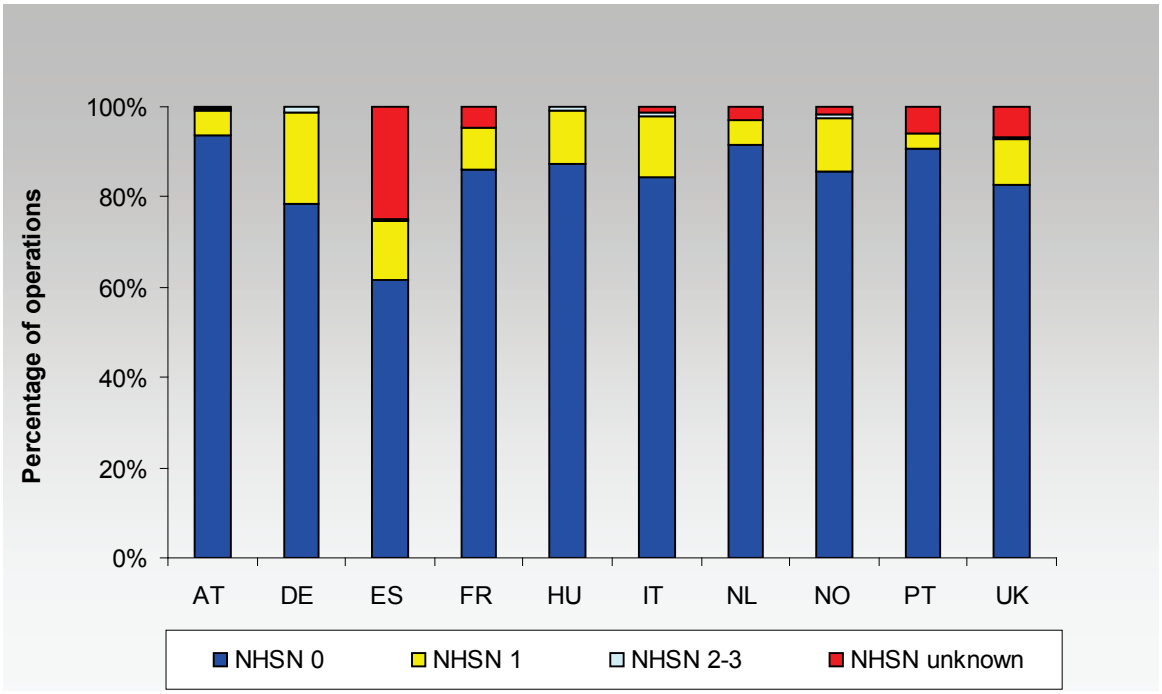


Figure 8: HPRO: NHSN risk index by country, 2007

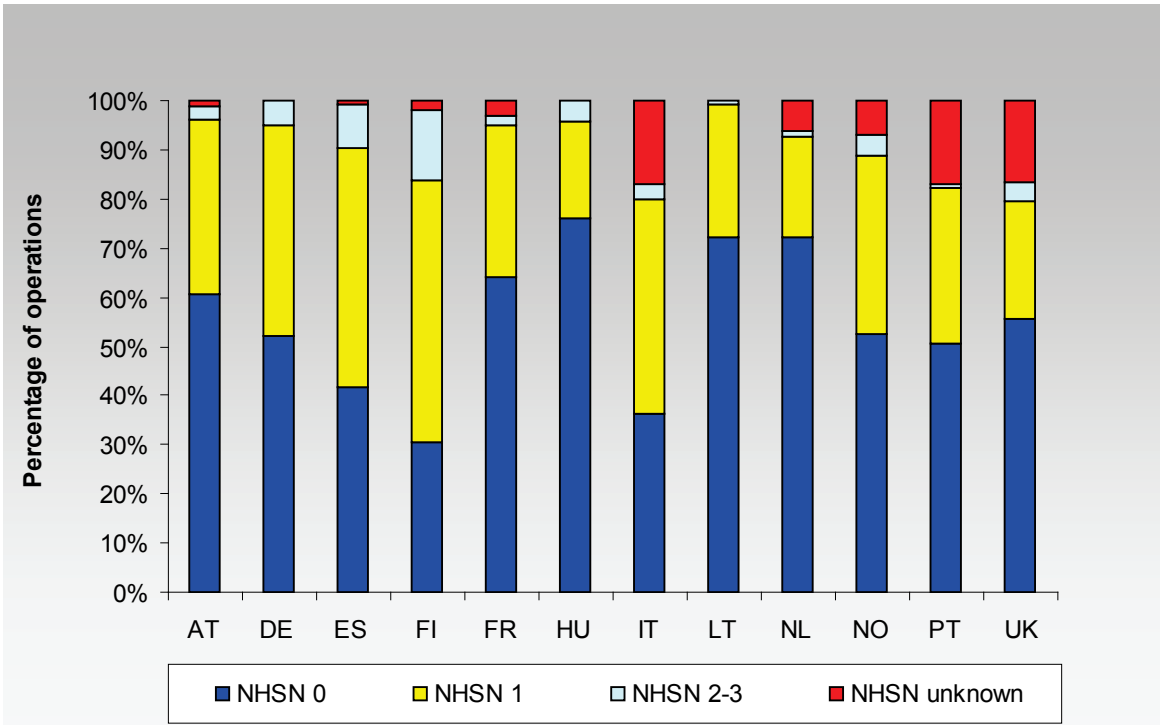


Figure 9: KPRO: NHSN risk index by country, 2007

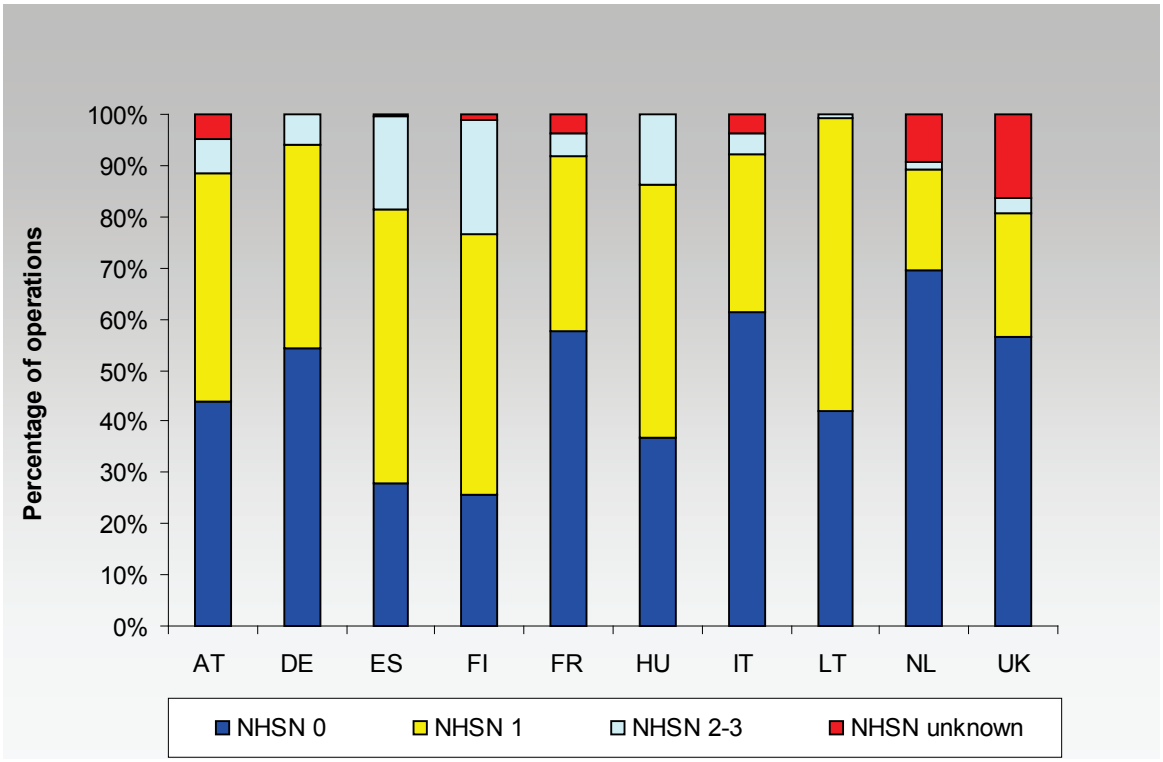
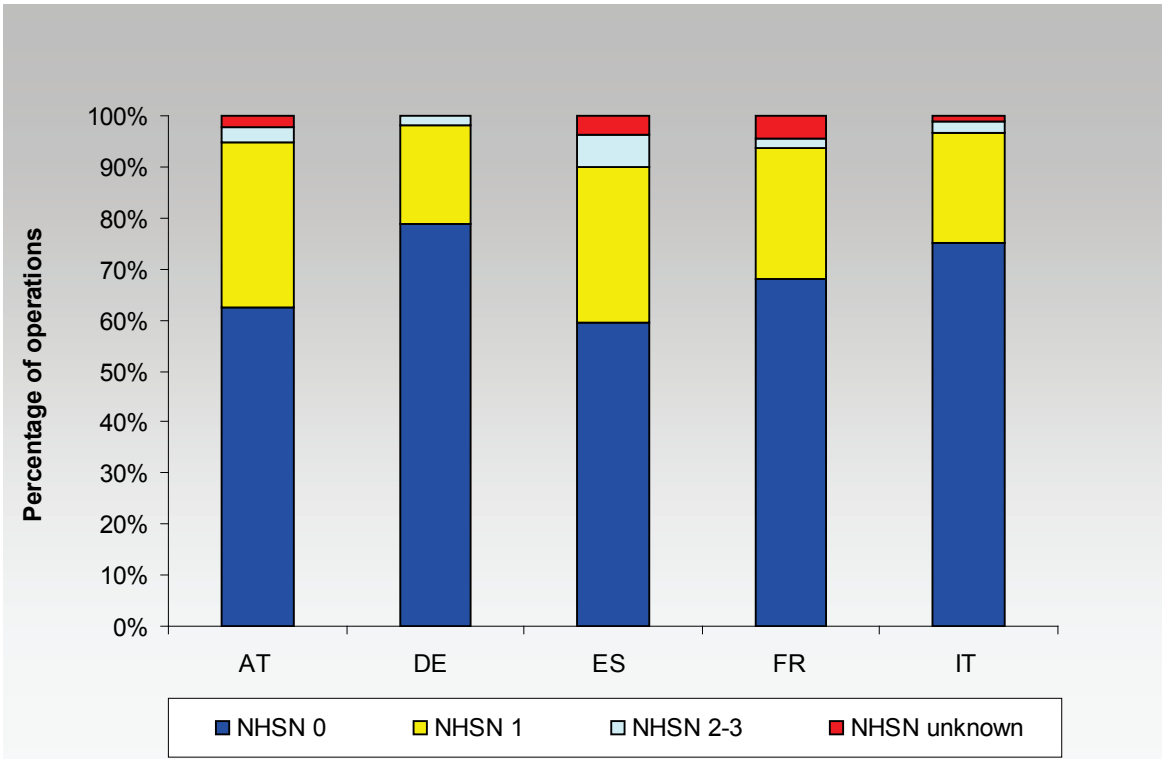


Figure 10: LAM: NHSN risk index by country, 2007



3.2 Characteristics of surgical site infections

3.2.1 Type of SSI

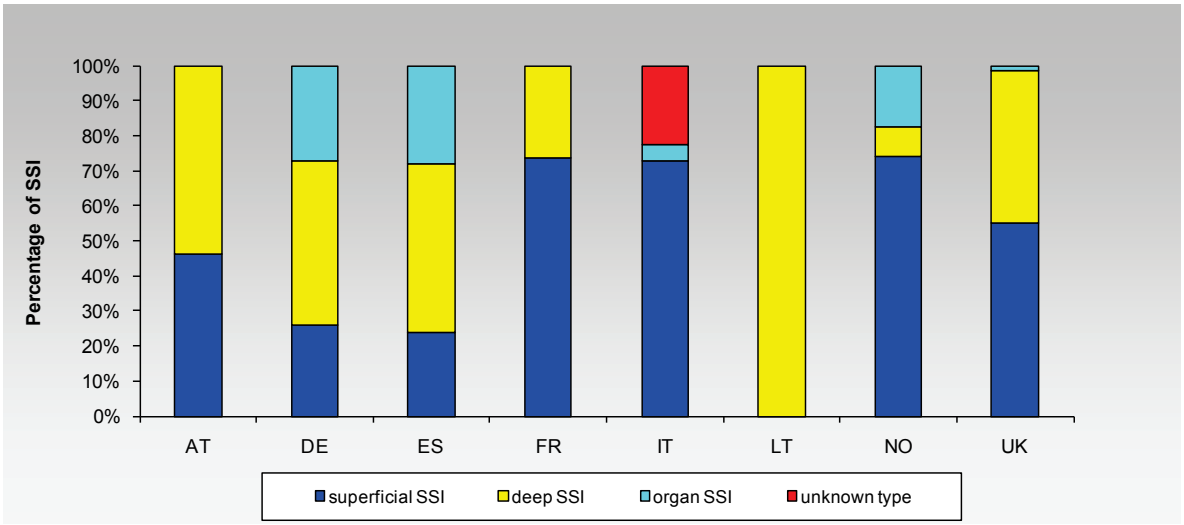
All surveillance networks classified surgical site infections in three types (superficial, deep and organ/space), in accordance with the HELICS-SSI protocol [2].

Overall, 59.6% of SSIs were superficial, 24.8% deep and 15.6% organ/space (missing excluded, n = 5 404); missing values for the type of infections occurred in 1.4% (n = 74) of all reported SSIs.

Again, as in previous years, major differences between countries were observed in the type of reported SSI within a same NHSN surgical procedure category (Figures 11–17). In CABG, for example, the proportion of superficial SSIs varied from 23.9% in Spain up to 73.9% in Norway. Large variations were again seen for KPRO with more than 75% of superficial SSI in the United Kingdom and less than 25% in Spain (countries with less than 10 SSI reported not considered, see figure legend).

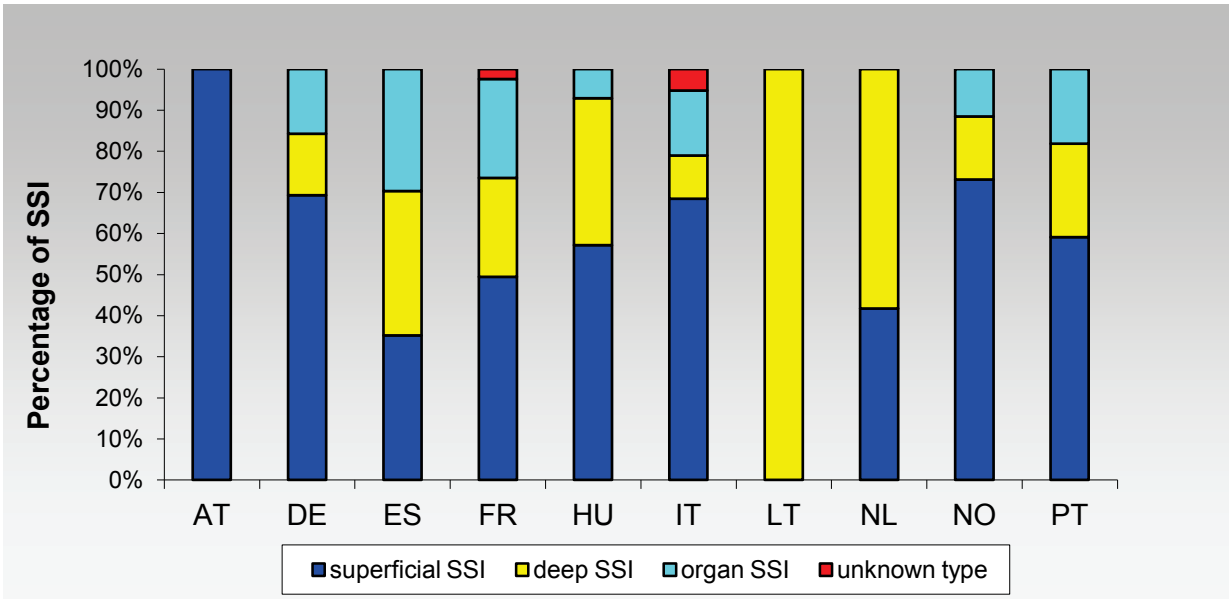
These differences may be due to a number of reasons: differences in the severity of infections, differences in the interpretation of case definitions, differences in the sensitivity of case-finding reporting, the proportion of missing values, or a combination of all of these reasons.

Figure 11: CABG: type of SSI by country, 2007



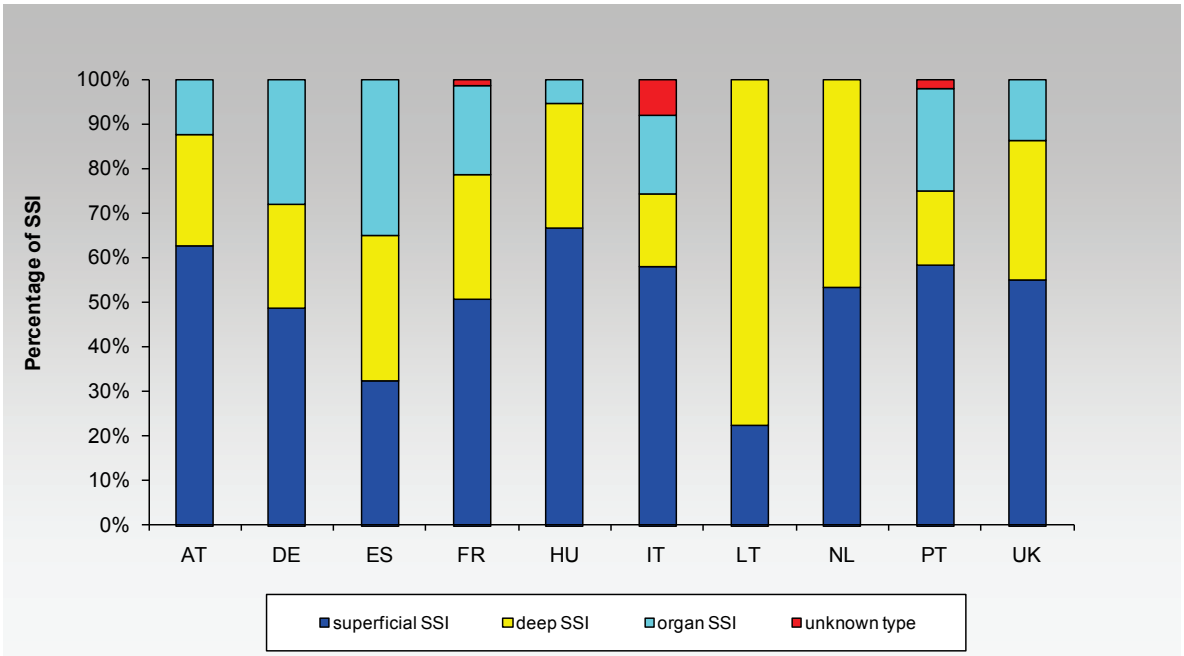
All countries reported 10 SSI or more.

Figure 12: CHOL: type of SSI by country, 2007



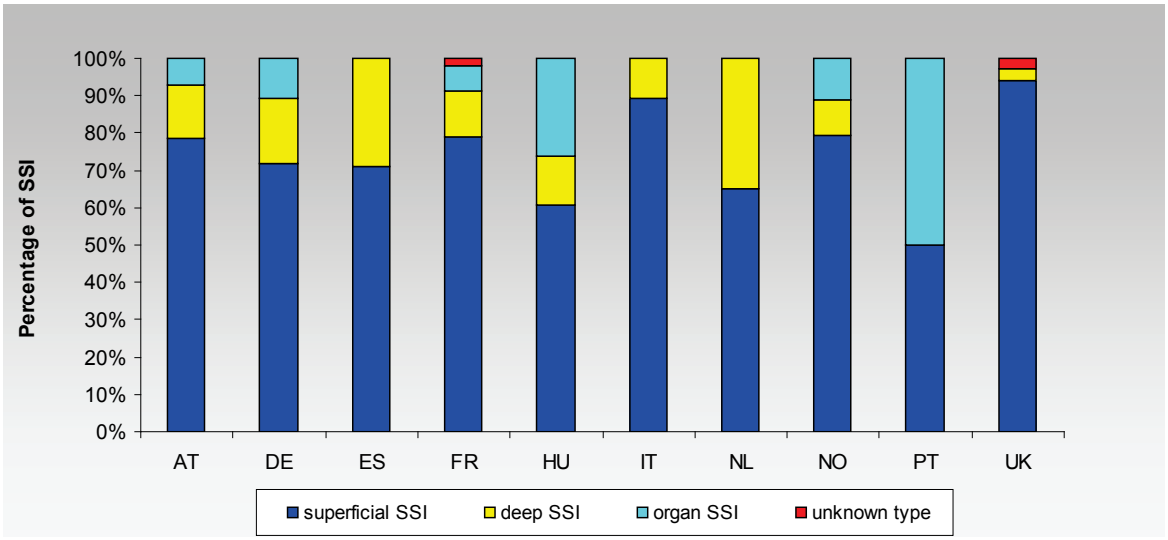
Less than 10 SSI in AT and LT.

Figure 13: COLO: type of SSI by country, 2007



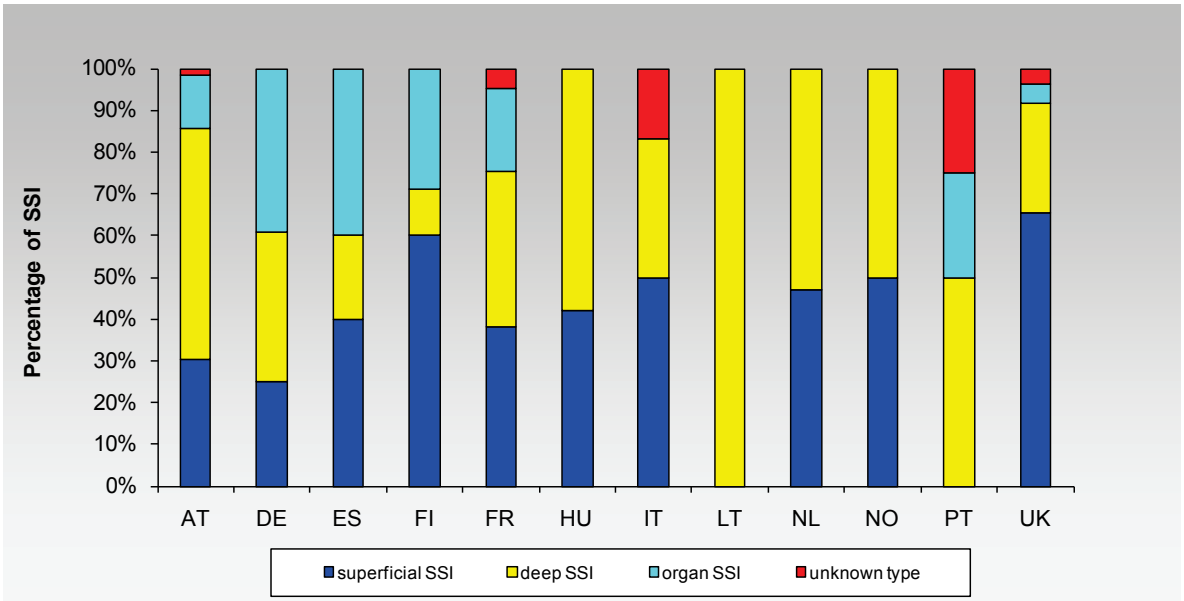
All countries reported 10 SSI or more.

Figure 14: CSEC: type of SSI by country, 2007



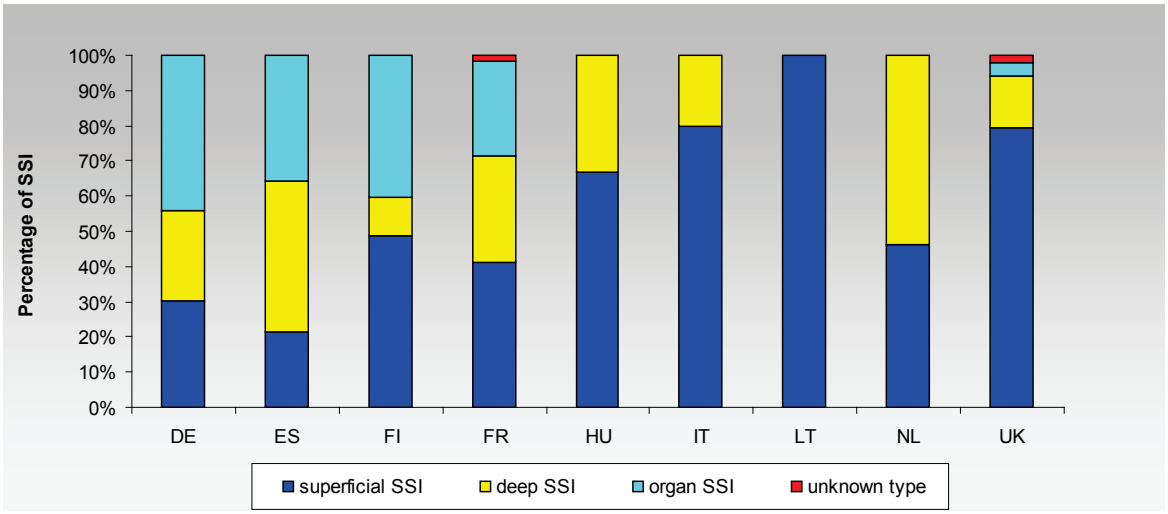
Less than 10 SSI in PT.

Figure 15: HPRO: type of SSI by country, 2007



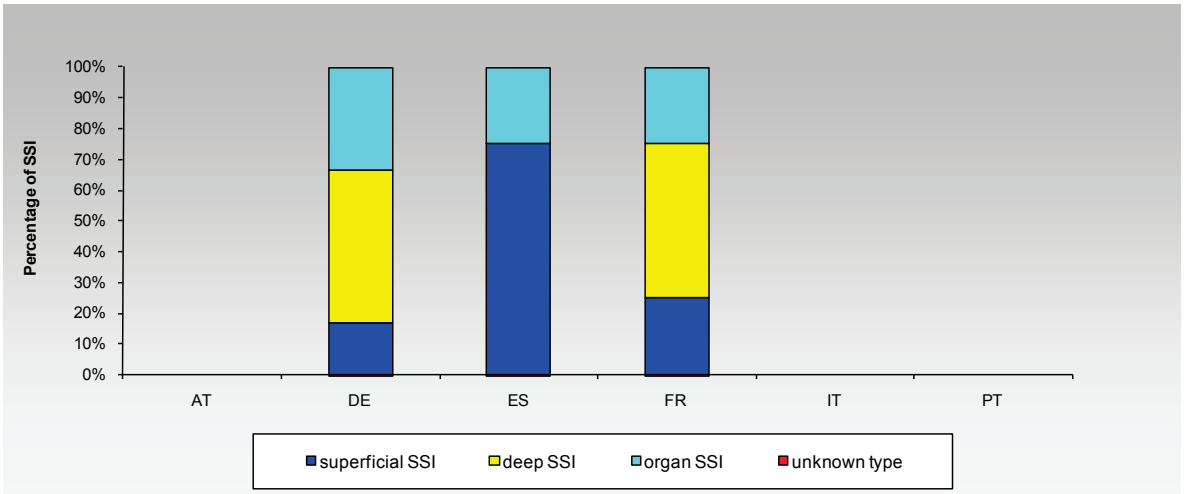
Less than 10 SSI in IT, LT, and PT.

Figure 16: KPRO: type of SSI by country, 2007



Less than 10 SSI in HU, IT, and LT.

Figure 17: LAM: type of SSI by country, 2007



Less than 10 SSI in all countries (AT, DE, ES, FR, IT, and PT).

3.2.2 Proportion of SSIs detected during post-discharge surveillance

As mentioned above, differences in cumulative incidence of SSIs may also arise from differences in post-discharge surveillance.

An indicator of the intensity of post-discharge surveillance is the proportion of SSIs detected after discharge from the hospital; overall this proportion was 40.6% (n = 1 897/4 677) when discharge date was known and was higher for superficial SSIs (46.8%) than for deep SSIs (33.3%) and organ/space SSIs (29.5%).

Table 9 and Table 10 show the percentage of SSIs detected after discharge from the hospital by surgical procedure category and by country. Table 9 includes SSIs for which discharge date was unknown in the denominator, Table 10 excludes missing data.

Table 9: Percentage of SSI detected after discharge from the hospital, by surgical procedure category and country, 2007; missing values included in the denominator (n = 5 478 infections)

	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM	Overall %	% Missing disch. date
AT	61.5	0.0	12.5	46.4	47.6	—	—	43.8	0.0
DE	28.4	27.2	4.0	25.0	22.5	27.5	16.7	18.1	34.3
ES	32.6	13.5	8.6	70.8	20.0	42.9	0.0	19.4	4.5
FI	—	—	—	—	28.1	56.8	—	38.6	55.0
FR	21.1	38.6	18.8	63.9	59.8	75.0	75.0	40.0	0.8
HU	—	28.6	0.0	18.4	10.5	0.0	—	17.5	0.0
IT	40.9	52.6	24.2	78.6	16.7	0.0	—	40.1	4.9
LT	30.4	25.0	0.0	—	0.0	0.0	—	17.0	0.0
NL	—	83.3	33.3	73.9	67.6	87.8	—	57.7	0.0
NO	91.3	73.1	—	77.6	71.2	—	—	77.0	0.0
PT	—	40.9	2.1	25.0	50.0	—	—	16.7	0.0
UK	0.0	—	0.0	51.3	21.9	48.1	—	37.6	15.0
Overall %	**29.2**	**35.8**	**11.9**	**54.9**	**35.4**	**50.0**	**28.6**	**34.6**	**14.6**

Table 10: Percentage of SSI detected after discharge from the hospital, by surgical procedure category and country, 2007; missing values excluded (n = 4 677 infections)

	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM	Overall %
AT	61.5	0.0	12.5	46.4	47.6	—	—	43.8
DE	49.3	33.3	5.5	35.4	36.2	69.8	33.3	27.5
ES	33.3	14.3	9.0	77.3	21.4	42.9	0.0	20.3
FI	—	—	—	—	73.5	100.0	—	85.7
FR	21.1	39.5	18.9	64.3	59.8	75.0	75.0	40.3
HU	—	28.6	0.0	18.4	10.5	0.0	—	17.5
IT	40.9	52.6	26.3	81.5	20.0	0.0	—	42.2
LT	30.4	25.0	0.0	—	0.0	0.0	—	17.0
NL	—	83.3	33.3	73.9	67.6	87.8	—	57.7
NO	91.3	73.1	—	77.6	71.2	—	—	77.0
PT	—	40.9	2.1	25.0	50.0	—	—	16.7
UK	0.0	—	0.0	69.6	23.4	49.6	—	44.3
Overall %	**37.8**	**38.5**	**13.0**	**65.4**	**43.7**	**62.0**	**40.0**	**40.6**

The percentage of SSI detected after discharge differed by surgical procedure; it is higher not only for surgical procedures with short length of postoperative hospital stay, such as CSEC and CHOL, but also for operations with the longest (one year) follow-up times (KPRO and HPRO).

The proportion of SSIs detected post-discharge varies considerably between countries. The Netherlands and Norway, as well as Finland (when missing data are excluded (Table 10)), have higher proportions of SSIs detected after discharge compared to the other countries.

In many countries formal methods of post-discharge surveillance are recommended and SSI reported, even though the sensitivity of case-finding post-discharge is likely to vary considerably according to the methods used; in some networks, such as UK-England, post-discharge SSIs were not reported in the surveillance system. In other countries (e.g. France), the follow-up time for orthopaedic surgery is 30 days instead of one year. Finally, in Germany and in Finland this indicator is affected by the high proportion of missing values for the date of discharge. In 2007, discharge date was missing for 34.3% of the reported SSIs and 37.9% of all interventions in Germany (decreased from 61.0% and 65.8% respectively in 2004–2006) and in 55% of SSIs and 59.8% of all interventions in Finland (increase from 38.6% and 45.5% respectively in 2004–2006).

3.2.3 Distribution of isolated microorganisms

For the 5 478 SSI reported in 2007, information on the results of microbiological analyses was available in 1 962 cases (35.8%). Only eight networks (AT, DE, ES, HU, LT, NL, PT, UK-England) reported information on microorganisms responsible for SSI, and, even if reported, it is often incomplete. Therefore, no country comparisons are included. An overview of microorganisms detected is given in Table 11.

Table 11: Distribution of microorganisms isolated in infections for which at least one microorganism was reported, pooled data from eight networks, 2007

	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM
Number of identified microorganisms[1]	**342**	**231**	**997**	**177**	**551**	**177**	**6**
Gram-positive cocci (%)	**69.6**	**22.5**	**35.8**	**35.0**	**63.2**	**72.3**	**0**
Staphylococcus aureus	34.5	6.5	7.9	14.7	33.6	46.3	0
MRSA[2]	18.7	14.3	62.0	6.3	37.4	21.3	
Coagulase-negative staphylococci	27.5	3.9	3.4	7.9	14.9	13.6	0
Enterococcus species	7.0	7.8	21.9	6.2	12.3	9.0	0
Streptococcus species	0.3	3.5	2.5	5.6	2.0	2.8	0
Other gram-positive cocci	0.3	0.9	0.1	0.6	0.4	0.6	0
Gram-negative cocci (%)	**0**	**0**	**0**	**0**	**0**	**0.6**	**0**
Gram-positive bacilli (%)	**0.6**	**0**	**0.4**	**0**	**2.5**	**2.3**	**16.7**
Gram-negative bacilli, Enterobacteriaceae (%)	**22.8**	**33.8**	**38.3**	**18.6**	**14.2**	**12.4**	**66.7**
Citrobacter species	1.5	3.0	0.9	0.6	0.4	0	0
Enterobacter species	5.8	5.2	3.1	2.3	3.6	2.8	16.7
Escherichia coli	4.1	16.0	23.5	12.4	3.4	2.3	16.7
Klebsiella species	4.4	3.9	3.3	1.7	1.8	1.7	0
Proteus species	2.0	3.9	4.4	1.1	3.3	3.4	16.7
Serratia species	4.1	0.4	0.8	0.6	0.4	2.3	0
Other Enterobacteriaceae	0.9	1.3	2.3	0	1.3	0	16.7
Gram-negative bacilli, non-fermentative bacilli (%)	**5.3**	**3.5**	**8.7**	**0**	**7.1**	**4.0**	**0**
Acinetobacter species	0.6	0.4	0.6	0	2.5	0.6	0
Haemophilus species	0.6	0.4	0.1	0	0.2	0	0
Pseudomonas aeruginosa	3.5	2.6	7.1	0	3.4	1.7	0
Pseudomonadaceae family, other	0.6	0	0.7	0	0.7	0.6	0
Stenotrophomonas maltophilia	0	0	0.2	0	0.2	1.1	0
Other non-fermentative bacilli	0	0	0	0	0	0	0
Anaerobes (%)	**0**	**1.7**	**3.3**	**1.1**	**0.7**	**1.7**	**16.7**
Bacteroides species	0	1.3	2.8	0.6	0	0.6	0
Other anaerobes	0	0.4	0.5	0.5	0.7	1.1	16.7
Other bacteria (%)	**0.9**	**0**	**6.7**	**0**	**5.1**	**3.4**	**0**
Fungi, parasites (%)	**0.9**	**1.3**	**1.6**	**0.6**	**0.2**	**0**	**0**
Aspergillus species	0	0	0	0	0	0	**0**
Candida species	0.9	1.3	1.6	0	0.2	0	**0**
Other fungi/parasites	0	0	0	0.6	0	0	**0**

[1] *Denominator for relative frequencies (unidentified/no examination/sterile culture excluded).*
[2] *Percentage of MRSA/SA was determined on the total of Staphylococcus aureus with known antibiotic susceptibility.*

3.3 Incidence of surgical site infections

In this report, a total of 260 414 operations were included and overall 5 478 SSI occurred. Of those SSIs, 5 366 (98%) occurred within the defined period of 30 days after the intervention or one year for HPRO and KPRO, and only 112 SSIs were reported as occuring after this period (around 2% of the total). The main reasons were that several countries excluded SSIs that occurred after the defined period, while others did not have any post-discharge surveillance. For the analysis of cumulative incidence, the SSIs reported after the defined period were excluded. However, they are included in the numerator of the incidence density if the infection occurs before the date of discharge.

3.3.1 Cumulative incidence

The first indicator that is routinely calculated is the crude percentage of operations resulting in a SSI, called the cumulative incidence of SSIs in the 30 days (one year for HPRO and KPRO) after the operation; overall the cumulative incidence was 2.1%, and it is shown by surgical procedure category and by country in Table 12 and Figures 18–24.

The percentage of SSIs varied according to the surgical procedure category, with the highest cumulative incidence among COLO (9.5%) and less than 1% among LAM and KPRO. However, since networks have varying degrees of post-discharge surveillance or no post-discharge surveillance at all, these numbers might be misleading for country comparisons.

The second indicator is the cumulative incidence of SSIs, SSIs detected post-discharge excluded. This indicator takes into account only the SSIs detected during the hospital stay. Therefore, it is independent of the sensitivity of case-finding after the discharge, but it is still dependent on the length of postoperative stay (the longer, the more infections will be detected). The indicator can only be calculated when date of discharge is known so the denominator only includes operations for which that information is available. Overall the cumulative incidence, post-discharge SSIs excluded, was 1.3%, and it is given in Table 13 and Figures 25–31 by surgical procedure category and by country.

This indicator is lower than the first one for several but not for all countries, depending on the number of missing discharge dates (see Table 13). Again, the percentage of SSI varied according to the surgical procedure category, with the highest cumulative incidence among COLO (8.8%) and less than 1% in CHOL, HPRO, KPRO and LAM.

Table 12: Cumulative incidence (%) of surgical site infections by surgical procedure category and by country, 2007

	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	Overall
CABG	3.7	2.9	6.8		2.4		5.0	3.5		3.4		1.7[1]	**2.8**
CHOL	0.7	1.3	3.5		0.8	2.8	1.9	0.5	2.9	7.6	2.0		**1.4**
COLO	8.8	8.2	19.6		9.1	9.7	9.0	9.3	14.2		11.0	8.1[2]	**9.5**
CSEC	1.2	0.8	3.3		1.9	2.3	1.6		1.8	7.4	0.5	6.4[3]	**2.8**
HPRO	1.6	1.2	1.5	2.4	0.8	3.0	1.0	0.4	3.3	3.8	1.9	0.8[4]	**1.2**
KPRO	0	0.9	3.2	1.8	0.7	2.8	0.7	0.6	2.3			0.7[4]	**0.8**
LAM	0	0.2	1.7		0.5		0						**0.4**

CABG, CHOL, COLO, CSEC, LAM: SSI within 30 days after intervention; HPRO, KPRO: SSI within one year after intervention; hospitals with less than 20 operations included.

[1] Data from UK-England.

[2] Data from UK-England.

[3] Data from UK-Scotland and UK-Wales.

[4] Data from UK-England, UK-Northern Ireland, UK-Scotland, UK-Wales.

Table 13: Cumulative incidence (%) of surgical site infections, post-discharge SSIs excluded, by surgical procedure category and by country, 2007

	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	Overall
CABG	1.7	1.5	5.3		2.0		3.4	3.1		0.3		1.8[1]	**1.9**
CHOL	0.7	1.0	3.4		0.5	2.0	1.0	0.4	0.5	2.0	1.3		**0.9**
COLO	8.2	8.8	18.4		7.7	9.7	7.4	9.2	9.6		10.7	8.1[2]	**8.8**
CSEC	0.7	0.5	0.7		0.7	1.9	0.4		0.5	1.7	0.4	1.7[3]	**0.9**
HPRO	0.9	0.8	1.3	0.7	0.3	2.7	0.7	0.4	1.1	1.1	0.9	0.6[4]	**0.6**
KPRO	0	0.2	1.8	0	0.2	2.8	0.7	0.6	0.3			0.3[4]	**0.3**
LAM	0	0.2	1.3		0.1		0						**0.2**

Hospitals with less than 20 operations included.

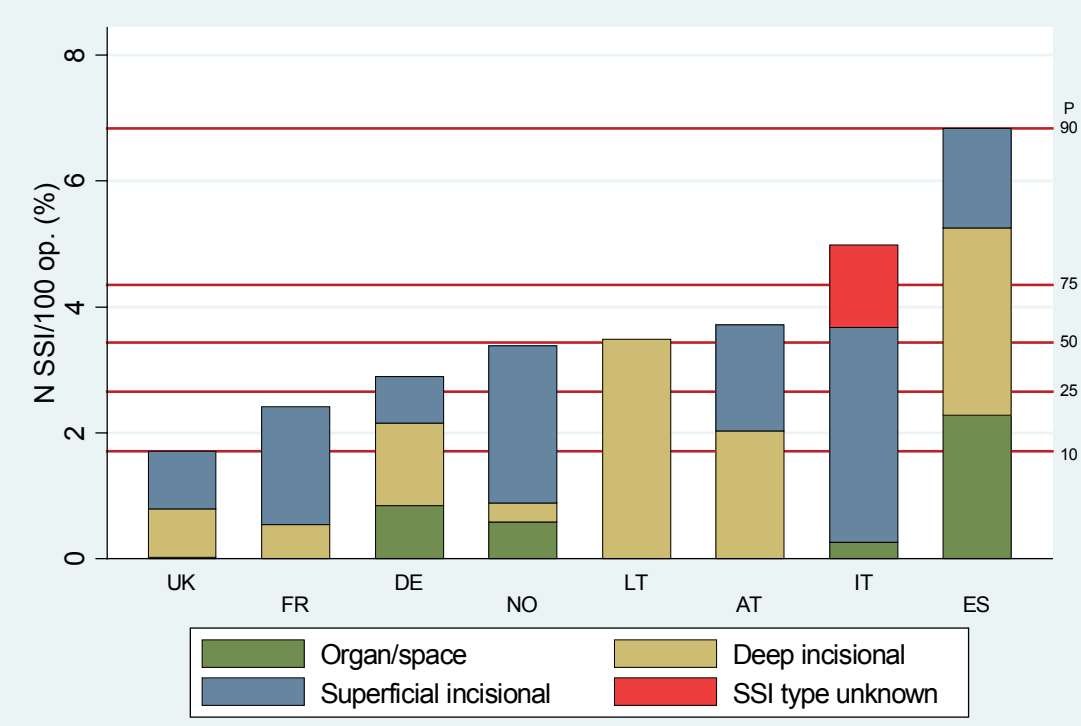
[1] Data from UK-England.

[2] Data from UK-England.

[3] Data from UK-Scotland and UK-Wales.

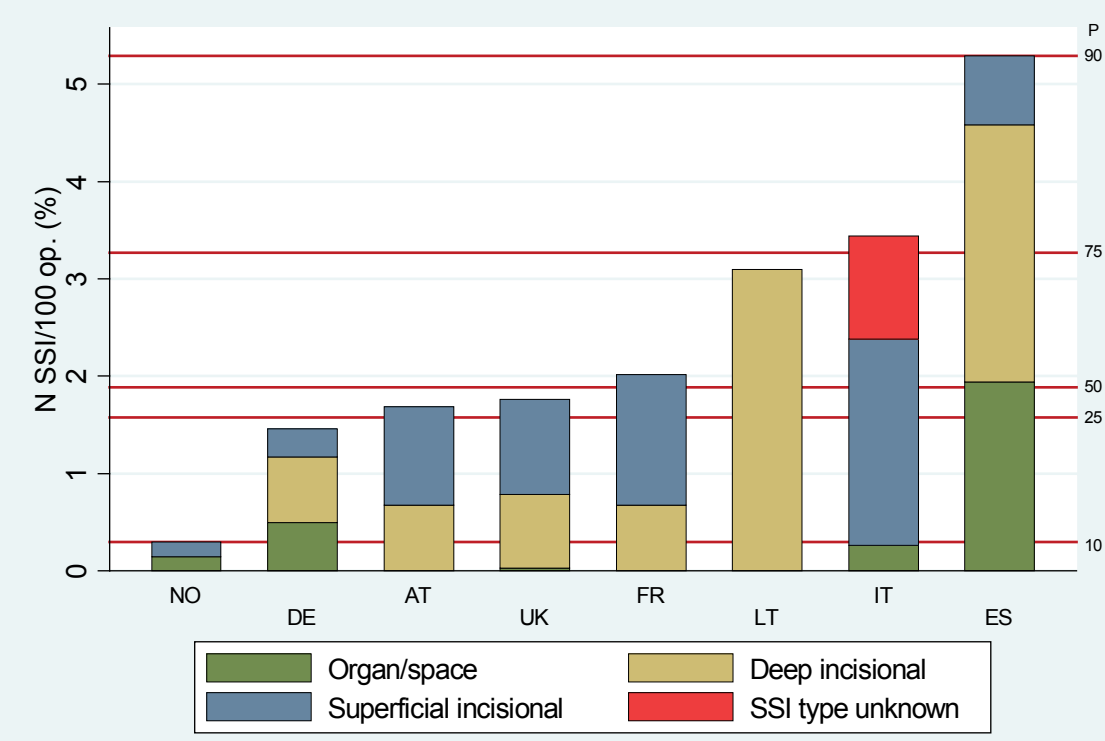
[4] Data from UK-England, UK-Northern Ireland, UK-Scotland, UK-Wales.

Figure 18: CABG: cumulative incidence by country, 2007



UK data from England only.

Figure 19: CABG: cumulative incidence by country, post-discharge SSI excluded, 2007



UK data from England only.

Figure 20: CHOL: cumulative incidence by country, 2007

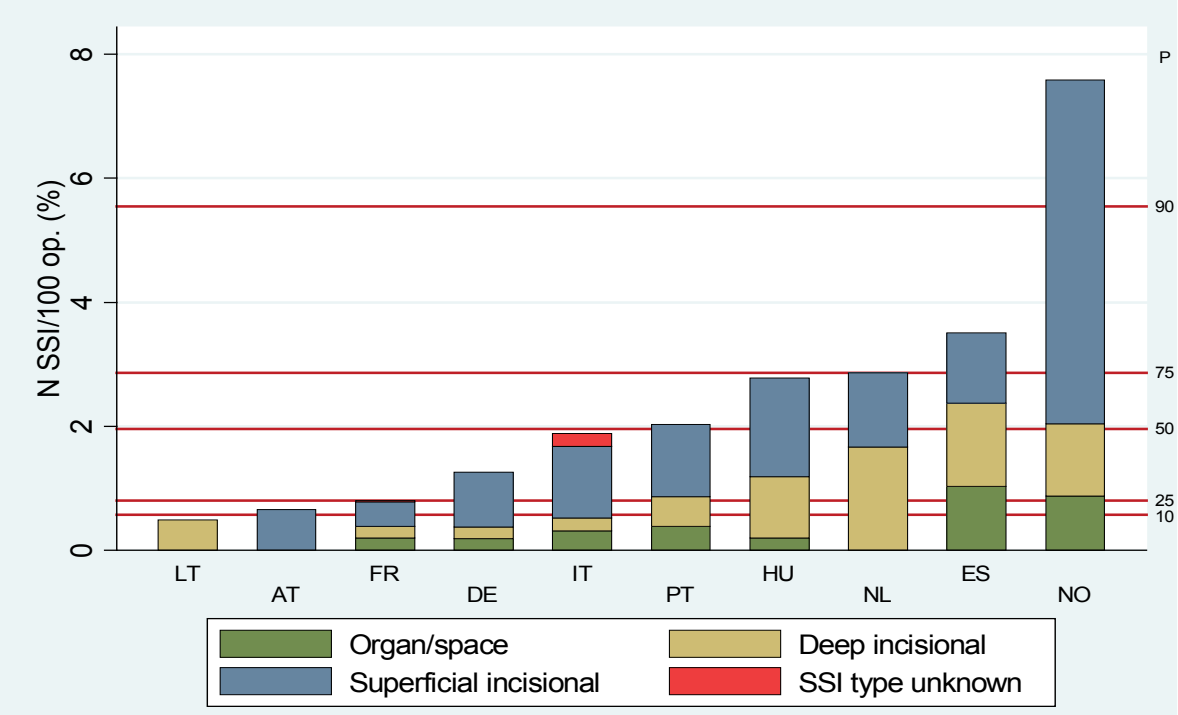


Figure 21: CHOL: cumulative incidence by country, post-discharge SSI excluded, 2007

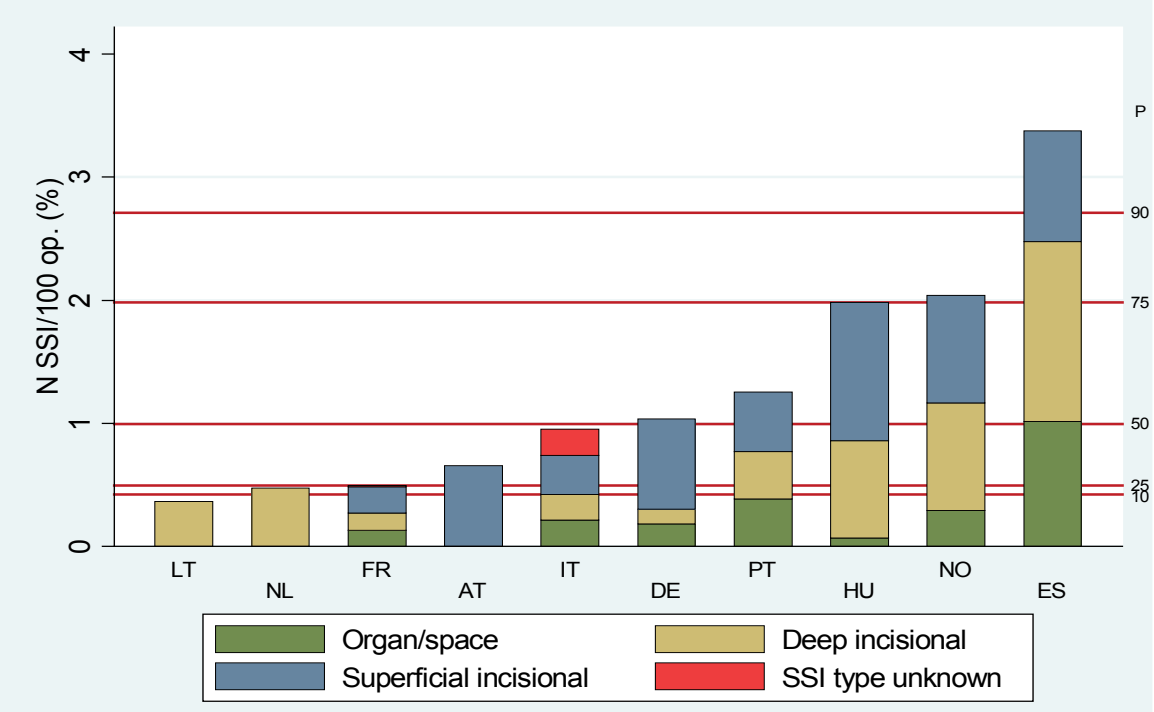
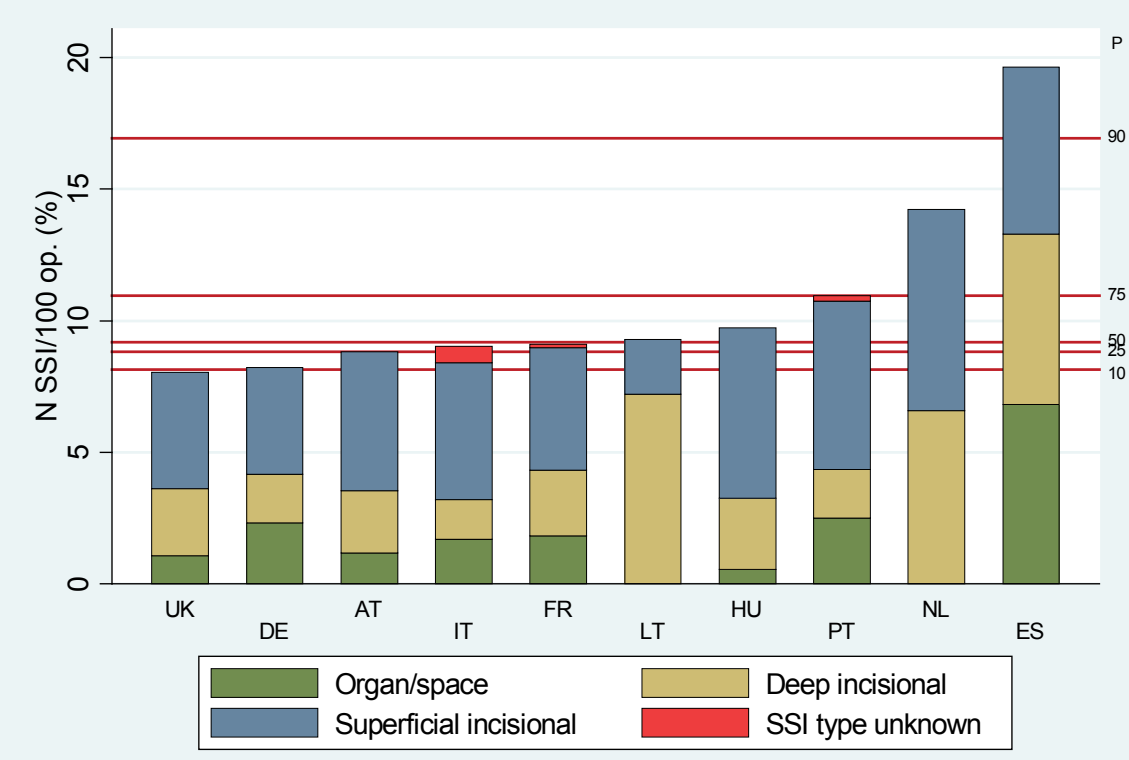
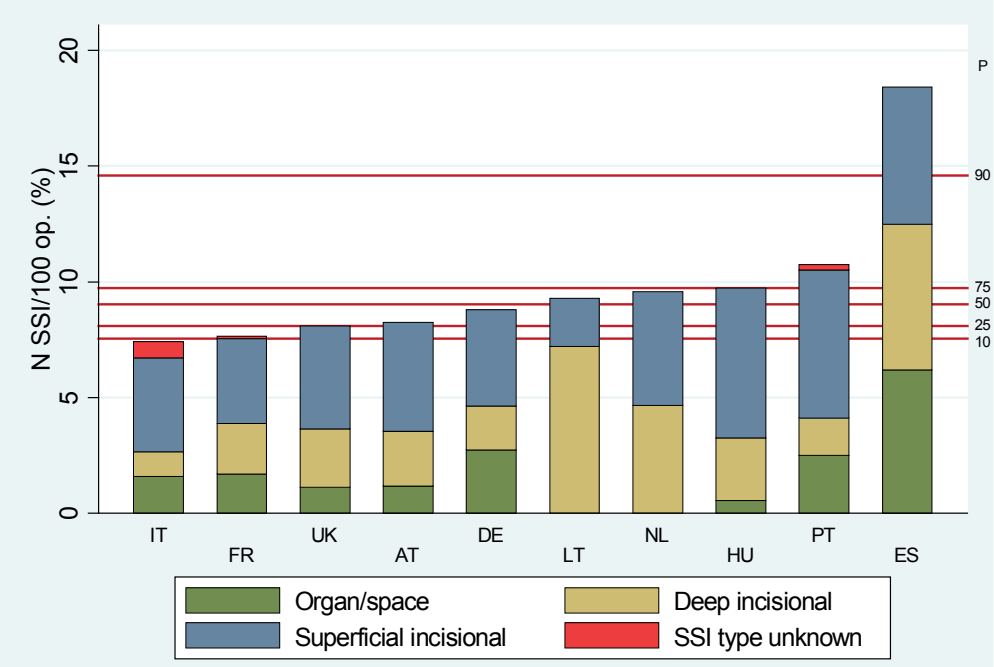


Figure 22: COLO: cumulative incidence by country, 2007



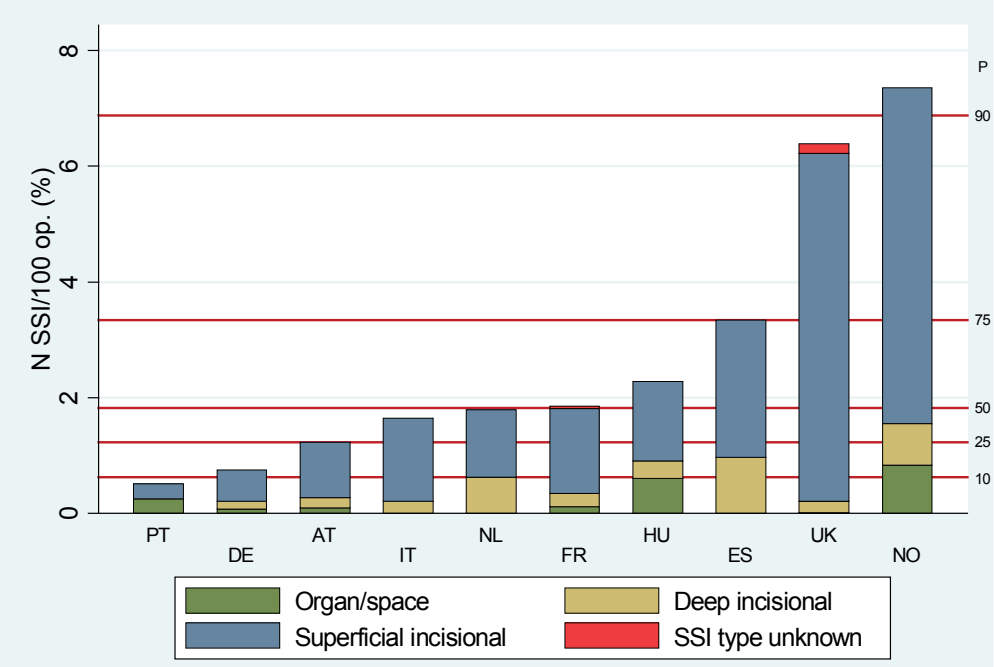
UK data from England only.

Figure 23: COLO: cumulative incidence by country, post-discharge SSI excluded, 2007



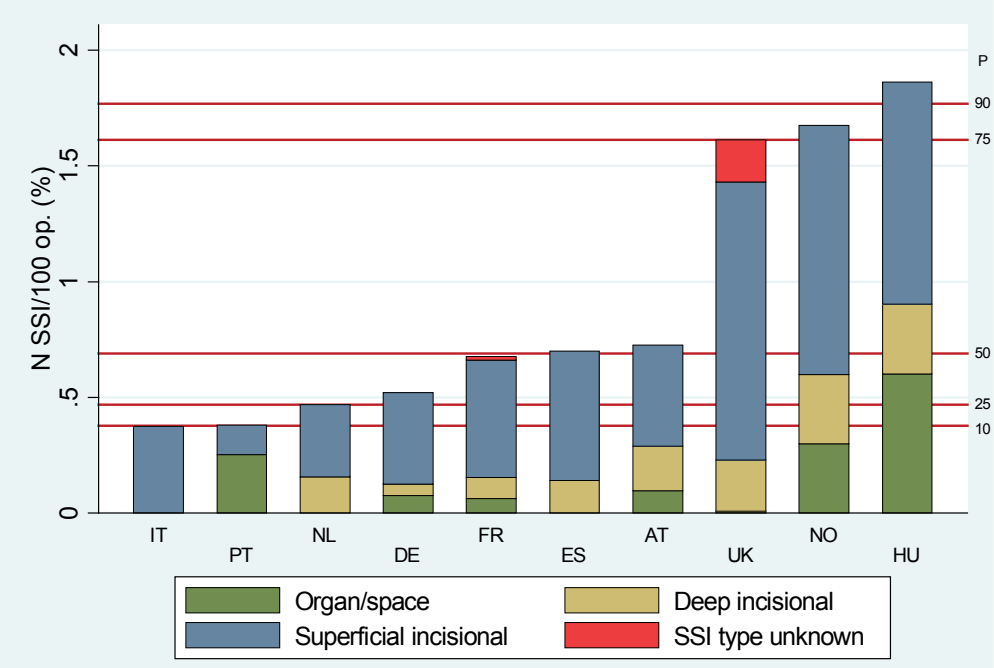
UK data from England only.

Figure 24: CSEC: cumulative incidence by country, 2007



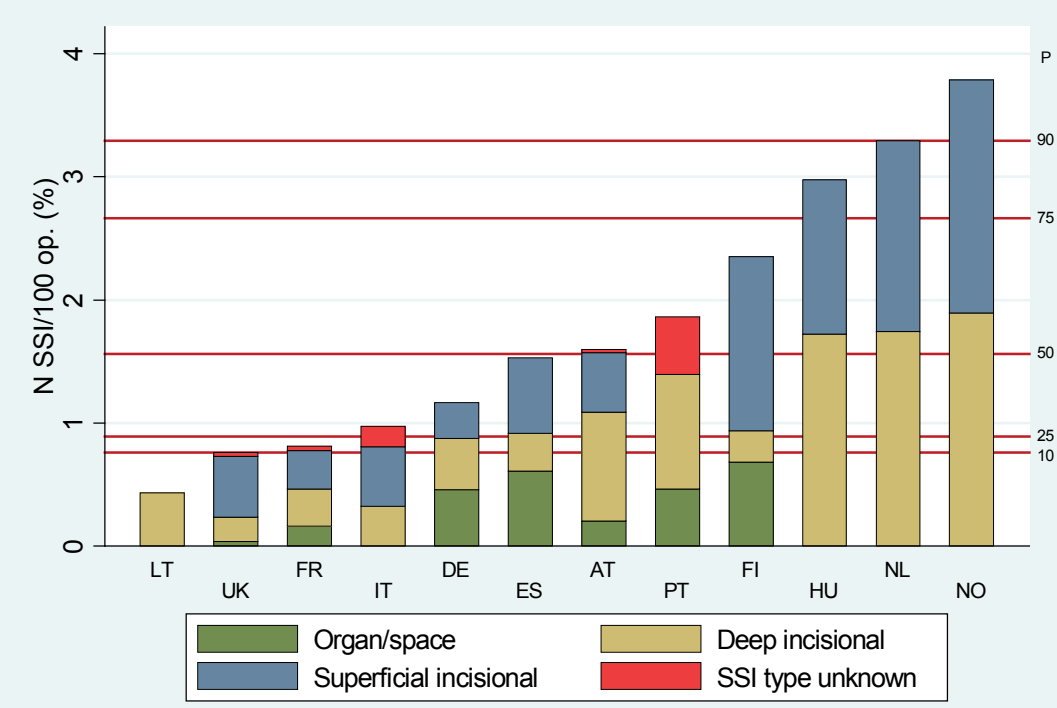
UK data from Scotland and Wales.

Figure 25: CSEC: cumulative incidence by country, post-discharge SSI excluded, 2007



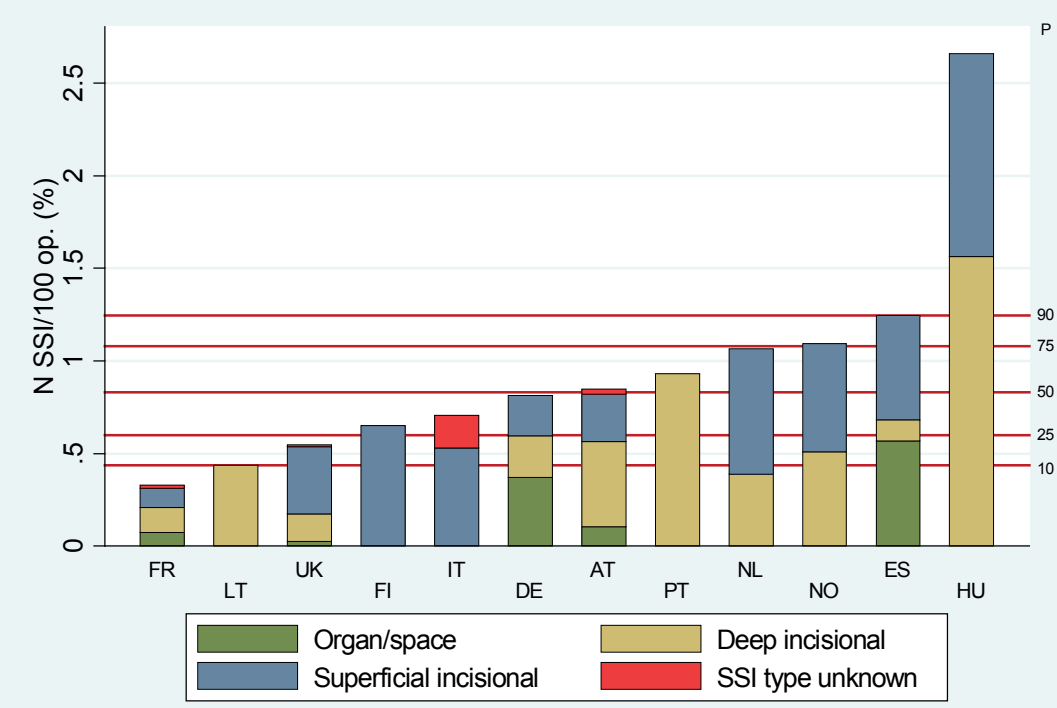
UK data from Scotland and Wales.

Figure 26: HPRO: cumulative incidence by country, 2007



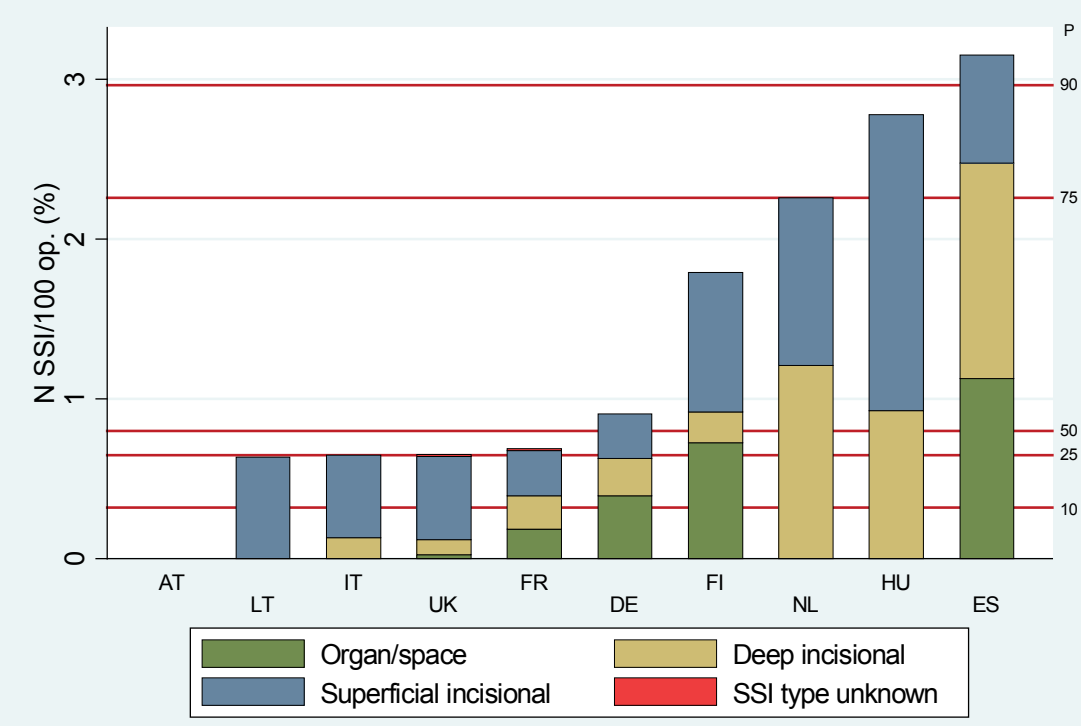
UK data from England, Northern Ireland, Scotland and Wales.

Figure 27: HPRO: cumulative incidence by country, post-discharge SSI excluded, 2007



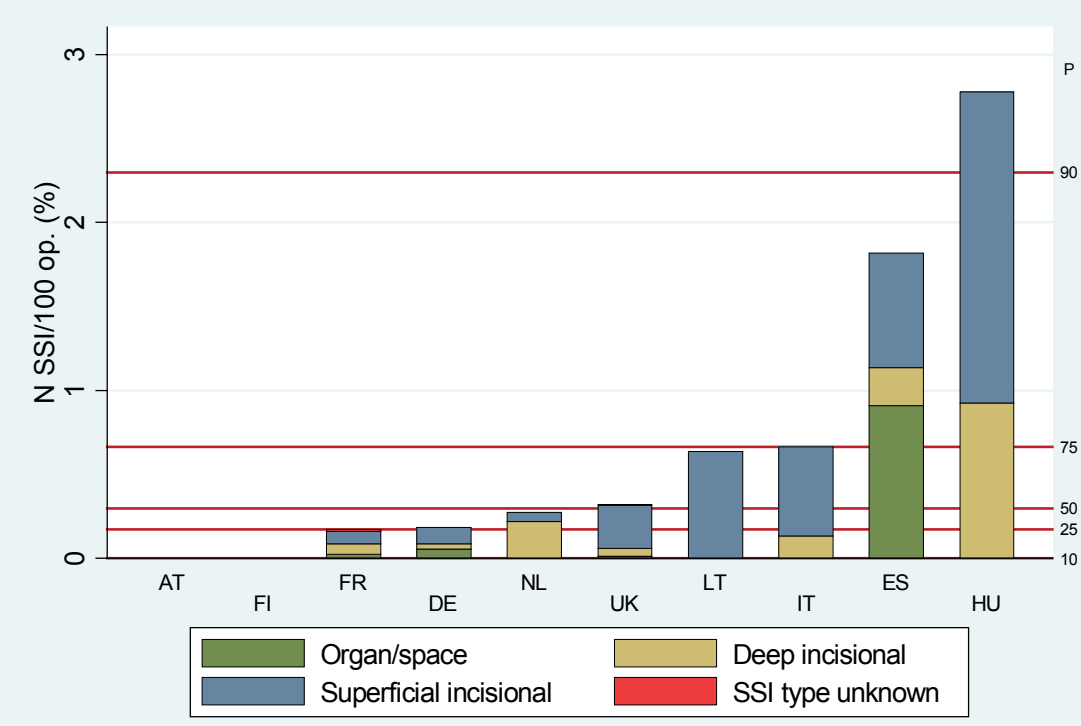
UK data from England, Northern Ireland, Scotland and Wales.

Figure 28: KPRO: cumulative incidence by country, 2007



UK data from England, Northern Ireland, Scotland and Wales.

Figure 29: KPRO: cumulative incidence by country, post-discharge SSI excluded, 2007



UK data from England, Northern Ireland, Scotland and Wales.

Figure 30: LAM: cumulative incidence by country, 2007

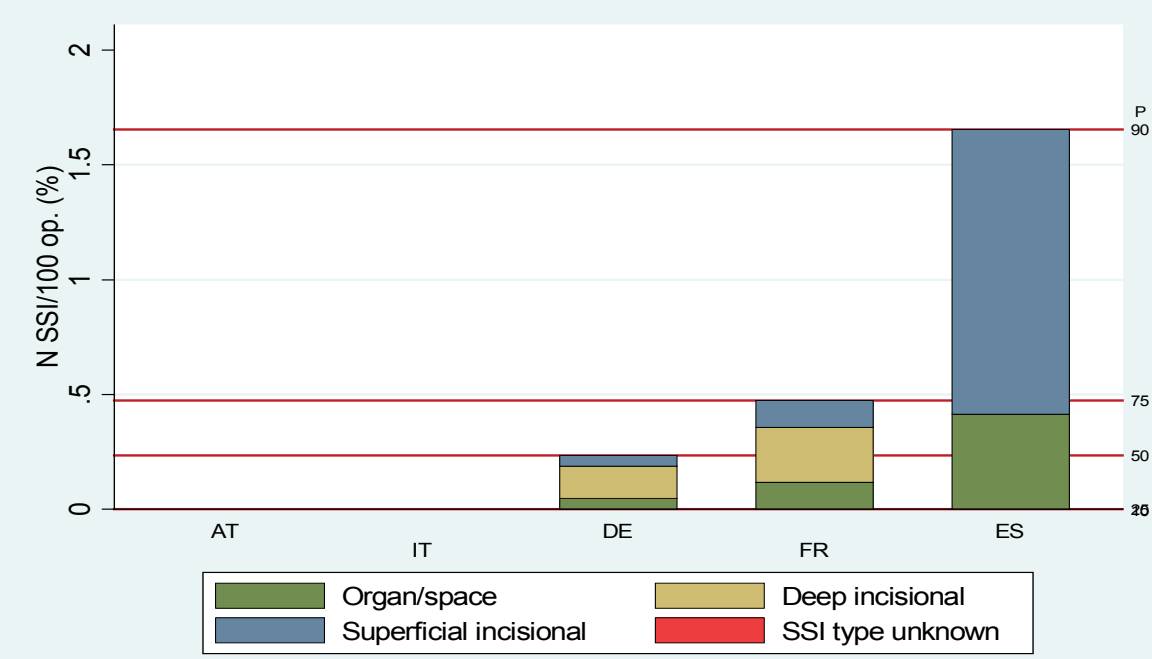
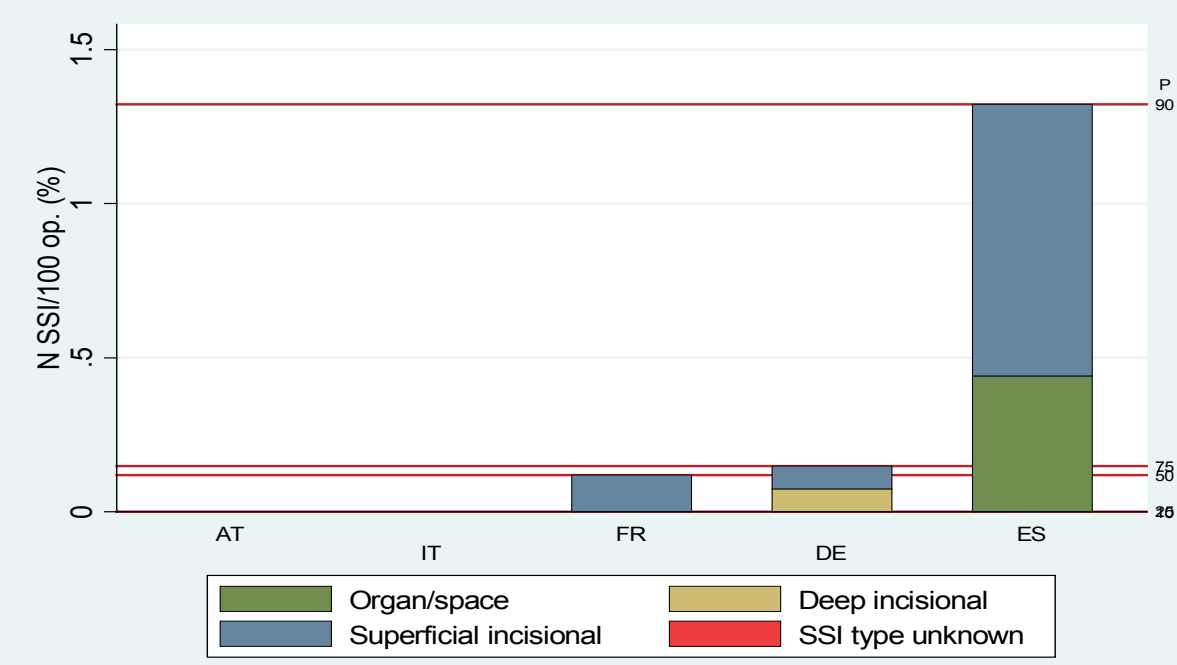


Figure 31: LAM: cumulative incidence by country, post-discharge SSI excluded, 2007



3.3.2 Incidence density

The third indicator is the number of first SSI per 1 000 postoperative days (POD) at risk (i.e. without prior SSI) in the hospital, or the incidence density (ID). In theory the incidence density is the favoured metric for the comparison of incidence between countries, as it only uses the observations during the hospital stay in both numerator and denominator and it corrects for differences in postoperative stay in the hospital.

Overall the incidence density was 1.5 per 1 000 POD, and it is given by surgical procedure category and by country in Table 14 and Figures 32–38.

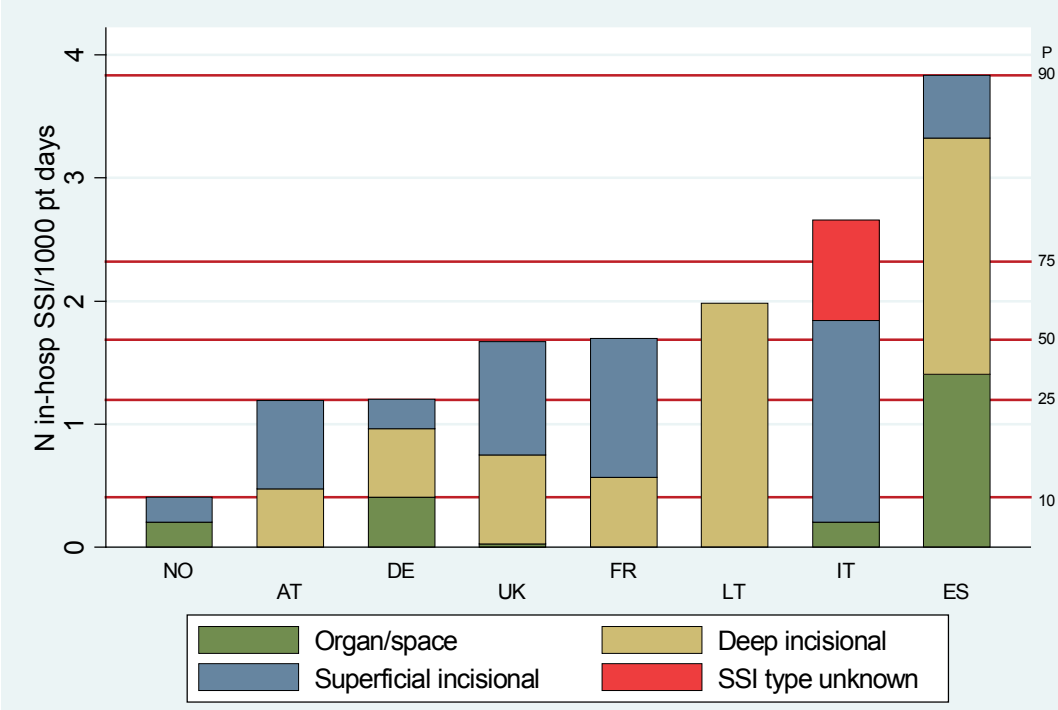
The incidence density of SSIs varied according to the surgical procedure category, with the highest incidence density in COLO (6.5/1 000 POD) to less than 1/1 000 POD in HPRO, KPRO and LAM.

Table 14: Incidence density (n in-hospital/1 000 post-operative patient days) of surgical site infection by surgical procedure category and by country, 2007

	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	Overall
CABG	1.2	1.2	3.8		1.7		2.7	2.0		0.4		1.7[1]	**1.6**
CHOL	1.0	1.7	6.5		1.0	4.0	1.6	0.7	1.5	7.4	3.0		**1.7**
COLO	5.7	5.7	12.1		5.8	7.3	5.9	6.6	7.0		9.0	6.6[1]	**6.5**
CSEC	1.0	0.8	1.3		1.0	2.9	0.7		0.9	2.9	0.8	3.6[2]	**1.5**
HPRO	0.6	0.6	1.2	1.3	0.3	2.4	0.5	0.4	1.2	1.2	0.8	0.7[3]	**0.6**
KPRO	0	0.1	1.7	0	0.2	2.2	0.6	0.5	0.4			0.4[4]	**0.3**
LAM	0	0.2	1.9		0.2		0						**0.3**

Hospitals with less than 20 operations included.
[1] Data from UK-England.
[2] Data from UK-Scotland and UK-Wales.
[3] Data from UK-England, UK-Northern Ireland, UK-Scotland, UK-Wales.

Figure 32: CABG: incidence density by country, 2007



UK data from England only.

Figure 33: CHOL: incidence density by country, 2007

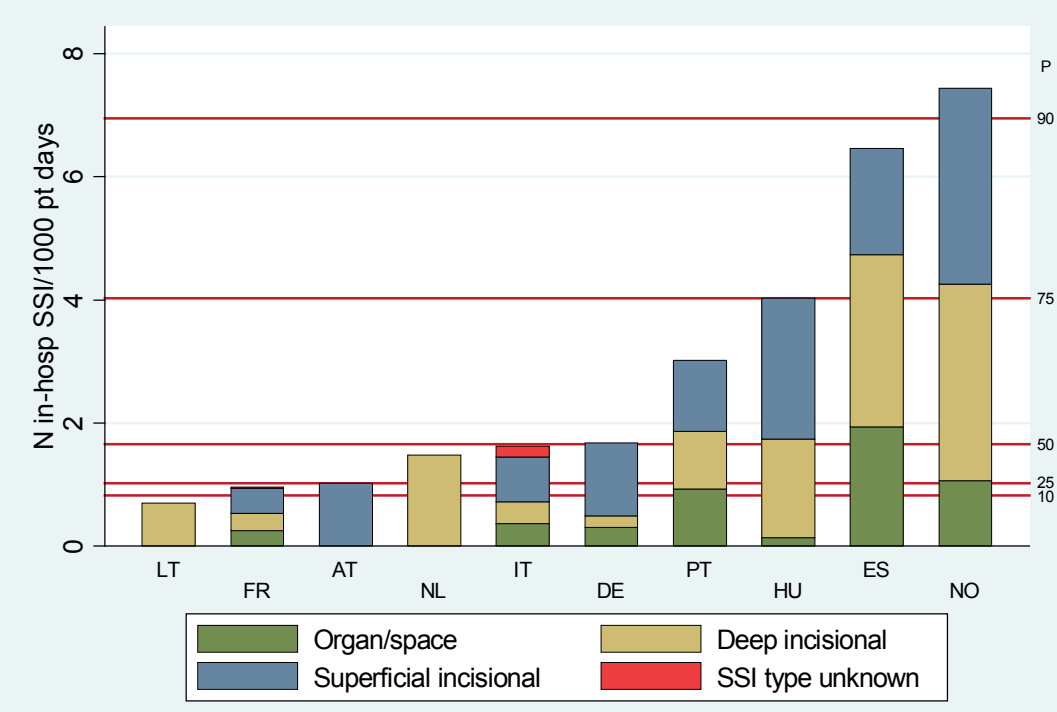
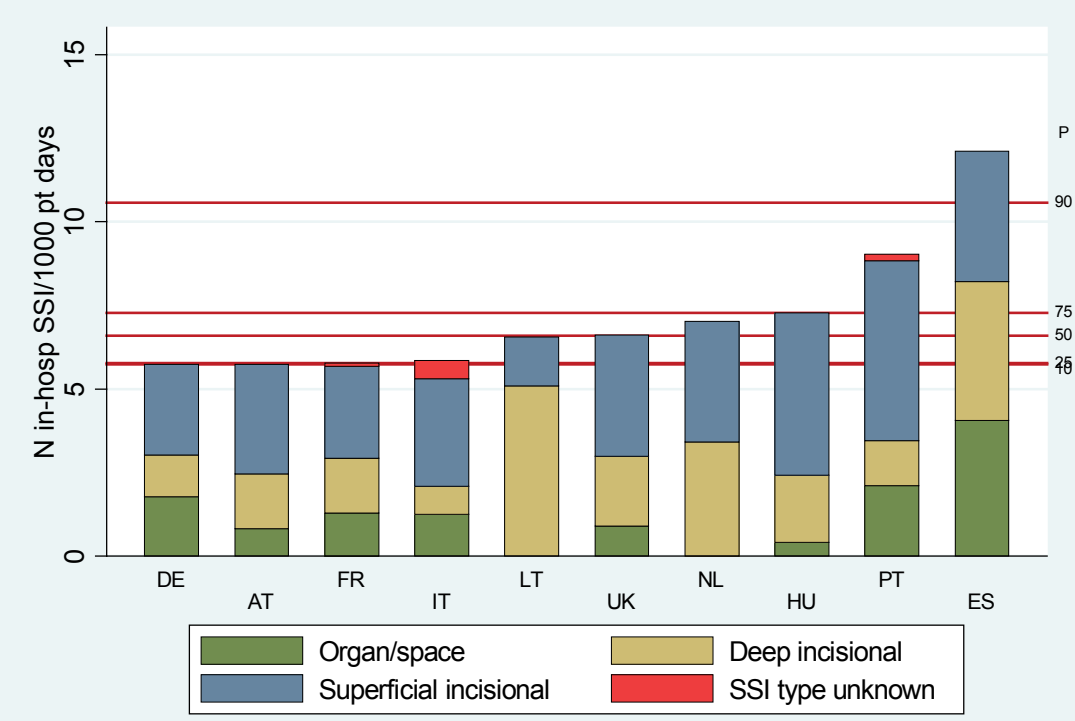
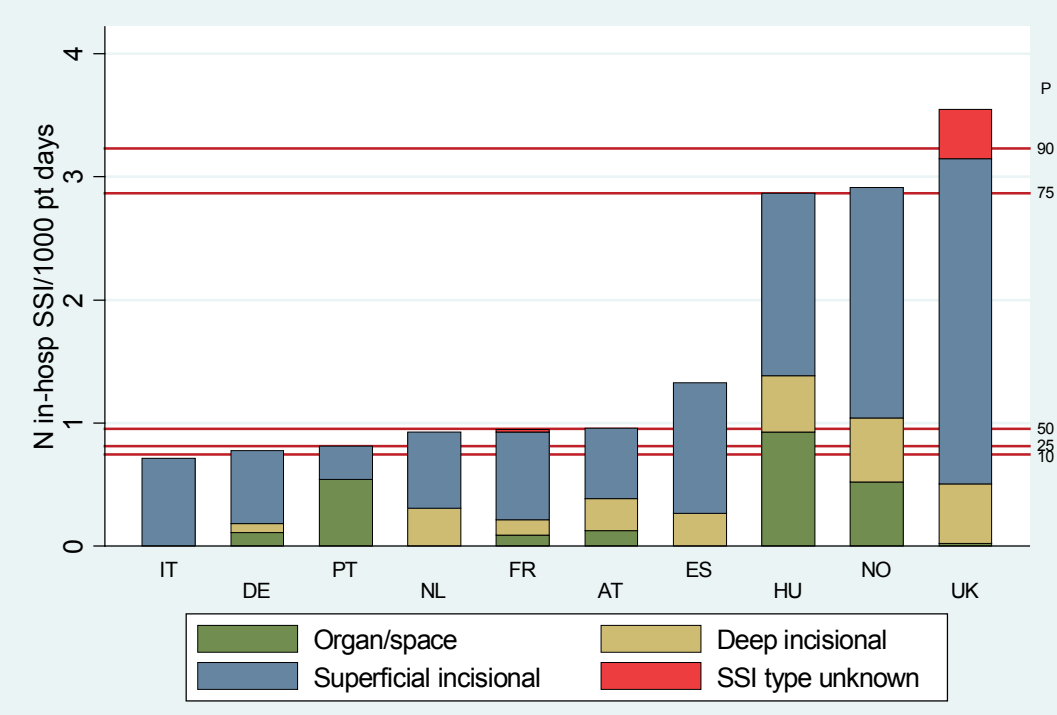


Figure 34: COLO: incidence density by country, 2007



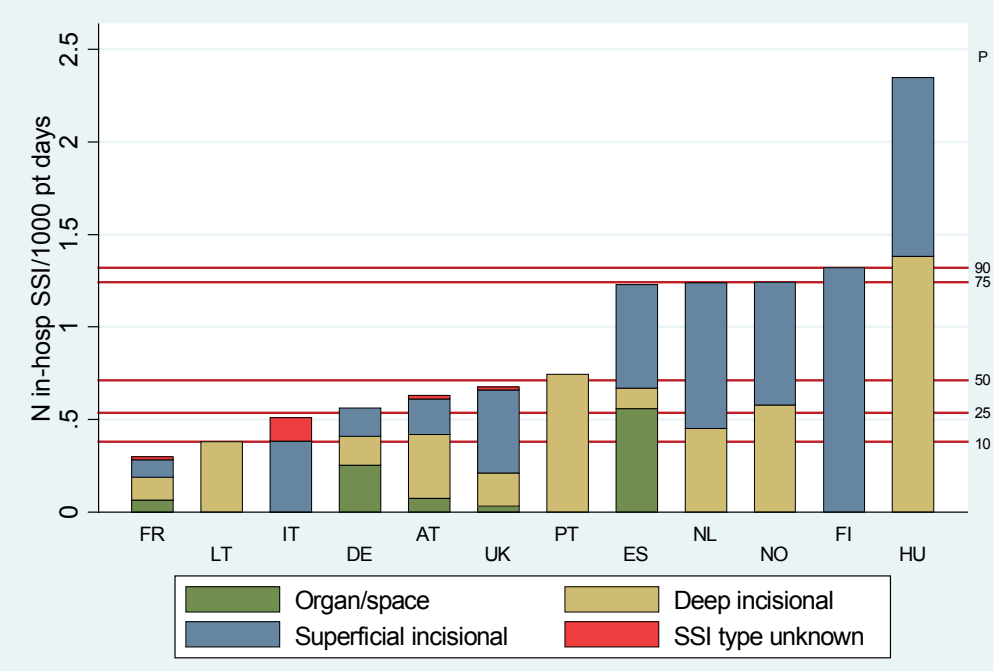
UK data from England only.

Figure 35: CSEC: incidence density by country, 2007



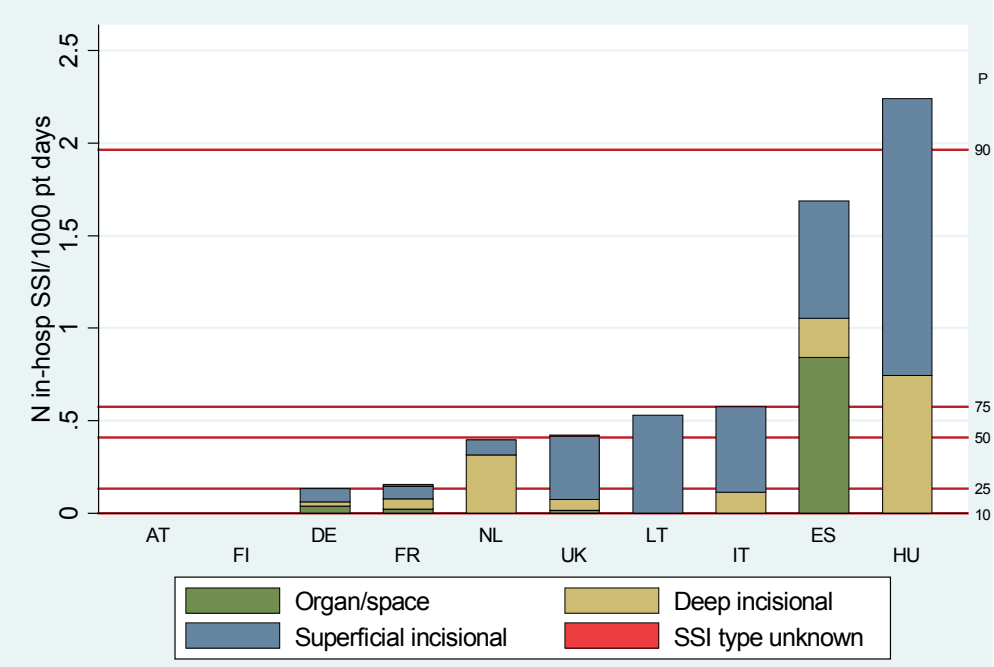
UK data from Scotland and Wales.

Figure 36: HPRO: incidence density by country, 2007



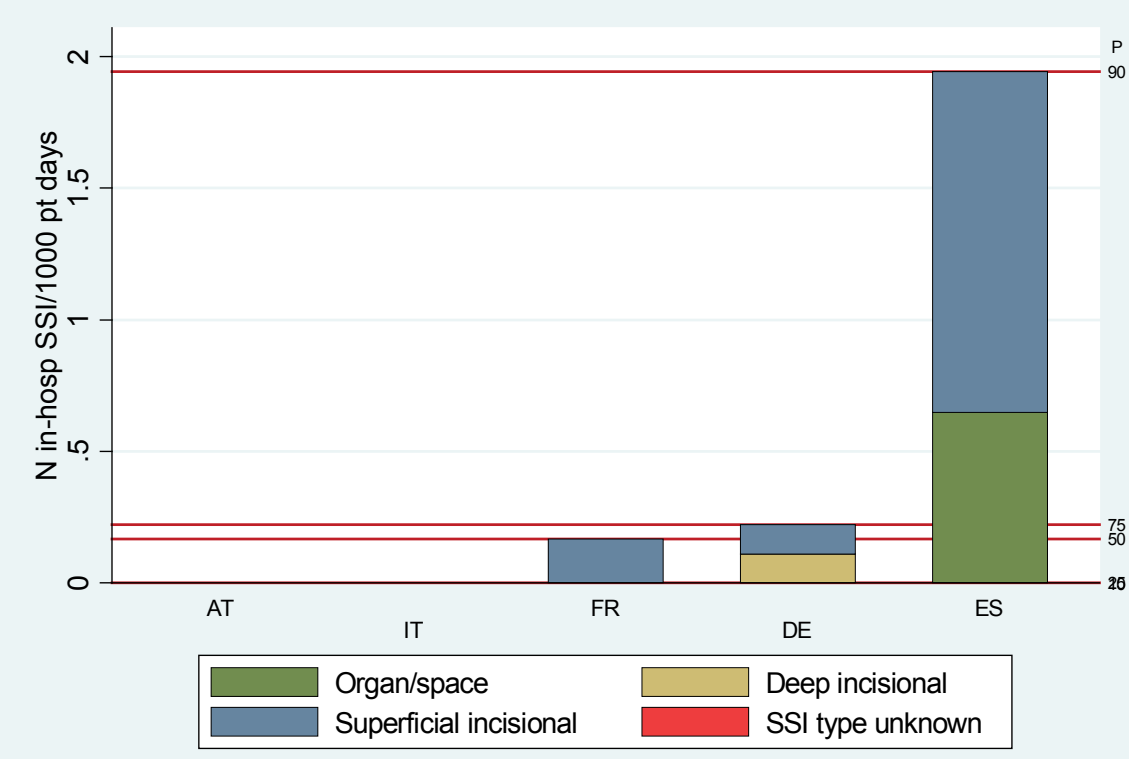
UK data from England, Northern Ireland, Scotland and Wales.

Figure 37: KPRO: incidence density by country, 2007



UK data from England, Northern Ireland, Scotland and Wales.

Figure 38: LAM: incidence density by country, 2007



To summarise, the incidence of SSIs depends on a number of factors other than quality of care:

- case mix (as reflected, e.g., by the NHSN risk index);
- case selection based, e.g., on the type of hospital and surgical unit;
- the overall sensitivity of surveillance (partly reflected by the proportion of superficial infections reported);
- the observation time in the hospital (length of postoperative hospital stay, corrected by the incidence density);
- the intensity of post-discharge surveillance (as reflected by the percentage of SSIs detected after discharge), corrected by the second and the third indicators.

3.3.3 SSI incidence by NHSN risk index

Figures 39–41 show the cumulative incidence, the cumulative incidence post-discharge excluded, and the incidence density by NHSN risk index for the different surgical procedure categories.

For most surgical procedure categories, the SSI incidence increases with increasing NHSN risk index. This correlation is clear for all surgical procedure categories, considering the cumulative incidence, post-discharge excluded, and the incidence density.

Figure 39: Cumulative incidence of surgical site infections by NHSN risk index and by surgical procedure category, 2007

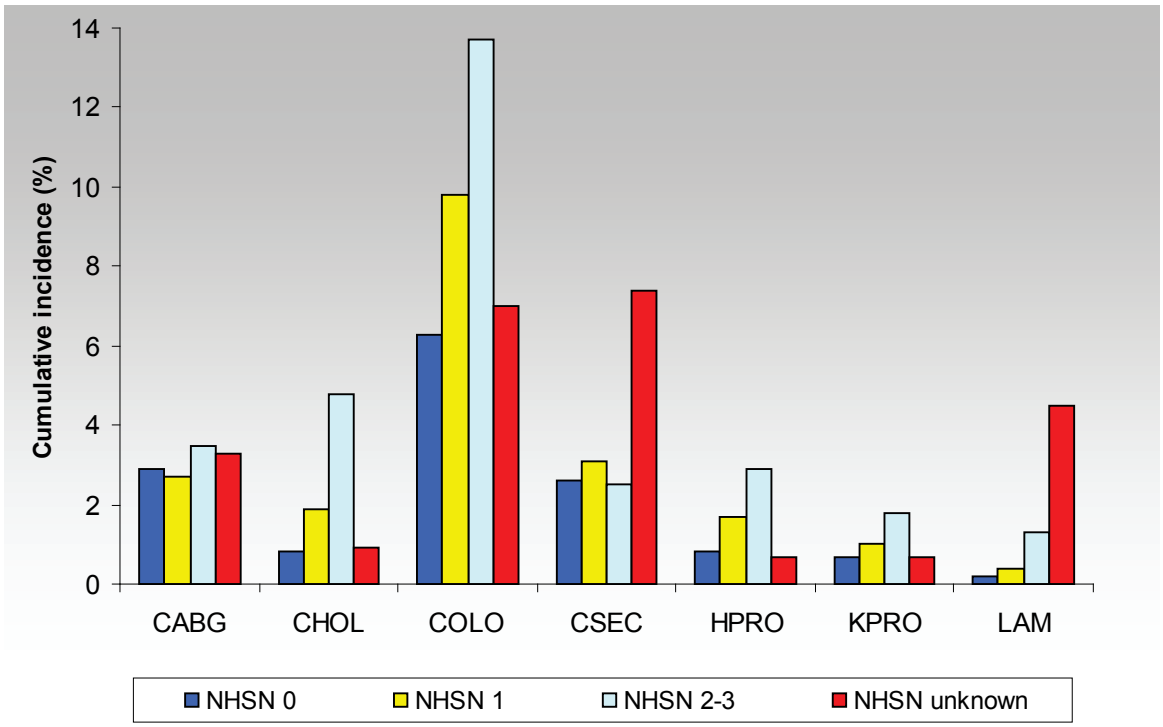


Figure 40: Cumulative incidence of surgical site infections, post-discharge infections excluded, by NHSN risk index and by surgical procedure category, 2007

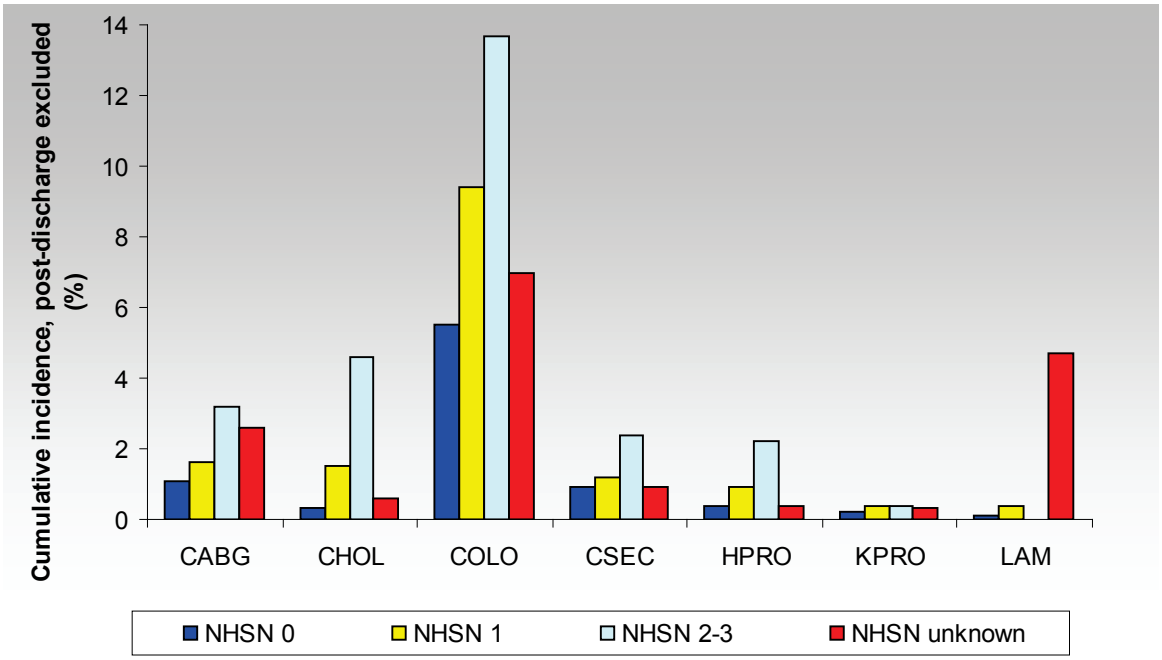
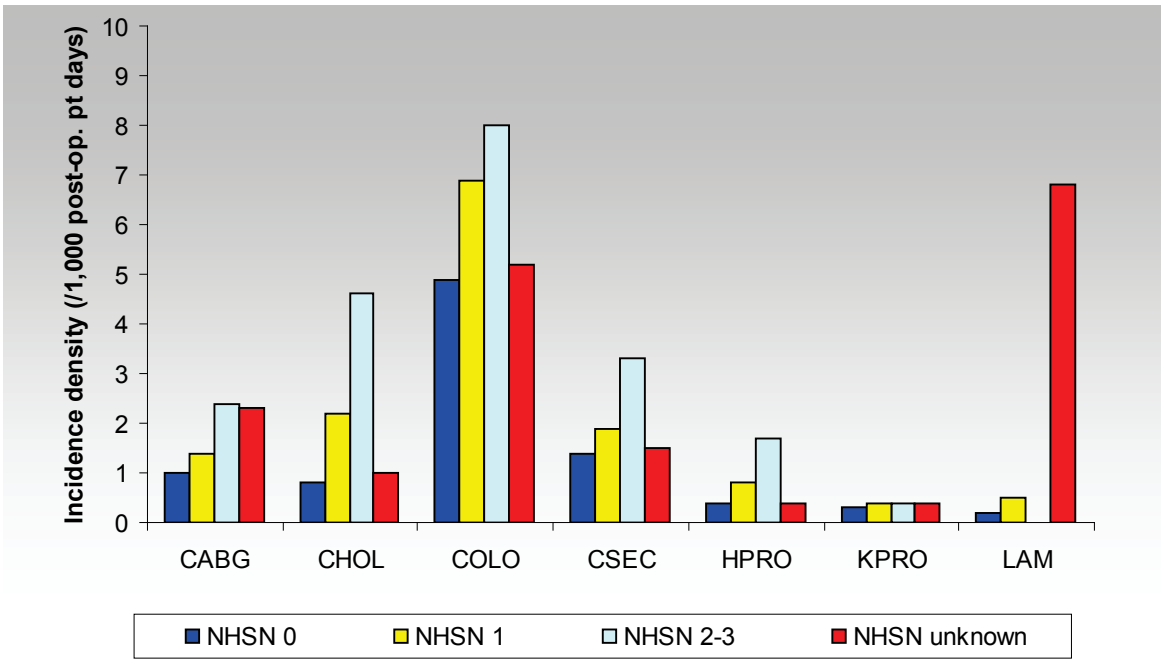


Figure 41: Incidence density of surgical site infections by NHSN risk index and by surgical procedure category, 2007

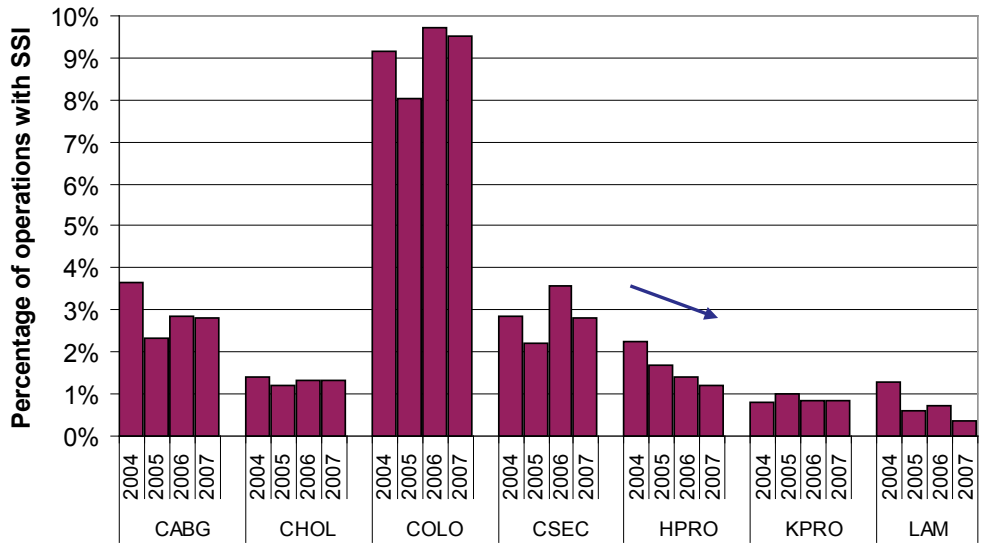


3.3.4 Trend analysis

Since incidence density of surgical site infections eliminates the effect of variations in post-discharge surveillance practice and takes into account the length of postoperative stay in hospitals, it is the preferred indicator on which to perform trend analysis. However, given the high number of missing discharge dates (in particular in Germany, Finland and Poland), trends were also analysed for cumulative incidence. All trend analyses were performed using Poisson regression and adjusted for the NHSN risk index.

The decreasing trend observed for HPRO observed in 2006 was confirmed in 2007 with an overall decrease of the cumulative incidence from 2.2% in 2004, 1.7% in 2005, 1.4% in 2006 and 1.2% in 2007 ($p < 0.001$) (Figure 42).

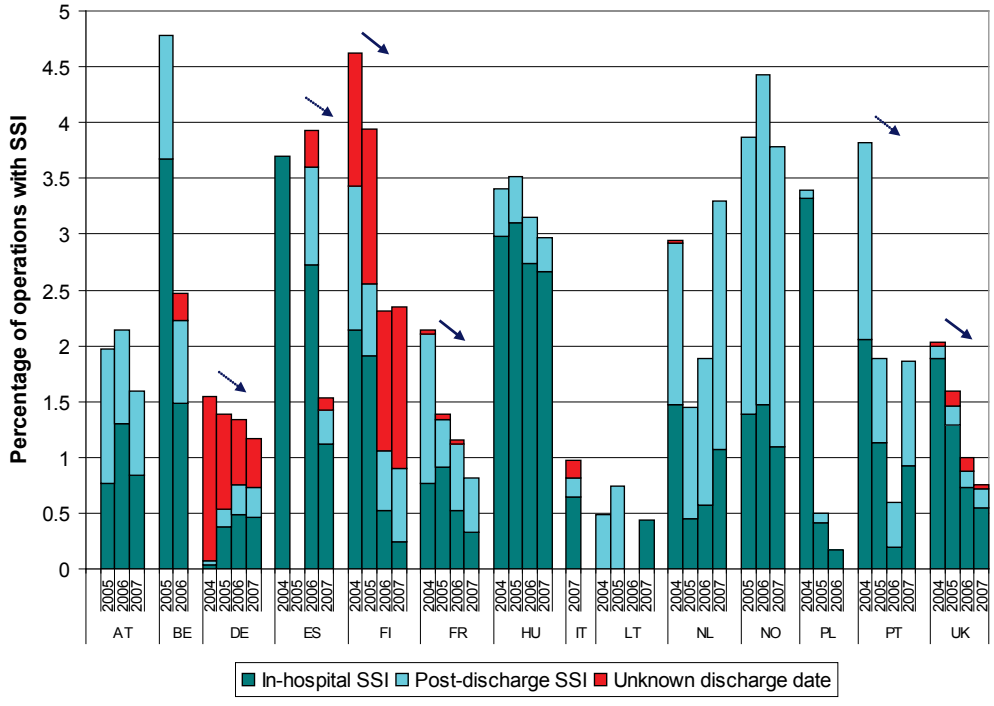
Figure 42: Trends in cumulative incidence of surgical site infections in Europe, by surgical procedure category, 2004–2007



Arrows indicate highly significant trends ($p < 0.001$)

This decrease in SSI cumulative incidence in HPRO was highly significant ($p < 0.001$) in Finland, France and the United Kingdom and moderately significant ($p < 0.05$) in Germany, Portugal and Spain (Figure 43).

Figure 43: Trends in cumulative incidence of surgical site infections in hip prosthesis, by country, 2004–2007



Austria and Belgium: data for 2004–2005 pooled because of small numbers; Belgium and Poland did not submit data for 2007; new surveillance network in Spain since 2006; arrows indicate significant trends (full line $p < 0.001$; dotted line $p < 0.05$).

Other significant decreasing trends in SSI cumulative incidence overall were observed for CABG ($p = 0.006$, significant decrease in France and in the United Kingdom) and significant decreases for CSEC in Germany, France, Poland and the United Kingdom; for KPRO (decrease in France, increase in the Netherlands); CHOL (increase in

Hungary, decrease in Poland until 2006); COLO (decrease in Lithuania and Poland); and LAM (decrease in Poland) (Table 15).

Table 15: Trend analysis of cumulative incidence of surgical site infections, multiple Poisson regression coefficients, by country and by operation category, 2007

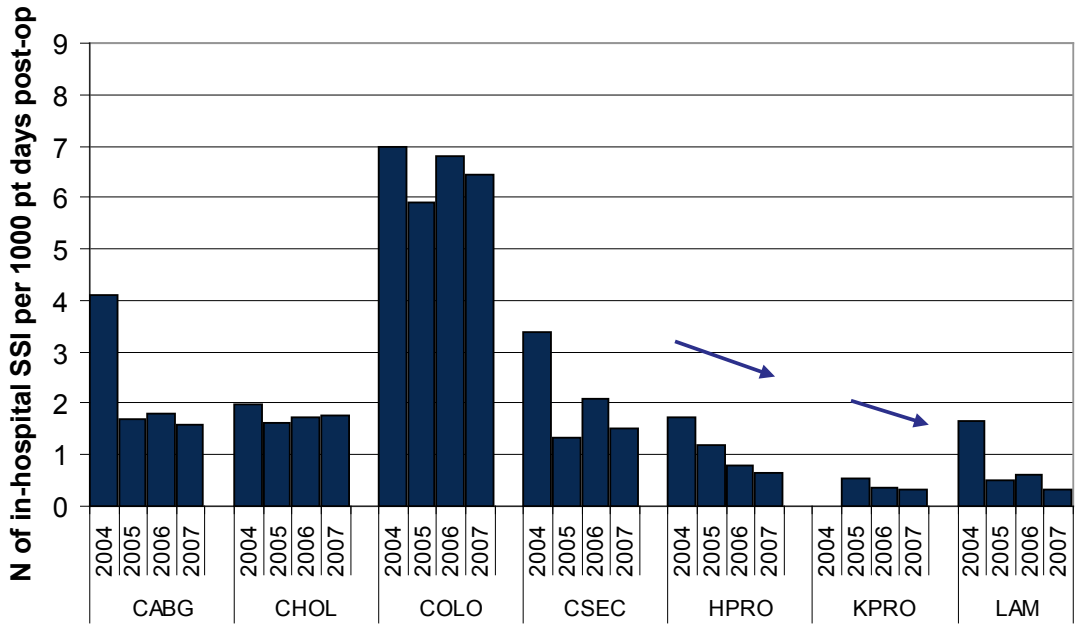
	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM
AT	-0.136	—	—	0.155	-0.155	-1.034**	—
DE	0.014	-0.053	0.024	-0.127**	-0.084**	0.067	-0.092
FI	—	—	—	—	-0.260***	—	—
FR	-0.356**	-0.081	0.015	-0.121***	-0.278***	0.190	-0.210
HU	—	0.439**	0.069	—	-0.005	—	—
LT	-0.153	-0.130	-0.269**	—	-0.105	—	—
NL	—	0.084	0.063	0.267	-0.010	0.508**	—
NO	-0.242	0.121	—	0.013	-0.031	—	—
PL	—	-0.976***	-0.257*	-1.061*	-1.490***	—	-0.901*
PT	—	0.062	-0.113	-0.217	-0.474*	—	—
UK	-0.130**	—	-0.034	-0.114***	-0.323***	-0.280***	—
Overall coefficient**	-0.069**	-0.041	-0.002	-0.119**	-0.221***	-0.080	-0.266***

**p value < 0.05; **p value < 0.01; ***p value < 0.001; total: only p values < 0.01 given as significant because of large numbers; country-specific trends were only calculated when at least three years of surveillance data were available and at least 1 000 interventions were performed; analyses of country trends were adjusted for NHSN risk index, but not for varying hospital-mix; analysis of total trend adjusted for NHSN risk index and country.*

To eliminate the effect of post-discharge surveillance and variations in case-mix, trends were also analysed for infections detected before patient discharge adjusting for the length of stay in the hospital and the NHSN risk index (trend analysis of incidence density).

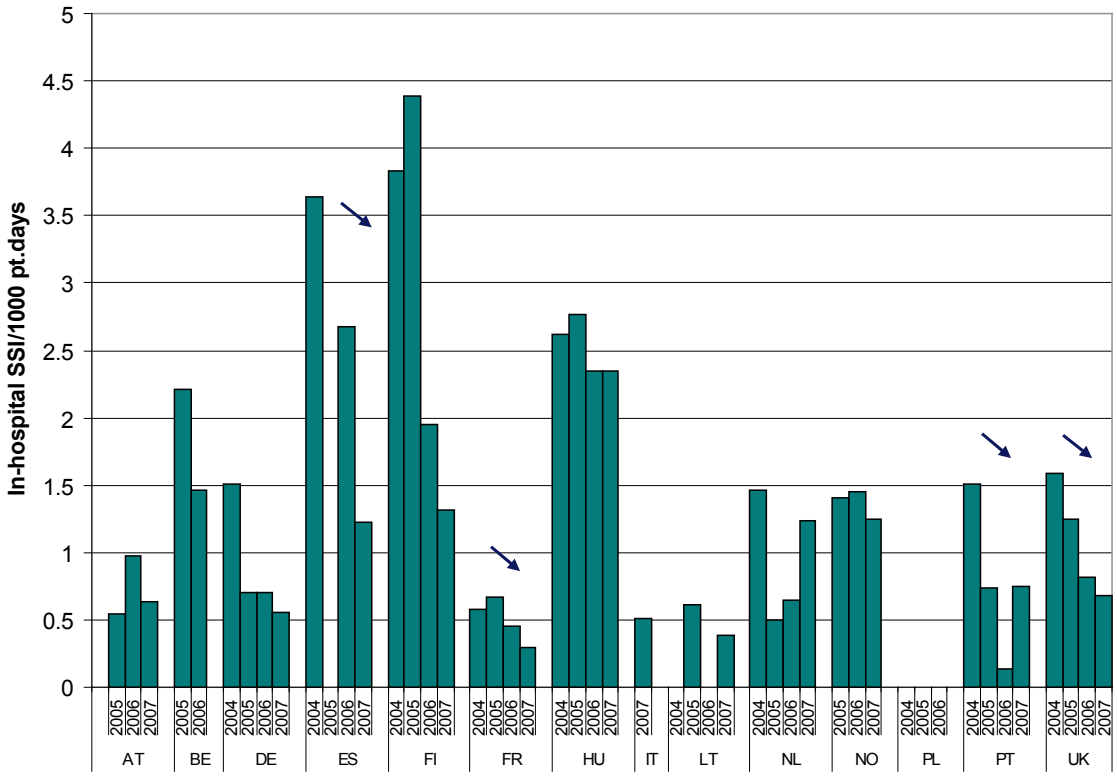
Overall, a highly significant downward trend was again observed for HPRO, but a consistent downward trend in SSI incidence density for KPRO has also been observed since 2005 ($p < 0.001$).

Figure 44: Trends in incidence density of surgical site infections in Europe, by surgical procedure category, 2004–2007



For HPRO, post-discharge and risk-adjusted trends were significant in France ($p = 0.011$), Portugal ($p = 0.047$), Spain for the last two years ($p = 0.045$) and the United Kingdom ($p < 0.001$), but only at the limit of significance for Germany (0.078). The incidence density trend analysis for HPRO in Finland was not significant. However, these analyses in Finland and Germany were compromised by the fact that the discharge date was often missing (see above).

Figure 45: Trends in incidence density of surgical site infections in hip prosthesis by country, 2004–2007



For KPRO, downward trends were significant in Germany and the United Kingdom (Table 16). Other downward trends in SSI incidence density were observed for CABG in Austria, France, Lithuania and the United Kingdom; for COLO in Lithuania; and for CSEC in France.

Table 16: Trend analysis of in-hospital incidence density of surgical site infections, multiple Poisson regression coefficients by country and by operation category

	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM
AT	-0.536*	—	—	-0.158	-0.059	-0.666	—
DE	0.183	-0.129	0.004	0.001	-0.132	-0.412*	0.293
FI	—	—	—	—	-0.019	—	—
FR	-0.319*	0.043	0.039	-0.114*	-0.205*	0.275	-0.435
HU	—	0.393**	0.099	—	-0.018	—	—
LT	-0.169*	-0.114	-0.222*	—	0.231	—	—
NL	—	-0.191	0.052	0.223	-0.159	0.402	—
NO	-0.244	0.873	—	0.345	-0.058	—	—
PT	—	0.204	-0.019	0.311	-0.578*	—	—
UK	-0.148**	—	-0.003	-0.031	-0.288***	-0.256***	—

P value < 0.05;p value < 0.01;***p value < 0.001; trends were only calculated when at least three years of surveillance data were available and at least 1 000 interventions were performed; analyses were adjusted for NHSN risk index and length of post-operative stay in the hospital, but not for varying hospital-mix.*

4 Conclusions part I

4.1 Participation in the ECDC SSI surveillance

In 2007 the participation in the ECDC SSI surveillance in terms of number of surveyed operations had increased by 9.2% since 2006, and by 60.3% since 2005. Overall, nearly 10 out of every 100 performed operations were surveyed, even though the estimated SSI surveillance coverage varies between countries with a very large range (0.2–60.1%), considering the different surveillance strategies.

4.2 Data quality

The quality of data in 2007 was similar to that in previous years. Expressed as a proportion of data available according to the HELICS-SSI protocol [11], a high degree of compatibility was achieved: 89% for mandatory and required variables combined, and 81% for all variables including the optional variables.

As in previous years, calculation of the NHSN risk index was not possible for 7% of the records; out of the three variables needed to calculate NHSN risk index, wound contamination class and duration of operation were only sporadically missing while the ASA score was missing for 5% of records.

Of the required variables, one of the most important is the date of discharge, which is fundamental to the calculation of the cumulative incidence, post-discharge SSIs excluded, and the incidence density. In all countries apart from Germany and Finland, the proportion of missing values was always less than 7%. The proportion of missing values in Germany was lower than in previous years: decreasing from 64.8% in 2004–2006 to 37.9% in 2007.

4.3 SSI incidence indicators: intercountry comparisons

Intercountry comparisons of SSI indicators should be made with caution because at least some of the differences can be explained by one or several of the following parameters:

- differences in post-discharge surveillance methods (e.g. more intensive in Finland, the Netherlands and Norway);
- differences in postoperative length of stay in hospital: infections are more likely to be detected during the hospital stay than after the discharge from hospital;
- selection of hospitals with specific problems in countries with low participation in the SSI surveillance module;
- differences in hospital mix participating from one year to another;
- differences in case-mix and type of operation (although these are partly taken into account by the NHSN risk index), e.g. some countries perform more total hip prostheses and fewer partial hip prostheses (higher intrinsic infection risk) than others within the HPRO category;
- different interpretations of the same case definitions, resulting in different percentages of superficial infections being reported;
- organisational aspects such as mandatory participation with public disclosure of individual (hospital-based) SSI indicators (e.g. in the UK).

Part II – Surveillance of healthcare-associated infections in intensive care units

5 Methods

5.1 The HELICS-ICU protocol and case definitions

The HELICS-ICU protocol [3] includes a unit-based (level 1, minimal data set) and a patient-based (level 2) module. In unit-based surveillance, denominator data (patient-days) are collected for the entire unit, in patient-based surveillance, data (including risk factors for risk-adjusted inter-hospital comparisons) are collected for each patient, infected or not.

Patients staying less than three days in ICU are excluded from both levels, so that denominators and indicators in both levels are comparable. Most national or regional protocols for the surveillance of ICU-acquired infections are patient-based (Austria, Belgium, France, Spain, Luxembourg, Lithuania, Portugal, Italy, Slovakia). Germany has a unit-based system derived from the NHSN system of the Centers for Disease Control and Prevention, Atlanta [5], and is not fully compatible with the HELICS unit-based protocol because separate data on patient-days for patients staying three days or more in ICU are not provided (i.e. data from patients staying two days or less are also included in the denominator). Also, case definitions in the German surveillance differ slightly from the HELICS case definitions. In particular, case categories for pneumonia and bloodstream infections differ. Data from Germany were excluded for the calculation of indicators, but included for the descriptive analysis of the infections.

In both surveillance levels, one record per infection is collected. Infections occurring after day 2 in the ICU are considered as ICU-acquired. ICU-acquired pneumonia (PN) is defined according to clinical criteria (X-rays, fever > 38°C, leucocytosis > 12 000 WBC/mm^3, purulent sputum, etc.) and further subcategorised in five groups according to the level of microbiological confirmation [3]:

- PN1: minimally contaminated lower respiratory tract sample with quantitative culture (10^4 CFU/ml for broncheoalveolar lavage, 10^3 CFU/ml for protected brush samples or distal protected aspirate);
- PN2: non-protected sample (endotracheal aspirate, ETA) with quantitative culture (10^6 CFU/ml);
- PN3: alternative microbiological criteria (e.g. positive blood culture);
- PN4: sputum bacteriology or non-quantitative ETA;
- PN5: no microbiological documentation.

A bloodstream infection is defined as a positive blood culture for a recognised pathogen or the combination of clinical symptoms (fever > 38°C, chills, hypotension) and two positive blood cultures for a common skin contaminant from two separate blood samples drawn within 48 hours.

6 Data analysis

6.1 Infection episodes

Subsequent infection episodes in the same patient were recalculated in the analysis, using an arbitrary minimum of four days' interval between two episodes of pneumonia and seven days for bloodstream infections, urinary tract infections and catheter-related infections. This was done because some countries or ICUs reported microorganisms isolated on the day following the date of infection as a new infection on the next day.

The microorganisms reported under these so-called new episodes were 'recovered' under the first episode, replacing less specific codes with more specific codes.

When the origin of bloodstream infections differed after this correction (which may have been another reason to register different records for the same infection episode), the origin was replaced according to the following order of priority: catheter-related>secondary origin (Pneumonia>Urinary tract infection>Surgical site infection>Skin/Soft tissue infection>Digestive tract infection>Other) >unknown >missing origin.

Finally, reported infections occurring on day 1 and day 2 in the ICU were also removed.

6.2 Microbiological results

The HELICS protocols include two code lists for microorganisms [3]. The enlarged list includes 147 codes and specifies genus and species for a selection of the most important (either by frequency of occurrence or by their public health importance) nosocomial pathogens, while grouping rare microorganisms in larger categories. The minimal list only includes 31 codes and mostly only specifies the genus (except for *S. aureus*, coagulase-negative staphylococci, *P. aeruginosa* and *S. maltophilia*).

6.3 Exclusion criteria

In order to improve the comparability of the results and adherence to the protocol specifications, the following data were excluded from the analysis:

- ICUs with less than 20 patients in the surveillance database were excluded for unit-based percentile analyses (percentile distributions, etc.);
- patients staying less than three days in the ICU were excluded from all patient-based databases;
- patients staying more than 400 days in the ICU (< 0.01%) and patients with missing discharge dates were excluded from all patient-based databases;
- when there was a mismatch in the hierarchical database, the entire record (in all tables) was removed if this mismatch concerned minimal data;
- duplicate patient records (same ICU, patient number and ICU admission date);
- exclusion of infections:
  - infections on day 1 and day 2, post-discharge infections;
  - infection records with missing infection site or missing infection date;
  - duplicate infection records (same patient, infection site and infection date);
  - 'infection episodes' (records) with interval of less than four days between subsequent infection dates for pneumonia and seven days for other infection types;
- exclusion of microorganisms:
  - real duplicates, duplicate after recovering microorganisms from 'duplicate' infection records;
  - for country databases where more than three microorganisms by infection were allowed, the following algorithm was used to remove the fourth (or fifth…) microorganism if the other three records had valid microorganisms:
    - removal of 'empty' codes (NONID, NOEXE, STERI) – if after this correction there were still infection records with > 3 microorganisms, then (number of microorganisms recalculated after each step):
      a) removal of 'other' code categories (e.g. BCTTOT, ETBTOT, etc.);
      b) removal of non-specified genus if other records contained more specific code (e.g. STANSP when STAAUR was reported as well);
      c) removal of *Candida spp*. for infection types other than bloodstream infections (BSI);
      d) removal of coagulase-negative staphylococci for infection types other than BSI;
      e) removal of other possible skin contaminants and 'non-nosocomial' microorganisms: CORSPP, HAESPP, STRSPP;
      f) removal of enterococci;
      g) removal of less frequent enterobacteriaceae;
- exclusion in level 1 denominator data + corresponding infection data;
  - 'ICUs' with 0% of intubated patients.

6.4 Other standardised data management and analysis procedures

- Definition of device-associated infection based on device use in the 48 hours before infection: in patient-based data, intubation use (one or two days) in the two days before the infection date, including invasive device use on the infection date itself, will result in classifying the infection as device-associated and recoding the variable inv_dev to 1 if it was 0 or missing.
- Pneumonia reported as PN5 with at least one valid microorganism are recoded to PN4.
- Pneumonia reported as PN4 without valid microorganism are recoded to PN5.
- The subcategory BSI-B of bloodstream infections was created to allow compatibility with the CDC/NNIS protocol. Reporting of these BSI with only one positive blood culture of a common skin contaminant (see HELICS protocol definitions [3,11]) was optional and only rarely done. Germany follows the CDC protocol and, therefore, does include them; however, the BSI-B subcategory was never specified and correction of the German data could not be made. Since 2005 CDC/NHSN changed its definitions and omitted this category of BSI, the subcategory can now be deleted from the HELICS definition of BSI, and theoretically the German data no longer include BSI-B since 2006–2007, which may also account for some changes observed in the epidemiology of ICU-acquired bloodstream infections. For countries that did report BSI-B separately, these infections were excluded from the analysis (in 2007, these were five BSIs in Italy and two BSIs in Luxembourg).
- Antimicrobial resistance data were deduplicated to keep the first isolate per patient (ICU stay) across different infection types for the overall percentage of resistance or by infection type for site-specific results.
- The HELICS-ICU data format for day-by-day exposure data does not allow for missing values. Missing exposure data are considered as no exposure. While this will be corrected in the new ECDC TESSy data definitions for ICU surveillance, reported device use in this report may differ from figures obtained by national analysis.

7 Participation

Nine patient-based networks (Austria, Belgium, France, Spain, Portugal, Italy, Luxembourg, Lithuania and Slovakia), two unit-based (Germany and Croatia) surveillance networks and two piloting countries (Romania, England – unit-based) contributed data from 754 hospitals, including 888 ICUs with at least 20 patients. This is slightly more than in 2006 when 678 hospitals and 786 ICUs participated (see Table 17). Beside level 2 data, Belgium also contributed level 1 data for ICU-acquired bloodstream infections only, from the national surveillance of nosocomial bloodstream infections (NSIH-SEP).

Patient-based data were available for 55 988 patients staying more than two days in the ICU, while denominator data from unit-based surveillance included 370 454 patients, the majority from Germany. The evolution of the number of patients reported to the European surveillance of ICU-acquired infections from 2004 to 2007 is given in Table 18.

Figure 46: Participation in EU surveillance of ICU-acquired infections, status in 2007

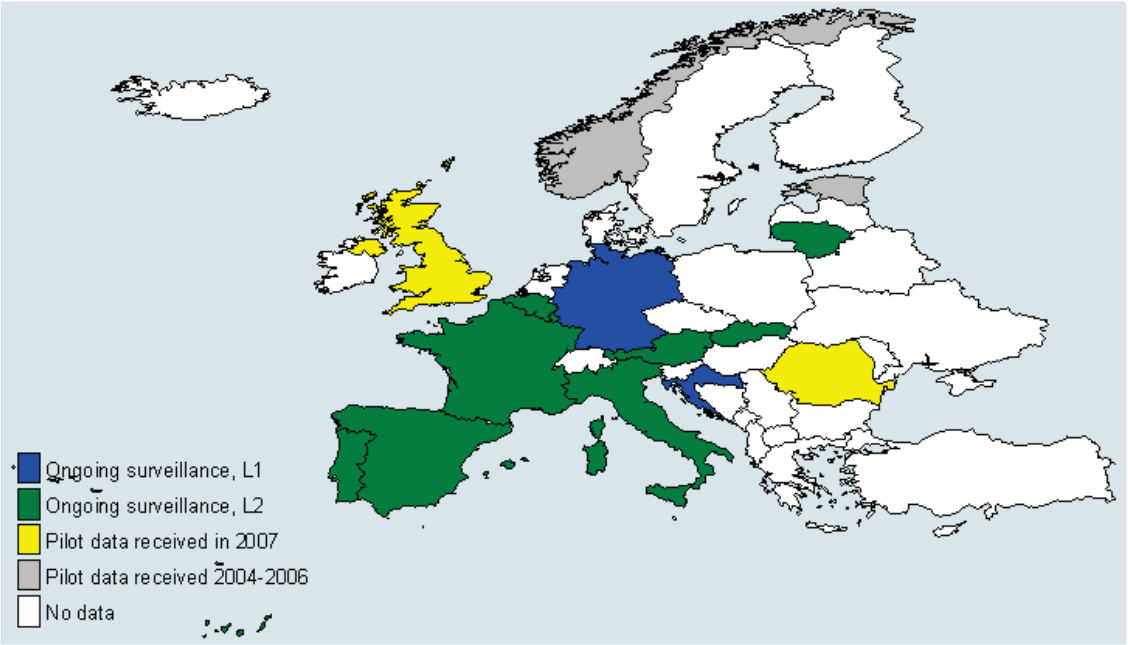


Table 17: Number of hospitals reporting the EU surveillance of ICU-acquired infections, by country, 2004–2007

	2004	2005	2006	2007
AT	54	30	33	37
BE	84	70	76	78
DE	184	234	262	308
EE	—	—	1	—
ES	41	75	108	122
FR	118	132	141	148
HR	—	—	—	6
IT	—	—	34	29
LT	10	8	7	6
LU	5	5	6	7
NO	2	—	—	—
PT	3	11	7	6
RO	—	—	—	1
SK	—	2	3	5
UK	—	—	—	1
Total	**501**	**567**	**678**	**754**

Table 18: Number of patients reported, by country, 2004–2007

	2004	2005	2006	2007
Patient-based surveillance				
AT	10 855	5 686	6 534	7 441
BE	6 220	4 677	3 213	2 684
EE	0	0	47	0
ES	3 046	10 558	13 145	15 906
FR	16 566	19 446	21 951	22 927
IT	0	0	1 726	1 993
LT	1 133	2 042	1 810	1 546
LU	2 119	2 083	2 144	2 710
NO	27	0	0	0
PT	240	1 138	787	596
SK	0	77	103	185
Total patient-based	**40 206**	**45 707**	**51 460**	**55 988**
Unit-based surveillance				
BE (inc. BSI)	19 458	22 394	25 717	25 201
DE	212 104	262 186	286 266	345 012
HR	—	—	—	3 260
UK (PN)	—	—	—	241
Total unit-based	**231 562**	**284 569**	**311 983**	**37 3714**
Grand total	**274 682**	**329 643**	**363 266**	**429 702**

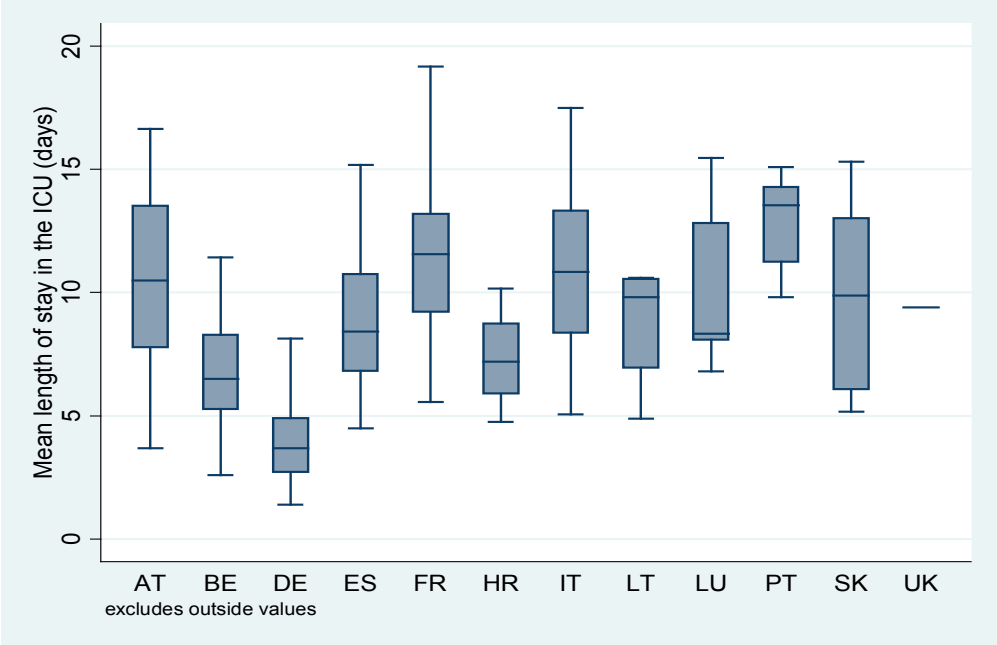
Note: denominator data for Romania were not included.

8 Results

8.1 Characteristics of ICUs and patients

The mean length of stay in the ICU was 7.6 days, but was lower in Germany (3.8 days) mainly because of the inclusion in the denominator of patients staying less than two days, as shown in Figure 47. The mean length of stay in level 2 surveillance was 10.2 days, varying from 7.5 days in scheduled surgery patients, 10.2 days in medical patients and 12.6 days in patients admitted for urgent surgery.

Figure 47: Distribution of the mean length of stay in intensive care units (days) by country, 2007



Note: ICUs with less than 20 patients excluded; denominator data from Romania were not available.

The type of ICU is given in Table 19. In accordance with the CDC definition, ICUs were classified as medical or surgical if at least 80% of the patients belong to the corresponding admission type. This variable was calculated based on the patient database, except for Germany, where this information was provided directly. Since the calculation was made for patients staying more than two days, the number of surgical units was possibly underestimated because of the shorter length of stay for scheduled surgery patients. Also, ICUs reporting themselves to which ICU type they belong (unit-based data) may sometimes have fewer patients than the defined 80% belonging to a given category (e.g. an ICU with 75% surgical patients may still classify itself as a surgical ICU).

Table 19: ICU types as a percentage of the total in each country in 2007 (ICUs with fewer than 20 patients excluded); total numbers of ICU, by country and by ICU type

	Multidisciplinary	Medical	Surgical	Coronary care unit (CCU)	Burns	Neurosurgy	Paediatrics	Other	Missing	Total N of ICUs
AT	40.5	32.4	27.0	0	0	0	0	0	0	**37**
BE	84.2	15.8	0	0	0	0	0	0	59	**78**
DE	50.1	15.8	21.9	1.9	0	3.3	3.5	3.5	0	**425**
ES	52.2	42.5	4.4	0.9	0	0	0	0	0	**113**
FR	61.2	27.3	10.3	0.6	0.6	0	0	0	0	**165**
HR	25.0	25.0	50.0	0	0	0	0	0	5	**9**
IT	60.0	6.7	20.0	10.0	0	0	3.3	0	0	**30**
LT	55.6	0	22.2	0	0	0	22.2	0	0	**9**
LU	77.8	11.1	0	0	0	11.1	0	0	0	**9**
PT	66.7	0	33.3	0	0	0	0	0	0	**6**
RO	100	0	0	0	0	0	0	0	0	**1**
SK	100	0	0	0	0	0	0	0	0	**5**
UK	100	0	0	0	0	0	0	0	0	**1**
Total N of ICUs	**446**	**179**	**137**	**13**	**1**	**15**	**18**	**15**	**64**	**888**

Note: Figures are percentages of total number of ICUs in each country – missing values, except for category missing (=n of ICUs); individual ICUs within the same hospital could not be identified in Belgium and Spain; Data from BSI surveillance from BE do not contain data on ICU type.

Table 20: Patient characteristics* at ICU admission, patient-based surveillance, 2007

	AT	BE	ES	FR	IT	LT	LU	PT	SK	Overall
N of patients	7 441	2 684	15 906	22 927	1 993	1 546	2 710	596	185	55 988
Mean age (years)	64.4	67.4	61.6	62.2	63.8	48.6	64.8	59.1	57.6	61.1
Sex ratio male-to-female	1.39	1.37	1.93	1.58	1.66	1.61	1.09	1.96	1.68	1.56
Mean length of stay in ICU (days)	10.4	8.2	9.5	11.2	11.2	8.9	10.2	13.1	9.5	10.2
ICU mortality (%)	11.8	13.6	12.1	18.1	17.6	15.6	10.3	15.7	22.7	15.3
Mean SAPS II score	38.2	41.5	29.8	41.7	32.3	18.9	21.8	47	56.3	36.4
Patients from community (%)	43.3	60.4	57.1	60.4	56.9	14.7	51.1	51.4	59.2	50.5
Mean LOS hospital bef. ICU adm.	5.3	4.2	4.1	—	3.8	—	—	4.9	2.7	4.2
Admission type (%)										
– Medical	54.8	68.0	69.7	67.6	56.8	37.6	67.9	54.2	53.8	58.9
– Surgery, scheduled	23.4	21.0	17.5	13.8	25.2	31.5	20.1	9.5	12.5	19.4
– Surgery, unscheduled	21.8	11.0	12.8	18.6	18.0	30.9	11.9	36.3	33.2	21.6
– Unknown (not in total)	0.1	0.8	6.7	0.3	2.7	1.5	0	0	0.5	1.4
Trauma patients (%)	11.6	7.5	10.1	10.3	4.0	14.6	3.8	26.2	30.4	13.2
Coronary care (%)	2.5	17.5	23.1	—	28.9	—	—	—	22.1	18.8
Impaired immunity (%)	0.1	3.8	8.1	12.8	4.0	19.3	0.3	4.8	45.5	11
Antibiotics <>48h admission (%)	43.6	36.0	34.7	55.2	62.5	27.0	21.0	41.5	83.3	45

** Only patients staying more than two days in ICU are included.*

Table 21: Use of invasive devices among patients staying more than two days in ICU, patient-based surveillance, 2007

	AT	BE	ES	FR	IT	LT	LU	PT	SK
Patients with ≥ 1 day CVC (%)	79.7	63.4	72.9	59.2	85.5	76.5	53.4	93.6	81.6
Patients with ≥ 1 day intubation (%)	61.4	38.0	44.8	63.8	72.6	55.9	29.8	88.8	89.2
Patients with ≥ 1 day UC (%)	72.5	71.4	74.4	83.6	—	87.1	65.8	94.6	97.8
CVC days/100 patient-days	87.4	69.4	75.8	62.1	73.8	76.3	56.2	83.2	79.9
Intubation days/100 patient-days	61.1	39.8	49.3	60.6	58.9	39.8	29.3	73.3	61.9
UC days/100 patient days	73.0	75.8	78.1	81.2	—	82.2	65.8	86.6	89.6

CVC=central venous catheter; UC=urinary catheter

8.2 ICU-acquired infections

The HELICS-ICU protocol collects data on ICU-acquired bloodstream infections (BSI), pneumonia (PN) and optionally on urinary tract infections (UTI), catheter-related infections (CRI) and other infections as a group (OTH) [3]. As shown in Table 22, all 13 participating countries (or piloting ICUs) collected data on pneumonia, all but one (UK, pilot study) on BSI, all but one on urinary tract infections, eight countries on CRI (although only five provided the optional risk factor data that should be collected for this indicator) and eight countries specified other infections (mostly more detailed in their respective national protocols).

Table 22: Number of infections reported in 2007, by infection type and country

	PN	BSI	UTI	CRI	OTH	Total
AT	430	282	557	139	716	2 124
BE	516	126/739*	52	3	13	1 449
DE	3 514	1 467	1 808	0	417	7 206
ES	1 251	940	668	346	1 400	4 605
FR	2 421	985	1 449	382	0	5 237
HR	51	10	9	5	0	75
IT	207	86	60	25	0	378
LT	79	38	18	4	83	222
LU	70	52	177	0	0	299
PT	67	33	20	0	20	140
RO	26	5	3	0	2	36
SK	32	10	26	6	15	89
UK	36	0	0	0	0	36
Total	**8 700**	**4 773**	**4 847**	**910**	**2 666**	**21 896**

PN=pneumonia; BSI=bloodstream infection; UTI=urinary tract infection; CRI=catheter-related infection; OTH=other infection types.
** Belgian data from ICU surveillance/bloodstream infection surveillance.*

8.2.1 ICU-acquired pneumonia

Incidence

Of 55 988 patients staying more than two days in the ICU (patient-based data), 7.0% acquired a pneumonia (Table 23). The mean of ICU means for unit- and patient-based data combined was 8.0%, excluding Germany, and 5.4% including Germany, where the denominator includes patients staying less than three days in the ICU (Table 24).

Table 23: Percentage of ICU patients with ICU-acquired pneumonia and incidence density, by country, patient-based surveillance, 2007

	N of patients	Patient days	Mean length of ICU stay	N of PN (1st)	N of PN episodes	PN%	PNs /1 000 pt days
AT	7 441	75 997	10.2	275	353	3.7%	4.6
BE	2 684	21 999	8.2	121	138	4.5%	6.3
ES	15 906	142 072	8.9	1 043	1 237	6.6%	8.7
FR	22 927	257 638	11.2	2 056	2 405	9.0%	9.3
IT	1 993	22 304	11.2	167	203	8.4%	9.1
LT	1 546	13 715	8.9	71	73	4.6%	5.3
LU	2 710	27 683	10.2	68	70	2.5%	2.5
PT	596	7 800	13.1	59	66	9.9%	8.5
SK	185	1 760	9.5	32	32	17.3%	18.2
Overall	**55 988**	**570 968**	**10.2**	**3 892**	**4 577**	**7.0%**	**8.0**

Table 24: Percentile distribution of percentage of patients with ICU-acquired pneumonia (n of first pneumonia per 100 patients) by percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2007

% intubated patients	N of ICUs	Mean % PN	P10	P25	P50	P75	P90
< 30%	63	3.2	0.0	0.4	2.6	4.2	7.1
30–59%	138	6.8	1.0	2.5	5.5	9.1	14.6
≥ 60%	195	10.5	1.3	4.0	7.9	13.0	23.5
Overall excluding DE	**396**	**8.0**	**0.0**	**2.6**	**6.1**	**10.3**	**17.6**
Overall inlcuding DE	**819**	**5.4**	**0.0**	**0.4**	**1.9**	**6.1**	**12.0**

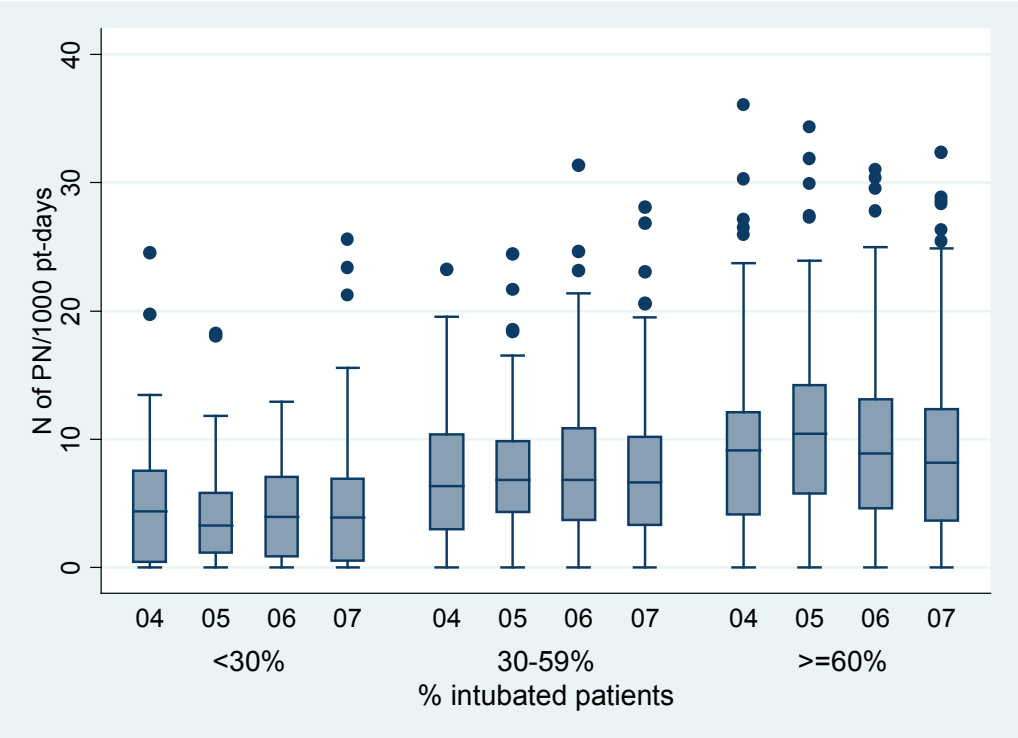
The mean pneumonia incidence density varied from 5.3 PN episodes per 1 000 patient days in ICUs with less than 30% patients intubated, to 7.6 per 1 000 patient days in ICUs with 30–59% patients intubated, and 9.5 per 1 000 patient days in ICUs with ≥ 60% of patients intubated (Table 25).

Table 25: Percentile distribution of incidence density of ICU-acquired pneumonia (n of pneumonia episodes/1 000 patient-days) by percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2007

% intubated patients	N of ICUs	Mean PN incidence density	P10	P25	P50	P75	P90
<30%	63	5.3	0.0	0.5	3.9	6.9	13.2
30-59%	138	7.6	1.1	3.3	6.7	10.5	14.5
≥ 60%	195	9.5	1.2	3.6	8.2	12.8	18.1
Overall excluding DE	**396**	**8.2**	**0.0**	**3.1**	**7.0**	**11.5**	**17.1**
Overall including DE	**819**	**5.4**	**0.0**	**1.2**	**3.5**	**7.6**	**12.9**

The pneumonia incidence density remained stable from 2004 to 2007. The decrease observed in units with a high percentage of intubation from 2005 to 2007 (Figure 48) was not statistically significant in unit-based analysis.

Figure 48: Incidence density of ICU-acquired pneumonia (n of pneumonia episodes/1 000 patient-days) by year and percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2004–2007



The incidence density of pneumonia did not vary significantly according to the type of ICU, except for lower rates in coronary care units (CCUs), where invasive mechanical ventilation is also much less frequent. Table 26 below shows the percentile distribution of the pneumonia incidence density by type of ICU for 2004 to 2007 combined, because the numbers of infrequent ICU types are too small, considering the exclusion of Germany for the rates in patients staying more than two days.

Table 26: Percentile distribution of incidence density of ICU-acquired pneumonia (n of pneumonia episodes/1 000 patient-days) by type of ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2004–2007

ICU type	N of ICU-years	Mean PN incidence density	P10	P25	P50	P75	P90
Mixed	732	8.7	1.2	3.9	7.5	12.0	17.5
Medical	406	7.7	0.0	3.7	7.2	11.2	14.8
Surgical	177	8.0	0.0	1.8	6.6	10.9	19.1
CCU	15	2.7	0.0	0.0	0.0	8.4	9.2
Neurosurgical	6	4.8	0.0	0.0	2.3	10.4	13.6
Paediatric	10	7.3	1.6	3.1	7.0	8.2	15.3
Other/missing type	212	12.4	0.0	0.0	11.3	24.7	27.4
Overall excluding DE	**1 558**	**8.2**	**0.0**	**3.4**	**7.2**	**11.6**	**16.7**
Overall including DE	**2 729**	**5.6**	**0.0**	**1.4**	**3.9**	**8.0**	**13.0**

Pneumonia was intubation-associated in 91.3% of the patients. The device-associated pneumonia rate (N of intubator-associated pneumonia/1 000 intubation days) ranged from 7.2 intubation-associated pneumonia (IAP) per 1 000 intubation days in Luxembourg to 22 IAP/1 000 intubation days in Slovakia. As shown in Table 27, the 'ranking' of countries varied considerably according to the indicator used, because of differences in case-mix.

Table 27: Device-adjusted pneumonia rates by country, patient-based surveillance, 2007

	Pt days	N of int. days, all	IUR	N int. days before infection	N of IAP (first)	IAP episodes	IAP/1 000 int. days before infection	IAPs/1 000 int. days
AT	75 997	46 063	60.6	41 927	273	351	6.5	7.6
BE	21 999	8 746	39.8	7 616	92	101	12.1	11.5
ES	142 072	66 618	46.9	52 392	967	1 148	18.5	17.2
FR	257 638	156 235	60.6	122 399	1 862	2 171	15.2	13.9
IT	22 304	12 807	57.4	10 678	160	191	15.0	14.9
LT	13 715	5 457	39.8	5 136	62	64	12.1	11.7
LU	27 683	8 101	29.3	7 543	56	58	7.4	7.2
PT	7 800	5 714	73.3	5 052	58	65	11.5	11.4
SK	1 760	1 089	61.9	944	24	24	25.4	22.0
Overall	**570 968**	**310 830**	**54.4**	**253 687**	**3 554**	**4 173**	**14.0**	**13.4**

Pt= patient days; IUR=intubation utilisation rate (N of intubation days/100 patient days);IAP=intubation-associated pneumonia; IAPs=intubation-associated pneumonia episodes; int. days=intubation days

The incidence density and the two device-adjusted rates presented in Table 27 respectively adjust the pneumonia percentage ('crude cumulative incidence') for length of stay, overall device use (the CDC/NHSN indicator) and device-use before infection only (thus excluding therapeutical ventilation use for patients with pneumonia). Percentile distributions for the two different device-adjusted pneumonia rates are given in Tables 28 and 29.

Table 28: Percentile distribution of the number of pneumonia (first) per 1 000 intubation days before the first pneumonia, patients staying more than two days in the ICU, ICUs with fewer than 20 patients excluded, 2007

Country	N of ICUs	Mean	P10	P25	P50	P75	P90
AT	37	6.2	0.0	0.0	4.0	11.8	16.1
BE	17	17.0	0.0	0.5	9.3	30.7	49.7
ES	111	20.0	2.3	8.9	15.6	26.9	41.0
FR	165	15.6	4.0	7.5	14.2	20.8	29.1
IT	27	18.6	0.0	2.2	6.1	19.1	68.8
LT	9	14.3	0.0	1.6	8.2	11.0	45.8
LU	8	6.7	0.0	3.8	6.5	9.6	14.0
PT	6	11.5	3.4	5.6	10.2	17.9	21.4
SK	5	20.7	0.0	0.0	14.6	42.3	46.8
Overall	**385**	**16.0**	**0.0**	**6.1**	**12.8**	**20.8**	**35.0**

Table 29: Percentile distribution of the number of pneumonia episodes per 1 000 intubation days (all), patients staying more than two days in the ICU, ICUs with fewer than 20 patients excluded, 2007

Country	N of ICUs	Mean	P10	P25	P50	P75	P90
AT	37	6.7	0.0	0.0	5.4	12.1	17.1
BE	17	13.6	0.0	0.5	8.4	25.3	38.2
ES	111	16.9	2.1	8.7	14.5	22.5	34.1
FR	165	13.2	4.2	6.9	12.7	17.2	24.0
IT	27	14.4	0.0	2.1	6.6	16.3	43.7
LT	9	13.3	0.0	1.6	7.7	10.3	47.8
LU	8	6.4	0.0	3.5	6.4	9.1	13.4
PT	6	10.5	3.3	5.4	9.3	17.1	18.4
SK	5	16.9	0.0	0.0	14.2	35.1	35.3
Overall	**385**	**13.6**	**0.0**	**5.8**	**11.5**	**18.0**	**27.9**

Patient-based surveillance is designed to further adjust infection rates according to intrinsic patient risk factors, to stratify device-adjusted rates according to these characteristics and eventually to standardardise the rates by expressing the number of observed infections relative to the number of expected infections based on the case-mix of the ICU patient population (standardised pneumonia ratio). Univariate risk factor analysis for 2007 and stratification of pneumonia rates by risk factor are given in Annex 2 Table 117.

The multivariate risk factor analysis of ICU-acquired pneumonia is presented in Table 31. ICUs with 100 patients or more that reported no pneumonia or bloodstream infections were excluded from the analyis (the probability of zero infections with an average percentage of 9.0% is lower than 1/10 000). ICUs with fewer than 20 patients and ICUs reporting no exposure to either intubation or urinary catheters were also excluded. The total number of patients excluded from multivariate analysis are given by country in Table 30.

Table 30: Patients excluded from multivariate analysis, by country

	Zero infections & ≥ 100 pts		ICUs < 20 patients		No device exposure		Total excluded	
	2004–2007	**2007**	**2004–2007**	**2007**	**2004–2007**	**2007**	**2004–2007**	**2007**
AT	37.3%	38.3%	0.1%	0.0%	0.0%	0.0%	37.3%	38.3%
BE	0.6%	0.0%	0.2%	0.0%	0.0%	0.0%	0.6%	0.0%
ES	0.0%	0.0%	0.4%	0.5%	2.9%	3.1%	2.9%	3.1%
FR	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%
IT	19.2%	20.6%	8.2%	4.8%	0.0%	0.0%	19.2%	20.6%
LT	5.2%	8.3%	0.3%	0.0%	17.3%	0.0%	22.5%	8.3%
LU	5.3%	5.8%	0.0%	0.0%	0.0%	0.0%	5.3%	5.8%
PT	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SK	0.0%	0.0%	7.1%	0.0%	6.6%	0.0%	6.6%	0.0%
Overall	**7.1%**	**6.3%**	**0.3%**	**0.3%**	**1.2%**	**0.0%**	**8.3%**	**7.2%**
N excluded	**13 709**	**3 539**	**590**	**170**	**2402**	**494**	**16 111**	**4 033**

The model presented in Table 31 confirms the importance of including systemic antimicrobial use in the 48 hours before or after ICU admission (antimicrobial use for an infectious event present at admission) in the risk adjustment of pneumonia rates. The risk of intubation-associated ICU-acquired pneumonia in the first week of intubation is indeed lower in patients under systemic antimicrobial use, in particular after three to six days of intubation. The analysis also shows that after adjustment for other risk factors, the admission type only marginally adds to the risk adjustment of pneumonia rates, except for trauma patients.

Table 31: Multivariate risk factor analysis of ICU-acquired pneumonia, N=172 698 patients, 2004–2007

Variable	OR	95% CI	p-value
Intubation (OR without antibiotics at admission)			
0d	Ref		
1–2d	3.7	3.2–4.2	< 0.001
3–4d	18.5	16.3–21.0	< 0.001
5–6d	29.5	25.8–33.6	< 0.001
7–13d	26.8	23.6–30.4	< 0.001
≥ 14d	22.2	19.5–25.4	< 0.001
Antibiotics in 48h before/after admission (OR without intubation)			
No	ref.		
Yes	1.5	1.3–1.8	< 0.001
Antibiotics (AB) at admission* intubation (combined OR – for intubation effect only compared to AB=yes – and p interaction given)			
AB*1–2d intubation	4.4	3.8–-5.1	0.092
AB*3–4d intubation	10.0	8.7–11.4	< 0.001
AB*5–6d intubation	13.4	11.7–15.4	< 0.001
AB*7–13d intubation	17.9	15.8–23.1	< 0.001
AB*≥ 14d intubation	20.3	17.9–23.1	0.340
Male gender	**1.4**	**1.3–1.4**	**< 0.001**
Impaired immunity	**1.2**	**1.1–1.3**	**< 0.001**
SAPS II score			
< 25	ref.		
25–34	1.4	1.3–1.5	< 0.001
35–64	1.5	1.4–1.7	< 0.001
≥ 65	1.4	1.2–1.5	< 0.001
Missing	1.4	1.2–1.6	< 0.001
Admission type			
Medical	ref.		
Scheduled surgery	0.9	0.9–1.0	0.031
Unscheduled surgery	0.9	0.9–1.0	0.025
Unknown	2.7	2.3–3.4	< 0.001
Trauma	**1.6**	**1.5–1.7**	**< 0.001**

OR=odds ratio; CI=confidence interval; h=hours, d=day(s); SAPS=Simplified Acute Physiology Score; antibiotics in 48h before and/or after ICU admission: systemic antibiotics used for treatment of an infection present at admission.

Adding country as a stratifier to the model did not affect the findings. Other variables with more missing frequent values significantly associated when added to the above model were type of surgery (n=60 008, OR coronary surgery 1.5 [1.2–1.8]; other cardiac surgery 1.2 [1.0–1.1]; other thoracic surgery 1.5 [1.2–1.9] and other surgery 0.8 [0.7–0.9]), non-invasive ventilation before pneumonia (OR 0.9 by week, p for trend 0.001) and at least one reintubation before pneumonia (OR 1.2; 1.0–1.3, n=84 071). Although less than one week of feeding through an naso-intestinal tube before infection onset was positively associated (OR 2.1; 2.0–2.3, n=75 080), long-lasting artificial feeding (≥ 1 week) was negatively associated with pneumonia ('protective effect'), both for parenteral feeding (OR 0.6; 0.6–0.7) and less importantly for enteral feeding (0.8 [0.8–0.9]).

Impact of risk adjustment on intercountry comparisons and inter-unit comparisons

Five indicators of the incidence of ICU-acquired pneumonia were compared:

- the percentage of patients acquiring at least one pneumonia during the ICU stay (cumulative incidence);
- incidence density: the number of pneumonia episodes per 1 000 patient days;
- the device-adjusted pneumonia rate: number of intubation-associated pneumonia episodes per 1 000 intubation days (the 'CDC/NHSN' indicator);

- the unit-based device-adjusted pneumonia rate: from level 1 surveillance, number of intubation-associated pneumonia episodes * 1 000 / (% intubated patients * patient-days); and
- the standardised pneumonia ratio (O/E): number of observed patients with pneumonia/number of expected patients with pneumonia (based on the case-mix risk factors included in the multiple logistic regression model above, 2004–2007).

Table 32 shows the different indicators per country for 2007. The figures shown may differ considerably from those given in Tables 23 and 27 because of the exclusion criteria, in particular where many ICUs with zero reported infections were excluded to improve the quality of the model (e.g. Austria). While Slovakia ranks the highest with all indicators, the second-ranked country in the percentage pneumonia comparison (Portugal) only ranked sixth (equal with Austria) for the standardised pneumonia ratio, illustrating a high impact of the severity of case-mix on the percentage of infected patients in this country.

Table 32: Percentage of pneumonia, pneumonia incidence density, device-adjusted pneumonia rate, device-adjusted pneumonia rate from level 1 surveillance and standardised pneumonia ratio by country, 2007*

	%PN	PN incidence density	Number of IAPs/1 000 int. days	Unit-based device-adjusted PN rate	O/E
AT	6.0	7.1	10.6	10.3	0.66
BE	3.8	5.2	10.4	10.8	0.77
ES	6.4	8.7	16.4	17.9	1.04
FR	9.0	9.3	13.9	13.2	1.00
IT	7.6	8.1	12.2	9.7	0.77
LT	3.3	3.5	6.6	5.3	0.28
LU	2.7	2.7	7.2	7.1	0.58
PT	9.8	8.7	12.0	9.6	0.66
SK	36.4	23.7	32.4	24.7	2.22
Overall	**7.3**	**8.3**	**13.6**	**13.3**	**0.93**

**Differences from Tables 23 and 27 are due to exclusion criteria.*

Table 33 shows the Pearson correlation coefficients for the ranking of ICUs according to different indicators, for all ICUs from 2004 to 2007, using exclusion criteria mentioned in Table 30 (n=1 138 ICU-years). Lower correlation coefficients indicate that the percentile of a particular unit in inter-ICU comparisons may vary considerably according to the indicator used.

The ICU rank using the device-adjusted pneumonia rate (IAP rate, number of intubation-associated pneumonia/1 000 intubation-days) correlated quite well with its level 1 surveillance approximation at the ICU level (correlation coefficient 0.92, r^2 0.85), suggesting that this indicator could be used for limited risk-adjusted comparisons in level 1 (minimal data collection), whereby only the mean percentage of intubated patients (one percentage per year) has to be reported instead of total device use collected on a daily basis in the ICU.

Table 33: Pearson correlation coefficients between the ranking of ICUs* according to different indicators, 2004–2007 (n ICU-years=1 138)

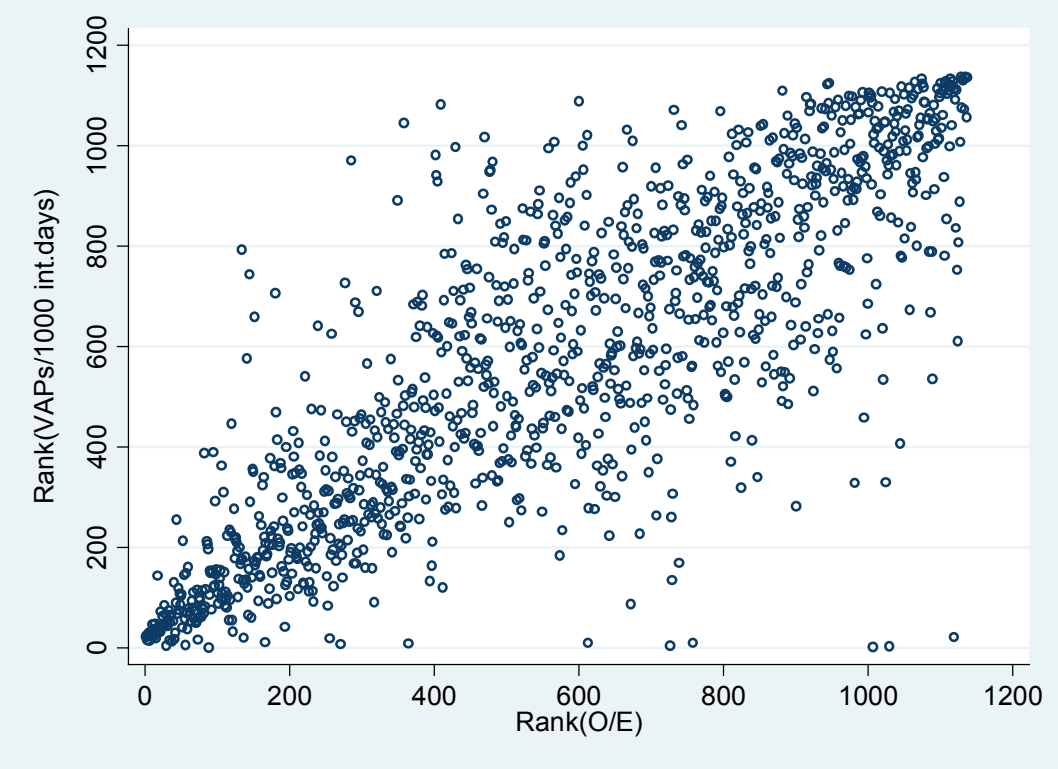
	% PN	Incidence density	IAP rate	Unit-based device-adjusted PN rate	O/E
%PN	1.0000				
Incidence density	0.9012	1.0000			
IAP rate	0.6593	0.8445	1.0000		
Unit-based device-adjusted PN rate	0.6000	0.7806	0.9206	1.0000	
O/E	0.7999	0.8694	0.8302	0.8164	1.0000

**Correlation coefficients do not reflect the correlation between the indicators themselves, but between the ICU ranks (≈ percentiles).*

% PN: Percentage of patients with at least one ICU-acquired pneumonia; Incidence density: number of pneumonia episodes per 1 000 patient days; IAP rate: device-associated pneumonia rate, number of intubation-associated pneumonia per 1 000 intubator days; unit-based device-adjusted PN rate: number of intubation-associated pneumonia x 1 000/(percentage of intubated patients x patient days); O/E: standardised pneumonia ratio, number of observed over number of expected patients with pneumonia.

The correlation between the ICU rank according to the device-adjusted pneumonia rate and the rank using the standardised pneumonia ratio according to the basic level 2 risk model was 0.83 (r2=0.69) and is shown in Figure 49. The change in position was 20 percentiles or more for 18.4% of the ICUs, 25 percentiles or more for 12.6% of the ICUs, and 37.3% of the ICUs changed their position from one side of the median to the other.

Figure 49: Correlation between the ICU rank according to device-adjusted pneumonia rate and the standardised pneumonia ratio, 2004–2007. Each circle represents one ICU-year.



Characteristics of pneumonia

Mortality and length of stay associated with pneumonia

The ICU mortality in patients with ICU-acquired pneumonia was 31.2%, 2.29 (95% CI 2.16–2.44) times higher than in patients without pneumonia (see Table 34). Remarkably, PN-associated mortality in Slovakia was lower than in non-PN patients and lower than in other countries. Although this may be related to relatively small numbers of patients in Slovakia, it possibly indicates that surveillance of pneumonia was considerably more sensitive (or less specific) in that country, which may partly explain the higher pneumonia rates. Overall, the length of stay in the ICU for patients with pneumonia was approximately 3.5 times higher than for patients without pneumonia. Figures of associated mortality and length of stay are of course unadjusted for confounders and should be interpreted with caution since they do not allow calculation of the true excess mortality and length of stay.

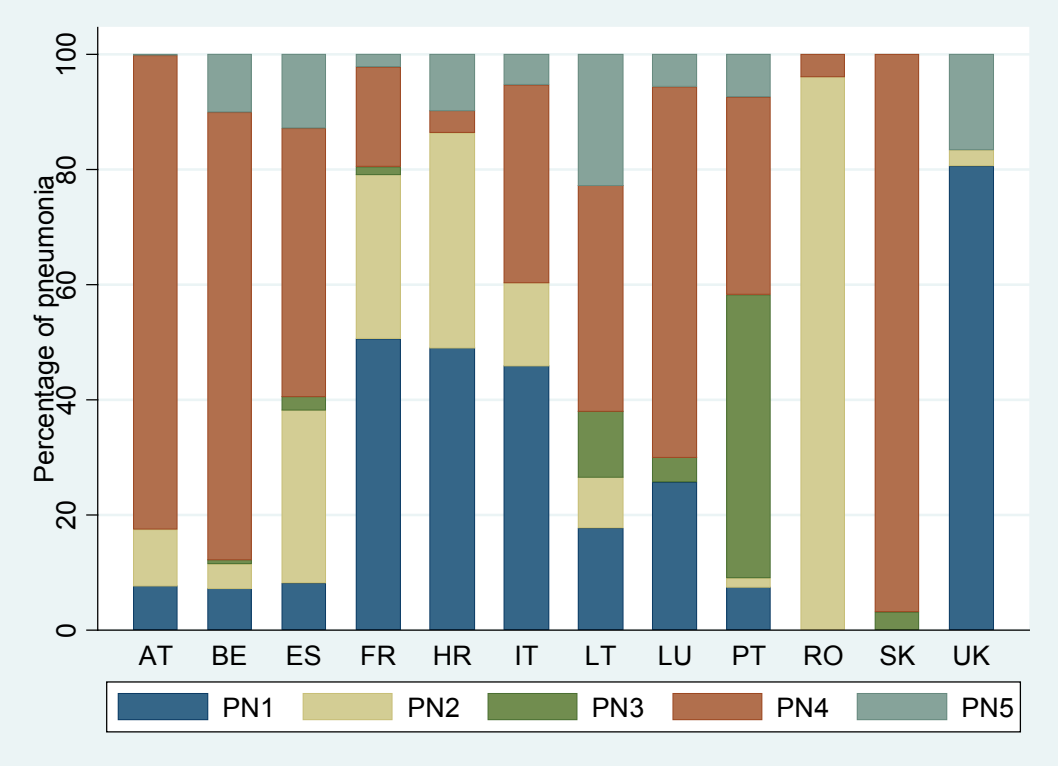
Table 34: Associated mortality and length of ICU stay (in days) in ICU-acquired pneumonia

	No PN		PN	
	% death	LOS (d)	% death	LOS (d)
AT	11.4%	9.7	23.9%	29.0
BE	12.8%	7.6	29.8%	20.8
ES	10.6%	7.7	32.8%	28.3
FR	16.7%	9.0	31.9%	33.7
IT	16.2%	9.6	32.9%	28.8
LT	14.9%	8.4	31.3%	20.0
LU	9.7%	9.6	32.4%	33.9
PT	15.2%	11.6	20.3%	26.7
SK	24.2%	7.4	15.6%	19.5
Overall	**13.6%**	**8.7**	**31.2%**	**30.9**

Diagnostic category of ICU-acquired pneumonia

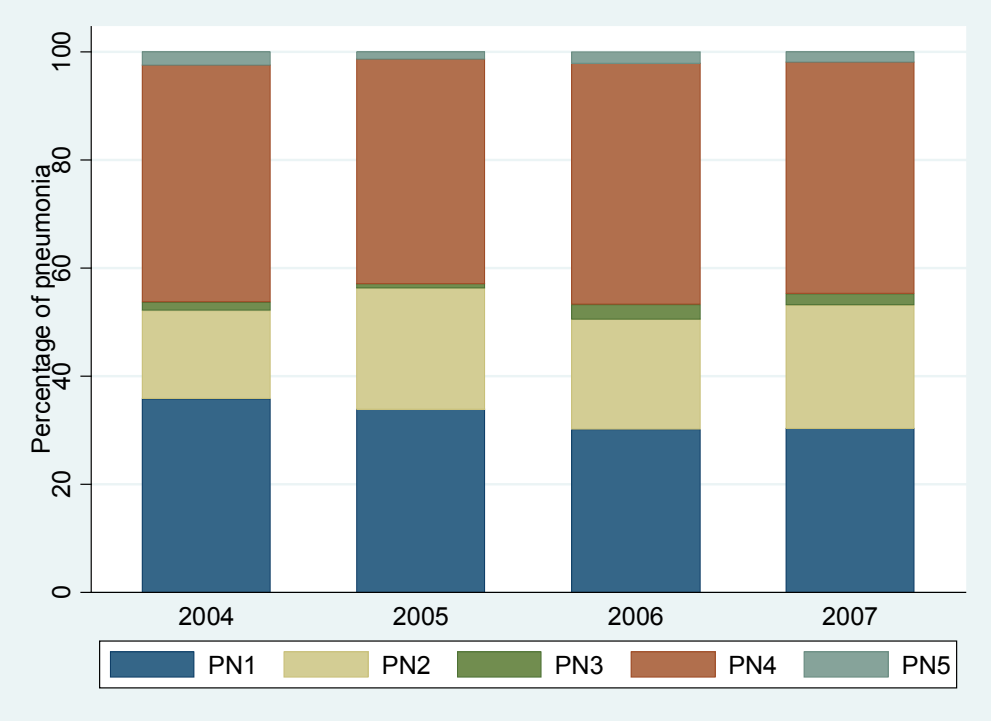
The subcategories of the HELICS case definition of ICU-acquired pneumonia were reported by all countries except Germany, since the KISS (Krankenhaus Infektions Surveillance System) surveillance is using NHSN/CDC definitions, which do not allow identification of the different pneumonia subcategories, although the overall picture is likely to be very similar. Microbiological confirmation of pneumonia by either semi-quantitative culture of invasive samples (broncheoalveolar lavage, protected brush, etc.) or by quantitative culture of non-protected respiratory samples (endotracheal aspirate) was done most frequently in France, Italy and Croatia, as well as in piloting ICUs from England and Romania. Compared with previous years, the overall proportion of pneumonia documented by (semi-) quantitative microbiological results remained stable (slightly higher than 50%) while the proportion of pneumonia not documented by microbiological results was lower than 5%.

Figure 50: Diagnostic category of ICU-acquired pneumonia by country, 2007



PN1: Pneumonia documented by invasive diagnostic sample with semi-quantitative culture; PN2: PN documented by endotracheal aspirate with quantitative culture; PN3: Pneumonia documented by alternative microbiological results, eg. positive blood culture; PN4: Pneumonia documented by qualitative microbiological results; PN5: clinical pneumonia without microbiological results.

Figure 51: Diagnostic category of ICU-acquired pneumonia by year, 2007

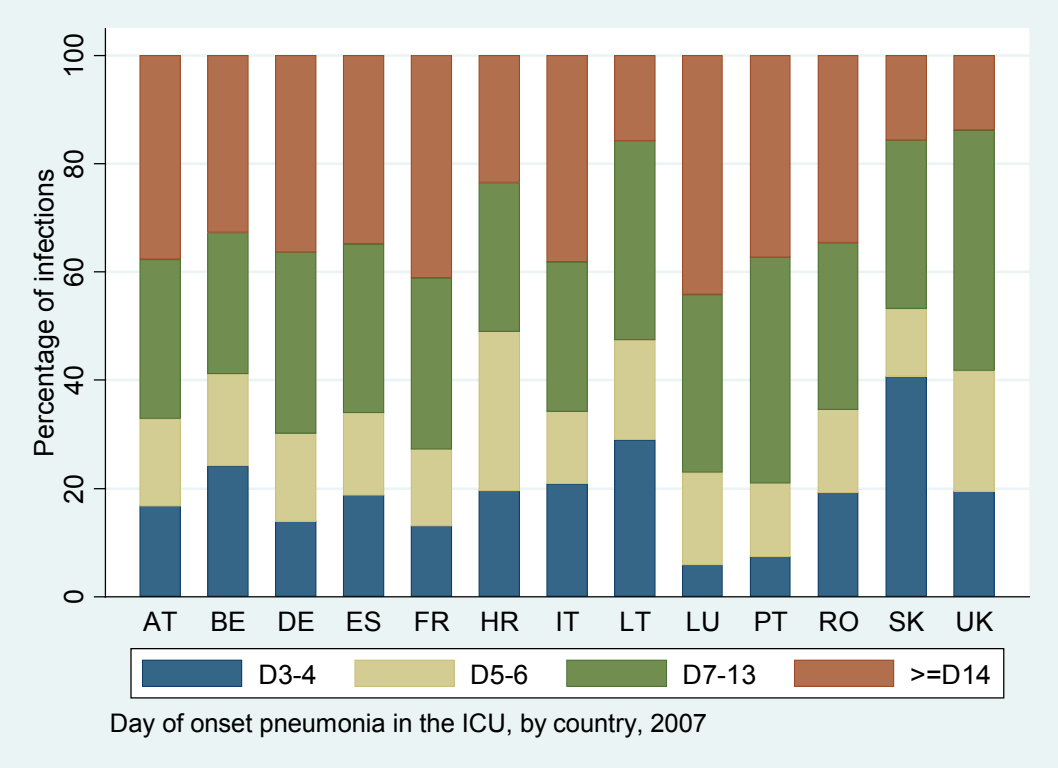


Day of onset of ICU-acquired pneumonia, 2007

In the HELICS-ICU protocol, the definition of the key term 'ICU-acquired', similar to the key term 'nosocomial', is different from the definition in CDC/NHSN surveillance [5]. In the European protocol, infections should be reported if the date of onset of infection is on day 3 or later in the ICU, while the CDC definition – not present nor in incubation at admission – may lead to more subjective interpretation of the key term. Although the protocol asks for infections to be reported from day 3 on, national networks and hospital staff involved in ICU surveillance may in practice use a more subjective definition. Although the day of onset of the infection may be an indicator of 'infection-free days in the ICU', it certainly also reflects these differences in reporting behaviour. Early onset (D3-4) ICU-acquired pneumonia represented 16.1% overall and were most frequently reported by Slovakia, Lithuania and Belgium and less frequently in Portugal, Luxembourg, France and Germany (Figure 52). The median incubation time from ICU admission to onset of pneumonia was 10 days (mean 15.5 days), and was similar to that for the period 2004–2006.

Microorganisms isolated according to the onset of infections are shown in Table 35.

Figure 52: Day of onset of ICU-acquired pneumonia, 2007



Microorganisms isolated in ICU-acquired pneumonia

The most frequently isolated microorganisms in ICU-acquired pneumonia overall were *Pseudomonas aeruginosa* and *Staphylococcus aureus*, with large variations between countries (Table 35). *Acinetobacter* spp. was the most frequently reported genus in Lithuania and Croatia, and was also more frequently isolated in Spain, Italy, Portugal and Slovakia than other reporting countries. *Klebsiella* spp. was the primary organism in Slovakia and Lithuania (same number as *Acinetobacter* spp.) while *Enterobacter* spp. was most frequently isolated in Belgium and Luxembourg.

Table 35: Relative frequency of most frequent microorganisms isolated in ICU-acquired pneumonia (unit- and patient-based surveillance combined), by country, 2007

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK	UK	Total
N of isolates	489	596	3 760	1 315	2 943	68	242	92	87	73	46	40	9 749
P. aeruginosa (%)	19.2	23.3	16.6	18.8	21.5	26.5	22.3	13.0	18.4	32.9	23.9	2.5	19.2
S. aureus (%)	12.1	7.0	18.0	16.9	17.9	14.7	16.9	10.9	11.5	17.8	6.5	30.0	16.7
E. coli (%)	9.2	6.7	9.9	7.0	9.3	1.5	4.5	6.5	9.2	4.1	8.7	5.0	8.8
Klebsiella spp. (%)	9.8	10.4	10.1	7.5	5.6	1.5	7.0	15.2	6.9	8.2	28.3	5.0	8.3
Enterobacter spp. (%)	6.1	12.8	7.6	6.7	8.4	7.4	6.6	4.3	10.3	5.5	8.7	2.5	7.9
Candida spp. (%)	14.9	1.3	11.1	5.7	3.9	1.5	6.2	5.4	11.5	0.0	4.3	2.5	7.4
Acinetobacter spp. (%)	1.2	0.8	2.3	12.2	2.7	33.8	11.6	15.2	1.1	13.7	10.9	2.5	4.3
Haemophilus spp. (%)	2.2	2.0	2.6	4.7	5.1	4.4	2.1	3.3	4.6	6.8	0.0	27.5	3.7
S. maltophilia (%)	3.7	4.0	3.4	3.9	3.4	0.0	8.7	1.1	6.9	1.4	0.0	0.0	3.6
Serratia spp. (%)	1.8	3.7	3.9	2.8	3.1	0.0	2.1	1.1	4.6	2.7	0.0	5.0	3.3
Proteus spp. (%)	1.6	2.7	2.9	1.5	3.1	2.9	2.1	3.3	2.3	2.7	4.3	0.0	2.7
Enterococcus spp. (%)	4.9	3.0	4.3	1.4	0.7	0.0	1.7	2.2	4.6	1.4	0.0	0.0	2.6
Streptococcus spp. (%)	3.5	2.3	0.0	3.2	4.2	4.4	1.7	9.8	3.4	0.0	0.0	12.5	2.3
Coagulase-negative staphylococci (CNS) (%)	3.3	1.8	1.9	1.1	2.9	1.5	1.2	5.4	1.1	0.0	0.0	0.0	2.1
Citrobacter spp. (%)	0.6	1.5	2.2	1.2	1.9	0.0	1.7	1.1	1.1	1.4	2.2	0.0	1.8

Since 2004, the relative frequency of gram-positive bacteria in ICU-acquired pneumonia decreased significantly from 30.8% to 25.7% ($p < 0.001$). This decrease was most pronounced in France and Germany, and was at the limit of significance in Lithuania. On the other hand, gram-negative bacteria posing increasing therapeutic problems, such as Enterobacteriaceae and non-fermenters, increased significantly during the same period (Figure 53).

Figure 53: Trends in relative frequency of microorganisms isolated in ICU-acquired pneumonia, 2004–2007

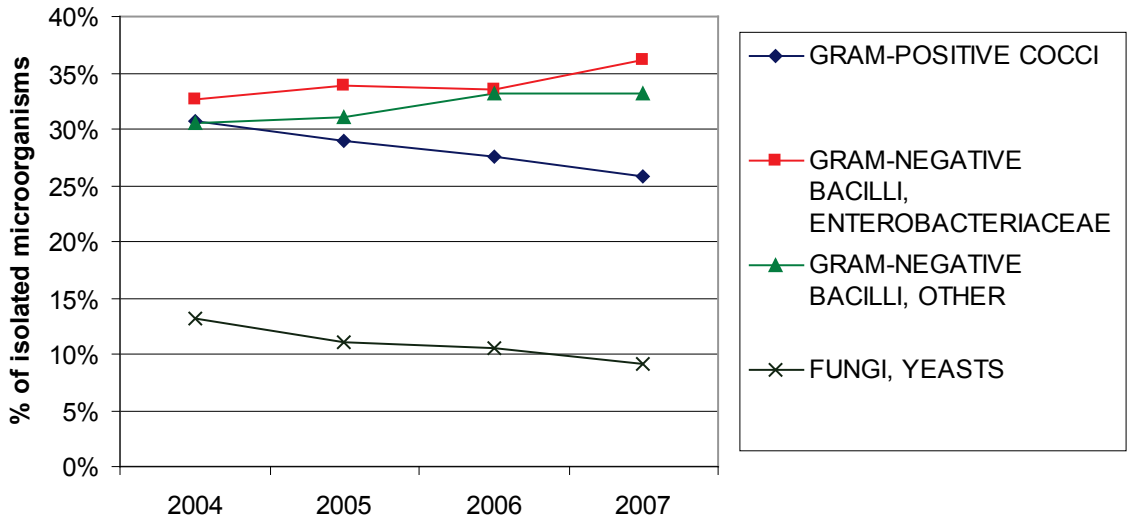


Table 36 shows that the percentage non-fermenters (*P. aeruginosa*, *Acinetobacter* spp., *Stenotrophomonas* spp.) is approximately twice as high in late onset as early onset pneumonia in the ICU, while the percentage of typical 'community' pathogens such as pneumococci and *Haemophilus influenzae* decreases with the day of onset. *Staphylococcus aureus* is also more frequently involved in early onset than in late onset pneumonia, however, the percentage MRSA in late infections was 2.2 times higher in pneumonia with onset on day 7 or later (41.2% compared with 18.7% in pneumonia with onset before day 7).

Table 36: Relative frequency of most frequent microorganisms isolated in ICU-acquired pneumonia (unit- and patient-based surveillance combined) by day of onset after admission to the ICU, 2007

Microorganism	Day of onset infection				Percentage of total
	3–4D	5–6D	7–13D	≥ 14D	
Number of isolates	**1 447**	**1 485**	**3 072**	**3 777**	**100.0**
Pseudomonas aeruginosa (%)	10.8	12.3	17.1	27.4	19.2
Staphylococcus aureus (%)	21.0	19.9	16.2	13.9	16.7
– MRSA/SA (%)	19.3	18.0	35.1	47.3	32.9
Escherichia coli (%)	10.4	10.0	9.0	7.6	8.8
Klebsiella spp. (%)	8.0	9.0	9.0	7.6	8.3
Enterobacter spp. (%)	7.1	7.9	9.0	7.4	7.9
Candida spp. (%)	6.7	8.5	8.2	6.6	7.4
Acinetobacter spp. (%)	2.5	3.0	5.0	5.0	4.3
Haemophilus spp. (%)	8.4	7.7	2.6	1.0	3.7
Stenotrophomonas maltophilia (%)	2.1	1.8	3.1	5.3	3.6
Serratia spp. (%)	4.4	3.6	3.2	2.8	3.3
Proteus spp. (%)	2.9	2.8	2.8	2.5	2.7
Enterococcus spp. (%)	1.6	1.9	2.7	3.3	2.6
Streptococcus spp. (%)	5.0	3.2	1.9	1.0	2.3
Coagulase-negative staphylococci (%)	1.5	1.8	2.4	2.3	2.1
Citrobacter spp. (%)	1.5	2.0	2.0	1.7	1.8
Other Enterobacteriaceae (%)	2.1	1.1	1.6	1.1	1.4
Other/unsp. fungi/yeasts (%)	0.8	0.8	1.0	0.8	0.9
Other gram-positive cocci (%)	0.8	0.5	0.8	0.8	0.7
Aspergillus spp. (%)	0.3	0.1	0.7	0.5	0.5
Gram-negative cocci (%)	0.8	0.7	0.2	0.2	0.3
Gram-positive bacilli (%)	0.3	0.5	0.3	0.3	0.3
Other. gram-negative bacilli, non-Enterobacteriaceae (%)	0.3	0.3	0.4	0.3	0.3
Virus (%)	0.1	0.1	0.2	0.4	0.3
Pseudomonadaceae family, other (%)	0.3	0.1	0.2	0.2	0.2
Other bacteria (%)	0.2	0.1	0.2	0.1	0.1
Anaerobes other than *Bacteroides* spp. (%)	0.1	0.1	0.1	0.0	0.1
Legionella spp. (%)	0.0	0.1	0.0	0.1	0.1
Bacteroides spp. (%)	0.1	0.2	0.0	0.0	0.0

8.2.2 ICU-acquired bloodstream infections

Incidence

Of all patients staying more than two days in the ICU (patient-based data), 3.9% acquired a bloodstream infection (BSI), ranging from 1.9% in Luxembourg and Lithuania to 5.4% in Slovakia and Portugal (Table 37).

Table 37: Percentage of ICU patients with ICU-acquired bloodstream infection and BSI incidence density, by country, patient-based surveillance, 2007

	N	pt days	Mean length of ICU stay	≥ 1 BSI	BSI episodes	BSI%	BSIs /1 000 pt days
AT	7 441	75 997	10.2	218	253	2.9%	3.3
BE	2 684	21 999	8.2	57	62	2.1%	2.8
ES	15 906	142 072	8.9	788	885	5.0%	6.2
FR	22 927	257 638	11.2	889	963	3.9%	3.7
IT	1 993	22 304	11.2	82	98	4.1%	4.4
LT	1 546	13 715	8.9	30	33	1.9%	2.4
LU	2 710	27 683	10.2	51	51	1.9%	1.8
PT	596	7 800	13.1	32	33	5.4%	4.2
SK	185	1760	9.5	10	10	5.4%	5.7
Overall	**55 988**	**570 968**	**10.2**	**2 157**	**2 388**	**3.9%**	**4.2**

The mean of ICU means for unit-based and patient-based surveillance data combined was 4.2% for patients staying more than two days in the ICU and 2.4% when data from Germany (ITS-KISS) and ICU-specific data from the Belgian bloodstream infection surveillance (NSIH-SEP) were also included (Table 38). Although the latter NSIH surveillance component does collect ICU denominator data for patients staying more than two calendar days, these denominator data are frequently missing and replaced by denominator data on all ICU patients (as in the ITS-KISS system). Furthermore, NSIH-SEP does not collect the percentage of intubated patients nor the type of ICU. As shown in Table 39, the percentage of patients with BSI increased strongly with increasing levels of this variable, illustrating that the percentage of intubated patients is a good indicator of disease severity at the ICU level.

Table 38: Percentile distribution of percentage of patients with ICU-acquired bloodstream infections (n of first BSI per 100 patients) by percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2007

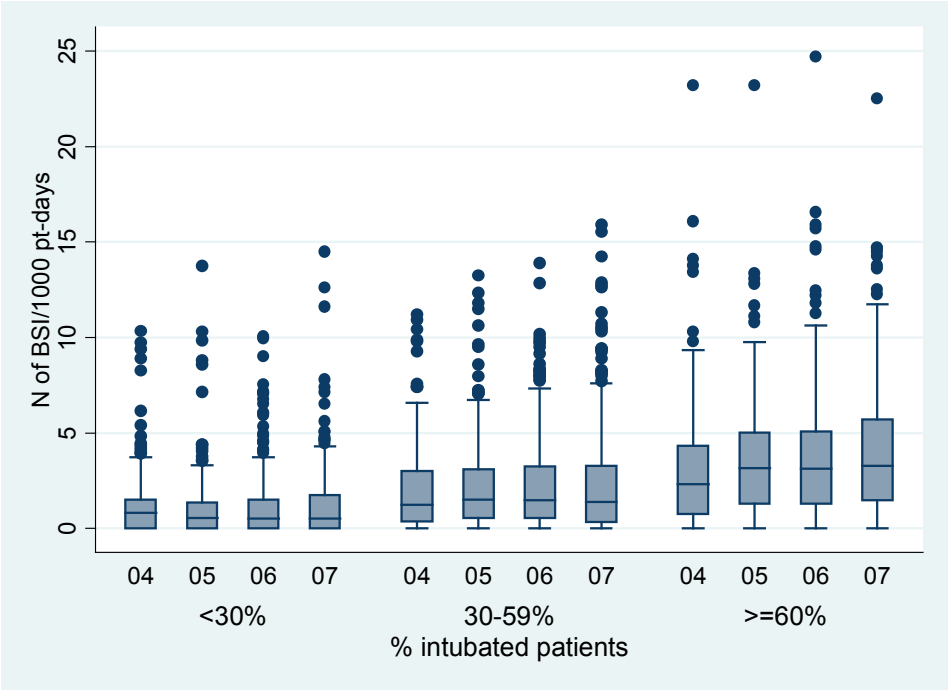
% intubated patients	N of ICUs	Mean % BSI	P10	P25	P50	P75	P90
< 30%	63	1.7	0.0	0.0	1.2	2.6	3.7
30–59%	138	3.9	0.0	1.1	2.8	5.2	8.8
≥ 60%	194	5.2	0.0	2.2	4.2	7.1	11.2
Overall excluding DE/BE-BSI	**395**	**4.2**	**0.0**	**1.2**	**2.9**	**5.8**	**9.4**
Overall including DE/BE-BSI	**885**	**2.4**	**0.0**	**0.1**	**0.9**	**3.1**	**6.7**

The mean BSI incidence density varied from 2.5 BSI episodes per 1 000 patient-days in ICUs with less than 30% patients intubated, to 4.5 per 1 000 patient-days in ICUs with ≥ 60% of patients intubated (Table 39). There were no significant differences in mean or median BSI incidence from 2004 to 2007 (Figure 54).

Table 39: Percentile distribution of incidence density of ICU-acquired bloodstream infections (n of BSI episodes/1 000 patient-days) by percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2007

% intubated patients	N of ICUs	Mean BSI incidence density	P10	P25	P50	P75	P90
<30%	63	2.5	0.0	0.0	2.0	4.2	5.1
30–59%	138	4.0	0.0	1.1	3.1	5.5	9.4
≥ 60%	194	4.5	0.0	2.0	3.7	6.4	9.8
Overall excluding DE/BE-BSI	**395**	**4.0**	**0.0**	**1.4**	**3.2**	**5.6**	**9.1**
Overall including DE/BE-BSI	**885**	**2.7**	**0.0**	**0.4**	**1.6**	**4.0**	**6.9**

Figure 54: Incidence density of ICU-acquired bloodstream infections (n of BSI episodes/1 000 patient-days) by year and percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2004–2007



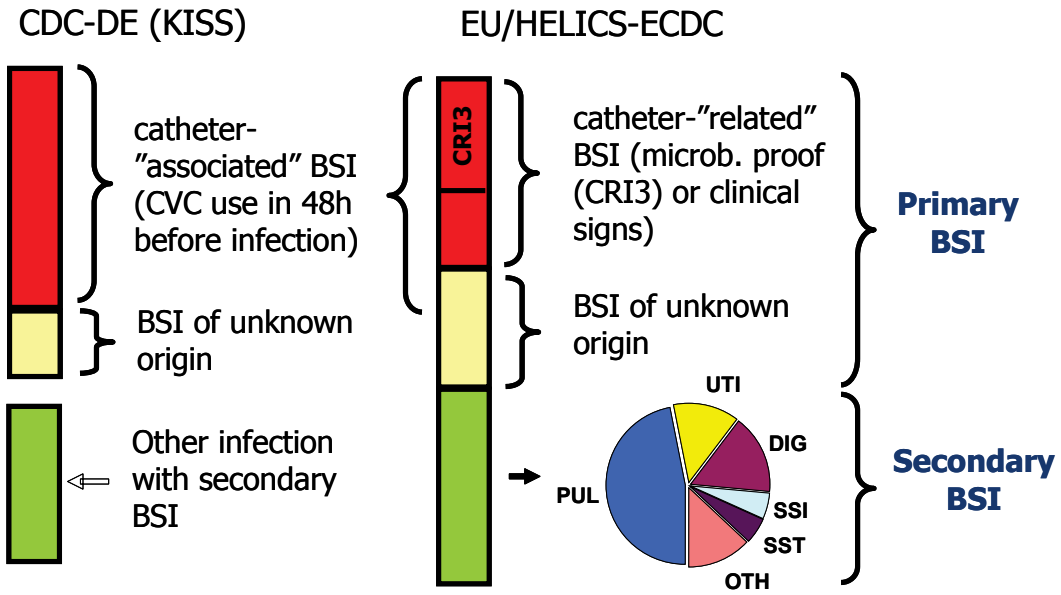
As for pneumonia, the incidence density of bloodstream infections by ICU type is given for 2004–2007 because of small numbers of specific ICU types in a single year. Although BSI rates appear to be slightly lower in surgical units, there were no statistical differences in BSI incidence density between different ICU types in the ICU-based analyses (Table 40).

Table 40: Percentile distribution of incidence density of ICU-acquired bloodstream infections (n of BSI episodes/1 000 patient-days) by type of ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2004–2007

ICU type	N of ICU-years	Mean BSI incidence density	P10	P25	P50	P75	P90
Mixed	731	3.9	0.0	1.3	3.2	5.4	8.1
Medical	406	3.4	0.0	1.0	2.8	4.7	7.6
Surgical	177	3.1	0.0	0.0	2.2	4.4	8.0
CCU	15	3.5	0.0	0.0	1.0	6.4	13.6
Neurosurgical	6	1.3	0.0	0.0	0.7	3.0	3.7
Paediatric	10	3.0	0.0	1.3	2.7	4.2	6.8
Other	212	4.7	0.0	1.8	3.8	6.7	10.2
Overall excluding DE/BE-BSI	**1 557**	**3.8**	**0.0**	**1.1**	**3.1**	**5.3**	**8.3**
Overall including DE/BE-BSI	**2 928**	**2.6**	**0.0**	**0.4**	**1.5**	**3.7**	**6.7**

Device-associated bloodstream infections are registered and classified differently according to whether the CDC (NHSN) surveillance protocol is used or the HELICS protocol. In CDC/NHSN, catheter-associated bloodstream infections are defined as primary (=not secondary to another infection site) with central line use in the 48 hours before the onset of the infection. In HELICS, all BSI are registered (not only the primary) and the origin of the BSI is determined as catheter-'related' (=microbiological proof by catheter tip culture or clinical signs), unknown origin, or secondary to another infection (pulmonary, urinary tract, digestive tract, surgical site infection, skin and soft tissue infection and other infection sites). In the CDC/NHSN protocol, secondary BSI are only recorded as a complication of another ICU-acquired infection, which most probably results in a proportion of secondary BSI with onset after day 2 in the ICU that remain unreported (Figure 55).

Figure 55: Difference in categories of bloodstream infections between HELICS and CDC/NHSN protocol



The entity of 'catheter-associated' BSI can also be identified from the HELICS data, as any primary bloodstream infection with reported central line use in the 48 hours preceding the infection; the inverse, however, is not possible. Therefore catheter-associated bloodstream infection rates are also reported in the current report. Another difference between catheter-related and catheter-associated bloodstream infections is that the origin 'catheter' in the HELICS definition also includes peripheral and arterial catheters, while catheter-associated bloodstream infections only look at central line use. In three countries who reported the type of catheter involved, central venous catheter-related bloodstream infections represented 77%, arterial catheter-related BSI 14%, and peripheral catheter-related BSI 9% in ICU-acquired bloodstream infections reported from 2004 to 2007.

Catheter-associated bloodstream infections (CA-BSI) rates varied from 1.9 CA-BSI per 1 000 central line days in Austria to 5.0 CA-BSI per 1 000 central line days in Slovakia (Table 41). Since the origin of the bloodstream infection was not recorded exactly according to the HELICS protocol in all countries, part of the variation of both the catheter-associated as the catheter-related BSI (CR-BSI) rates may be explained by methodological differences. The CR-BSI rate ranged from 0.3 CR-BSI/1 000 central line days in Lithuania to 3.4 per 1 000 CVC days in Spain. Reference percentile distributions for CA-BSI rates in patients staying more than two days in the ICU are given in Table 42.

Table 41: Device-adjusted bloodstream infection rates by country, 2007

	Pt days	N of CVC days, all	CUR	N of CA-BSI episodes	N of CR-BSI episodes	CA-BSIs/ 1 000 CVC days	CR-BSIs/ 1 000 CVC days
AT	75997	66359	87.3	128	108	1.9	1.6
BE	21999	15263	69.4	44	27	2.9	1.8
ES	142072	103030	72.5	497	355	4.8	3.4
FR	257638	160059	62.1	575	181	3.6	1.1
IT	22304	16467	73.8	75	33	4.6	2.0
LT	13715	10466	76.3	24	3	2.3	0.3
LU	27683	15559	56.2	43	41	2.8	2.6
PT	7800	6487	83.2	20	17	3.1	2.6
SK	1760	1407	79.9	7	3	5.0	2.1
Overall	**570968**	**395097**	**69.2**	**1259**	**751**	**3.2**	**1.9**

*CUR=Central line utilisation rate (n of CVC days * 100/ n of patient days)*

Table 42: Percentile distribution of the number of catheter-associated bloodstream infection episodes per 1 000 central line-days (all), patients staying more than two days in the ICU, ICUs with less than 20 patients excluded, 2007

Country	N of ICUs	Mean of means	P10	P25	P50	P75	P90
AT	37	1.3	0.0	0.0	0.0	1.8	5.3
BE	17	3.2	0.0	0.0	0.7	3.9	7.4
ES	111	3.2	0.0	0.0	2.4	4.6	7.4
FR	165	3.4	0.0	1.2	2.9	4.9	6.9
IT	30	3.3	0.0	0.0	0.0	7.9	11.2
LT	9	1.5	0.0	0.0	0.0	2.8	6.1
LU	8	1.7	0.0	0.4	1.3	3.1	3.9
PT	6	3.2	0.0	2.3	2.6	5.7	6.0
SK	5	4.6	0.0	3.4	4.7	6.3	8.5
Overall	**388**	**3.1**	**0.0**	**0.0**	**2.3**	**4.6**	**7.4**

Characteristics of ICU-acquired bloodstream infections

Mortality and length of stay in in ICU for bloodstream infections

The ICU mortality in patients with ICU-acquired bloodstream infections was 33.2%, 2.4 (95% CI 2.2–2.5) times higher than for patients without BSI (Table 43). Overall, the length of stay in the ICU for patients with BSI was approximately 3.5 times higher than for patients without BSI. As with pneumonia, these figures are not adjusted for confounders and should therefore be interpreted with caution.

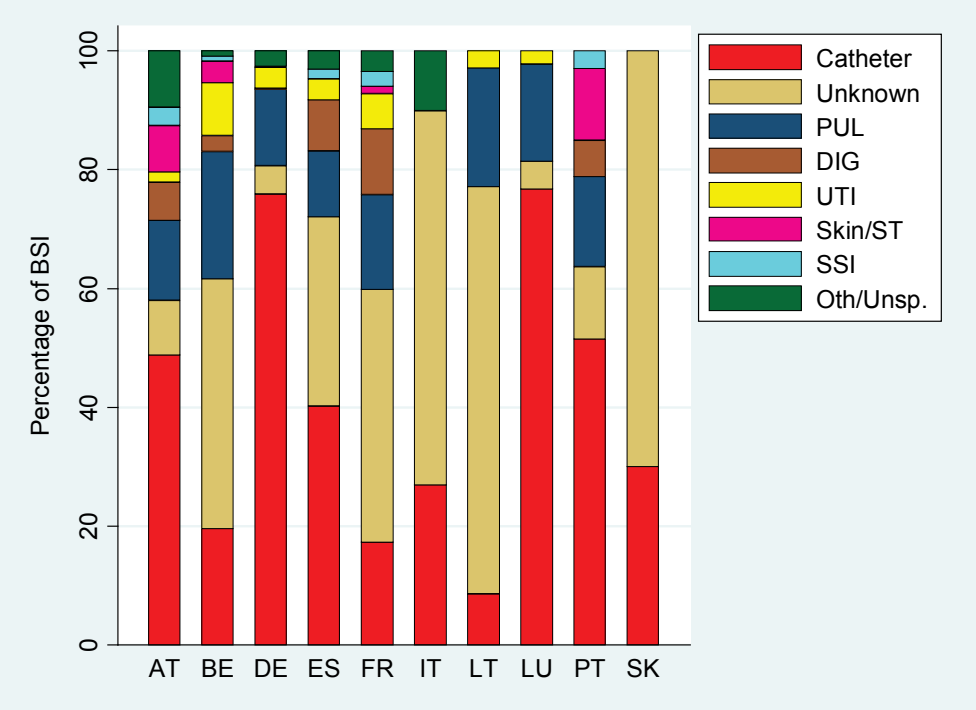
Table 43: Associated mortality and length of ICU stay (in days) for patients with ICU-acquired bloodstream infections

	No BSI		BSI	
	% death	Length of stay (d)	% death	Length of stay (d)
AT	11.6%	9.8	18.7%	30.8
BE	13.1%	7.8	35.1%	28.4
ES	11.1%	8.0	30.1%	29.2
FR	17.1%	10.2	41.3%	36.3
IT	16.9%	10.3	33.3%	32.6
LT	15.4%	8.6	25.9%	23.8
LU	10.0%	9.7	23.5%	39.6
PT	16.1%	12.1	9.4%	31.1
SK	22.9%	8.8	20.0%	21.4
Overall	**14.1%**	**9.3**	**33.2%**	**32.6**

Origin of bloodstream infections

The origin of bloodstream infections as defined in Figure 56 was not always registered directly in the national protocols and often contained large numbers of missing values. In countries using the HELICS methodology (or similar) in 2007, 30.0% of bloodstream infections were reported as catheter-related, 36.2% as unkown origin and 33.8% as secondary to another infection site. The primary infection site in the latter group was pulmonary for 40.2% of infections, digestive tract for 25.2%, urinary tract for 12.8%, skin and soft tissue for 6.0%, surgical site for 4.6% and another site for 11.2%. The distribution of the origin of ICU-acquired bloodstream infections is given by country in Figure 56. As explained above, the catheter-related BSI in Germany represent catheter-associated BSI, i.e. primary BSI with presence of a central venous catheter in the 48 hours before onset of infection.

Figure 56: Origin (source) of ICU-acquired bloodstream infections by country, 2007

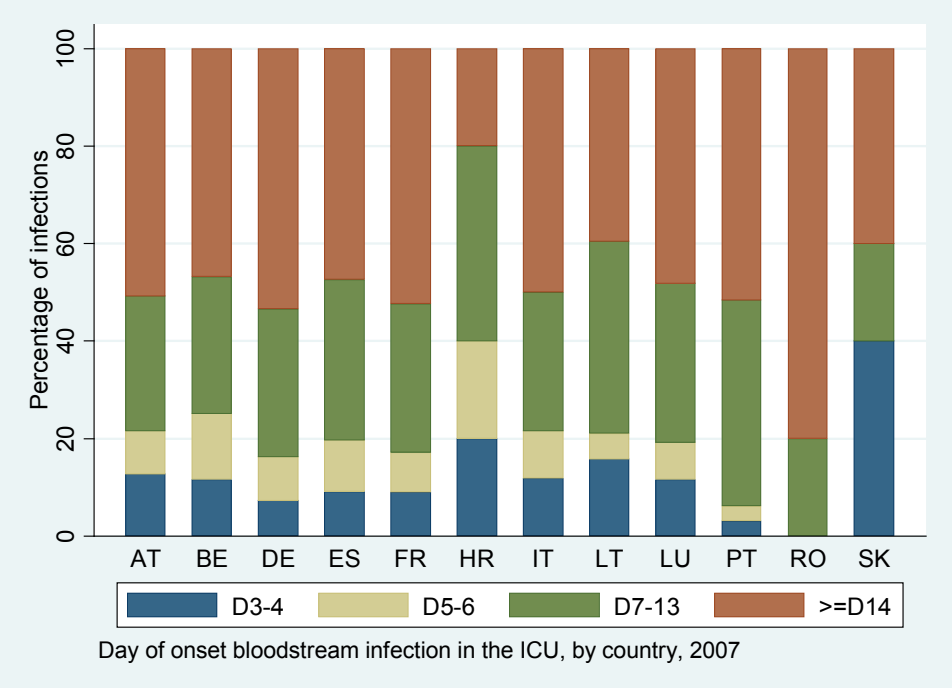


SSI=surgical site infection; UTI=urinary tract infection; PUL=pulmonary infection; DIG=digestive tract infection; Skin/ST=skin and soft tissue infection;Oth/Unsp.=other or unspecified infection.

Day of onset of ICU-acquired bloodstream infections

The day of onset of ICU-acquired bloodstream infections is presented by country in Figure 57. Early onset (onset on day 3 or 4 in the ICU) represented 9.7% of the total BSI, which is considerably less than for pneumonia. This can partially be explained by the fact that secondary BSI mostly occur slightly later than the primary infection. The median incubation time from ICU admission to onset of bloodstream infection was 14 days (mean 19.6 days), one day more than in 2004–2006.

Figure 57: Day of onset of ICU-acquired bloodstream infections by country, unit- and patient-based surveillance combined, 2007



Microorganisms isolated in ICU-acquired bloodstream infections

The most frequently isolated microorganisms in ICU-acquired bloodstream infections overall were coagulase-negative staphylococci (CNS), accounting for 28.5% of the total isolates. The large variation between countries for these microorganisms (from 7.3% to 46.7%, Table 44) probably rather reflects differences in reporting CNS-bloodstream infections than true differences in their occurrence. This underscores the need for field validation studies to verify these reported infections against the case definition of laboratory-confirmed bloodstream infections, which requires two positive blood cultures for skin contaminants within a period of 48 hours. Furthermore, differences in the practice and frequency of taking blood cultures may affect the frequency of isolation of CNS more than that of other microorganisms. The second most frequently isolated microorganism in ICU-acquired bloodstream infections was *Staphylococcus aureus*, followed by *Enterococcus* spp., *Pseudomonas aeruginosa, Candida* spp. and *Escherichia coli*. When eliminating CNS from the total, these five microorganisms represented 15.9%, 15.7%, 12.7%, 10.6% and 10.3% of the isolated blood pathogens respectively. A detailed distribution of microorganisms isolated in ICU-acquired bloodstream infections by country, with percentages expressed relative to the total excluding CNS is given in Annex 2c.

Table 44: Microorganisms most frequently isolated in ICU-acquired bloodstream infections (unit- and patient-based surveillance combined), percentage by country, 2007

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK	Total
Total number of infections	**272**	**993**	**1 293**	**940**	**1 159**	**13**	**106**	**41**	**46**	**36**	**12**	**4 911**
Coag-negative staphylococci	46.7	19.5	33.8	35.5	21.1	30.8	37.7	7.3	10.9	33.3	16.7	28.5
S. aureus	6.6	8.9	16.0	6.5	13.4	15.4	3.8	4.9	15.2	30.6	16.7	11.4
Enterococcus spp.	12.1	12.5	16.1	10.6	5.9	0.0	4.7	0.0	17.4	8.3	0.0	11.2
P. aeruginosa	5.5	9.9	6.7	8.6	11.6	0.0	14.2	7.3	10.9	13.9	8.3	9.0
Candida spp.	10.3	6.4	5.1	7.1	10.4	0.0	10.4	9.8	8.7	0.0	0.0	7.5
E. coli	4.4	11.1	5.1	6.1	8.9	7.7	4.7	4.9	8.7	2.8	8.3	7.3
Klebsiella spp.	2.6	9.5	4.7	5.4	5.2	15.4	0.0	17.1	13.0	2.8	16.7	5.9
Enterobacter spp.	1.8	6.1	3.6	5.6	8.5	0.0	2.8	12.2	6.5	0.0	8.3	5.6
Serratia spp.	0.4	1.8	2.1	1.9	2.0	0.0	2.8	2.4	2.2	0.0	0.0	1.9
Streptococcus spp.	1.8	2.9	0.0	1.4	1.7	0.0	0.0	4.9	2.2	0.0	0.0	1.4
Proteus spp.	0.4	1.5	1.3	1.4	1.1	0.0	1.9	2.4	2.2	0.0	0.0	1.3
Other Enterobacteriaceae	0.4	2.0	0.5	0.5	1.5	0.0	0.0	4.9	0.0	0.0	0.0	1.1
S. maltophilia	0.0	1.4	0.9	0.6	1.2	0.0	2.8	4.9	2.2	0.0	0.0	1.1
Bacteroides spp.	0.0	1.0	0.3	0.2	2.2	0.0	0.9	0.0	0.0	0.0	0.0	0.9
Citrobacter spp.	0.4	1.0	0.7	0.6	0.8	0.0	0.9	4.9	0.0	0.0	0.0	0.8
Gram-positive bacilli	1.8	0.4	0.5	0.2	0.8	0.0	0.9	0.0	0.0	0.0	0.0	0.6
Acinetobacter spp.	0.4	1.8	1.8	6.6	1.4	30.8	5.7	12.2	0.0	8.3	25.0	0.5

The percentage of gram-positives in blood isolates (excluding CNS) decreased from 38% in 2005 to 34% in 2007, while the percentage of Enterobacteriaceae remained stable and gram-negative non-fermenters increased from 16% in 2004 to 19% in 2007 (Figure 58).

Figure 58: Trends in relative frequency of microorganisms (excluding coagulase-negative staphylococci) isolated in ICU-acquired bloodstream infections, 2004–2007

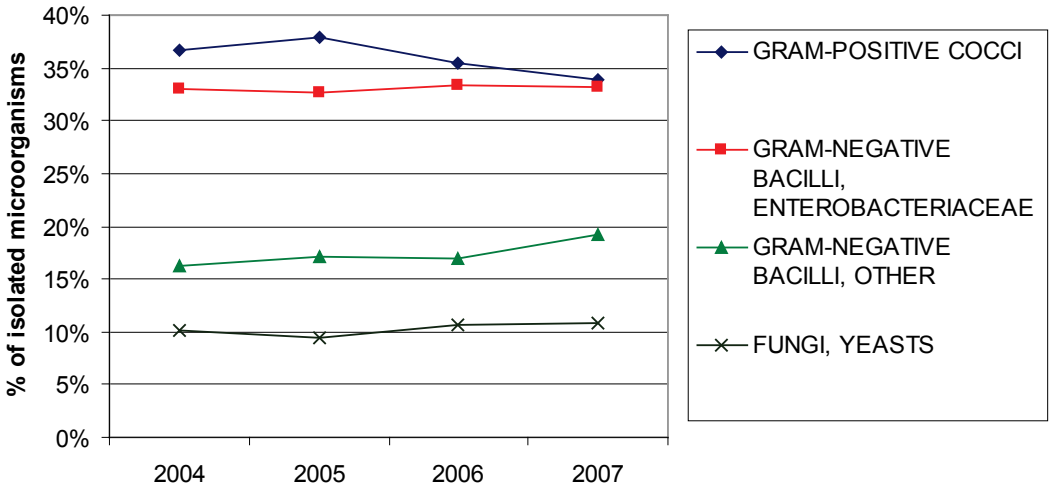


Table 45 shows the distribution of microorganisms by day of onset of the bloodstream infection in the ICU. The percentage of mainly *P. aeruginosa* and *Enterococcus* spp. was much higher among the late onset than early onset bloodstream infections in the ICU, while the percentage of pathogens frequently associated with infections in the community (pneumococci, *S. aureus* and *E. coli*) decreased with the day of onset. The percentage of CNS, *Candida* spp. and Enterobacteriaceae other than *E. coli* was independent of the day of onset of the infection.

Table 45: Relative frequency of microorganisms most frequently isolated in ICU-acquired bloodstream infections (level 1 and level 2 surveillance combined) by day of onset after admission to the ICU, 2007

Microorganism	Day of onset infection				Percentage of total
Coagulase-negative staphylococci (%)	23.7	29.9	30.4	28.3	28.7
S. aureus (%)	16.4	15.3	10.9	9.9	11.4
Enterococcus spp. (%)	7.3	8.7	10.9	12.6	11.2
P. aeruginosa (%)	4.9	5.6	6.3	12.0	9.0
Candida spp. (%)	6.9	6.4	7.8	7.5	7.4
E. coli (%)	12.6	9.7	7.2	6.1	7.4
Klebsiella spp. (%)	6.0	4.9	6.0	6.1	6.0
Enterobacter spp. (%)	4.9	3.1	7.4	5.1	5.6
Acinetobacter spp. (%)	2.7	2.9	3.0	2.8	2.9
Serratia spp. (%)	1.1	1.2	1.9	2.1	1.9
Streptococcus spp. (%)	4.4	3.7	1.0	0.7	1.4
Proteus spp. (%)	1.1	1.4	1.6	1.2	1.3
Other Enterobacteriaceae (%)	1.6	1.6	1.6	0.6	1.1
Stenotrophomonas maltophilia (%)	0.7	0.0	0.9	1.4	1.1
Bacteroides spp. (%)	0.4	2.1	0.7	0.8	0.9
Citrobacter spp. (%)	1.1	1.0	0.8	0.6	0.8
Gram-positive bacilli (%)	1.3	0.2	0.5	0.5	0.6
Anaerobes, non-*Bacteroides* spp. (%)	1.3	0.4	0.2	0.5	0.5
Pseudomonadaceae family, other (%)	0.4	0.6	0.2	0.4	0.4
Other/unsp. fungi/yeasts (%)	0.0	0.0	0.1	0.4	0.2
Haemophilus spp. (%)	0.2	0.8	0.1	0.0	0.2
Viruses (%)	0.2	0.0	0.3	0.1	0.2
Other gram-negative bacilli, non-Enterobacteriaciae (%)	0.2	0.0	0.1	0.1	0.1
Gram-negative cocci (%)	0.2	0.4	0.0	0.1	0.1
Other/unspecified bacteria (%)	0.2	0.0	0.0	0.0	0.0
Number of isolates	**451**	**485**	**1 482**	**2 505**	**4 923**

The isolated microorganisms also varied according to the source (origin) of the bloodstream infection (Table 46). Coagulase-negative staphylococci is the most common microorganism isloted in catheter-related (catheter-associated for Germany) bloodstream infections, while in bloodstream infections secondary to another infection site Enterobacteriaceae and *P. aeruginosa* are the most common.

Table 46: Relative frequency of isolated microorganisms by origin of bloodstream infections (percentage), 2007

	Origin of bloodstream infection		
	Catheter	Unknown	Secondary
N of isolates	1 995	1 257	1 656
Gram-positive cocci	**66.5**	**48.9**	**39.0**
Staphylococcus aureus	12.8	9.1	11.3
Coagulase-negative *staphylococci*	41.3	30.5	12.3
Enterococcus spp.	12.0	9.8	11.2
Streptococcus spp.	0.4	1.9	2.4
Gram-negative cocci	**0.1**	**0.1**	**0.1**
Gram-positive bacilli	**0.6**	**1.0**	**0.3**
Gram-negative bacilli, Enterobacteriaceae	**15.6**	**23.9**	**33.7**
Escherichia coli	4.0	6.4	12.2
Enterobacter spp.	3.2	7.4	7.1
Klebsiella spp.	4.4	5.7	7.9
Proteus spp.	1.0	1.3	1.7
Citrobacter spp.	0.8	0.6	0.9
Serratia spp.	1.9	1.4	2.2
Other Enterobacteriaceae	0.5	1.2	1.7
Gram-negative bacilli, other	**9.8**	**12.8**	**18.8**
Acinetobacter spp.	3.1	2.7	2.7
Pseudomonas aeruginosa	5.6	7.9	14.1
Stenotrophomonas maltophilia	0.8	1.0	1.5
Pseudomonaceae, other	0.2	0.7	0.3
Haemophilus spp.	0.1	0.2	0.2
Other gram-negative bacilli	0.1	0.3	0.0
Anaerobes	**0.3**	**1.9**	**2.1**
Bacteroides spp.	0.3	1.3	1.3
Other anaerobes	0.1	0.6	0.8
Fungi/yeasts	**6.9**	**8.8**	**7.7**
Candida spp.	6.6	8.8	7.5
Other fungi/yeasts	0.4	0.1	0.2
Viruses	**0.3**	**0.1**	**0.1**

8.2.3 Central venous catheter-related infections

In 2007, optional numerator data on central venous catheter-related infections (CRI) were collected by eight countries. However, optional central venous catheter (CVC) risk factor data used for risk adjustment of the CRI indicator, were only collected by France, Belgium, Italy (partially) and Slovakia. Because of the limited number of data, data from 2006 and 2007 were included in the analysis.

Type of catheter-related infections and isolated microorganisms

The case definition of catheter-related infections includes three subcategories: CRI1, with only local clinical signs at the catheter insertion site combined with a positive CVC culture, CRI2 with generalised sepsis, a positive CVC culture, but without concomitant bloodstream infection and the generalised CRI3 with positive blood culture. The latter is actually a (subtype of) bloodstream infection with origin catheter, and should also be reported as a bloodstream infection.

In 2006–2007 data, CRI1 represented 38.4% of all CVC-related infections, CRI2 20.6% and CRI3 41.0%, excluding Austria that only reported CRI1 (54%) and CRI2 (46%).

The most frequently isolated microorganisms in CVC-related infections were CNS (38.7%), *P. aeruginosa* 11.7%, *S. aureus* (10.1%), *Candida* spp. (6.5%), *Enterobacter* spp. (6.3%) and *Enterococcus* spp. (6.1%).

Risk factors of CVC-related infections

The mean duration that CVCs were left in place before removal was 9.9 days (median 7 days) and is given by country together with the distribution of the insertion site in Table 47.

The overall CVC-related infection rate was 2.1 CRI per 1 000 CVC-days and varied from 0.5 per 1 000 CVC-days in Belgium to 4.3 per 1 000 CVC-days in Slovakia.

Table 47: Number of central venous catheters included in the optional CVC risk factor data collection (surveillance of catheter-related infections) by site and by country, 2006–2007

	BE	FR	IT	SK	Overall
N of ICUs	3	54	14	4	75
N of catheters	764	7 503	3 944	265	12 476
Duration of CVC in place, mean	**9.6**	**9.9**	**10**	**7.8**	**9.9**
1–3d	17.5%	16.5%	19.6%	18.9%	17.6%
4–6d	25.4%	27.8%	30.9%	33.2%	28.7%
7–13d	38.2%	33.1%	29.8%	38.1%	32.5%
≥ 14d	18.8%	22.6%	19.7%	9.8%	21.1%
CVC site					
Subclavia	49.1%	51.2%	31.3%	63.0%	45.0%
Jugular	38.4%	27.9%	35.8%	34.3%	31.2%
Femoral	12.0%	15.9%	3.5%	1.1%	11.4%
Other	0.3%	0.5%	8.6%	1.5%	3.1%
Unknown/missing	0.3%	4.4%	20.8%	0.0%	9.2%
CRI / 1 000 CVC-days	**0.5**	**2.7**	**1.1**	**4.3**	**2.1**

Central venous catheter-related infections were more frequent when the catheter was in place for a longer time, and less frequent in subclavia catheters than for other CVC sites. CRI rates were also associated with giving antibiotics via the catheter, and with the presence of another infection and any organ failure when the CVC was removed (Table 48). These results are consistent with the previous findings of the French Reacat network that constituted the basis for this optional risk factor module in the HELICS-ICU protocol [3].

Table 48: Risk factors of catheter-related infections (all categories combined), optional risk factor data from Belgium, France, Italy and Slovakia, 2006–2007 (n=12 476), multiple logistic regression

	N of CVCs	% CRI	# CRI/ 1 000 CVC days	OR*	95% CI	p-value
Duration of CVC in place						
1–3d	2 196	0.6	2.3	ref.		
4–6d	3 586	0.9	1.8	1.5	0.8–3.0	0.186
7–13d	4 056	2.2	2.4	3.8	2.1–6.8	< 0.001
≥ 14d	2 638	4.7	2.0	8.5	4.7–15.3	< 0.001
CVC site						
Subclavia	5 619	2.2	1.9	ref.		
Jugular	3 890	2.2	2.5	1.4	1.0–1.8	0.029
Femoral	1 428	3.1	3.6	1.5	1.1–2.2	0.025
Other	385	1.0	1.2	1.0	0.4–2.8	0.990
Unknown/missing	1 154	0.6	0.7	0.5	0.2–1.1	0.072
Antibiotic perfusion through catheter						
No	2 170	2.1	3.1	ref.		
Yes	5 443	2.8	2.6	0.6	0.4–0.9	0.015
Unknown/missing	4 863	1.3	1.3	1.1	0.5–2.4	0.816
Other infection at removal						
No	3 514	1.8	2.3	ref.		
Yes	3 945	3.4	3.1	1.5	1.0–2.1	0.025
Unknown/missing	5 017	1.2	1.2	0.9	0.4–2.0	0.703
At least one organ failure at removal						
No	3 276	1.6	1.9	ref.		
Yes	3 539	3.9	3.7	2.0	1.5–2.8	< 0.001
Unknown/missing	5 661	1.2	1.2	0.7	0.4–1.4	0.317

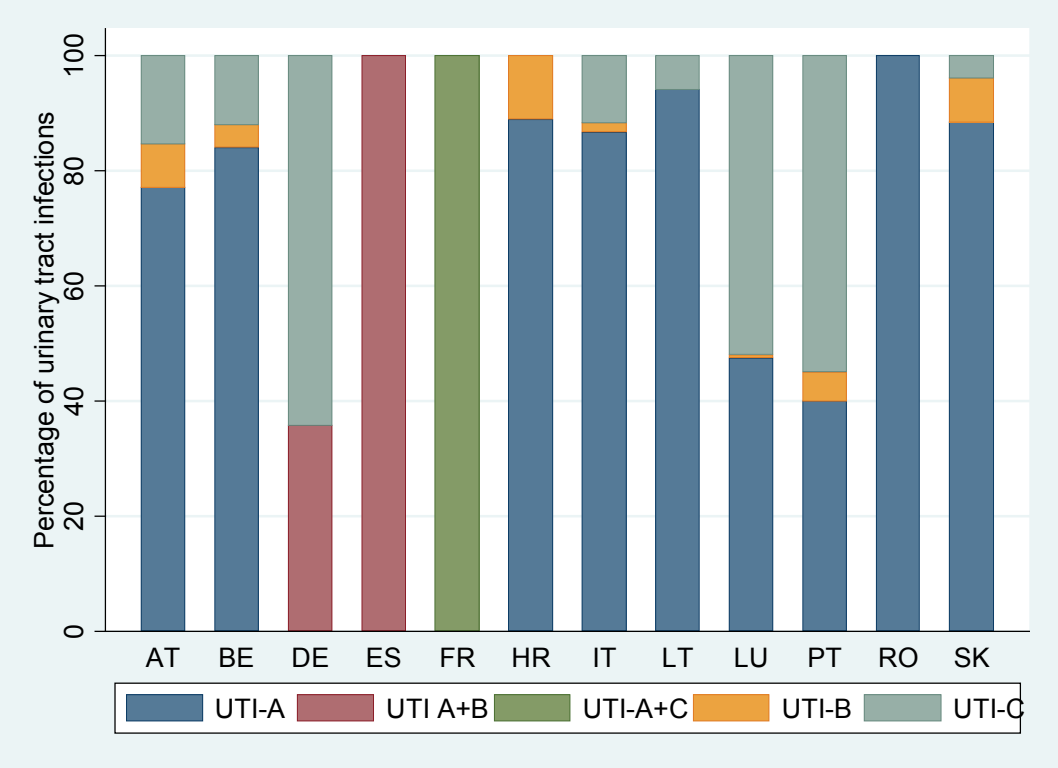
*CRI=central vascular catheter-related infections; CVC=central venous catheter; *Odds ratio (OR) and 95% confidence intervals are adjusted for all other risk factors in the multiple logistic regression model and presented in the table.*

8.2.4 ICU-acquired urinary tract infections

Application of the HELICS case definitions of urinary tract infections

The HELICS case definition of urinary tract infection (UTI) is similar to the CDC/NHSN case definition. The only difference is that asymptomatic bacteriuria were defined as the subcategory UTI-C in HELICS, not as a separate definition. Otherwise, the subcategories UTI-A and UTI-B are the same as respectively criterion 1 and 2 of the CDC/NHSN definition of symptomatic urinary tract infection. As shown in Figure 59, Germany, France and Spain do not specify all categories of UTI. In France, reported UTI include microbiologically confirmed symptomatic (UTI-A) and asymptomatic (UTI-C) urinary tract infections, without distinguishing between both categories. In Germany and Spain, symptomatic UTI comprise UTI-A and B, again without specifying the subcategory. In countries who did report the three categories, their proportions varied considerably, in particular for the proportion of UTI-C. Most of these surveillance systems, however, seem to rely primarily on microbiological confirmation of symptomatic urinary tract infections (UTI-A) given that the UTI-B category only represents 3.9% of reported UTI overall.

Figure 59: Subcategories of reported urinary tract infections by country, 2007



Incidence of urinary tract infections

Given the above-mentioned differences in case definitions of urinary tract infections, the calculation of overall incidence figures and intercountry comparisons should be interpreted with caution. The mean percentage of patients staying more than two days in 312 ICUs that collected data on urinary tract infections (all categories combined) was 6.8%, varying from 2.9% in ICUs with less than 30% of intubated patients to 8.5% in ICUs with 60% or more of intubated patients (table not shown).

The mean incidence density (all categories combined) among patients staying more than two days was 5.6 UTI episodes per 1 000 patient-days. Incidence density figures by UTI category are given by country and by percentage of intubated patients in Tables 49 to 51.

Table 49: Incidence density per 1 000 patient-days of urinary tract infections by diagnostic subcategory and country, 2007, unit- and patient-based surveillance combined

	pt days	UTI-A	UTI-B	UTI-A+B	UTI-C	UTI-A+C	UTI-A+B+C
AT	44 796	8.0	0.8	8.8	1.6	9.6	10.4
BE	24 787	1.7	0.1	1.8	0.2	1.9	2.0
DE	879 094	—	—	0.7	1.3	—	2.1
ES	133 308	—	—	4.9	—	—	—
FR	245 407	—	—	—	—	5.8	—
HR	8 879	0.9	0.1	1.0	0.0	0.9	1.0
IT	10 562	4.9	0.1	5.0	0.7	5.6	5.7
LT	9 695	1.4	0.0	1.4	0.1	1.5	1.5
LU	24 496	3.4	0.0	3.4	3.7	7.1	7.1
PT	6 471	1.2	0.2	1.4	1.7	2.9	3.1
SK	1 083	21.2	1.8	23.1	0.9	22.2	24.0
Overall including DE				**1.7**	**1.3**		**2.6**
Overall excluding DE		**4.5**	**0.3**	**4.9**	**1.4**	**5.9**	**6.3**

Table 50: Percentile distribution of incidence density of ICU-acquired symptomatic urinary tract infections (n UTI A+B episodes/1 000 patient-days)* by percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2007

% intubated patients	N of ICUs	Mean of means	P10	P25	P50	P75	P90
< 30%	36	2.9	1.0	1.5	2.3	4.3	5.7
30–59%	57	4.9	0.4	2.7	3.9	6.3	8.5
≥ 60%	61	6.5	1.2	2.2	4.5	8.0	15.3
Total - DE/FR	**154**	**5.1**	**1.1**	**2.1**	**3.8**	**6.3**	**9.2**
Total - FR	**431**	**2.3**	**0.0**	**0.3**	**1.0**	**3.1**	**6.0**

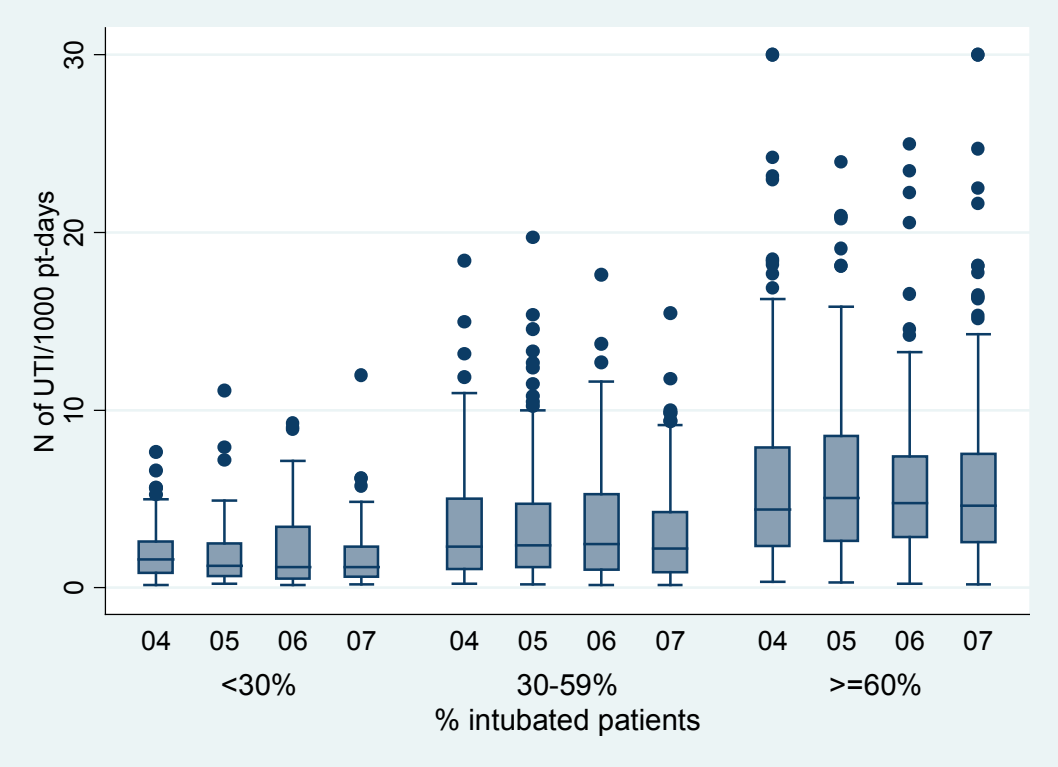
**France excluded because subcategories of symptomatic UTI are not given.*

Table 51: Percentile distribution of incidence density of ICU-acquired urinary tact infections (n UTI A+B+C episodes/1 000 patient-days)* by percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2007

% intubated patients	N of ICUs	Mean of means	P10	P25	P50	P75	P90
< 30%	16	3.4	1.1	1.6	2.5	4.4	6.2
30–59%	62	4.9	1.4	2.7	4.5	6.3	9.0
≥ 60%	136	6.8	1.5	3.1	5.3	8.8	14.3
Total - DE/ES	**214**	**6.0**	**1.5**	**2.7**	**4.7**	**7.5**	**11.2**
Total - ES, +DE	**491**	**3.8**	**0.5**	**1.1**	**2.6**	**5.1**	**8.7**

**Spain excluded because asymptomatic UTI are not included; data for France do not include UTI-B.*

Figure 60: Incidence density of ICU-acquired urinary tract infections (n UTI A+B+C episodes/1 000 patient-days) by year and percentage of intubation in the ICU, ICUs with fewer than 20 patients excluded, unit- and patient-based surveillance combined, 2004–2007



The majority of urinary tract infections (96.4%) were associated with the use of a urinary catheter. In level 2 surveillance, the device-associated UTI rate varied from 1.9 catheter-associated urinary tract infections per 1 000 urinary catheter days in Lithuania to 22.1 catheter-associated urinary tract infections per 1 000 urinary catheter days in Slovakia (Table 52).

Table 52: Device-adjusted urinary tract infection rates by country, 2007

	Pt days	N of UC days, all	UCUR	N CA-UTI	CA-UTIs/ 1 000 UC days
AT	44 796	34 632	77.3	316	9.1
BE	6 266	4 908	78.3	13	2.6
ES	133 308	99 135	74.4	597	6.0
FR	245 407	198 752	81.0	1211	6.1
LT	9 695	8 095	83.5	15	1.9
LU	25 931	17 821	68.7	161	9.0
PT	6 471	5 888	91.0	14	2.4
SK	1 083	1 040	96.0	23	22.1
Overall	**483 294**	**370 271**	**76.6**	**2 400**	**6.5**

Pt days=patient-days; UC=urinary catheter; UCUR=urinary catheter utilisation rate (number of urinary catheter days per 100 patient-days); CA-UTI: catheter-associated urinary tract infection.

Characteristics of urinary tract infections

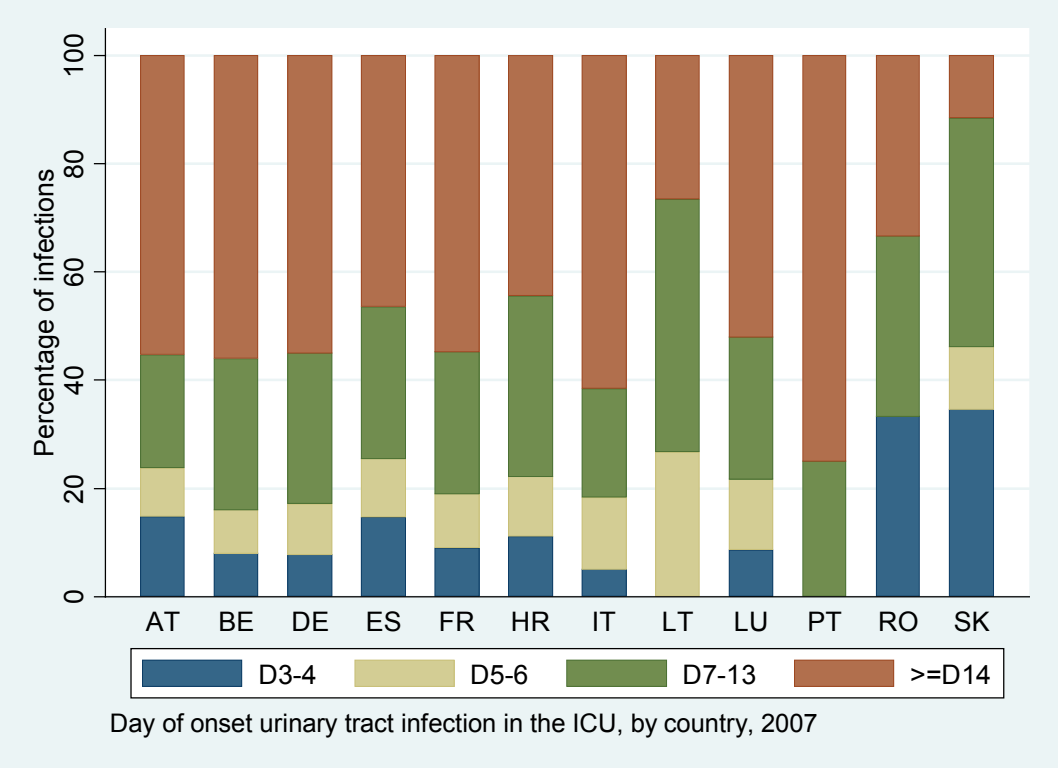
Mortality and length of stay in urinary tract infections

The ICU mortality in patients with ICU-acquired urinary tract infections was 22.8%, 1.6 (95% CI 1.5–1.8) times higher than in patients without UTI (Table 53). In countries specifying the subcategories of UTI, there was no difference in associated mortality between symptomatic UTI (18.9%) and asymptomatic UTI (18.0%). Overall, the length of stay in the ICU in patients with UTI was approximately 3.5 times higher in infected patients than in patients without UTI. As above, these figures are not adjusted for confounders and should therefore be interpreted with caution.

Table 53: Associated mortality and length of ICU stay (in days) in patients with ICU-acquired urinary tract infections, 2007, patient-based surveillance

	No UTI		UTI	
	% death	LOS (d)	% death	LOS (d)
AT	13.6%	10.1	17.0%	28.5
BE	11.7%	7.5	6.7%	45.5
ES	11.4%	8.2	24.4%	28.7
FR	17.9%	9.9	23.9%	35.1
IT	17.1%	10.6	37.3%	30.8
LT	14.2%	9.1	28.6%	20.4
LU	9.3%	8.8	15.9%	34.8
PT	16.0%	12.2	23.5%	35.2
SK	23.7%	6.6	23.1%	17.9
Overall	**14.8%**	**9.3**	**22.8%**	**32.4**

Figure 61: Day of onset of ICU-acquired urinary tract infections by country, unit- and patient-based surveillance combined, 2007



The median time from ICU admission to the onset of urinary tract infections was 15 days (mean 20.5 days) which is similar to that for bloodstream infections (median 14 days) but longer than for pneumonia (median 10 days). It was the shortest for Slovakia (7.5 days) and the longest for Portugal (19.5 days), as can also be estimated from Figure 61.

The most frequently isolated microorganism in urinary tract infections was *E. coli,* followed by *Enterococcus* spp., *Candida* spp. but also *P. aeruginosa*, which is the second most isolated pathogen in late onset urinary tract infections (Tables 54 and 55).

Table 54: Microorganisms most frequently isolated in ICU-acquired urinary tract infections (unit- and patient-based surveillance combined) by country, 2007

	AT	BE	DE	ES	FR	IT	LT	LU	PT	SK	Overall
N of isolates	556	56	1 895	647	1 610	66	18	211	22	36	5 117
E. coli (%)	15.1	19.6	24.9	26.6	30.6	19.7	33.3	19.4	9.1	5.6	25.3
Enterococcus spp. (%)	19.2	19.6	24.1	13.4	11.1	9.1	0.0	31.3	9.1	11.1	18.0
Candida spp. (%)	28.6	12.5	10.7	24.9	14.8	28.8	27.8	19.4	18.2	30.6	16.6
P. aeruginosa (%)	14.4	17.9	14.0	12.2	15.9	13.6	5.6	11.8	50.0	16.7	14.5
Klebsiella spp. (%)	4.9	1.8	6.8	4.2	5.3	6.1	11.1	2.8	4.5	19.4	5.6
Enterobacter spp. (%)	3.1	5.4	4.6	3.1	6.6	10.6	5.6	2.4	4.5	5.6	4.9
Proteus spp. (%)	2.2	1.8	4.3	2.5	3.7	1.5	0.0	0.0	4.5	5.6	3.4
Coagulase-negative staphylococci (%)	6.5	5.4	2.5	3.1	2.5	1.5	5.6	2.8	0.0	0.0	3.0
Other/unsp. yeast/fungi (%)	0.2	5.4	3.3	0.0	0.9	0.0	0.0	0.0	0.0	0.0	1.6
Citrobacter spp. (%)	1.3	0.0	1.3	0.6	1.7	1.5	0.0	0.5	0.0	0.0	1.3
S. aureus (%)	0.9	0.0	1.3	0.5	1.5	1.5	0.0	3.3	0.0	2.8	1.3
Acinetobacter spp. (%)	0.7	0.0	0.5	4.8	0.7	6.1	0.0	0.0	0.0	2.8	1.2
Other Enterobacteriaceae (%)	1.1	1.8	0.7	1.2	1.4	0.0	5.6	2.4	0.0	0.0	1.1
Serratia spp. (%)	0.5	0.0	0.7	0.8	0.6	0.0	0.0	0.9	0.0	0.0	0.6
Streptococcus spp. (%)	0.7	0.0	0.0	0.8	1.1	0.0	0.0	1.9	0.0	0.0	0.6
Stenotrophomonas maltophilia (%)	0.5	0.0	0.3	0.2	0.6	0.0	0.0	0.5	0.0	0.0	0.4

Table 55: Relative frequency of microorganisms most frequently isolated in ICU-acquired urinary tract infections (unit- and patient-based surveillance) by day of onset after admission to the ICU, 2007

Microorganism	Day of onset infection				Percentage of total
	3–4D	5–6D	7–13D	≥ 14D	
N of isolates	**487**	**486**	**1 361**	**2 781**	**5 115**
E. coli (%)	32.5	34.9	29.2	20.5	25.3
Enterococcus spp. (%)	22.1	20.3	16.8	17.3	18.0
Candida spp. (%)	13.1	14.6	19.2	16.2	16.6
P. aeruginosa (%)	6.7	7.4	10.3	19.2	14.5
Klebsiella spp. (%)	7.2	5.7	5.6	5.4	5.6
Enterobacter spp. (%)	3.9	4.3	3.2	6.0	4.9
Proteus spp. (%)	4.3	3.3	4.2	2.9	3.4
Coagulase-negative staphylococci (%)	3.3	3.1	2.4	3.2	3.0
Other/unspec. yeasts/fungi (%)	0.6	0.4	2.2	1.7	1.6
Citrobacter spp. (%)	1.6	1.2	1.4	1.2	1.3
S. aureus (%)	1.4	1.8	1.2	1.2	1.3
Acinetobacter spp. (%)	0.4	0.2	1.1	1.6	1.2
Other Enterobacteriaceae (%)	0.6	1.4	1.5	1.0	1.1
Serratia spp. (%)	0.0	0.0	0.5	0.9	0.6
Streptococcus spp. (%)	1.8	0.4	0.3	0.5	0.6
Stenotrophomonas maltophilia (%)	0.0	0.0	0.1	0.6	0.4

8.3 Antimicrobial resistance in the ICU-acquired infections

The protocol for surveillance of ICU-acquired infections allows for the collection of antimicrobial (AMR) resistance data in isolated microorganisms, either as AMR markers or using optional full resistance data. The collection of meticillin resistance in *S. aureus* is not optional in the HELICS-ICU protocol, but still two networks did not provide this information (Luxembourg and Lithuania). Although Lithuania has a separate microorganism code for MRSA, this does not guarantee that all microorganisms reported as *S. aureus* are sensitive to oxacillin, therefore these data were not used. AMR data collection by marker methods only was done by France, Austria and Germany. Full resistance data were available from Belgium, Spain, Italy, Slovakia and Portugal.

8.3.1 *Staphylococcus aureus*

In 2007, the overall percentage of meticillin (oxacillin) resistance in *S. aureus* (MRSA) in eight reporting countries was 34.5% (mean 44.5%) and was lower in pneumonia (32.6%, n=1 582 isolates) than in bloodstream infections (41.6%, n=546 isolates). The highest percentages of resistance were observed in Portugal and Italy (Figure 62). Between 2004 and 2007, there was an overall decreasing trend in meticillin resistance in *S. aureus* isolated in ICU-acquired infections ($p=0.002$). This decrease was significant in Austria ($p < 0.05$), in France ($p < 0.001$), and in Spain for the decrease between 2006 and 2007 ($p < 0.01$). The observed decrease in Portugal was not statistically significant due to small numbers. In 2007, there was only one reported *S. aureus* infection with reduced susceptibility to glycopeptides from Austria.

Figure 62: Percentage meticillin resistance in *S. aureus* isolates in ICU-acquired infections by country and by year, 2004–2007

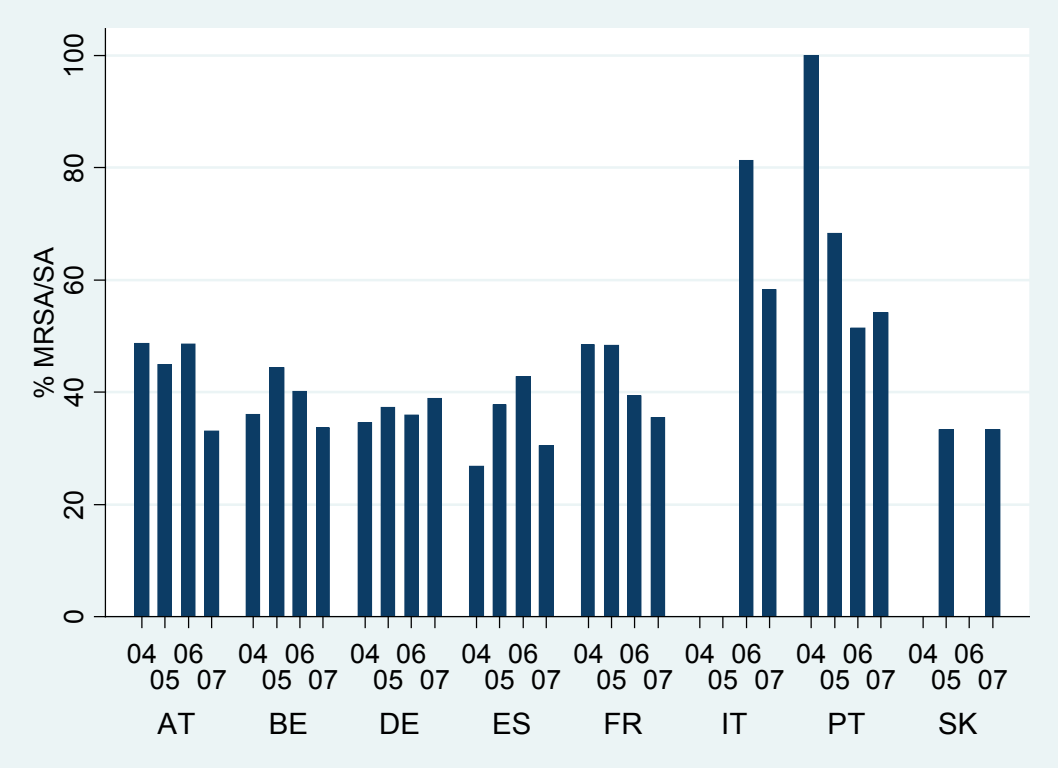


Table 56: Resistance markers in ICU-acquired infections by country, infection type and by year, 2004–2007: meticillin resistance in *S. aureus*

	2004	2005	2006	2007
By country				
AT	48.7	44.9	48.6	33.1
BE	36.1	44.4	40.2	33.6
DE	34.5	37.3	35.9	38.9
ES	26.8	37.8	42.4	30.4
FR	48.5	48.4	39.4	35.6
HR	—	—	—	83.3
IT	—	—	81.3	56.5
PT	100.0	68.3	51.4	54.2
SK	—	33.3	—	33.3
By infection type				
Bloodstream infections	45.7	47.4	42.5	41.7
Pneumonia	38.1	39.3	37.0	32.9
Urinary tract infections	32.3	42.9	49.2	44.4
Catheter-related infections	54.7	59.6	47.4	43.8
Other	47.1	49.1	49.4	45.2

Optional resistance data collected for MRSA strains in 2007 are given in Table 57. Susceptibility to vancomycin or teicoplanin was excellent (as mentioned above), and high for co-trimaxazole and linezolid (three non-susceptible strains reported from Spain and one from Romania).

Table 57: Co-resistance to selected antimicrobials in MRSA isolated from ICU-acquired infections, optional resistance data*, 2007

	N of ICUs	N of MRSA	S	I	R	U	% I+R / all	% I+R / (S+I+R)
Glycopeptides	72	181	179	0	0	2	0.0%	0.0%
Co-trimoxazole	65	165	124	1	11	29	7.3%	8.8%
Fluoroquinolones	67	167	11	0	110	46	65.9%	90.9%
Gentamicin	65	166	88	3	49	26	31.3%	37.1%
Linezolid	63	162	85	1	3	73	2.5%	4.5%

**From Belgium, Spain, Croatia, Italy, Portugal, Romania and Slovakia.*
S=susceptible, I=intermediate, R=resistant, U= unknown

8.3.2 Coagulase-negative staphylococci

Antimicrobial resistance in coagulase-negative staphylococci (96% *S. epidermidis* when the species was specified) was reported by seven countries. Oxacillin resistance (MRSE) was 83%, with no significant trend since 2004. Reduced susceptibility to vancomycin was reported in 2.2% of coagulase-negative staphylococci (18/834 strains). In optional resistance data, 511 MRSE strains were co-resistant to gentamicin in 67% (274/408 tested), fluoroquinolones in 81% (209/257), cotrimoxazole in 55% (228/415) , rifampicin in 19% (58/303), linezolid in 3% (7/234) and showed reduced susceptibility to glycopeptides in 1.2% (four reported GISE and two reported GRSE out of 503 tested MRSE strains).

8.3.3 *Enterococcus* species

Ampicillin resistance in *Enterococcus* spp was reported in 311 out of 987 tested isolates (31.5%) in eight countries. Vancomycin resistance was reported by nine countries (including Germany) and was 2.5% overall (47 of 1 895 isolates). Where the species was specified, ampicillin resistance was 84% in *E. faecium* (249/297) and 7% in *E. faecalis* (47/634). Vancomycin resistance in *E. faecium* and *E. faecalis* was 2.7% and 0.3%, respectively.

8.3.4 *Escherichia coli*

The overall percentage of third-generation cephalosporin resistance (marker of extended spectrum beta-lactamase (ESBL)-producing bacteria) in *E. coli* (n=1 606 isolates) was 11.7%, with a moderate increase overall from 8.9% in 2004–2005 to 11.9% in 2006–2007 ($p < 0.01$). In Belgium there was a decreasing trend ($p < 0.05$). In the optional resistance data from five countries (n=75 C3 resistant *E. coli* infections), there was co-resistance to fluoroquinolones in 77%, gentamicin 40%, amikacin 14%, and carbapenems 6%. Overall resistance in *E. coli* to these antibiotics (n=578 infections) was 32% (378/555), 15% (71/462), 5% (19/421) and 1.2% (5/407) respectively.

Table 58: Resistance markers in ICU-acquired infections by country, infection type and by year, 2004–2007: third-generation cephalosporin resistance in *E. coli*

	2004	2005	2006	2007
By country				
AT	11.6	15.4	23.1	15.4
BE	11.7	6.3	6.6	3.5
ES	14.7	12.8	13.1	15.6
FR	7.9	5.3	9.1	8.1
HR	—	—	—	20.0
IT	—	—	18.2	28.6
PT	0.0	0.0	11.8	14.3
SK	—	50.0	—	40.0
By infection type				
Bloodstream infections	10.2	9.0	18.3	12.9
Pneumonia	11.4	6.2	11.3	11.1
Urinary tract infections	6.4	7.9	9.1	9.7
Catheter-related infections	18.2	21.7	22.9	15.8
Other	15.3	16.5	18.6	16.7

8.3.5 *Klebsiella* species

The overall percentage of third-generation cephalosporin resistance in *Klebsiella* spp. in ICU-acquired infections (n=794 isolates) was 22%, and increased from 15.1% in 2004–2005 to 22.9% in 2006–2007 ($p < 0.001$). Where the species level was specified, C3 resistance was 24.0% in *K. pneumoniae* (n=375) and 16.8% in *K. oxytoca* (n=214). In optional resistance data (n=407 *Klebsiella* spp. isolates from seven countries), there was co-resistance in 83 C3-resistant isolates to cefepim in 88%, fluoroquinolones in 79%, gentamicin in 69%, amikacin 38% and carbapenems 7.2%. Overall resistance to these antimicrobials in *Klebsiella* spp. in 2007 was 29% (74/251), 27% (104/389), 23% (68/294), 14% (43/307) and 2% (7/324), repectively. In 23 strains tested for colistin susceptibility, there was no resistance reported.

Table 59: Percentage third-generation cephalosporin resistance in *Klebsiella* spp.

	2004	2005	2006	2007
By country				
AT	17.1	8.2	6.5	15.7
BE	20.3	15.4	14.7	16.3
ES	10.6	17.1	24.5	20.5
FR	14.9	10.2	22.6	20.9
HR	—	—	—	75.0
IT	—	—	40.0	36.4
PT	0.0	5.9	9.1	0.0
SK	—	70.0	90.9	68.4
By infection type				
Bloodstream infections	14.7	17.5	27.4	24.8
Pneumonia	14.0	9.5	15.4	16.8
Urinary tract infections	23.1	15.7	28.0	22.4
Other	14.5	10.2	13.0	22.5

8.3.6 *Enterobacter* species

The overall percentage of third-generation cephalosporin resistance in *Enterobacter* spp. in ICU-acquired infections (n=923 isolates in 2007) was 45%, fluctuating between 43% in 2005 and 54% in 2006. Where the species level was specified, C3 resistance was 45.2% in *E. aerogenes* (n=250) and 48.1% in *E. cloacae* (n=607). In optional resistance data (n=372 *Enterobacter* spp. isolates from six countries), there was co-resistance in 131 C3-resistant *Enterobacter* spp. isolates to cefepim in 37%, fluoroquinolones in 29%, amikacin 12% and carbapenems in 7.6%. Overall resistance to these antimicrobials in *Enterobacter* spp. in 2007 was 17% (38/226), 17% (63/364), 5.7% (16/276), and 3% (9/303) repectively.

8.3.7 *Pseudomonas aeruginosa*

Combined piperacillin- and ceftazidime resistance in *P. aeruginosa* isolated in ICU-acquired infections was 25% in 2007 (n=2 299 isolates), and did not vary from 2004 to 2007 overall. However, variations in individual countries could be observed, with slightly significant downward trends in France ($p < 0.05$), Austria ($p < 0.05$) and Portugal ($p < 0.05$, although a moderate increase was observed between 2007 and 2006) and a significant increase in Spain ($p < 0.01$) (Table 60). Resistance of *P. aeruginosa* in optional resistance data (n=966 isolates) was 25% to piperacillin–tazobactam (217/869), 32% to ceftazidime (308/941), 34% to fluoroquinolones (312/931), 14% to amikacin (125/884), 38% to at least one carbapenem (333/874, but no difference could be made between meropenem and imipenem/enzyme inhibitor), and 3.3% to colistin (13 of 396 tested isolates, reported from Spain, Croatia, Italy and Slovakia).

Table 60: Percentage combined piperacillin- and ceftazidime resistance in *P. aeruginosa*

	2004	2005	2006	2007
By country				
AT	22.4	28.1	15.9	16.7
BE	36.8	28.6	27.4	33.3
ES	27.1	27.0	30.4	31.4
FR	26.8	22.4	23.4	20.7
HR	—	—	—	12.5
IT	—	—	48.8	39.7
PT	52.4	26.3	16.7	20.0
SK	—	45.5	43.8	41.2
By infection type				
Bloodstream infections	30.7	22.6	28.6	26.8
Pneumonia	28.9	25.3	24.7	23.0
Urinary tract infections	21.0	21.4	22.0	24.5
Catheter-related infections	23.9	30.3	36.9	19.4
Other	23.5	30.5	27.6	30.1

8.3.8 *Acinetobacter* spp.

Combined piperacillin- and ceftazidime resistance in *Acinetobacter* spp. isolated in ICU-acquired infections (96% *Acinetobacter baumannii,* 2% *Acinetobacter calcoaceticus* and 2% others when the species was specified) was 73% in 2007 (n=208 isolates) with no marked increase from 2004 to 2007, but with marked differences between countries (17% in Belgium, 53% in Austria, 73% in France, and more than 80% in Spain, Croatia, Italy, Romania and Slovakia). Resistance of *Acinetobacter* spp. in optional resistance data (n=493 isolates) was 89% to ceftazidime (83/93), 86% to fluoroquinolones (79/92), 68% to amikacin (321/471), 73% (360/491) to at least one carbapenem and 3.6% to colistin. The latter two susceptibilities were much more frequently reported (since 2005) than the former two, in particular by Spain that has the highest weight in the database. Intercountry differences for these susceptibilities to amikacin and carbapenems are given in Table 61.

Table 61: Non-susceptibility to amikacin, carbapenems and colistin in *Acinetobacter* spp. by country, 2007

	Amikacin		Carbapenems		Colistin	
	N tested	% I/R	N tested	% I/R	N tested	% I/R
BE	7	0.0%	7	0.0%	1	0.0%
ES	378	69.0%	392	77.3%	342	2.3%
HR	30	70.0%	30	33.3%	18	27.8%
IT	38	84.2%	38	84.2%	13	0.0%
PT	10	20.0%	13	76.9%	3	0.0%
RO	2	100.0%	2	100.0%	0	—
SK	6	50.0%	9	33.3%	8	12.5%
Total	471	68.2%	491	73.3%	385	3.6%
Mean %	—	57.7%	—	59.8%	—	6.6%

I=intermediate, R=resistant.

8.3.9 *Stenotrophomonas maltophilia*

Of S. maltophilia isolates in 2007, 61% (86/142) were resistant to ceftazidime, 77% (101/131) to cefepime in, 81% (109/134) to amikacin , 53% to fluoroquinolones and 8% (12/149) to sulfamethoxazole . From 2005 to 2007, sulfamethoxazole resistance in *S. maltophilia* was 1.9% in Belgium, 4.4% in Spain, 8.3% in Portugal and 36.7% in Italy (2006 and 2007 only).

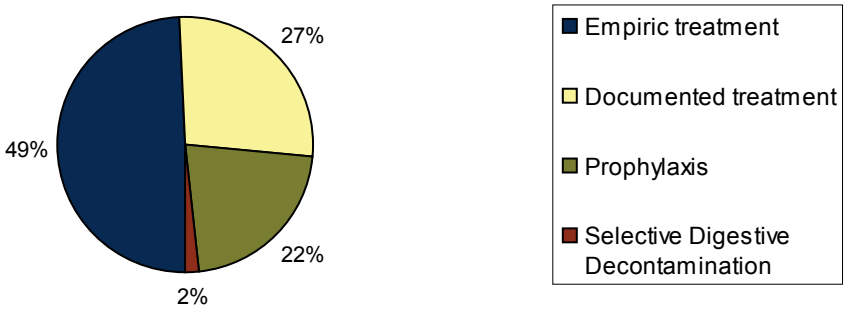
8.4 Antimicrobial use in intensive care units

In 2007, optional patient-based antimicrobial use data were provided by 205 ICUs from six countries. On average, 77.4% of the patients received at least one systemic antimicrobial (ATC2-codes J01 or J02[i]) in the ICU. The number of different antimicrobials varied from 1.9 to 2.5 per patient (Table 62). Since information on dosage is not collected in the protocol, antimicrobial consumption was expressed as the number of ICU days with at least one antimicrobial administered (two different antimicrobials on one day = 1 day) as well as the total number of antimicrobial days (two different antimicrobials on one day = 2 days) per 100 patient days in the ICU.

Table 62: Indicators of antimicrobial use in the ICU by country, 2007

	% documented treatment days/ total treatment days	% of patients receiving antimicrobial in the ICU	Mean number of antimicrobials/ patient	Number of antimicrobial days (any) /100 patient days	Number of antimicrobial days (all) /100 patient days
BE	37.9%	73.4%	1.9	61.3	83.5
ES	47.0%	56.7%	2.2	55.9	100.3
IT	38.7%	71.4%	2.1	64.7	216.7
LT	31.6%	83.1%	2.0	68.5	121.6
PT	22.4%	92.3%	2.5	79.4	139.5
SK	59.8%	87.3%	2.5	75.0	129.1
Overall	39.6%	77.4%	2.2	67.5	131.8

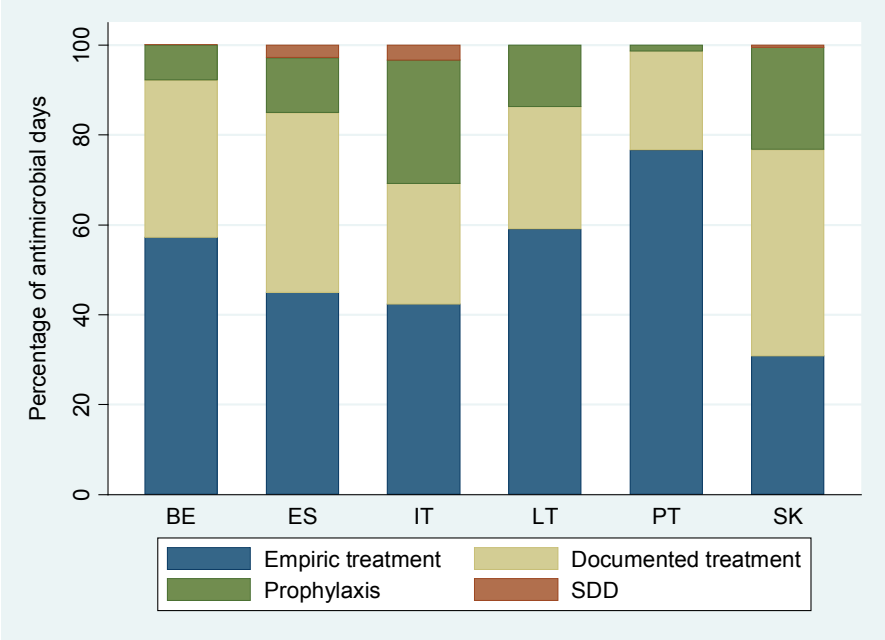
Figure 63: Indications for antimicrobial use in the ICU as a percentage of prescribed antimicrobial agents, all countries, 2007



Overall, 22% of the antimicrobials were administered as prophylaxis, 1.7% for selective digestive decontamination and 76.3% for antimicrobial treatment (Figure 63). Of the total number of antimicrobial days, these indications represented 14.9%, 2.5% and 82.6%, respectively (Figure 64). Of the antimicrobial treatment days, 39.6% were reported to be documented by microbiological results, with the highest percentage in Slovakia and the lowest in Portugal (Table 62). In countries providing more details on the type of documented antimicrobial treatment (all but Spain), 19.3% of the documented treatment days were based on Gram stain or culture results only and 80.7% on antibiogram results. Selective digestive decontamination was mainly used in Spain (2.9%) and Italy (3.3%), in 8% and 7% of the ICUs, respectively.

[i] ATC = Anatomical Therapeutical Chemical classification (http://www.whocc.no/atcddd/); ATC level 1 J = antiinfectives for systemic use; ATC level 2 = J01: antibacterials for systemic use; J02: antimycotics for systemic use.

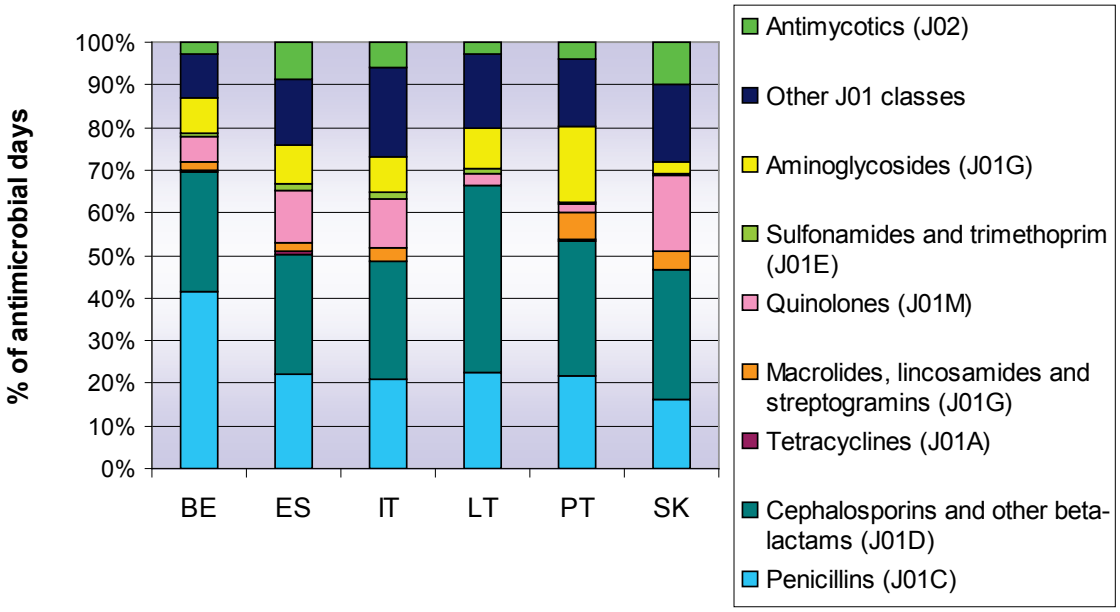
Figure 64: Indications for antimicrobial use in the ICU by country, 2007



Empiric treatment=antimicrobial treatment without microbiological results;
Documented treatment=antimicrobial treatment based on Gram stain results, culture results (microorganism) or microorganism with antibiogram;
Prophylaxis=surgical or medical prophylaxis;
SDD=Selective digestive decontamination.

The most frequently used antibiotic classes (ATC code level 3) were cephalosporins and other beta-lactams, followed by penicillins, quinolones and aminoglycosides (Figure 65). Other J01 classes, including glycopeptides and polymixins, represented 19.2% of the antimicrobial days and 13.9% of the antimicrobial agents. Antimycotics (not including D01B molecules griseofulvin and terbinafine) accounted for 6.9% of the total antimicrobial (J01+J02) days and 5.1% of the antimicrobial agents.

Figure 65: Relative frequency of antimicrobials for systemic use (ATC groups J01 and J02) used in intensive care units by country, 2007



At the ATC4 level, the most frequently used antimicrobials were combinations of penicillins with enzyme inhibitors, carbapenems, third-generation cephalosporins, fluoroquinoles, glycopeptides, aminoglycosides and triazole derivate antimycotics, with large variations between countries (Table 63). First-generation cephalosporins, which are known

to be mostly used for antibiotic prophylaxis in surgical patients (see also Figure 66), accounted for 2.9% of the total antimicrobial days (mean of country percentages 5.0%) (Table 63), but, given the short duration of prophylaxis, 6.6% of the microbial agents (mean of country percentages 8.5%, table not shown).

Table 63: Antimicrobials (J01 and J02 ATC level 4 except ATC3 for J01E) used in intensive care units in decreasing order of antimicrobial days of use, by country, 2007. Figures by ATC4 code represent percentages of total antimicrobial days.

	ATC4	BE	ES	IT	LT	PT	SK	Overall	Mean %*
Total N of antimicrobial-days**		8 863	136 344	48 322	16 679	10 760	1 979	222 947	
Combinations of penicillins, incl. beta-lactamase inhibitors	J01CR	32.4	19.7	18.7	2.5	20.0	7.7	18.6	16.8
Carbapenems	J01DH	10.6	13.6	10.7	11.2	14.1	3.8	12.6	10.6
Fluoroquinolones	J01MA	6.1	12.5	11.6	2.6	1.7	17.8	10.8	8.7
Third-generation cephalosporins	J01DD	8.2	9.4	12.6	6.8	9.6	18.5	9.9	10.9
Glycopeptides	J01XA	7.6	9.1	12.8	8.6	7.3	1.9	9.7	7.9
Aminoglycosides, excl. streptomycins	J01GB	8.3	9.0	8.3	9.6	17.9	2.9	9.2	9.3
Triazole derivates	J02AC	2.1	6.0	3.6	2.5	3.1	9.3	5.0	4.4
Other antibacterials***	J01XX	0.7	4.2	2.2	0.7	3.1	0.8	3.3	1.9
First-generation cephalosporins	J01DB	3.8	2.0	1.6	10.6	7.1	4.8	2.9	5.0
Second-generation cephalosporins	J01DC	2.2	1.2	2.3	14.3	1.3	2.3	2.5	3.9
Polymyxins	J01XB	0.5	2.1	2.4	0.0	1.2	7.6	2.0	2.3
Imidazole derivatives, antibacterials	J01XD	1.5	0.0	3.2	8.0	3.7	7.6	1.6	4.0
Sulfonamides and trimethoprim	J01E	0.7	1.7	1.4	1.0	0.4	0.4	1.5	0.9
Macrolides	J01FA	1.4	0.9	2.0	0.1	5.4	0.4	1.3	1.7
Other antimycotics for systemic use	J02AX	0.4	1.7	1.1	0.4	0.2	0.0	1.3	0.6
Beta-lactamase resistant penicillins	J01CF	1.1	1.2	0.4	3.3	0.7	1.1	1.2	1.3
Fourth-generation cephalosporins	J01DE	2.9	1.4	0.5	0.9	0.0	0.0	1.2	1.0
Penicillins with extended spectrum	J01CA	1.7	0.8	1.2	2.4	1.1	6.1	1.1	2.2
Beta-lactamase inhibitors	J01CG	6.2	0.0	0.6	7.7	0.0	1.0	1.0	2.6
Lincosamides	J01FF	0.7	1.0	0.8	0.0	1.3	4.2	0.9	1.3
Antimycotics, antibiotics	J02AA	0.1	0.9	1.2	0.0	0.5	0.0	0.8	0.5
Beta-lactamase sensitive penicillins	J01CE	0.1	0.2	0.1	6.8	0.0	0.0	0.7	1.2
Monobactams	J01DF	0.5	0.7	0.1	0.0	0.0	1.0	0.5	0.4
Tetracyclines	J01AA	0.2	0.5	0.0	0.0	0.2	0.0	0.3	0.2
Amphenicols	J01BA	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.1
Streptogramins	J01FG	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.0
Nitrofuran derivatives	J01XE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Imidazole derivatives, antimycotics	J02AB	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1
Combinations of antibacterials	J01RA	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1
Other quinolones	J01MB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

** Mean percentage: mean of country percentages (weighted mean), different from total 'database' percentage where countries contributing more data have higher weight;*
*** Excluding antimicrobial days for which ATC4 level was not reported (1.9% of total J01 and J02 antimicrobial days);*
**** Includes linezolid.*

Figure 66 shows the 32 most frequently used antimicrobials (ATC5 level) accounting for 95% of the antimicrobial days in the six countries reporting optional antimicrobial use data in the total database (with higher weight of countries with larger numbers of ICUs).

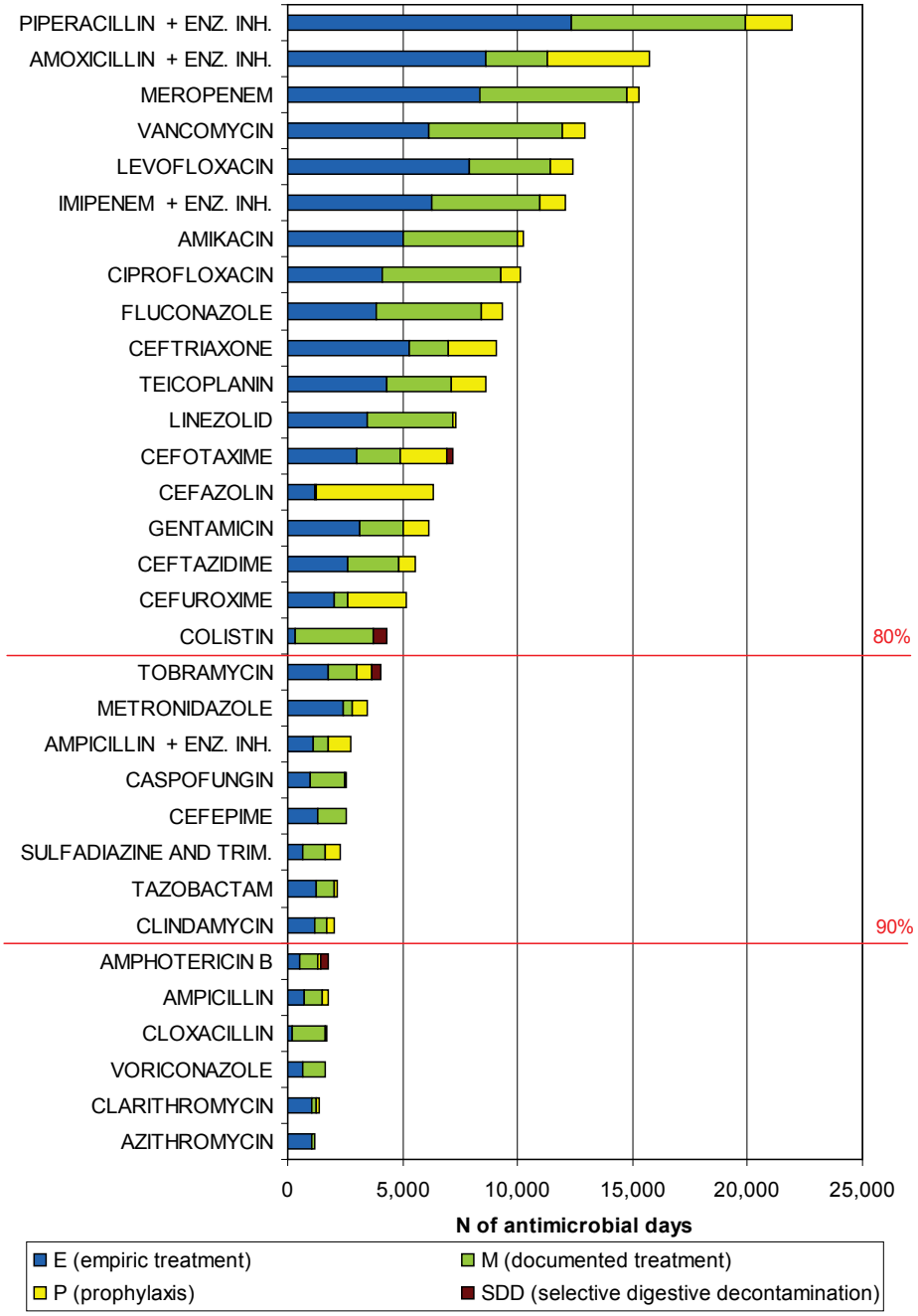
The antipseudomonal piperacillin–tazobactam combination was the most reported drug (9.8% of all antimicrobial days) with 35% of treatment days being based on microbiological results. Amoxicillin–clavulanate (7.1% of all antimicrobial days) was often used as prophylaxis (28%), but when it was used for treatment it was mostly for empiric treatment and only documented in 19% of total prescriptions, suggesting high levels of resistance of ICU pathogens to this treatment. Meropenem was the third most frequently used drug (6.9% overall), imipenem (+ enzyme inhibitor) ranked fifth (5.4%). Vancomycin, teicoplanin and linezolid were the main reported drugs used to treat MRSA infections in 2007, accounting for 13% of the antimicrobial days overall. Eighty percent of first-generation cephalosporin (mainly cefalotin) and 50% of second-generation cephalosporin (mainly cefuroxime)

antimicrobial days were administered for prophylaxis. Remarkably, colistin use accounted for as much as 1.9% of the total antimicrobial use, 88.2% of which for documented treatment, indicating documented carbapenem resistance in infections with gram-negatives.

There were large variations between countries with regard to the antimicrobial agents used (see Figure 70 in Annex 2g). When ranked according to the weighted mean of country percentages, the most frequently used antimicrobials were amoxicillin–clavulanate, followed by meropenem, vancomycin, piperacillin–tazobactam and ciprofloxacin. Colistin still accounted for 2.5% of all antimicrobial days after weighting.

As for all data in this report on ICU-acquired infections, one should consider the limited number of participating countries and ICUs when interpreting these data.

Figure 66: Most frequent antibacterial (J01) and antimycotic (J02) agents (ATC5 level) accounting for 95% of total use of antimicrobials, in antimicrobial days by indication, 2007



9 Conclusions part II

Twelve Member States and one candidate country provided data on the surveillance of ICU-acquired infections for the year 2007 (with follow-up until March 2008), with two countries providing pilot data only. The extension of the surveillance to other ICUs and countries remains a priority and ECDC will continue to support the setup of new surveillance networks through technical country visits, during which surveillance courses are provided to potential participants (including the use of the HELICSwin software tool) and tools for data analysis are provided to the network coordinators. Synergy with other EU-funded projects is also sought to support the extension through the use of EU surveillance data for other purposes such as analyses of attributable morbidity or mortality in ICU-acquired infections with resistant bacteria or the evaluation of prevention strategies.

Results in 2007 confirmed the high burden of ICU-acquired infections in participating countries and showed worrying trends in antimicrobial resistance in gram-negative bacteria; in particular for *Acinetobacter* spp. and *Pseudomonas aeruginosa*. The frequent use of 'last-ressort' antimicrobials such as colistin also confirmed the high incidence of life-threatening ICU-acquired infections with multiresistant bacteria.

The main reason for intensive care units to participate in national surveillance networks is to compare their own results with those of other participating ICUs as a tool for infection control, patient population follow-up and antibiotic stewardship. Since smaller countries may have insufficient reference data at the national level, reference tables of several indicators were elaborated using the European surveillance data. These indicators should, however, be risk-adjusted to allow meaningful comparisons. Results showed that the incidence of ICU-acquired infections depended strongly on the severity of the case-mix, justifying the combination of a simple unit-based surveillance protocol for follow-up of trends in incidence and antimicrobial resistance and an optional, more labour-intensive patient-based protocol for advanced risk adjustment for inter-ICU and intercountry comparisons of rates of ICU-acquired infections. In particular, the patient-based data showed that an important part of the variation of the device-adjusted pneumonia rate (the CDC/NHSN indicator) is explained by other (mostly intrinsic) risk factors collected at the patient level (see tables 31–33 and Figure 49). Other country-specific factors also influenced the comparibility of the results, such as the important proportion of paediatric patients in Lithuania (Table 19, Figure 67) and the selection of a small number of ICUs with severe case-mix and possibly more sensitive surveillance of ICU-acquired infections in Slovakia (Tables 20 and 34, Figure 52).

In order to enhance the interpretation of rates of ICU-acquired infections as well as the processes influencing them, a selection of unit-based indicators of infection control processes and antimicrobial use (formerly collected in IPSE work package 5 – Care-ICU) will also be integrated into the final protocol of the European surveillance of ICU-acquired infections. Also, variables with large proportions of missing values are likely to be removed from the future protocol in agreement with the Member States.

The data also still showed important differences in surveillance practices, in particular the diagnostic practices used for the diagnosis of pneumonia, the use of different case definitions and methods (CDC/NHSN instead of HELICS-ICU) by one country (Germany), different practices with regard to the reporting of early infections with onset on day 3 or shortly after versus more specific interpretation of the key term 'ICU-acquired' infection, different attitudes with regard to reporting possible contaminants in both pneumonia and bloodstream infections, etc. The theoretical importance of some of these remaining methodological differences is currently being addressed by a concordance study of case definitions and definitions of key terms funded by ECDC. However, intercountry methodological differences may persist despite a common methodology and further emphasis should be given to harmonisation of methods, for example through training in surveillance methods and through the elaboration of a European field validation protocol to assess the sensitivity and specificity of the different surveillance systems as compared to the case definitions of standardised HELICS protocols.

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Annex 1: Surveillance of surgical site infections

a) Data quality

The data quality check is based on 14 variables of the data table ssi_o (patient and surgical procedure characteristics) and four variables of the data table ssi_i (surgical site infection data) of the HELICS-SSI protocol[i].

The percentage of missing values partly depends on whether the considered variables were included in the countries' national surveillance protocol or not. In 2007 only three networks (ES, PT, UK-England) supplied data on all 18 variables.

In 2007 the EU mean percentage of missing values (18.8, range 4.8–36.5) was lower than in 2004–2006 (19.9, range 9.0–46.2), while the mean percentage with optional variables excluded was a little bit higher than in 2004–2006 (11.0, 2007, versus 10.7, 2004–2006; range 0–23.7, 2007, versus 0.2–26.4, 2004–2006).

Table 64: Percentage of missing values by country for 18 variables included in the HELICS-SSI protocol (patient and surgical procedure characteristics, and surgical site infection data), 2007

Country	Number of operations	Total % missing[1]	% missing optional variables excluded[2]
AT	7 215	13.8	3.4
DE	68 858	36.5	23.7
ES	4 772	4.8	2.1
FI	9 575	33.0	12.1
FR	55 885	23.1	12.2
HU	4 105	20.9	0
IT	4 933	25.2	17.6
LT	1 914	8.3	1.7
NL	7 453	21.1	19.6
NO	4 070	16.1	11.4
PT	2 489	9.2	8.7
UK	89 145	9.2	7.4
EU mean	17 361	18.8	11.0

[1] *Sum of missing values*100/((14*n of surgical procedures)+(4*n of SSI))*
[2] *Sum of non-optional missing values*100/((10*n of surgical procedures)+(4*n of SSI))*

Table 65 shows in detail the percentage of missing values for each considered variable.

Components of the NHSN risk index were not always available, although they are mandatory in the HELICS-SSI protocol[i]. However, rather than excluding the records completely from the database, adding a category 'missing NHSN risk index' for the stratification of the SSI rates allowed stratified analysis of SSI incidence. In 2007, the overall proportion of surgical procedures where the NHSN risk index could be calculated was 92.9% (range 84.2–100) compared to 93.0 (range 74.2–100) in 2004–2006.

[i] Hospital in Europe Link for Infection Control through Surveillance. Surveillance of Surgical Site Infections. Protocol Version 9.1. September 2004. Available from: http://www.ecdc.europa.eu/IPSE/helicshome.htm.

Table 65: Percentage of missing values by variable and by country (patient and surgical procedure characteristics, and surgical site infection data), 2007

A[1]	Variable label	AT	DE	ES	FI	FR	HU	IT	LT	NL	NO	PT	UK	EU
Surgical procedure data[2]														
M	Date of operation	0	0	0	0	0	0	0	0	0	0	0	0	0
M	NHSN operation code	0	0	0	0	0	0	0	0	0	0	0	0	0
M	Wound contamination class	1.2	0	0	0,7	1.3	0	8.8	1.0	0.5	3.9	1.4	1.9	1.3
M	Duration of operation	0.2	0	0	0	1.5	0	5.3	0	0.1	0.3	0	4.5	2.2
M	ASA physical status classification	1.7	0	5.4	1.1	2.4	0	8.7	14.9	5.5	0	1.3	11.7	5.2
	NHSN risk index[3]	*2.2*	*0*	*5.7*	*1.7*	*4.1*	*0*	*14.3*	*15.8*	*6.1*	*4.6*	*10.4*	*15.3*	*7.1*
R	Age (years)	0	0	0	0	11.3	0	24.3	0.4	0	0	1.1	0.7	3.1
R	Gender	0.1	0	0	0	0	0	0.1	0	0	0	0	0.8	0.3
R	Discharge date or date of last follow-up in the hospital	2.5	37.9	4.9	59.8	0.8	0	6.6	0	0	0	0	1.7	13.3
R	Discharge status	3.2	NR[4]	5.1	55.5	NR	0	74.9	0	NR	99.4	46.7	18.9	62.9
R	Urgent/elective operation	7.1	NR	2.0	0	0.4	0	5.2	0	1.4	0	0	14.2	31.7
R	Endoscopic procedure	15.2	0	1.8	0	1.2	0	38.0	0	5.9	0	26.7	21.6	9.2
O	Date of hospital admission	0	NR	0.1	NR	0.7	0	NR	0	0	0	0	5.4	34.0
O	Date of last follow-up post-discharge	NR	NR	38.5	NR	2.0	95.4	28.9	NR	0	0	41.2	74.1	62.6
O	ICD-9-CM operation code	37.1	75.0	8.3	43.5	NR	NR	0	0	NR	NR	0	25.4	58.8
O	Perioperative prophylactic antibiotics	23.8	NR	0.5	NR	NR	NR	48.3	0	0	0	0.5	15.6	60.3
Infection data[5]														
M	Date of infection	0	0	0	0	0	0	0	0	0	0	0	0	0
R	Type of SSI	0.8	0	0	0	2.0	0	8.5	0	0	0	2.6	2.4	1.4
O	Information on microbiological exam	66.9	29.0	18.8	NR	NR	52.5	NR	0	36.2	NR	73.1	69.9	62.4
R	Resistance microorganism[6]	54.5	3.8	1.0	100	100	9.2	100	8.5	24.8	100	9.0	74.3	48.8

[1] A field attribute: M=mandatory, if missing, record will be rejected in routine data collection/analysis; R=required, used for routine analysis, record not rejected if missing; O=optional.
[2] Percentage of surgical procedures.
[3] Missing variables of NHSN risk index.
[4] Not reported.
[5] Percentage of infections.
[6] MRSA only – Considered as 100% missing if no microorganism data.

b) Surgical procedure category profiles

CORONARY ARTERY BYPASS GRAFTING

Characteristics of patients and surgical procedures, 2007

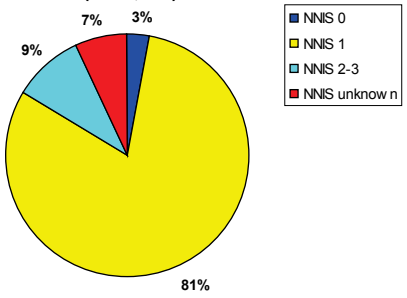
		% of missing value
Total number of operations	14 569	
% of operation surveyed in Germany	52.0	0
Sex ratio (M:F)	3.6	0.2
Median age	68 years	0.7
% of dead at discharge	1.0	63.1
% of contaminated or dirty operations	0.2	0.7
% of ASA > 2	90.5	5.9
Median duration of operation	195 minutes	1.2
Median LOS[1]	9 days	18.6
% of urgent operations	4.8	52.8
% of antibiotic prophylaxis	37.3	62.3

[1] *Length of postoperative stay in hospital.*

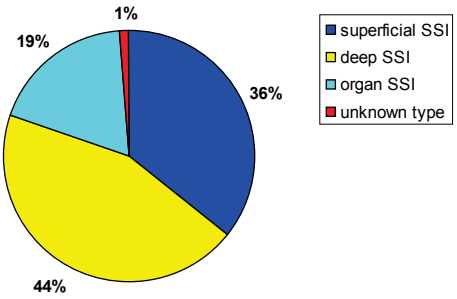
Characteristics of the surgical site infections (SSIs), 2007

		% of missing value
Total number of SSIs	456	
% of SSIs occurred within 30 days after operation	90.4	0
% of SSIs detected after discharge	29.2	22.8 (discharge date)
% of superficial SSIs	36.0	1.1
% of SSIs with information on microbiological exam	76.3	23.7

Operations by NNIS risk index, 2007 (n=14,537)

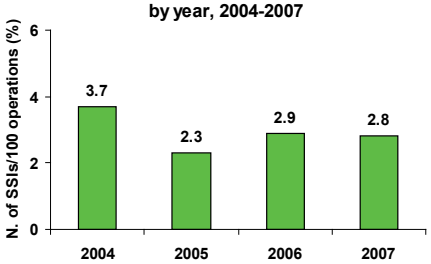


Type of surgical site infections, 2007 (n=456)



Hospitals with ≥ 20 operations in each NHSN category.

Cumulative incidence of SSIs within 30 days by year, 2004-2007



Incidence density of SSIs by year, 2004-2007

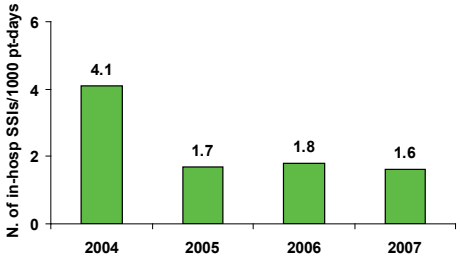


Table 66: Coronary artery bypass grafting – Cumulative incidence within 30 days by country, 2007

Country	Number of hospitals	Number of operations	Number of SSIs	Cumulative incidence of SSIs		Cumulative incidence of deep and organ/space SSIs	
				SSI%	95% confidence interval (CI)	SSI%	95% CI
AT	1	296	11	3.72	1.86–6.65	2.03	0.74–4.41
DE	15	7 569	219	2.89	2.52–3.30	2.15	1.84–2.51
ES	8	571	39	6.83	4.86–9.34	5.25	3.54–7.50
FR	13	744	18	2.42	1.43–3.82	0.54	0.15–1.38
IT	7	381	19	4.99	3.00–7.79	0.26	0.01–1.46
LT	1	517	18	3.48	2.06–5.50	3.48	2.06–5.50
NO	5	681	23	3.38	2.14–5.07	0.88	0.32–1.92
UK	10	3 810	65	1.71	1.32–2.17	0.79	0.53–1.12

Table 67: Coronary artery bypass grafting – Cumulative incidence within 30 days by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of SSIs	SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	54	14 537	412	2.8 (2.6–3.1)	0.5	1.5	3.4	4.8	8.1
Risk index 0	38	447	13	2.9 (1.5–5.0)	0.0	0.0	0.0	0.0	5.9
Risk index 1	52	11 718	318	2.7 (2.4–3.0)	0.0	0.7	2.7	5.1	9.5
Risk index 2–3	46	1 379	48	3.5 (2.6–4.6)	0.0	0.0	0.0	5.3	9.1
Risk index unknown	20	993	33	3.3 (2.3–4.7)	0.0	0.0	1.3	4.2	8.3

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 68: Coronary artery bypass grafting – Cumulative incidence, post-discharge SSIs excluded, by country, 2007

Country	Number of hospitals	Number of operations**	Number of in-hospital SSIs	Cumulative incidence of in-hospital SSIs		Cumulative incidence of deep and organ/space in-hospital SSIs	
				In-hospital SSI%	95% CI	In-hospital SSI%	95% CI
AT	1	296	5	1.69	0.55–3.94	0.68	0.08–2.44
DE	15	4 869	71	1.46	1.14–1.84	0.75	0.89–1.52
ES	8	567	30	5.29	3.57–7.55	4.55	3.00–6.72
FR	13	744	15	2.02	1.13–3.33	0.67	0.22–1.57
IT	7	378	13	3.44	1.83–5.88	0.26	0.01–1.47
LT	1	517	16	3.09	1.77–5.03	3.09	1.77–5.03
NO	5	681	2	0.29	0.04–1.06	0.15	0.00–0.82
UK	10	3 810	67	1.76	1.36–2.23	0.79	0.53–1.12

*** Only operations with discharge date detected.*

Table 69: Coronary artery bypass grafting – Cumulative incidence, post-discharge SSIs excluded, by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of in-hospital SSIs	In-hospital SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	48	11 829	218	1.8 (1.6–2.1)	0.0	0.6	1.7	3.6	7.5
Risk index 0	32	356	4	1.1 (0.3–2.9)	0.0	0.0	0.0	0.0	1.1
Risk index 1	46	9 373	152	1.6 (1.4–1.9)	0.0	0.0	1.5	3.8	6.0
Risk index 2–3	40	1 108	36	3.2 (2.3–4.5)	0.0	0.0	0.0	4.9	10.8
Risk index unknown	20	992	26	2.6 (1.7–3.8)	0.0	0.0	0.0	3.0	6.3

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 70: Coronary artery bypass grafting – Incidence density by country 2007

Country	Number of hospitals	Number of patient days (pt days)	Number of in-hospital SSIs	Incidence density of SSIs		Incidence density of deep and organ/space SSIs	
				In-hospital SSIs/ 1 000 pt days	95% CI	In-hospital SSIs/ 1 000 pt days	95% CI
AT	1	4 204	5	1.19	0.39–2.78	0.48	0.01–0.17
DE	15	59 056	71	1.2	0.94–1.52	0.97	0.07–0.13
ES	8	7 821	30	3.84	2.59–5.48	3.32	0.22–0.49
FR	13	8 843	15	1.7	0.95–2.80	0.57	0.02–0.13
IT	7	4 888	13	2.66	1.42–4.55	0.2	0.00–0.11
LT	1	8 080	16	1.98	1.13–3.22	1.98	0.11–0.32
NO	5	4 923	2	0.41	0.05–1.47	0.2	0.00–0.11
UK	10	40 102	67	1.67	1.29–2.12	0.75	0.05–0.11

Table 71: Coronary artery bypass grafting – Incidence density by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of pt days	Number of in-hospital SSIs	In-hospital SSIs/1 000 pt days (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	48	137 524	218	1.59 (1.38–1.81)	0.0	0.7	1.6	3.1	4.4
Risk index 0	32	4 199	4	0.95 (0.26–2.44)	0.0	0.0	0.0	0.0	1.1
Risk index 1	46	106 618	152	1.43 (1.21–1.67)	0.0	0.0	1.3	3.3	5.0
Risk index 2–3	40	15 263	36	2.36 (1.65–3.27)	0.0	0.0	0.0	4.2	7.4
Risk index unknown	20	11 444	26	2.27 (1.48–3.33)	0.0	0.0	0.0	2.9	5.2

** Only hospitals with ≥ 20 operations in each NHSN category included.*

CHOLECYSTECTOMY

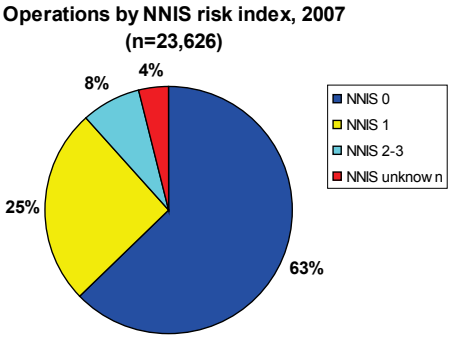
Characteristics of patients and surgical procedures, 2007

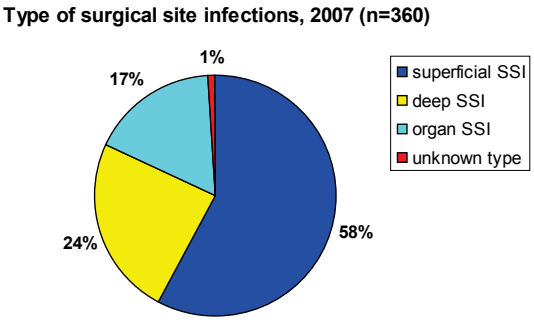
		% of missing value
Total number of operations	25 176	
% of operations surveyed in France	39.8	0
Sex ratio (M:F)	0.5	0
Median age	57 years	7.1
% of dead at discharge	0	83.9
% of contaminated or dirty operations	15.7	1.3
% of ASA > 2	18.1	2.3
Median duration of operation	60 minutes	0.7
Median LOS[1]	4 days	12.6
% of urgent operations	7.9	35.9
% of endoscope use	80.1	4.3
% of antibiotic prophylaxis	8.7	84.5

[1] *Length of postoperative stay in hospital.*

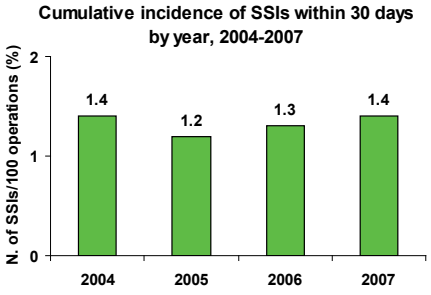
Characteristics of the surgical site infections, 2007

		% of missing value
Total number of SSIs	360	
% of SSIs occurred within 30 days after operation	97.5	0
% of SSIs detected after discharge	35.8	6.9 (discharge date)
% of superficial SSIs	57.8	0.8
% of SSIs with information on microbiological exam	35.0	65.0





Hospitals with ≥ 20 operations in each NHSN category.



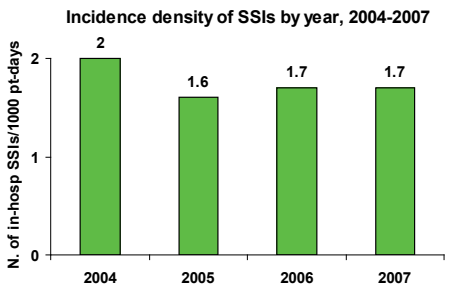


Table 72: Cholecystectomy – Cumulative incidence within 30 days by country, 2007

Country	Number of hospitals	Number of operations	Number of SSIs	Cumulative incidence of SSIs		Cumulative incidence of deep and organ/space SSIs	
				SSI%	95% confidence interval (CI)	SSI%	95% CI
AT	5	152	1	0.66	0.02–3.67	0	0.00–2.43
DE	59	8 961	113	1.26	1.04–1.52	0.38	0.26–0.53
ES	12	963	34	3.53	2.45–4.93	2.39	1.51–3.58
FR	296	10 020	80	0.8	0.63–0.99	0.39	0.28–0.53
HU	9	1 509	42	2.78	2.01–3.76	1.19	0.71–1.89
IT	21	955	18	1.88	1.12–2.98	0.52	0.17–1.22
LT	4	816	4	0.49	0.13–1.26	0.49	0.13–1.26
NL	3	420	12	2.86	1.48–4.99	1.67	0.67–3.43
NO	12	343	26	7.58	4.95–11.11	2.04	0.82–4.20
PT	10	1 037	21	2.03	1.25–3.10	0.87	0.40–1.65

Table 73: Cholecystectomy – Cumulative incidence within 30 days by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of SSIs	SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	257	23 626	331	1.4 (1.3–1.6)	0.0	0.0	0.0	2.1	4.4
Risk index 0	252	14 838	119	0.8 (0.7–1.0)	0.0	0.0	0.0	0.6	2.9
Risk index 1	251	6 013	115	1.9 (1.6–2.3)	0.0	0.0	0.0	0.0	8.7
Risk index 2–3	198	1 865	89	4.8 (3.8–5.9)	0.0	0.0	0.0	2.6	20.0
Risk index unknown	65	910	8	0.9 (0.4–1.7)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 74: Cholecystectomy – Cumulative incidence, post-discharge SSIs excluded, by country, 2007

Country	Number of hospitals	Number of operations **	Number of in-hospital SSIs	Cumulative incidence of in-hospital SSIs		Cumulative incidence of deep and organ/space in-hospital SSIs	
				In-hospital SSI%	95% CI	In-hospital SSI%	95% CI
AT	5	152	1	0.66	0.02–3.67	0.00	0.00–2.43
DE	59	5 987	62	1.04	0.79–1.33	0.20	0.18–0.48
ES	12	882	30	3.40	2.29–4.86	2.28	1.56–3.78
FR	296	9 921	49	0.49	0.37–0.65	0.27	0.18–0.40
HU	9	1 509	30	1.99	1.34–2.84	0.86	0.46–1.47
IT	21	947	9	0.95	0.43–1.80	0.42	0.12–1.08
LT	4	816	3	0.37	0.08–1.07	0.37	0.08–1.07
NL	3	420	2	0.48	0.06–1.72	0.48	0.06–1.72
NO	12	343	7	2.04	0.82–4.20	1.17	0.32–2.99
PT	10	1 037	13	1.25	0.67–2.14	0.77	0.33–1.52

*** Only operations with discharge date detected.*

Table 75: Cholecystectomy – Cumulative incidence, post-discharge SSIs excluded, by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of in-hospital SSIs	In-hospital SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	243	20 464	193	0.9 (0.8–1.1)	0.0	0.0	0.0	1.0	3.4
Risk index 0	238	12 925	44	0.3 (0.2–0.5)	0.0	0.0	0.0	0.0	0.9
Risk index 1	237	5 141	76	1.5 (1.2–1.9)	0.0	0.0	0.0	0.0	6.7
Risk index 2–3	185	1 490	68	4.6 (3.5–5.8)	0.0	0.0	0.0	0.0	15.4
Risk index unknown	65	908	5	0.6 (0.2–1.3)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 76: Cholecystectomy – Incidence density by country, 2007

Country	Number of hospitals	Number of patient days (pt days)	Number of in-hospital SSIs	Incidence density of SSIs		Incidence density of deep and organ/space SSIs	
				In-hospital SSIs/ 1 000 pt days	95% CI	In-hospital SSIs/ 1 000 pt days	95% CI
AT	5	978	1	1.02	0.03–5.70	0.00	0.00–0.38
DE	59	36 975	62	1.68	1.29–2.15	0.49	0.03–0.08
ES	12	4 643	30	6.46	4.36–9.22	4.74	0.30–0.72
FR	296	51 280	49	0.96	0.71–1.26	0.53	0.03–0.08
HU	9	7 459	30	4.02	2.71–5.74	1.74	0.09–0.30
IT	21	5 537	9	1.63	0.74–3.09	0.72	0.02–0.18
LT	4	4 303	3	0.7	0.14–2.04	0.7	0.01–0.20
NL	3	1 349	2	1.48	0.18–5.36	1.48	0.02–0.54
NO	12	941	7	7.44	2.99–15.33	4.25	0.12–1.09
PT	10	4 303	13	3.02	1.61–5.17	1.86	0.08–0.37

Table 77: Cholecystectomy – Incidence density by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of pt days	Number of in-hospital SSIs	In-hospital SSIs/1,000 pt days (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	243	109 019	193	1.77 (1.53–2.04)	0.0	0.0	0.0	2.1	5.9
Risk index 0	238	55 392	44	0.79 (0.58–1.07)	0.0	0.0	0.0	0.0	2.2
Risk index 1	237	33 949	76	2.24 (1.76–2.80)	0.0	0.0	0.0	0.0	9.3
Risk index 2–3	185	14 729	68	4.62 (3.59–5.85)	0.0	0.0	0.0	0.0	14.3
Risk index unknown	65	4 949	5	1.01 (0.33–2.36)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

COLON SURGERY

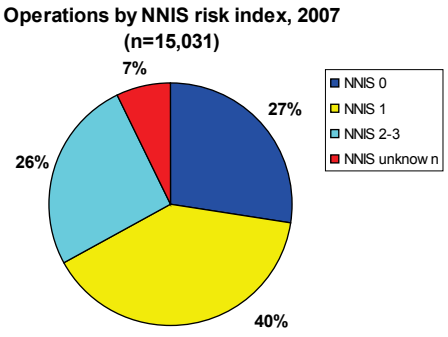
Characteristics of patients and surgical procedures, 2007

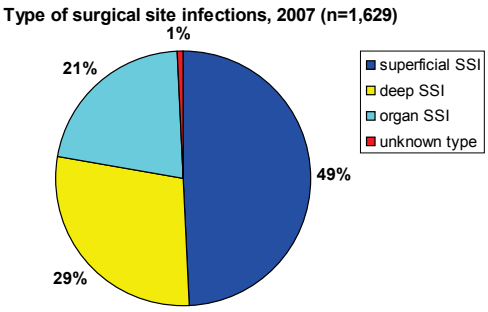
		% of missing value
Total number of operations	16 655	
% of operations surveyed in France	35.0	0
Sex ratio (M:F)	1.0	0.1
Median age	69 years	6.5
% of dead at discharge	1.0	76.1
% of contaminated or dirty operations	35.7	3.2
% of ASA > 2	37.7	4.6
Median duration of operation	135 minutes	1.5
Median LOS[1]	11 days	11.8
% of urgent operations	9.6	33.1
% of endoscope use	18.7	3.2
% of antibiotic prophylaxis	24.2	72.2

[1] *Length of postoperative stay in hospital.*

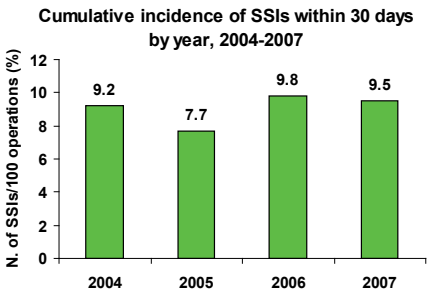
Characteristics of the surgical site infections , 2007

		% of missing value
Total number of SSIs	1 629	
% of SSIs occurred within 30 days after operation	97.5	0
% of SSIs detected after discharge	11.9	8.4 (discharge date)
% of superficial SSIs	49.2	0.9
% of SSIs with information on microbiological exam	43.4	56.6





Hospitals with ≥ 20 operations in each NHSN category.



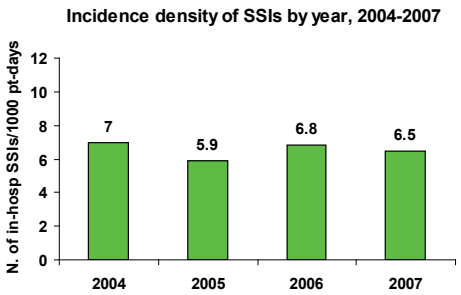


Table 78: Colon surgery – Cumulative incidence within 30 days by country, 2007

Country	Number of hospitals	Number of operations	Number of SSIs	Cumulative incidence of SSIs		Cumulative incidence of deep and organ/space SSIs	
				SSI%	95% confidence interval (CI)	SSI%	95% CI
AT	4	170	15	8.82	4.94–14.55	3.53	1.30–7.68
DE	57	5 333	439	8.23	7.48–9.04	4.16	3.63–4.75
ES	14	851	167	19.62	16.76–22.84	13.28	10.94–15.96
FR	257	5 832	531	9.1	8.35–9.91	4.32	3.80–4.89
HU	3	185	18	9.73	5.77–15.38	3.24	1.19–7.06
IT	23	654	59	9.02	6.87–11.64	3.21	1.99–4.91
LT	3	194	18	9.28	5.50–14.66	7.22	3.95–12.11
NL	11	836	119	14.23	11.79–17.03	6.58	4.96–8.56
PT	10	438	48	10.96	8.08–14.53	4.34	2.61–6.77
UK	18	2 162	174	8.05	6.90–9.34	3.61	2.85–4.50

Table 79: Colon surgery – Cumulative incidence within 30 days by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of SSIs	SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	188	15 031	1 449	9.6 (9.2–10.1)	1.1	3.6	8.4	14.0	20.7
Risk index 0	173	4 113	260	6.3 (5.6–7.1)	0.0	0.0	1.7	9.1	16.7
Risk index 1	186	5 932	579	9.8 (9.0–10.6)	0.0	3.0	8.6	16.7	25.0
Risk index 2–3	184	3 883	533	13.7 (12.6–14.9)	0.0	0.0	10.0	20.4	33.3
Risk index unknown	63	1 103	77	7.0 (5.5–8.7)	0.0	0.0	0.0	20.0	36.4

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 80: Colon surgery – Cumulative incidence, post-discharge SSIs excluded, by country, 2007

Country	Number of hospitals	Number of operations**	Number of in-hospital SSIs	Cumulative incidence of in-hospital SSIs		Cumulative incidence of deep and organ/space in-hospital SSIs	
				In-hospital SSI%	95% CI	In-hospital SSI%	95% CI
AT	4	170	14	8.24	4.50–13.82	3.53	1.30–7.68
DE	57	3 553	312	8.78	7.83–9.81	3.09	3.96–5.41
ES	14	825	152	18.42	15.61–21.60	12.10	10.19–15.14
FR	257	5 761	441	7.65	6.96–8.40	3.82	3.38–4.41
HU	3	185	18	9.73	5.77–15.38	3.24	1.19–7.06
IT	23	566	42	7.42	5.35–10.03	2.29	1.48–4.37
LT	3	194	18	9.28	5.50–14.66	7.22	3.95–12.11
NL	11	836	80	9.57	7.59–11.91	4.67	3.32–6.38
PT	10	438	47	10.73	7.88–14.27	4.11	2.44–6.49
UK	18	2 162	175	8.09	6.94–9.39	3.65	2.89–4.55

*** Only operations with discharge date detected.*

Table 81: Colon surgery – Cumulative incidence, post-discharge SSIs excluded, by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of in-hospital SSIs	In-hospital SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	172	13 112	1 195	9.1 (8.6–9.6)	0.0	3.2	7.9	13.7	18.4
Risk index 0	158	3 785	207	5.5 (4.7–6.3)	0.0	0.0	0.0	8.3	14.3
Risk index 1	170	5 058	473	9.4 (8.5–10.2)	0.0	0.0	7.7	15.0	24.0
Risk index 2–3	168	3 219	441	13.7 (12.5–15.0)	0.0	0.0	10.0	20.9	33.3
Risk index unknown	62	1 050	74	7.0 (5.5–8.8)	0.0	0.0	1.0	15.3	40.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 82: Colon surgery – Incidence density by country, 2007

Country	Number of hospitals	Number of patient days (pt days)	Number of in-hospital SSIs	Incidence density of SSIs		Incidence density of deep and organ/space SSIs	
				In-hospital SSIs/ 1 000 pt days	95% CI	In-hospital SSIs/ 1 000 pt days	95% CI
AT	4	2 443	14	5.73	3.13–9.62	2.46	0.09–0.53
DE	57	54 446	312	5.73	5.11–6.40	3.03	0.26–0.35
ES	14	12 544	152	12.12	10.27–14.20	8.21	0.67–1.00
FR	257	76 410	441	5.77	5.25–6.34	2.92	0.25–0.33
HU	3	2 471	18	7.28	4.32–11.51	2.43	0.09–0.53
IT	23	7 166	42	5.86	4.22–7.92	2.09	0.12–0.35
LT	3	2 745	18	6.56	3.89–10.36	5.1	0.28–0.86
NL	11	11 399	80	7.02	5.56–8.73	3.42	0.24–0.47
PT	10	5 209	47	9.02	6.63–12.00	3.46	0.20–0.55
UK	18	26 467	175	6.61	5.67–7.67	2.98	0.24–0.37

Table 83: Colon surgery – Incidence density by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of pt days	Number of in-hospital SSIs	In-hospital SSIs/1 000 pt days (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	172	180 997	1 195	6.60 (6.23–6.99)	0.0	2.9	5.6	10.0	12.8
Risk index 0	158	42 581	207	4.86 (4.22–5.57)	0.0	0.0	0.0	6.8	12.6
Risk index 1	170	68 776	473	6.88 (6.27–7.53)	0.0	0.0	5.5	11.4	17.9
Risk index 2–3	168	55 295	441	7.98 (7.25–8.76)	0.0	0.0	6.2	12.3	19.2
Risk index unknown	62	14 345	74	5.16 (4.05–6.48)	0.0	0.0	0.7	12.5	25.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

CAESAREAN SECTION

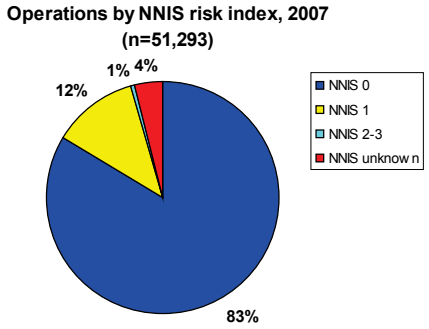
Characteristics of patients and surgical procedures, 2007

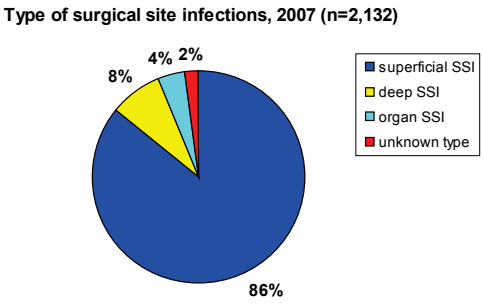
		% of missing value
Total number of operations	51 816	
% of operations surveyed in France	34.3	0
Sex ratio (M:F)	—	—
Median age	31 years	3.7
% of dead at discharge	0	86.9
% of contaminated or dirty operations	3.7	1.0
% of ASA > 2	1.9	1.8
Median duration of operation	37 minutes	1.6
Median LOS[1]	6 days	11.1
% of urgent operations	30.3	47.3
% of antibiotic prophylaxis	31.3	64.3

[1] *Length of postoperative stay in hospital.*

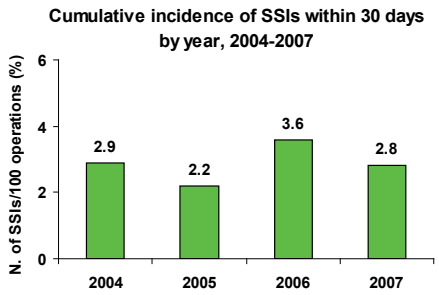
Characteristics of the surgical site infections, 2007

		% of missing value
Total number of SSIs	1 481	
% of SSIs occurred within 30 days after operation	99.0	0
% of SSIs detected after discharge	65.4	16.1 (discharge date)
% of superficial SSIs	85.8	1.9
% of SSIs with information on microbiological exam	6.3	93.7





Hospitals with ≥ 20 operations in each NHSN category



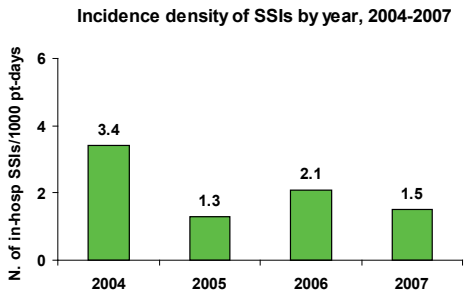


Table 84: Caesarean section – Cumulative incidence within 30 days by country, 2007

Country	Number of hospitals	Number of operations	Number of SSIs	Cumulative incidence of SSIs		Cumulative incidence of deep and organ/space SSIs	
				SSI%	95% confidence interval (CI)	SSI%	95% CI
AT	12	2 200	27	1.23	0.81–1.79	0.27	0.10–0.59
DE	45	11 997	90	0.75	0.60–0.92	0.21	0.13–0.31
ES	7	719	24	3.34	2.14–4.97	0.97	0.39–2.01
FR	194	17 791	330	1.85	1.66–2.07	0.35	0.27–0.45
HU	5	1 664	38	2.28	1.62–3.13	0.9	0.50–1.49
IT	13	1 461	24	1.64	1.05–2.44	0.21	0.04–0.60
NL	9	1 282	23	1.79	1.14–2.69	0.62	0.27–1.23
NO	35	1 672	123	7.36	6.11–8.78	1.56	1.02–2.28
PT	2	789	4	0.51	0.14–1.30	0.25	0.03–0.92
UK	33	12 241	782	6.39	5.95–6.85	0.20	0.13–0.30

Table 85: Caesarean section – Cumulative incidence within 30 days by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of SSIs	SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	297	51 293	1445	2.8 (2.7–3.0)	2.6	0.0	0.0	1.2	3.2
Risk index 0	295	42 900	1105	2.6 (2.4–2.7)	0.0	0.0	1.2	3.0	6.7
Risk index 1	284	6 181	190	3.1 (2.7–3.5)	0.0	0.0	0.0	2.1	12.5
Risk index 2–3	83	275	7	2.5 (1.0–5.2)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	118	1 937	143	7.4 (6.2–8.7)	0.0	0.0	0.0	0.0	10.5

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 86: Caesarean section – Cumulative incidence, post-discharge SSIs excluded, by country, 2007

Country	Number of hospitals	Number of operations**	Number of in-hospital SSIs	Cumulative incidence of in-hospital SSIs		Cumulative incidence of deep and organ/space in-hospital SSIs	
				In-hospital SSI%	95% CI	In-hospital SSI%	95% CI
AT	12	2 069	15	0.72	0.41–1.20	0.27	0.11–0.63
DE	45	8 062	42	0.52	0.38–0.70	0.08	0.06–0.23
ES	7	714	5	0.70	0.23–1.63	0.14	0.00–0.78
FR	194	17 585	119	0.68	0.56–0.81	0.15	0.10–0.22
HU	5	1 664	31	1.86	1.27–2.64	0.90	0.50–1.49
IT	13	1 339	5	0.37	0.12–0.87	0.00	0.00–0.28
NL	9	1 282	6	0.47	0.17–1.02	0.16	0.02–0.56
NO	35	1 672	28	1.67	1.11–2.42	0.60	0.29–1.10
PT	2	789	3	0.38	0.08–1.11	0.25	0.03–0.92
UK	33	10 911	176	1.61	1.38–1.87	0.20	0.15–0.34

*** Only operations with discharge date detected.*

Table 87: Caesarean section – Cumulative incidence, post-discharge SSIs excluded, by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of in-hospital SSIs	In-hospital SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	281	45 564	424	0.9 (0.8–1.0)	0.0	0.0	0.3	1.1	2.4
Risk index 0	279	38 605	342	0.9 (0.8–1.0)	0.0	0.0	0.0	1.2	2.6
Risk index 1	268	5 151	62	1.2 (0.9–1.5)	0.0	0.0	0.0	0.0	2.4
Risk index 2–3	73	210	5	2.4 (0.8–5.6)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	116	1 598	15	0.9 (0.5–1.5)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 88: Caesarean section – Incidence density by country, 2007

Country	Number of hospitals	Number of patient days (pt days)	Number of in-hospital SSIs	Incidence density of SSIs		Incidence density of deep and organ/space SSIs	
				In-hospital SSIs/1 000 pt days	95% CI	In-hospital SSIs/1 000 pt days	95% CI
AT	12	15 646	15	0.96	0.54–1.58	0.38	0.01–0.08
DE	45	54 073	42	0.78	0.56–1.05	0.18	0.01–0.03
ES	7	3 773	5	1.33	0.43–3.09	0.27	0.00–0.15
FR	194	125 430	119	0.95	0.79–1.14	0.22	0.01–0.03
HU	5	10 822	31	2.86	1.95–4.07	1.39	0.08–0.23
IT	13	7 021	5	0.71	0.23–1.66	0	0.00–0.05
NL	9	6 474	6	0.93	0.34–2.02	0.31	0.00–0.11
NO	35	9 611	28	2.91	1.94–4.21	1.04	0.05–0.19
PT	2	3 687	3	0.81	0.17–2.38	0.54	0.01–0.20
UK	33	49 603	176	3.55	3.04–4.11	0.5	(0.03–0.07)

Table 89: Caesarean section – Incidence density by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of pt days	Number of in-hospital SSIs	In-hospital SSIs/1 000 pt days (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	281	282 534	424	1.50 (1.36–1.65)	0.0	0.0	0.4	1.9	3.8
Risk index 0	279	237 893	342	1.44 (1.29–1.60)	0.0	0.0	0.0	1.8	3.9
Risk index 1	268	32 987	62	1.88 (1.44–2.41)	0.0	0.0	0.0	0.0	4.7
Risk index 2–3	73	1 537	5	3.25 (1.06–7.59)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	116	10 117	15	1.48 (0.83–2.45)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

HIP PROSTHESIS

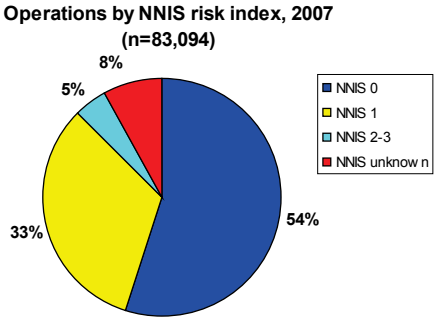
Characteristics of patients and surgical procedures, 2007

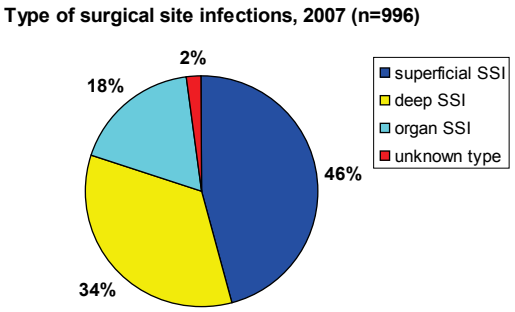
		% of missing value
Total number of operations	84 286	
% of operations surveyed in the United Kingdom	40.6	0
Sex ratio (M:F)	0.6	0.4
Median age	71 years	3.1
% of dead at discharge	0.6	52.8
% of contaminated or dirty operations	0.4	1.4
% of ASA > 2	30.0	5.9
Median duration of operation	80 minutes	2.4
Median LOS[1]	8 days	15.2
% of urgent operations	6.9	25.6
% of antibiotic prophylaxis	42.4	56.2

[1] *Length of postoperative stay in hospital.*

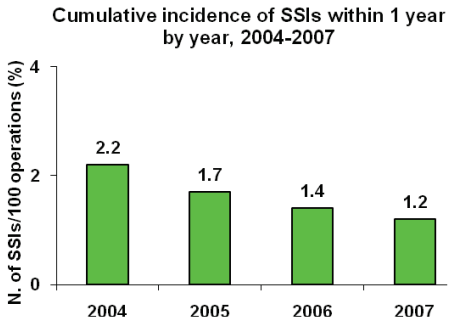
Characteristics of the surgical site infections, 2007

		% of missing value
Total number of SSIs	996	
% of SSIs occurred within one year after operation	100	
% of SSIs detected after discharge (discharge date)	35.4	19.0
% of superficial SSIs	45.9	1.8
% of SSIs with information on microbiological exam	46.8	53.2





Hospitals with ≥ 20 operations in each NHSN category.



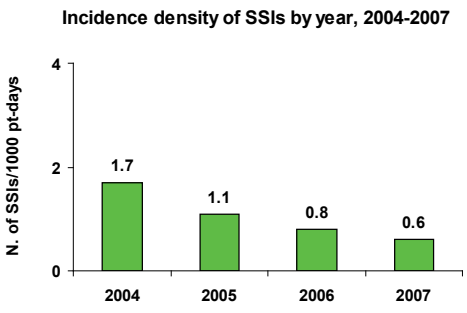


Table 90: Hip prosthesis – Cumulative incidence within one year by country, 2007

Country	Number of hospitals	Number of operations	Number of SSIs	Cumulative incidence of SSIs		Cumulative incidence of deep and organ/space SSIs	
				SSI%	95% confidence interval (CI)	SSI%	95% CI
AT	18	3 946	63	1.6	1.23–2.04	1.09	0.79–1.47
DE	120	20 935	244	1.17	1.02–1.32	0.87	0.75–1.01
ES	20	982	15	1.53	0.85–2.52	0.92	0.42–1.74
FI	13	5 441	128	2.35	1.96–2.80	0.94	0.70–1.23
FR	296	12 545	102	0.81	0.66–0.99	0.46	0.35–0.60
HU	4	639	19	2.97	1.79–4.64	1.72	0.86–3.08
IT	17	618	6	0.97	0.36–2.11	0.32	0.04–1.17
LT	3	230	1	0.43	0.01–2.42	0.43	0.01–2.42
NL	21	3 099	102	3.29	2.68–4.00	1.74	1.31–2.27
NO	25	1 374	52	3.78	2.83–4.96	1.89	1.24–2.77
PT	5	215	4	1.86	0.51–4.76	1.4	0.29–4.08
UK	185	34 262	260	0.76	0.67–0.86	0.23	0.19–0.29

Table 91: Hip prosthesis–Cumulative incidence within one year by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of SSIs	SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	529	83 094	969	1.2 (1.1–1.2)	0.0	0.0	0.6	2.1	3.5
Risk index 0	525	45 714	364	0.8 (0.7–0.9)	0.0	0.0	0.0	1.2	2.9
Risk index 1	522	27 016	451	1.7 (1.5–1.8)	0.0	0.0	0.0	2.2	4.8
Risk index 2–3	390	3 749	109	2.9 (2.4–3.5)	0.0	0.0	0.0	0.0	8.9
Risk index unknown	230	6 615	45	0.7 (0.5–0.9)	0.0	0.0	0.0	0.0	2.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 92: Hip prosthesis – Cumulative incidence, post-discharge SSIs excluded, by country, 2007

Country	Number of hospitals	Number of operations **	Number of in-hospital SSIs	Cumulative incidence of in-hospital SSIs		Cumulative incidence of deep and organ/space in-hospital SSIs	
				In-hospital SSI%	95% CI	In-hospital SSI%	95% CI
AT	18	3 896	33	0.85	0.58–1.19	0.56	0.35–0.85
DE	120	11 927	97	0.81	0.66–0.99	0.34	0.46–0.75
ES	20	882	11	1.25	0.62–2.23	0.61	0.25–1.48
FI	13	1 998	13	0.65	0.35–1.11	0.00	0.00–0.18
FR	296	12 514	41	0.33	0.24–0.44	0.21	0.14–0.30
HU	4	639	17	2.66	1.55–4.26	1.56	0.75–2.88
IT	17	567	4	0.71	0.19–1.81	0.00	0.00–0.65
LT	3	230	1	0.43	0.01–2.42	0.43	0.01–2.42
NL	21	3 099	33	1.06	0.73–1.50	0.39	0.20–0.68
NO	25	1 374	15	1.09	0.61–1.80	0.51	0.20–1.05
PT	5	215	2	0.93	0.11–3.36	0.93	0.11–3.36
UK	185	34 161	187	0.55	0.47–0.63	0.17	0.13–0.22

*** Only operations with discharge date detected.*

Table 93: Hip prosthesis – Cumulative incidence, post-discharge SSIs excluded, by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of in-hospital SSIs	In-hospital SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	484	70 311	440	0.6 (0.6–0.7)	0.0	0.0	0.0	1.0	2.2
Risk index 0	480	39 458	154	0.4 (0.3–0.5)	0.0	0.0	0.0	0.0	1.5
Risk index 1	477	21 643	203	0.9 (0.8–1.1)	0.0	0.0	0.0	0.0	3.1
Risk index 2–3	350	2 718	59	2.2 (1.7–2.8)	0.0	0.0	0.0	0.0	7.1
Risk index unknown	222	6 492	24	0.4 (0.2–0.6)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 94: Hip prosthesis – Incidence density by country, 2007

Country	Number of hospitals	Number of patient days (pt days)	Number of in-hospital SSIs	Incidence density of SSIs		Incidence density of deep and organ/space SSIs	
				In-hospital SSIs/ 1 000 pt days	95% CI	In-hospital SSIs/ 1 000 pt days	95% CI
AT	18	52 437	33	0.63	0.43 - 0.88	0.42	0.03–0.06
DE	120	172 879	97	0.56	0.46–0.68	0.41	0.03–0.05
ES	20	8 944	11	1.23	0.61–2.20	0.67	0.02–0.15
FI	13	9 844	13	1.32	0.70–2.26	0	0.00–0.04
FR	296	137 074	41	0.3	0.21–0.41	0.19	0.01–0.03
HU	4	7 243	17	2.35	1.37–3.76	1.38	0.07–0.25
IT	17	7 831	4	0.51	0.14–1.31	0	0.00–0.05
LT	3	2 632	1	0.38	0.01–2.12	0.38	0.00–0.21
NL	21	26 629	33	1.24	0.85–1.74	0.45	0.02–0.08
NO	25	12 073	15	1.24	0.70–2.05	0.58	0.02–0.12
PT	5	2 680	2	0.75	0.09–2.70	0.75	0.01–0.27
UK	185	276 741	187	0.68	0.58–0.78	0.21	(0.02–0.03)

Table 95: Hip prosthesis – Incidence density by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of pt days	Number of in-hospital SSIs	In-hospital SSIs/1,000 pt days (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	484	701 645	440	0.63 (0.57–0.69)	0.0	0.0	0.0	0.9	2.0
Risk index 0	480	362 955	154	0.42 (0.36–0.50)	0.0	0.0	0.0	0.0	1.6
Risk index 1	477	249 199	203	0.81 (0.71–0.93)	0.0	0.0	0.0	0.0	2.5
Risk index 2–3	350	34 817	59	1.69 (1.29–2.19)	0.0	0.0	0.0	0.0	4.6
Risk index unknown	222	54 674	24	0.44 (0.28–0.65)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

KNEE PROSTHESIS

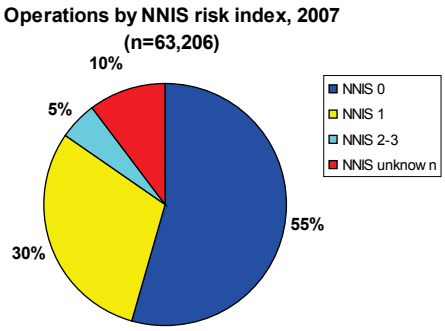
Characteristics of patients and surgical procedures, 2007

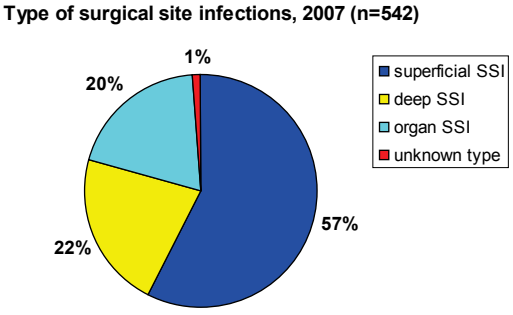
		% of missing value
Total number of operations	64 453	
% of operations surveyed in the United Kingdom	56.9	0
Sex ratio (M:F)	0.6	0.6
Median age	71	1.0
% of dead at discharge	0.1	43.7
% of contaminated or dirty operations	0.2	1.0
% of ASA > 2	24.8	8.4
Median duration of operation	80 minutes	3.6
Median LOS[1]	7 days	11.3
% of urgent operations	0.7	18.9
% of antibiotic prophylaxis	51.6	47.9

[1] *Length of postoperative stay in hospital.*

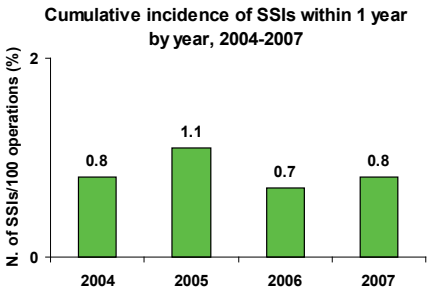
Characteristics of the surgical site infections, 2007

		% of missing value
Total number of SSIs	542	
% of SSIs occurred within one year after operation	99.8	0
% of SSIs detected after discharge	50.0	19.4 (discharge date)
% of superficial SSIs	57.4	1.1
% of SSIs with information on microbiological exam	37.1	62.9





Hospitals with ≥ 20 operations in each NHSN category.



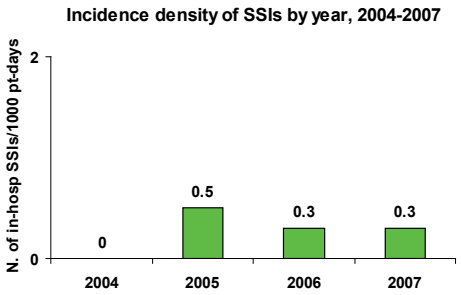


Table 96: Knee prosthesis – Cumulative incidence within one year by country, 2007

Country	Number of hospitals	Number of operations	Number of SSIs	Cumulative incidence of SSIs		Cumulative incidence of deep and organ/space SSIs	
				SSI%	95% confidence interval (CI)	SSI%	95% CI
AT	2	318	0	0	0.00–1.16	0	0.00–1.16
DE	67	11 927	108	0.91	0.74–1.09	0.63	0.49–0.79
ES	11	444	14	3.15	1.72–5.29	2.48	1.24–4.43
FI	12	4 134	74	1.79	1.41–2.25	0.92	0.65–1.26
FR	271	8 109	56	0.69	0.52–0.90	0.39	0.27–0.56
HU	2	108	3	2.78	0.57–8.12	0.93	0.02–5.16
IT	24	770	5	0.65	0.21–1.52	0.13	0.00–0.72
LT	3	157	1	0.64	0.02–3.55	0	0.00–2.35
NL	20	1 816	41	2.26	1.62–3.06	1.21	0.76–1.83
UK	168	36 670	239	0.65	0.57–0.74	0.12	0.09–0.16

Table 97: Knee prosthesis – Cumulative incidence within one year by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of SSIs	SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	396	63 206	522	0.8 (0.8–0.9)	0.0	0.0	0.0	1.2	2.9
Risk index 0	392	34 355	230	0.7 (0.6–0.8)	0.0	0.0	0.0	0.4	2.4
Risk index 1	393	19 128	189	1.0 (0.9–1.1)	0.0	0.0	0.0	0.0	3.6
Risk index 2–3	309	3 167	57	1.8 (1.4–2.3)	0.0	0.0	0.0	0.0	2.3
Risk index unknown	197	6 556	46	0.7 (0.5–0.9)	0.0	0.0	0.0	0.0	1.4

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 98: Knee prosthesis – Cumulative incidence, post-discharge SSIs excluded, by country, 2007

Country	Number of hospitals	Number of operations**	Number of in-hospital SSIs	Cumulative incidence of in-hospital SSIs		Cumulative incidence of deep and organ/space in-hospital SSIs	
				In-hospital SSI%	95% CI	In-hospital SSI%	95% CI
AT	2	318	0	0.00	0.00–1.16	0.00	0.00–1.16
DE	67	7 028	13	0.18	0.10–0.32	0.05	0.03–0.19
ES	11	440	8	1.82	0.78–3.58	1.13	0.37–2.65
FI	12	1 851	0	0.00	0.00–0.20	0.00	0.00–0.20
FR	271	8 062	14	0.17	0.09–0.29	0.09	0.03–0.18
HU	2	108	3	2.78	0.57–8.12	0.93	0.02–5.16
IT	24	753	5	0.66	0.22–1.55	0.13	0.00–0.74
LT	3	157	1	0.64	0.02–3.55	0.00	0.00–2.35
NL	20	1 816	5	0.28	0.09–0.64	0.22	0.06–0.56
UK	168	36 624	117	0.32	0.26–0.38	0.06	0.04–0.09

*** Only operations with discharge date detected.*

Table 99: Knee prosthesis – Cumulative incidence, post-discharge SSIs excluded, by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of in-hospital SSIs	In-hospital SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	364	55 934	160	0.3 (0.2–0.3)	0.0	0.0	0.0	0.0	1.2
Risk index 0	361	31 060	72	0.2 (0.2–0.3)	0.0	0.0	0.0	0.0	0.6
Risk index 1	361	16 032	58	0.4 (0.3–0.5)	0.0	0.0	0.0	0.0	0.8
Risk index 2–3	279	2 342	9	0.4 (0.2–0.7)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	192	6 500	21	0.3 (0.2–0.5)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 100: Knee prosthesis – Incidence density by country, 2007

Country	Number of hospitals	Number of patient days (pt days)	Number of in-hospital SSIs	Incidence density of SSIs		Incidence density of deep and organ/space SSIs	
				In-hospital SSIs/1 000 pt days	95% CI	In-hospital SSIs/1 000 pt days	95% CI
AT	2	4 142	0	0.00	0.00–0.89	0.00	0.00–0.09
DE	67	97 886	13	0.13	0.07–0.23	0.06	0.00–0.01
ES	11	4 742	8	1.69	0.73–3.32	1.05	0.03–0.25
FI	12	8 589	0	0	0.00–0.43	0	0.00–0.04
FR	271	88 814	14	0.16	0.09–0.26	0.08	0.00–0.02
HU	2	1 340	3	2.24	0.46–6.54	0.75	0.00–0.42
IT	24	8 704	5	0.57	0.19–1.34	0.11	0.00–0.06
LT	3	1 882	1	0.53	0.01–2.96	0	0.00–0.20
NL	20	12 629	5	0.4	0.13–0.92	0.32	0.01–0.08
UK	168	277 662	117	0.42	0.35–0.51	0.08	0.00–0.01

Table 101: Knee prosthesis – Incidence density by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of pt days	Number of in-hospital SSIs	In-hospital SSIs/1,000 pt days (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	364	492 349	160	0.32 (0.28–0.38)	0.0	0.0	0.0	0.0	1.3
Risk index 0	361	261 600	72	0.28 (0.22–0.35)	0.0	0.0	0.0	0.0	0.7
Risk index 1	361	156 727	58	0.37 (0.28–0.48)	0.0	0.0	0.0	0.0	0.8
Risk index 2–3	279	24 329	9	0.37 (0.17–0.70)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	192	49 693	21	0.42 (0.26–0.65)	0.0	0.0	0.0	0.0	0.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

LAMINECTOMY

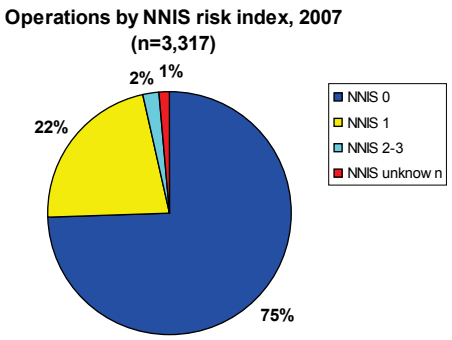
Characteristics of patients and surgical procedures, 2007

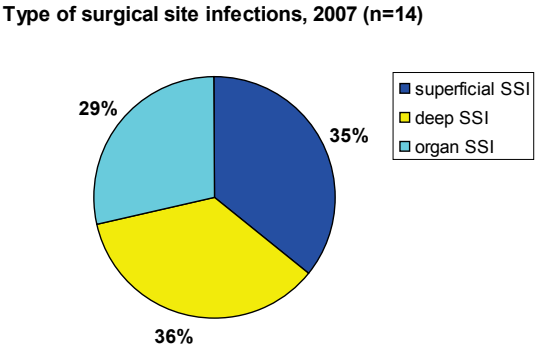
		% of missing value
Total number of operations	3 459	
% of operations surveyed in Germany	61.8	0
Sex ratio (M:F)	1.2	0
Median age	54 years	2.3
% of dead at discharge	0	88.1
% of contaminated or dirty operations	0.3	0.8
% of ASA > 2	14.2	0.7
Median duration of operation	71 minutes	0.7
Median LOS[1]	6 days	24.6
% of urgent operations	5.2	64.3
% of antibiotic prophylaxis	8.6	89.3

[1] *Length of postoperative stay in hospital.*

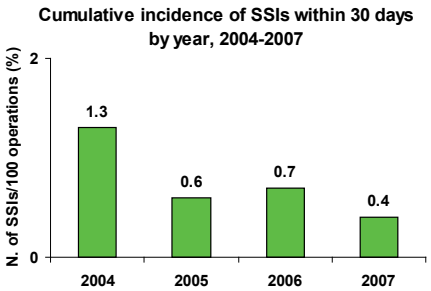
Characteristics of the surgical site infections, 2007

		% of missing value
Total number of SSIs	14	
% of SSIs occurred within 30 days after operation	92.9	0
% of SSIs detected after discharge	28.6	28.6 (discharge date)
% of superficial SSIs	35.7	0
% of SSIs with information on microbiological exam	57.1	42.9





Hospitals with ≥ 20 operations in each NHSN category.



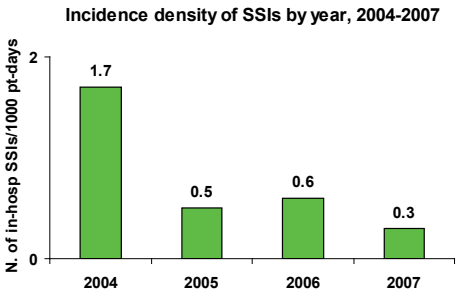


Table 102: Laminectomy – Cumulative incidence within 30 days by country, 2007

Country	Number of hospitals	Number of operations	Number of SSIs	Cumulative incidence of SSIs		Cumulative incidence of deep and organ/space SSIs	
				SSI%	95% confidence interval (CI)	SSI%	95% CI
AT	1	133	0	0	0.00–2.77	0	0.00–2.77
DE	12	2 136	5	0.23	0.08–0.55	0.19	0.05–0.48
ES	6	242	4	1.65	0.45–4.23	0.41	0.01–2.30
FR	48	844	4	0.47	0.13–1.21	0.36	0.07–1.04
IT	3	94	0	0	0.00–3.92	0	0.00–3.92

Table 103: Laminectomy – Cumulative incidence within 30 days by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of SSIs	SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	32	3 317	11	0.3 (0.2–0.6)	0.0	0.0	0.0	0.2	1.3
Risk index 0	32	2 465	5	0.2 (0.1–0.5)	0.0	0.0	0.0	0.0	0.6
Risk index 1	32	731	3	0.4 (0.1–1.2)	0.0	0.0	0.0	0.0	0.0
Risk index 2–3	23	77	1	1.3 (0.0–7.2)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	7	44	2	4.5 (0.6–16.4)	0.0	0.0	0.0	20.0	100.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 104: Laminectomy – Cumulative incidence, post-discharge SSIs excluded, by country, 2007

Country	Number of hospitals	Number of operations**	Number of in-hospital SSIs	Cumulative incidence of in-hospital SSIs		Cumulative incidence of deep and organ/space in-hospital SSIs	
				In-hospital SSI%	95% CI	In-hospital SSI%	95% CI
AT	1	133	0	0.00	0.00–2.77	0.00	0.00–2.77
DE	12	1 341	2	0.15	0.02–0.54	0.05	0.00–0.42
ES	6	227	3	1.32	0.27–3.86	0.41	0.01–2.45
FR	48	842	1	0.12	0.00–0.66	0.00	0.00–0.44
IT	3	56	0	0.00	0.00–6.59	0.00	0.00–6.59

*** Only operations with discharge date detected.*

Table 105: Laminectomy – Cumulative incidence, post-discharge SSIs excluded, by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of operations	Number of in-hospital SSIs	In-hospital SSI% (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	30	2 467	6	0.2 (0.1-0.5)	0.0	0.0	0.0	0.0	1.5
Risk index 0	30	1 834	2	0.1 (0.0-0.4)	0.0	0.0	0.0	0.0	0.0
Risk index 1	30	536	2	0.4 (0.0-1.3)	0.0	0.0	0.0	0.0	0.0
Risk index 2–3	21	54	0	0.0 (0.0-6.8)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	7	43	2	4.7 (0.6-16.8)	0.0	0.0	0.0	20.0	100.0

** Only hospitals with ≥ 20 operations in each NHSN category included.*

Table 106: Laminectomy – Incidence density by country, 2007

Country	Number of hospitals	Number of patient days (pt days)	Number of in-hospital SSIs	Incidence density of SSIs		Incidence density of deep and organ/space SSIs	
				In-hospital SSIs/ 1 000 pt days	95% CI	In-hospital SSIs/ 1 000 pt days	95% CI
AT	1	943	0	0.00	0.00–3.91	0.00	0.00–0.39
DE	12	9,069	2	0.22	0.03–0.80	0.11	0.00–0.06
ES	6	1,545	3	1.94	0.40–5.67	0.65	0.00–0.36
FR	48	6,000	1	0.17	0.00–0.93	0	0.00–0.06
IT	3	272	0	0	0.00–13.56	0	0.00–1.36

Table 107: Laminectomy – Incidence density by NHSN risk index, 2007*

NHSN risk index	Number of hospitals	Number of pt days	Number of in-hospital SSIs	In-hospital SSIs/1,000 pt days (95% CI)	Percentile				
					P10	P25	P50 (median)	P75	P90
All risk categories	30	16,730	6	0.36 (0.13–0.78)	0.0	0.0	0.0	0.0	2.3
Risk index 0	30	11,343	2	0.18 (0.02–0.64)	0.0	0.0	0.0	0.0	0.0
Risk index 1	30	4,479	2	0.45 (0.05–1.61)	0.0	0.0	0.0	0.0	0.0
Risk index 2–3	21	614	0	0.00 (0.00–6.01)	0.0	0.0	0.0	0.0	0.0
Risk index unknown	7	294	2	6.80 (0.82–24.6)	0.0	0.0	0.0	20.8	76.9

** Only hospitals with ≥ 20 operations in each NHSN category included.*

c) Technical note

Surgical procedures under surveillance[i]

0 (see below) presents a selection of surgical procedures from which the participating centres may chose. These surgical procedures are defined according to the USA National Healthcare Safety Network (NHSN), former National Nosocomial Infections Surveillance (NHSN) System[i].

Table 108: Selected type of surgical procedures for SSI surveillance

NHSN category	Description	ICD-9-CM* codes included in the category
CBGB	Coronary artery bypass grafting with both chest and donor site incisions Chest procedure to perform direct revascularisation of the heart; includes obtaining suitable vein from donor site for grafting	36.10-36.14, 36.19
CBGC	Coronary artery bypass grafting with chest incision only Chest procedure to perform direct vascularisation of the heart using, e.g, the internal mammary artery	36.15-36.17, 36.2
CHOL	Cholecystectomy Removal of gallbladder; includes procedures performed using the laparoscope	51.03, 51.04, 51.2-51.24
COLO	Colon surgery Incision, resection or anastomosis of the large intestine; includes large-to-small and small-to-large bowel anastomosis	45.00, 45.03, 45.41, 45.49, 45.50, 45.52, 45.7-45.90, 45.92-45.95, 46.0, 46.03, 46.04, 46.1-46.14, 46.43, 46.52, 46.75, 46.76, 46.91, 46.92, 46.94, 48.5, 48.6-48.69
CSEC	Caesarean section	74.0-74.2, 74.4-74.99
HPRO	Hip prosthesis Arthroplasty of hip	81.51-81.53
KPRO	Knee prosthesis Arthroplasty of knee	81.54, 81.55
LAM	Laminectomy Exploration or decompression of spinal cord through excision or incision into vertebral structure	03.0-03.09, 80.50, 80.51, 80.59

**International Classification of Diseases-9-Clinical Modifications procedure codes vers. 2001*

Definitions [2]

Case definitions of surgical site infections

In the European surveillance, surgical site infections (SSIs) are defined according to the NHSN System[i]. Therefore, three types of SSIs are surveyed:

- superficial incisional
- deep incisional
- organ/space

Superficial incisional

Infection occurs within 30 days after the operation and involves only skin and subcutaneous tissue of the incision and at least one of the following:

- purulent drainage with or without laboratory confirmation, from the superficial incision;
- organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision;
- at least one of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative;
- diagnosis of superficial incisional SSI made by a surgeon or attending physician.

[i] Centers for Disease Control and Prevention. Surgical Site Infection (SSI) Event. Guidelines and procedures for monitoring SSI. March 2009. Available from: http://www.cdc.gov/nhsn/PDFs/pscManual/9pscSSIcurrent.pdf.

Deep incisional

Infection occurs within 30 days after the operation if no implant is left in place, or within one year if implant is in place, appears to be related to the operation and involves deep soft tissue (e.g. fascia, muscle) of the incision and at least one of the following:

- purulent drainage from the deep incision but not from the organ/space component of the surgical site;
- a deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (> 38º C), localised pain or tenderness, unless incision is culture-negative;
- an abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination;
- diagnosis of deep incisional SSI made by a surgeon or attending physician.

Organ/space

Infection occurs within 30 days after the operation if no implant is left in place, or within one year if implant is in place, appears to be related to the operation and involves any part of the anatomy (e.g. organs and spaces) other than the incision which was opened or manipulated during an operation and at least one of the following:

- purulent drainage from a drain that is placed through a stab wound into the organ/space;
- organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space;
- an abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination;
- diagnosis of organ/space SSI made by a surgeon or attending physician.

The Wound Contamination Class

Wound contamination class as described by Altemeier et al[i].

Clean wound
Uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital or uninfected urinary tracts are not entered. In addition clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incisional wounds that follow non-penetrating trauma should be included in this category.

Clean-contaminated wound
Operative wound in which the respiratory, alimentary, genital or uninfected urinary tracts are entered under controlled condition and without unusual contamination. Specifically operations involving the biliary tract, appendix, vagina and oropharynx are included in this category provided no evidence of infection or major break in technique is encountered.

Contaminated wound
Open, fresh, accidental wound. In addition, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included in this category.

Dirty or infected wound
Old traumatic wound with retained devitalised tissue and wound that involves existing clinical infection or perforated viscera. This definition suggests that the organisms causing postoperative infection were present in the operative field before the operation.

The ASA physical status classification (ASA score)

Physical status classification developed by the American Society of Anaesthesiology (ASA)[ii].

1=Normally healthy patient

2=Patient with mild systemic disease

3=Patient with severe systemic disease that is not incapacitating

4=Patient with an incapacitating systemic disease that is a constant threat to life

5=Moribund patient who is not expected to survive for 24 hours with or without operation.

[i] Altemeier WA, Burke JF, Pruitt BA, Sandusky WR. Manual on control of infection in surgical patients (2nd ed.). Philadelphia, PA: JB Lippincott; 1984.

[ii] Owens WD, Felts JA, Spitznagel EL. ASA physical status classification: a study of consistency of ratings. Anesthesiology 1978;49:239-43.

Duration of operation

0 shows the 75th percentile cut-off values for the selected NHSN surgical procedures.

In case of a reintervention within 72 hours after the primary operation, the duration of the reintervention needs to be added to the duration of the primary operation.

Table 109: Cut-off values for duration of operative procedure categories

NHSN category	75th percentile cut-off value in hours
CBGB	5
CBGC	4
CHOL	2
COLO	3
CSEC	1
HPRO	2
KPRO	2
LAM	2

NHSN risk index

The NHSN risk index[i] is weighted by information on:

- wound contamination class;
- ASA score;
- duration of operation.

Four levels of risk are defined (levels 0 to 3) using a combination of these three items with cut-off points presented in 0.

Table 110: Stratification points for the variables of the NHSN risk index

Variables for stratification	NHSN risk index	Stratification points
Wound classification	Class > 2	1
ASA score	> 2	1
Duration of operation	> 75th percentile (see Table 108)	1

Urgent/elective operation

An urgent operation is defined as an operation that was not planned at least 24 hours in advance.

An elective operation is defined as an operation that was planned at least 24 hours in advance

Perioperative prophylactic antibiotics

This is defined as the perioperative systemic administration of antibiotic agent(s) at or within two hours prior of primary skin incision with the aim of preventing infection in the operative site. In case of a caesarean section: after clamping of umbilical cord.

Date of infection

This is defined as the date when the first clinical evidence of SSI appeared or the date the specimen used to make or confirm the diagnosis was collected, whichever comes first.

Definition of incidence indicators

Cumulative incidence

For each surgical procedure category the cumulative incidence can be defined as the crude percentage of operations resulting in a surgical site infection.

Numerator: number of surgical site infections detected within 30 days after the operation or one year for hip prosthesis and knee prosthesis.

Denominator: the total number of operations.

[i] Centers for Disease Control and Prevention. Surgical Site Infection (SSI) Event. Guidelines and procedures for monitoring SSI. March 2009. Available from: http://www.cdc.gov/nhsn/PDFs/pscManual/9pscSSIcurrent.pdf.

This indicator gives the most complete picture for a given surgical procedure category, but is highly dependent on the length of postoperative stay in hospital and on the intensity of post-discharge surveillance.

Cumulative incidence, post-discharge surgical site infections excluded

For each surgical procedure category the cumulative incidence, post-discharge surgical site infections excluded, can be defined as the crude percentage of operations resulting in a surgical site infection detected before hospital discharge. It can only be calculated when the discharge date is known.

Numerator: number of surgical site infections detected before hospital discharge.

Denominator: the number of operations with known date of hospital discharge.

This indicator only considers surgical site infections detected in the hospital, therefore is independent of post-discharge surveillance. Anyway it depends on the length of postoperative stay in hospital.

Incidence density

For each surgical procedure category the incidence density can be defined as the rate of surgical site infections detected before hospital discharge standardised by the length of patient's postoperative stay in hospital. It can only be calculated when the discharge date is known.

Numerator: number of surgical site infections detected before hospital discharge.

Denominator: the total number of postoperative patient-days in the hospital.

This indicator only considers surgical site infections detected in the hospital and therefore it does not reflect the complete epidemiological picture. However, it is independent of post-discharge surveillance and corrects for differences in postoperative hospital stay. Therefore, this indicator may be more reliable for inter-hospital or intercountry comparisons.

Interpretation of percentiles of incidence indicators[i]

Step 1
Evaluate the incidence indicator you have calculated for your hospital and confirm that the variables in the incidence indicator (both numerator and denominator) are identical to the incidence indicator in the table.

Step 2
Examine the percentiles in each of the tables and look for the 50th percentile (or median). At the 50th percentile, 50% of the hospitals have lower incidence than the median, and 50% have higher incidence.

Step 3
Determine whether your hospital's incidence indicator is above or below this median.

Determining whether your hospital's incidence indicator is a high outlier

Step 4
If your hospital's incidence indicator is above the median, determine whether the incidence indicator is above the 75th percentile. At the 75th percentile, 75% of the hospitals had lower incidence, and 25% of the hospitals had higher incidence.

Step 5
If the incidence indicator is above the 75th percentile, determine whether it is above the 90th percentile. If it is, then the incidence indicator is a high outlier, which may indicate a problem.

Determining whether your hospital's incidence indicator is a low outlier

Step 6
If your hospital's incidence indicator is below the median, determine whether the incidence indicator is below the 25th percentile. At the 25th percentile, 25% of the hospitals had lower incidence, and 75% of the hospitals had higher incidence.

Step 7
If the incidence indicator is below the 25th percentile, determine whether it is below the 10th percentile. If it is, then the incidence indicator is a low outlier, which may be due to underreporting of infections.

[i] Edwards JR, Peterson KD, Andrus ML, et al. National Healthcare Safety Network (NHSN) Report, data summary for 2006 through 2007, issued November 2008. Am J Infect Control 2008;36:609-26.

Annex 2: Surveillance of ICU-acquired infections

a) Data quality

The data quality check is based on the data tables icu_u (ICU characteristics), icu_p (patient characteristics), icu_e (patient exposure data), icu_i (ICU-acquired infection data), icu_a (antibiotic use data) and icu_d (unit-based denominator data) of the HELICS-ICU protocol.

The percentage of non-missing values partly depends on whether the considered variables were included in the countries' national surveillance protocol or not.

Table 111: Missing data for patient and exposure data (level 2 surveillance of ICU-acuired infections), 2007, nine countries with patient-based 2 surveillance

Variable	N (%) of missing values
Patient variables	**N = 55 988**
Admission type (R)	1 217 (2.2%)
Discharge date from ICU (M)	9 (0.0%)
Discharge status from ICU (R)	140 (0.3%)
Age (R)	73 (0.1%)
Gender (R)	58 (0.1%)
SAPS II score	3 638 (6.5%)
APACHE II score	32 239 (57.6%)
Both saps & apache (R)	2 958 (5.3%)
Trauma (R)	1 549 (2.8%)
AB at admission (R)	792 (1.4%)
Patient origin (O)	502 (0.9%)
Admission date to hospital (O)	27 561 (49.2%)
Impaired immunity (R)	1 752 (3.1%)
Coronary care (O)	28 340 (50.6%)
Estimated Glasgow (O)	48 658 (86.9%)
Measured Glasgow (O)	53 954 (96.4%)
Previous surgical site (O)	32 582 (58.2%)
Day-by-day exposure variables	
N of patients with all exposure missing or 0	8 738 (15.6%)
N of hospitals with all exposure missing	5 (503 patients)
N of hospitals with all CVC missing (R)	7 (1.9%), 506 patients
N of hospitals with all INT missing (R)	9 (2.4%), 564 patients
N of hospitals with all UC missing (O)	36 (9.5%), 2 763 patients
N of hospitals with all NIT missing (O)	204 (54.0%), 30 492 patients
N of hospitals with all FNIT missing (O)	200 (52.9%), 28 950 patients
N of hospitals with all PNT missing (O)	206 (54.5%), 30 501 patients
N of hospitals with all NIV missing (O)	212 (56.1%), 31 050 patients
N of hospitals with all REINT missing (O)	185 (48.9%), 24 880 patients
N of hospitals with all VEN missing (O)	321 (84.9%), 46 085 patients

R=required; M=mandatory; O=optional; CVC=central venous catheter; INT=intubation; UC=urinary catheter; NIT=naso-oro intestinal tube without feeding; FNIT=feeding through naso-oro intestinal tube; PNT= parenteral nutrition; NIV=non-invasive mechanical ventilation; REINT=reintubation; VEN=invasive mechanical ventilation.

Except for patient origin, optional variables in the HELICS-ICU patient-based protocol were missing in at least half of the patients, mainly because they are not included in the national protocols of France, Luxembourg and Lithuania and other countries for some of the variables. The availability of each of the variables by country can be deduced from the tables describing the patient characteristics in Table 20.

Variables with very high missing percentages were candidates to be removed from the surveillance protocol and include the Glasgow score, reintubation (patient being extubated and reintubated on that day) and invasive

mechanical ventilation – the latter because it overlaps with intubation, except for those days were the patient is still intubated but not under mechanical ventilation. In 815 patients both intubation and invasive mechanical ventilation were reported, the overlap between these two variables was 98.3%.

In order to identify variables that could be omitted from the ICU surveillance protocol, further multivariate risk factor analysis was performed to evaluate the added value in risk adjustment of infection rates.

b) Microorganisms isolated in ICU-acquired pneumonia

Table 112: Microorganisms isolated in ICU-acquired pneumonia by year, 2004–2007

	2004	2005	2006	2007	TOTAL
TOTAL N of reported isolates	**7 496**	**8 205**	**7 906**	**9 329**	**31 802**
Gram-positive cocci	**30.8%**	**29.0%**	**27.6%**	**25.7%**	**29.1%**
Staphylococcus aureus	19.2%	20.3%	19.2%	17.6%	19.7%
Coagulase-negative staphylococci	4.0%	2.7%	2.6%	3.0%	3.2%
– *Staphylococcus epidermidis*	1.4%	0.8%	0.7%	0.9%	1.0%
– *Staphylococcus haemolyticus*	0.1%	0.1%	0.2%	0.1%	0.1%
– other coagulase-negative staphylococci (CNS)	0.4%	0.4%	0.4%	0.6%	0.5%
– coagulase-neg. staphylococci, not specified	1.6%	0.9%	0.8%	0.7%	1.0%
– *Staphylococcus* sp., not specified	0.5%	0.5%	0.6%	0.8%	0.6%
Enterococcus species	3.4%	3.1%	2.9%	2.8%	3.1%
– *Enterococcus faecalis*	0.9%	0.6%	0.8%	0.6%	0.8%
– *Enterococcus faecium*	0.3%	0.2%	0.2%	0.2%	0.2%
– *Enterococcus* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Enterococcus* sp., not specified	2.2%	2.2%	1.9%	1.9%	2.1%
Streptococcus species	4.1%	2.9%	2.9%	2.4%	3.1%
– *Streptococcus pneumoniae*	1.1%	1.6%	1.5%	1.3%	1.5%
– *Streptococcus agalactiae* (b)	0.1%	0.1%	0.2%	0.2%	0.2%
– *Streptococcus pyogenes* (a)	0.0%	0.1%	0.1%	0.0%	0.0%
– other haemol. Streptococcae (c, g)	0.2%	0.1%	0.3%	0.1%	0.2%
– *Streptococcus* sp., other	0.7%	0.8%	0.6%	0.7%	0.7%
– *Streptococcus* sp., not specified	2.0%	0.1%	0.1%	0.1%	0.6%
Other gram-positive cocci	0.2%	0.0%	0.0%	0.0%	0.1%
Gram-negative cocci	**0.5%**	**1.0%**	**0.5%**	**0.4%**	**0.6%**
Moraxella catharralis	0.2%	0.3%	0.1%	0.1%	0.2%
Moraxella sp., not specified	0.1%	0.2%	0.1%	0.1%	0.1%
Neisseria meningitidis	0.0%	0.0%	0.1%	0.0%	0.0%
Neisseria sp., other	0.1%	0.2%	0.1%	0.1%	0.1%
Neisseria sp., not specified	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative cocci, other	0.1%	0.3%	0.0%	0.0%	0.1%
Gram-negative cocci, not specified	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-positive bacilli	**0.3%**	**0.3%**	**0.4%**	**0.3%**	**0.3%**
Corynebacterium species	0.3%	0.3%	0.3%	0.3%	0.3%
Bacillus species	0.0%	0.0%	0.0%	0.0%	0.0%
Lactobacillus species	0.0%	0.0%	0.0%	0.0%	0.0%
Other gram-positive bacilli	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative bacilli, Enterobacteriaceae	**32.6%**	**33.8%**	**33.5%**	**36.2%**	**35.3%**
Escherichia coli	8.3%	8.5%	9.0%	9.3%	9.1%
Enterobacter species	7.2%	7.9%	7.4%	8.3%	8.0%
– *Enterobacter aerogenes*	1.8%	2.1%	1.7%	1.7%	1.9%
– *Enterobacter cloacae*	2.2%	2.5%	2.8%	3.4%	2.8%
– *Enterobacter agglomerans*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Enterobacter sakazakii*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Enterobacter* sp., other	0.1%	0.0%	0.0%	0.1%	0.1%

	2004	2005	2006	2007	TOTAL
– *Enterobacter* sp., not specified	3.1%	3.2%	2.9%	3.2%	3.2%
Klebsiella species	8.2%	7.9%	8.4%	8.9%	8.7%
– *Klebsiella pneumoniae*	2.3%	2.0%	2.6%	2.4%	2.4%
– *Klebsiella oxytoca*	1.4%	1.3%	1.4%	1.3%	1.4%
– *Klebsiella* sp., other	0.3%	0.7%	0.6%	0.9%	0.7%
– *Klebsiella* sp., not specified	4.3%	4.0%	3.9%	4.2%	4.2%
Proteus species	3.3%	3.2%	2.7%	2.8%	3.1%
– *Proteus mirabilis*	1.2%	1.5%	1.2%	1.3%	1.3%
– *Proteus vulgaris*	0.1%	0.1%	0.1%	0.0%	0.1%
– *Proteus* sp., other	0.2%	0.1%	0.3%	0.2%	0.2%
– *Proteus* sp., not specified	1.8%	1.6%	1.2%	1.3%	1.5%
Citrobacter species	1.3%	2.0%	1.5%	1.9%	1.7%
– *Citrobacter freundii*	0.4%	0.6%	0.3%	0.4%	0.4%
– *Citrobacter koseri* (ex. *Diversus*)	0.2%	0.3%	0.4%	0.4%	0.3%
– *Citrobacter* sp., other	0.1%	0.1%	0.0%	0.1%	0.1%
– *Citrobacter* sp., not specified	0.6%	1.0%	0.8%	1.0%	0.9%
Serratia species	2.9%	2.8%	3.0%	3.5%	3.2%
– *Serratia marcescens*	0.6%	0.6%	0.7%	0.8%	0.7%
– *Serratia liquefaciens*	0.0%	0.0%	0.1%	0.0%	0.0%
– *Serratia* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Serratia* sp., not specified	2.3%	2.1%	2.3%	2.7%	2.5%
Other Enterobacteriaceae	1.3%	1.5%	1.4%	1.5%	1.5%
– *Hafnia* species	0.2%	0.4%	0.3%	0.4%	0.4%
– *Morganella* species	0.6%	0.6%	0.7%	0.7%	0.7%
– *Providencia* species	0.1%	0.1%	0.1%	0.1%	0.1%
– *Salmonella* sp., other	0.0%	0.1%	0.0%	0.0%	0.0%
– Other Enterobacteriaceae	0.0%	0.1%	0.1%	0.0%	0.0%
– Enterobacteriaceae, not specified	0.4%	0.2%	0.2%	0.3%	0.3%
Gram-negative bacilli, other	**30.6%**	**31.1%**	**33.2%**	**33.2%**	**33.2%**
Acinetobacter species	3.5%	3.7%	4.4%	4.5%	4.2%
– *Acinetobacter baumannii*	1.8%	2.5%	2.9%	3.2%	2.7%
– *Acinetobacter calcoaceticus*	0.0%	0.0%	0.2%	0.0%	0.0%
– *Acinetobacter haemolyticus*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Acinetobacter lwoffi*	0.0%	0.1%	0.0%	0.0%	0.0%
– *Acinetobacter* sp., other	0.0%	0.1%	0.1%	0.2%	0.1%
– *Acinetobacter* sp., not specified	1.6%	1.0%	1.2%	1.1%	1.3%
Pseudomonas aeruginosa	18.9%	18.5%	20.4%	20.4%	20.3%
Stenotrophomonas maltophilia	3.1%	3.3%	3.4%	3.8%	3.5%
Pseudomonadaceae family, other	0.5%	0.6%	0.5%	0.2%	0.5%
– *Burkholderia cepacia*	0.2%	0.2%	0.2%	0.1%	0.2%
– Pseudomonadaceae family, other	0.2%	0.3%	0.2%	0.1%	0.2%
– Pseudomonadaceae family, not specified	0.1%	0.1%	0.1%	0.0%	0.1%
Haemophilus species	4.4%	4.4%	4.2%	3.9%	4.4%
– *Haemophilus influenzae*	1.2%	1.4%	1.0%	1.1%	1.2%
– *Haemophilus parainfluenzae*	0.1%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus* sp., not specified	3.2%	3.0%	3.2%	2.8%	3.1%
Legionella species	0.0%	0.1%	0.1%	0.1%	0.1%
Oth. gram-negative bacilli, non-Enterobacteriaciaea	0.2%	0.4%	0.4%	0.3%	0.4%
– *Achromobacter species*	0.0%	0.0%	0.0%	0.1%	0.0%
– *Aeromonas* species	0.0%	0.1%	0.0%	0.0%	0.0%
– *Alcaligenes* species	0.1%	0.1%	0.1%	0.1%	0.1%

	2004	2005	2006	2007	TOTAL
– *Campylobacter* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Flavobacterium* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Gardnerella* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Pasteurella* species	0.0%	0.0%	0.0%	0.0%	0.0%
– Other gram-negative bacilli, non-Enterobacteriaciaea	0.1%	0.2%	0.1%	0.1%	0.1%
Anaerobes	**0.2%**	**0.2%**	**0.1%**	**0.1%**	**0.2%**
Bacteroides species	0.1%	0.1%	0.1%	0.0%	0.1%
– *Bacteroides fragilis*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Bacteroides* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Bacteroides* species, not specified	0.0%	0.0%	0.0%	0.0%	0.0%
Other anaerobes	0.1%	0.1%	0.1%	0.1%	0.1%
– *Clostridium* sp., not specified	0.0%	0.0%	0.0%	0.0%	0.0%
– *Propionibacterium* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Prevotella* species	0.0%	0.0%	0.0%	0.0%	0.0%
– Other anaerobes	0.0%	0.1%	0.0%	0.0%	0.0%
– Anaerobes, not specified	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**
Mycobacterium tuberculosis complex	0.0%	0.1%	0.0%	0.0%	0.0%
Mycobacterium, atypical	0.0%	0.0%	0.0%	0.0%	0.0%
Mycoplasma species	0.0%	0.0%	0.0%	0.0%	0.0%
Chlamydia species	0.0%	0.0%	0.0%	0.0%	0.0%
Actinomyces species	0.0%	0.0%	0.0%	0.0%	0.0%
Nocardia species	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria	0.1%	0.0%	0.1%	0.0%	0.1%
Fungi, yeasts, parasites	**13.1%**	**11.0%**	**10.5%**	**9.2%**	**11.2%**
Candida species	10.9%	9.0%	9.0%	7.8%	9.4%
– *Candida albicans*	9.3%	8.1%	7.8%	6.7%	8.2%
– *Candida glabrata*	0.0%	0.1%	0.2%	0.1%	0.1%
– *Candida tropicalis*	0.0%	0.0%	0.1%	0.1%	0.1%
– *Candida parapsilosis*	0.0%	0.0%	0.0%	0.1%	0.0%
– *Candida* sp., other	0.2%	0.4%	0.5%	0.4%	0.4%
– *Candida* sp., not specified	1.3%	0.4%	0.4%	0.4%	0.7%
Aspergillus species	0.5%	0.6%	0.6%	0.5%	0.6%
– *Aspergillus fumigatus*	0.3%	0.4%	0.4%	0.3%	0.4%
– *Aspergillus niger*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Aspergillus* sp., other	0.0%	0.1%	0.0%	0.1%	0.1%
– *Aspergillus* sp., not specified	0.2%	0.2%	0.2%	0.1%	0.2%
Other fungi, yeasts, parasites	1.7%	1.4%	0.8%	0.9%	1.2%
– Other yeasts	0.1%	0.0%	0.0%	0.1%	0.1%
– Filaments other	0.0%	0.0%	0.1%	0.0%	0.0%
– Fungi, not specified	0.2%	0.4%	0.1%	0.0%	0.2%
– Fungi/parasites, not specified	1.4%	1.0%	0.6%	0.8%	1.0%
Viruses	**0.3%**	**0.4%**	**0.2%**	**0.3%**	**0.3%**

Table 113: Microorganisms isolated in ICU-acquired pneumonia by country, 2007

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK
Number of isolates	**548**	**600**	**3 760**	**1 318**	**2 949**	**68**	**240**	**92**	**87**	**73**	**46**
Gram-positive cocci	**25.9%**	**20.8%**	**24.2%**	**22.8%**	**26.3%**	**20.6%**	**22.1%**	**28.3%**	**20.7%**	**19.2%**	**6.5%**
Staphylococcus aureus	12.8%	7.0%	18.0%	16.8%	17.9%	14.7%	17.1%	10.9%	11.5%	17.8%	6.5%
Coagulase-negative staphylococci	4.9%	8.3%	1.9%	1.2%	3.5%	1.5%	1.7%	5.4%	1.1%	0.0%	0.0%
– *Staphylococcus epidermidis*	2.0%	0.8%	0.0%	0.4%	1.9%	1.5%	0.4%	3.3%	1.1%	0.0%	0.0%
– *Staphylococcus haemolyticus*	0.2%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other CNS	0.0%	1.0%	0.3%	0.8%	0.7%	0.0%	0.8%	2.2%	0.0%	0.0%	0.0%
– CNS, not specified	0.9%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Staphylococcus* sp., not specified	1.8%	6.5%	0.0%	0.1%	0.6%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
Enterococcus species	4.7%	3.2%	4.3%	1.4%	0.7%	0.0%	1.7%	2.2%	4.6%	1.4%	0.0%
– *Enterococcus faecalis*	1.3%	2.2%	0.0%	1.2%	0.5%	0.0%	0.8%	2.2%	4.6%	0.0%	0.0%
– *Enterococcus faecium*	2.9%	0.0%	0.0%	0.1%	0.1%	0.0%	0.4%	0.0%	0.0%	1.4%	0.0%
– *Enterococcus* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Enterococcus* sp., not specified	0.5%	1.0%	4.3%	0.2%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
Streptococcus species	3.5%	2.3%	0.0%	3.2%	4.2%	4.4%	1.7%	9.8%	3.4%	0.0%	0.0%
– *Streptococcus pneumoniae*	1.3%	1.0%	0.0%	2.3%	2.3%	2.9%	0.0%	5.4%	1.1%	0.0%	0.0%
– *Streptococcus agalactiae* (b)	0.2%	0.2%	0.0%	0.2%	0.4%	0.0%	0.4%	2.2%	0.0%	0.0%	0.0%
– *Streptococcus pyogenes* (a)	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other haemol. Streptococcae (c, g)	0.7%	0.0%	0.0%	0.0%	0.2%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
– *Streptococcus* sp., other	0.9%	1.0%	0.0%	0.5%	1.3%	0.0%	0.8%	2.2%	2.3%	0.0%	0.0%
– *Streptococcus* sp., not specified	0.2%	0.2%	0.0%	0.3%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%
Other gram-positive cocci	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative cocci	**0.4%**	**1.2%**	**0.0%**	**0.2%**	**0.7%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**2.2%**
Moraxella catharralis	0.0%	1.2%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Moraxella sp., not specified	0.2%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neisseria meningitidis	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neisseria sp., other	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neisseria sp., not specified	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
Gram-negative cocci, other	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative cocci, not specified	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-positive bacilli	**0.0%**	**0.2%**	**0.2%**	**0.4%**	**0.5%**	**0.0%**	**1.7%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Corynebacterium species	0.0%	0.2%	0.2%	0.4%	0.4%	0.0%	1.7%	0.0%	0.0%	0.0%	0.0%
Lactobacillus species	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative bacilli, Enterobacteriaceae	**29.9%**	**40.8%**	**37.3%**	**28.2%**	**33.8%**	**13.2%**	**23.3%**	**31.5%**	**35.6%**	**26.0%**	**52.2%**
Escherichia coli	8.6%	6.8%	9.9%	7.0%	9.3%	1.5%	4.6%	6.5%	9.2%	4.1%	8.7%
Enterobacter species	6.8%	12.7%	7.6%	6.7%	8.4%	7.4%	6.3%	4.3%	10.3%	5.5%	8.7%
– *Enterobacter aerogenes*	1.3%	5.8%	0.0%	1.3%	3.0%	1.5%	0.8%	1.1%	2.3%	1.4%	0.0%
– *Enterobacter cloacae*	4.9%	6.0%	0.0%	5.1%	5.2%	4.4%	5.0%	0.0%	8.0%	4.1%	8.7%
– *Enterobacter agglomerans*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	1.1%	0.0%	0.0%	0.0%
– *Enterobacter* sp., other	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	2.2%	0.0%	0.0%	0.0%
– *Enterobacter* sp., not specified	0.5%	0.8%	7.6%	0.3%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%
Klebsiella species	9.5%	10.3%	10.1%	7.4%	5.7%	1.5%	7.1%	15.2%	6.9%	8.2%	28.3%
– *Klebsiella pneumoniae*	6.6%	5.2%	0.0%	0.0%	3.7%	1.5%	6.3%	10.9%	4.6%	8.2%	26.1%
– *Klebsiella oxytoca*	2.6%	5.0%	0.0%	1.5%	1.8%	0.0%	0.8%	3.3%	1.1%	0.0%	2.2%
– *Klebsiella* sp., other	0.0%	0.2%	0.0%	5.8%	0.2%	0.0%	0.0%	1.1%	1.1%	0.0%	0.0%
– *Klebsiella* sp., not specified	0.4%	0.0%	10.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK
Proteus species	1.5%	2.7%	2.9%	1.5%	3.1%	2.9%	1.3%	3.3%	2.3%	2.7%	4.3%
– *Proteus mirabilis*	0.9%	2.2%	0.0%	1.2%	2.6%	2.9%	0.8%	3.3%	2.3%	2.7%	4.3%
– *Proteus vulgaris*	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Proteus* sp., other	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Proteus* sp., not specified	0.5%	0.2%	2.9%	0.2%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
Citrobacter species	0.7%	1.5%	2.2%	1.2%	1.9%	0.0%	1.7%	1.1%	1.1%	1.4%	2.2%
– *Citrobacter freundii*	0.2%	0.5%	0.0%	0.5%	0.7%	0.0%	1.3%	0.0%	1.1%	0.0%	2.2%
– *Citrobacter koseri* (ex. *Diversus*)	0.5%	0.3%	0.0%	0.1%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Citrobacter* sp., other	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%	0.4%	1.1%	0.0%	0.0%	0.0%
– *Citrobacter* sp., not specified	0.0%	0.5%	2.2%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%	0.0%
Serratia species	1.8%	3.7%	3.9%	2.9%	3.1%	0.0%	2.1%	1.1%	4.6%	2.7%	0.0%
– *Serratia marcescens*	0.0%	3.5%	0.0%	2.8%	0.0%	0.0%	2.1%	0.0%	4.6%	2.7%	0.0%
– *Serratia* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%
– *Serratia* sp., not specified	1.8%	0.2%	3.9%	0.1%	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other Enterobacteriaceae	1.1%	3.2%	0.6%	1.5%	2.3%	0.0%	0.4%	0.0%	1.1%	1.4%	0.0%
– *Hafnia* species	0.2%	0.5%	0.0%	0.2%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Morganella* species	0.7%	2.3%	0.0%	1.2%	0.9%	0.0%	0.4%	0.0%	1.1%	1.4%	0.0%
– *Providencia* species	0.2%	0.2%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other Enterobacteriaceae	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Enterobacteriaceae, not specified	0.0%	0.2%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative bacilli, other	**27.9%**	**32.0%**	**25.1%**	**40.4%**	**33.6%**	**64.7%**	**45.0%**	**33.7%**	**32.2%**	**54.8%**	**34.8%**
Acinetobacter species	1.1%	0.8%	2.3%	12.3%	2.6%	33.8%	11.7%	15.2%	1.1%	13.7%	10.9%
– *Acinetobacter baumannii*	0.7%	0.0%	0.0%	11.8%	2.4%	33.8%	11.7%	4.3%	1.1%	13.7%	0.0%
– *Acinetobacter calcoaceticus*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
– *Acinetobacter lwoffi*	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Acinetobacter* sp., other	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	10.9%	0.0%	0.0%	0.0%
– *Acinetobacter* sp., not specified	0.4%	0.8%	2.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%
Pseudomonas aeruginosa	21.2%	23.3%	16.6%	18.7%	21.5%	26.5%	22.1%	13.0%	18.4%	32.9%	23.9%
Stenotrophomonas maltophilia	3.5%	4.0%	3.4%	3.9%	3.4%	0.0%	8.8%	1.1%	6.9%	1.4%	0.0%
Pseudomonadaceae family, other	0.0%	1.2%	0.0%	0.5%	0.2%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
– *Burkholderia cepacia*	0.0%	0.2%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Pseudomonadaceae family, other	0.0%	0.7%	0.0%	0.1%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
– Pseudomonadaceae family, not specified	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Haemophilus species	2.0%	2.0%	2.6%	4.7%	5.1%	4.4%	2.1%	3.3%	4.6%	6.8%	0.0%
– *Haemophilus influenzae*	0.0%	2.0%	0.0%	4.6%	0.0%	4.4%	2.1%	3.3%	3.4%	6.8%	0.0%
– *Haemophilus* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%
– *Haemophilus* sp., not specified	2.0%	0.0%	2.6%	0.1%	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Legionella species	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%
Oth. gram-negative bacilli, non Enterobacteriaciaea	0.2%	0.7%	0.0%	0.3%	0.7%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%
– *Achromobacter* species	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%
– *Aeromonas* species	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Alcaligenes* species	0.0%	0.5%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Gram-negative bacilli, non-Enterobacteriaceae, not spec.	0.2%	0.2%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Anaerobes	**0.2%**	**0.2%**	**0.1%**	**0.0%**	**0.2%**	**0.0%**	**0.8%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Bacteroides species	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other anaerobes	0.2%	0.2%	0.0%	0.0%	0.2%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK
– *Propionibacterium* species	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%
– *Prevotella* species	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other anaerobes	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Anaerobes, not specified	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria	**0.7%**	**0.0%**	**0.0%**	**0.3%**	**0.1%**	**0.0%**	**0.0%**	**1.1%**	**0.0%**	**0.0%**	**0.0%**
Mycobacterium tuberculosis compl.	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chlamydia species	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Nocardia species	0.2%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%
Fungi, yeasts, parasites	**14.8%**	**3.5%**	**13.0%**	**7.4%**	**4.4%**	**1.5%**	**7.1%**	**5.4%**	**11.5%**	**0.0%**	**4.3%**
Candida species	13.7%	1.3%	11.1%	5.7%	3.9%	1.5%	6.3%	5.4%	11.5%	0.0%	4.3%
– *Candida albicans*	9.5%	0.7%	11.1%	3.3%	2.9%	0.0%	3.3%	2.2%	9.2%	0.0%	2.2%
– *Candida glabrata*	0.0%	0.2%	0.0%	0.5%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
– *Candida tropicalis*	0.0%	0.2%	0.0%	0.5%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%
– *Candida parapsilosis*	0.0%	0.2%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Candida* sp., other	0.0%	0.0%	0.0%	0.3%	1.1%	0.0%	0.8%	3.3%	1.1%	0.0%	0.0%
– *Candida* sp., not specified	4.2%	0.2%	0.0%	0.8%	0.0%	1.5%	0.8%	0.0%	1.1%	0.0%	2.2%
Aspergillus species	1.1%	2.0%	0.0%	1.4%	0.2%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%
– *Aspergillus fumigatus*	0.0%	1.8%	0.0%	1.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Aspergillus niger*	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Aspergillus* sp., other	0.0%	0.2%	0.0%	0.2%	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
– *Aspergillus* sp., not specified	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
Other fungi/parasites	0.0%	0.2%	1.9%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other yeasts	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Filaments other	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Fungi/parasites, not specified	0.0%	0.0%	1.9%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Viruses	**0.2%**	**1.3%**	**0.1%**	**0.2%**	**0.4%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

c) Microorganisms isolated in ICU-acquired bloodstream infections

Table 114: Microorganisms isolated in ICU-acquired bloodstream infections by year, 2004–2007

	2004	2005	2006	2007	TOTAL
TOTAL N of isolates	**3465**	**4216**	**4404**	**4988**	**17073**
Gram-positive cocci	**55.7%**	**55.9%**	**52.5%**	**52.8%**	**54.1%**
Staphylococcus aureus	13.5%	13.5%	12.7%	11.4%	12.7%
Coagulase-negative staphylococci	30.0%	29.0%	26.5%	28.6%	28.4%
– *Staphylococcus epidermidis*	11.4%	9.5%	8.9%	8.6%	9.5%
– *Staphylococcus haemolyticus*	1.2%	0.7%	0.7%	1.1%	0.9%
– Other coagulase-negative staphylococci (CNS)	5.1%	5.5%	4.5%	5.0%	5.0%
– Coagulase-neg. Staphylococci, not specified	11.0%	11.4%	10.2%	11.6%	11.1%
– *Staphylococcus* sp., not specified	1.4%	1.9%	2.1%	2.3%	2.0%
Enterococcus species	9.6%	11.6%	11.4%	11.2%	11.1%
– *Enterococcus faecalis*	4.2%	5.5%	5.1%	4.9%	4.9%
– *Enterococcus faecium*	1.3%	1.3%	1.6%	1.5%	1.4%
– *Enterococcus* sp., other	0.0%	0.1%	0.1%	0.1%	0.1%
– *Enterococcus* sp., not specified	4.1%	4.8%	4.7%	4.7%	4.6%
Streptococcus species	2.1%	1.8%	1.8%	1.4%	1.7%
– *Streptococcus pneumoniae*	0.3%	0.3%	0.1%	0.3%	0.3%
– *Streptococcus agalactiae* (b)	0.1%	0.1%	0.1%	0.1%	0.1%
– *Streptococcus pyogenes* (a)	0.1%	0.1%	0.1%	0.0%	0.1%
– Other haemol. Streptococcae (c, g)	0.1%	0.1%	0.1%	0.1%	0.1%
– *Streptococcus* sp., other	0.8%	0.8%	1.0%	0.7%	0.8%
– *Streptococcus* sp., not specified	0.8%	0.3%	0.3%	0.2%	0.4%
Other gram-positive cocci	0.3%	0.1%	0.1%	0.2%	0.2%
Gram-negative cocci	**0.0%**	**0.0%**	**0.0%**	**0.1%**	**0.0%**
Moraxella catharralis	0.0%	0.0%	0.0%	0.0%	0.0%
Moraxella sp., not specified	0.0%	0.0%	0.0%	0.1%	0.0%
Gram-negative cocci, other	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-positive bacilli	**0.9%**	**0.5%**	**0.8%**	**0.6%**	**0.7%**
Corynebacterium species	0.7%	0.3%	0.3%	0.4%	0.4%
Bacillus species	0.1%	0.2%	0.2%	0.1%	0.2%
Lactobacillus species	0.1%	0.0%	0.2%	0.0%	0.1%
Listeria monocytogenes	0.0%	0.0%	0.0%	0.0%	0.0%
Other gram-positive bacilli	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative bacilli, Enterobacteriaceae	**23.1%**	**23.2%**	**24.5%**	**23.7%**	**23.7%**
Escherichia coli	6.7%	6.9%	7.1%	7.3%	7.0%
Enterobacter species	6.0%	6.0%	6.2%	5.5%	5.9%
– *Enterobacter aerogenes*	1.8%	1.7%	1.6%	1.4%	1.6%
– *Enterobacter cloacae*	2.8%	2.6%	3.3%	3.1%	3.0%
– *Enterobacter agglomerans*	0.1%	0.0%	0.0%	0.0%	0.0%
– *Enterobacter* sp., other	0.1%	0.1%	0.1%	0.1%	0.1%
– *Enterobacter* sp., not specified	1.3%	1.6%	1.2%	1.0%	1.2%
Klebsiella species	5.5%	4.8%	5.5%	6.0%	5.5%
– *Klebsiella pneumoniae*	2.3%	2.1%	2.4%	2.6%	2.4%
– *Klebsiella oxytoca*	1.2%	0.8%	1.0%	1.4%	1.1%
– *Klebsiella* sp., other	0.3%	0.7%	0.6%	0.7%	0.6%
– *Klebsiella* sp., not specified	1.7%	1.2%	1.5%	1.3%	1.4%
Proteus species	1.4%	1.3%	1.4%	1.3%	1.4%
– *Proteus mirabilis*	1.1%	0.7%	0.9%	0.7%	0.8%

	2004	2005	2006	2007	TOTAL
– *Proteus vulgaris*	0.1%	0.1%	0.1%	0.1%	0.1%
– *Proteus* sp., other	0.1%	0.1%	0.1%	0.1%	0.1%
– *Proteus* sp., not specified	0.2%	0.5%	0.4%	0.4%	0.4%
Citrobacter species	0.8%	0.9%	0.7%	0.8%	0.8%
– *Citrobacter freundii*	0.3%	0.3%	0.3%	0.3%	0.3%
– *Citrobacter koseri* (ex. *Diversus*)	0.1%	0.2%	0.1%	0.1%	0.2%
– *Citrobacter* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Citrobacter* sp., not specified	0.4%	0.3%	0.3%	0.3%	0.3%
Serratia species	1.9%	2.3%	2.5%	1.8%	2.1%
– *Serratia marcescens*	0.7%	1.2%	1.2%	0.8%	1.0%
– *Serratia liquefaciens*	0.0%	0.1%	0.0%	0.0%	0.0%
– *Serratia* sp., other	0.0%	0.1%	0.0%	0.0%	0.0%
– *Serratia* sp., not specified	1.2%	1.0%	1.3%	1.0%	1.1%
Other Enterobacteriaceae	0.9%	1.0%	1.1%	1.0%	1.0%
– *Hafnia* species	0.0%	0.0%	0.1%	0.1%	0.1%
– *Morganella* species	0.5%	0.7%	0.7%	0.6%	0.6%
– *Providencia* species	0.1%	0.0%	0.1%	0.1%	0.1%
– *Salmonella enteritidis*	0.1%	0.0%	0.0%	0.0%	0.0%
– *Salmonella typhi or paratyphi*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Salmonella* sp., not specified	0.0%	0.0%	0.0%	0.0%	0.0%
– Other Enterobacteriaceae	0.0%	0.0%	0.0%	0.0%	0.0%
– Enterobacteriaceae, not specified	0.2%	0.1%	0.2%	0.2%	0.2%
Gram-negative bacilli, other	**11.4%**	**12.1%**	**12.5%**	**13.7%**	**12.5%**
Acinetobacter species	2.0%	2.0%	2.7%	3.0%	2.5%
– *Acinetobacter baumannii*	1.4%	1.4%	1.8%	2.2%	1.7%
– *Acinetobacter calcoaceticus*	0.0%	0.0%	0.1%	0.0%	0.0%
– *Acinetobacter haemolyticus*	0.1%	0.0%	0.0%	0.0%	0.0%
– *Acinetobacter lwoffi*	0.0%	0.0%	0.0%	0.1%	0.0%
– *Acinetobacter* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Acinetobacter* sp., not specified	0.5%	0.5%	0.8%	0.6%	0.6%
Pseudomonas aeruginosa	8.1%	8.6%	8.3%	9.0%	8.5%
Stenotrophomonas maltophilia	0.7%	0.8%	0.8%	1.0%	0.9%
Pseudomonadaceae family, other	0.3%	0.3%	0.3%	0.4%	0.3%
– *Burkholderia cepacia*	0.1%	0.1%	0.2%	0.1%	0.1%
– Pseudomonadaceae family, other	0.2%	0.1%	0.1%	0.2%	0.2%
– Pseudomonadaceae family, not specified	0.1%	0.1%	0.0%	0.0%	0.0%
Haemophilus species	0.2%	0.2%	0.1%	0.2%	0.2%
– *Haemophilus influenzae*	0.1%	0.1%	0.1%	0.1%	0.1%
– *Haemophilus parainfluenzae*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus* sp., not specified	0.1%	0.1%	0.1%	0.0%	0.1%
Legionella species	0.0%	0.0%	0.0%	0.0%	0.0%
Other gram-negative bacilli, non-Enterobacteriaciaea	0.1%	0.2%	0.2%	0.1%	0.2%
– *Achromobacter* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Aeromonas* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Agrobacterium* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Alcaligenes* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Campylobacter* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Flavobacterium* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Pasteurella* species	0.0%	0.0%	0.0%	0.0%	0.0%
– Other gram-negative bacilli, non-Enterobacteriaciaea	0.1%	0.1%	0.0%	0.1%	0.1%

	2004	2005	2006	2007	TOTAL
Anaerobes	**1.8%**	**1.4%**	**1.7%**	**1.3%**	**1.6%**
Bacteroides species	1.2%	1.1%	1.2%	0.8%	1.1%
– *Bacteroides fragilis*	0.7%	0.6%	0.7%	0.4%	0.6%
– *Bacteroides* sp., other	0.1%	0.2%	0.3%	0.3%	0.2%
– *Bacteroides* species, not specified	0.4%	0.3%	0.2%	0.2%	0.3%
Other anaerobes	0.6%	0.3%	0.6%	0.5%	0.5%
– *Clostridium difficile*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Clostridium* sp., not specified	0.1%	0.1%	0.1%	0.1%	0.1%
– *Propionibacterium* species	0.1%	0.0%	0.0%	0.1%	0.1%
– *Prevotella* species	0.1%	0.0%	0.1%	0.1%	0.1%
– Other anaerobes	0.1%	0.2%	0.2%	0.1%	0.2%
– Anaerobes, not specified	0.2%	0.0%	0.1%	0.0%	0.1%
Other bacteria	**0.0%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**
Chlamydia species	0.0%	0.0%	0.0%	0.0%	0.0%
Actinomyces species	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria	0.0%	0.1%	0.0%	0.0%	0.0%
Fungi, yeasts, parasites	**7.0%**	**6.6%**	**7.8%**	**7.8%**	**7.4%**
Candida species	6.3%	6.4%	7.5%	7.5%	7.0%
– *Candida albicans*	4.2%	4.5%	5.1%	5.1%	4.8%
– *Candida glabrata*	0.4%	0.6%	0.6%	0.5%	0.5%
– *Candida tropicalis*	0.1%	0.1%	0.1%	0.2%	0.2%
– *Candida parapsilosis*	0.1%	0.1%	0.4%	0.3%	0.2%
– *Candida* sp., other	0.5%	0.4%	0.8%	1.0%	0.7%
– *Candida* sp., not specified	0.8%	0.8%	0.4%	0.4%	0.6%
Aspergillus species	0.0%	0.0%	0.1%	0.0%	0.0%
– *Aspergillus fumigatus*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Aspergillus* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
Other fungi, yeasts, parasites	0.8%	0.2%	0.3%	0.2%	0.4%
– Other yeasts	0.1%	0.1%	0.1%	0.0%	0.1%
– Filaments other	0.0%	0.0%	0.0%	0.0%	0.0%
– Fungi, not specified	0.1%	0.0%	0.0%	0.0%	0.0%
– Fungi/parasites, not specified	0.5%	0.1%	0.2%	0.2%	0.2%
Viruses	**0.1%**	**0.1%**	**0.1%**	**0.2%**	**0.1%**
TOTAL	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 115: Microorganisms isolated in ICU-acquired bloodstream infections by country, 2007 (percentages expressed on total isolates excluding coagulase-negative staphylococci*)

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK
Number of isolates	**272**	**993**	**1 293**	**940**	**1 159**	**13**	**106**	**41**	**46**	**36**	**12**
Number of isolates excluding CNS	**145**	**799**	**856**	**606**	**914**	**9**	**66**	**37**	**41**	**24**	**10**
Gram-positive cocci	**68.0%**	**43.8%**	**65.9%**	**54.0%**	**42.5%**	**46.2%**	**48.1%**	**19.5%**	**47.8%**	**72.2%**	**33.3%**
Gram-positive cocci excluding CNS	**40.0%**	**30.2%**	**48.5%**	**28.7%**	**27.1%**	**22.2%**	**16.7%**	**10.8%**	**41.5%**	**58.3%**	**20.0%**
Staphylococcus aureus	12.4%	11.0%	24.2%	10.1%	17.0%	22.2%	6.1%	5.4%	19.5%	45.8%	20.0%
Coagulase-negative stafylococci*	46.7%	19.5%	33.8%	35.5%	21.1%	30.8%	37.7%	9.8%	10.9%	33.3%	16.7%
– *Staphylococcus epidermidis*	19.5%	4.2%	0.0%	18.0%	10.9%	7.7%	16.0%	4.9%	8.7%	19.4%	0.0%
– *Staphylococcus haemolyticus*	1.8%	0.9%	0.0%	0.0%	2.2%	0.0%	9.4%	0.0%	0.0%	11.1%	0.0%
– Other coag.-negative staphylococci (CNS)	0.0%	6.7%	0.1%	13.4%	3.0%	23.1%	7.5%	4.9%	2.2%	2.8%	8.3%
– Coag.-neg. Staphylococci, not spec.	19.9%	7.7%	33.7%	0.0%	0.0%	0.0%	2.8%	0.0%	0.0%	0.0%	0.0%
– *Staphylococcus* sp., not specified	5.5%	0.0%	0.0%	4.1%	5.1%	0.0%	1.9%	0.0%	0.0%	0.0%	8.3%
Enterococcus species	22.8%	15.5%	24.3%	16.5%	7.4%	0.0%	9.1%	0.0%	19.5%	12.5%	0.0%
– *Enterococcus faecalis*	7.6%	11.9%	0.0%	12.0%	5.3%	0.0%	9.1%	0.0%	14.6%	8.3%	0.0%
– *Enterococcus faecium*	10.3%	2.0%	0.0%	3.8%	1.5%	0.0%	0.0%	0.0%	4.9%	4.2%	0.0%
– *Enterococcus* sp., other	0.0%	0.1%	0.0%	0.2%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Enterococcus* sp., not specified	4.8%	1.5%	24.3%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Streptococcus species	3.4%	3.6%	0.0%	2.1%	2.2%	0.0%	0.0%	5.4%	2.4%	0.0%	0.0%
– *Streptococcus pneumoniae*	0.0%	1.0%	0.0%	0.7%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Streptococcus agalactiae* (b)	0.0%	0.1%	0.0%	0.2%	0.4%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
– *Streptococcus pyogenes* (a)	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other haemol. Streptococcae (c, g)	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Streptococcus* sp., other	0.7%	1.4%	0.0%	0.8%	1.4%	0.0%	0.0%	2.7%	2.4%	0.0%	0.0%
– *Streptococcus* sp., not specified	0.7%	0.9%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other gram-positive cocci	1.4%	0.0%	0.0%	0.0%	0.5%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
Gram-negative cocci	**0.0%**	**0.1%**	**0.0%**	**0.0%**	**0.3%**	**0.0%**	**1.5%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Moraxella catharralis	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Moraxella sp., not specified	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
Gram-positive bacilli	**3.4%**	**0.5%**	**0.8%**	**0.3%**	**1.0%**	**0.0%**	**1.5%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Corynebacterium species	2.8%	0.1%	0.8%	0.3%	0.7%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
Bacillus species	0.7%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lactobacillus species	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other gram-positive bacilli	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-neg. bacilli, Enterobacteriaceae	**19.3%**	**41.1%**	**27.1%**	**33.5%**	**35.3%**	**33.3%**	**25.8%**	**54.1%**	**39.0%**	**8.3%**	**40.0%**
Escherichia coli	8.3%	13.8%	7.7%	9.4%	11.3%	11.1%	10.6%	5.4%	9.8%	4.2%	10.0%
Enterobacter species	3.4%	7.6%	5.4%	8.7%	10.7%	0.0%	4.5%	13.5%	7.3%	0.0%	10.0%
– *Enterobacter aerogenes*	1.4%	3.1%	0.0%	2.1%	3.0%	0.0%	0.0%	5.4%	0.0%	0.0%	0.0%
– *Enterobacter cloacae*	2.1%	4.4%	0.0%	6.4%	7.3%	0.0%	4.5%	5.4%	7.3%	0.0%	10.0%
– *Enterobacter agglomerans*	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
– *Enterobacter* sp., other	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Enterobacter* sp., not specified	0.0%	0.1%	5.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Klebsiella species	4.8%	11.8%	7.1%	8.4%	6.6%	22.2%	1.5%	18.9%	14.6%	4.2%	20.0%

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK
– *Klebsiella pneumoniae*	3.4%	8.0%	0.0%	0.0%	4.9%	22.2%	1.5%	13.5%	7.3%	0.0%	20.0%
– *Klebsiella oxytoca*	1.4%	3.8%	0.0%	2.5%	1.6%	0.0%	0.0%	5.4%	4.9%	4.2%	0.0%
– *Klebsiella* sp., other	0.0%	0.0%	0.0%	5.8%	0.0%	0.0%	0.0%	0.0%	2.4%	0.0%	0.0%
– *Klebsiella* sp., not specified	0.0%	0.0%	7.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Proteus species	0.7%	1.9%	2.0%	2.1%	1.4%	0.0%	3.0%	2.7%	2.4%	0.0%	0.0%
– *Proteus mirabilis*	0.7%	1.4%	0.0%	1.7%	1.2%	0.0%	3.0%	2.7%	2.4%	0.0%	0.0%
– *Proteus vulgaris*	0.0%	0.3%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Proteus* sp., other	0.0%	0.0%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Proteus* sp., not specified	0.0%	0.3%	2.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Citrobacter species	0.7%	1.3%	1.1%	1.0%	1.0%	0.0%	1.5%	5.4%	0.0%	0.0%	0.0%
– *Citrobacter freundii*	0.7%	0.8%	0.0%	0.7%	0.5%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
– *Citrobacter koseri* (ex. *Diversus*)	0.0%	0.3%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Citrobacter* sp., other	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
– *Citrobacter* sp., not specified	0.0%	0.3%	1.1%	0.3%	0.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
Serratia species	0.7%	2.3%	3.0%	3.0%	2.5%	0.0%	4.5%	2.7%	4.9%	0.0%	0.0%
– *Serratia marcescens*	0.0%	2.1%	0.0%	3.0%	0.0%	0.0%	1.5%	2.7%	4.9%	0.0%	0.0%
– *Serratia liquefaciens*	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%	0.0%	0.0%
– *Serratia* sp., not specified	0.7%	0.0%	3.0%	0.0%	2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other Enterobacteriaceae	0.7%	2.5%	0.8%	0.8%	1.9%	0.0%	0.0%	5.4%	0.0%	0.0%	0.0%
– *Hafnia* species	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Morganella* species	0.7%	2.0%	0.0%	0.7%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Providencia* species	0.0%	0.5%	0.0%	0.0%	0.2%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
– *Salmonella* enteritidis	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
– Other Enterobacteriaceae	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Enterobacteriaceae, not specified	0.0%	0.0%	0.8%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative bacilli, other	**11.7%**	**17.8%**	**14.1%**	**25.4%**	**19.3%**	**44.4%**	**40.9%**	**27.0%**	**14.6%**	**33.3%**	**40.0%**
Acinetobacter species	0.7%	2.3%	2.7%	10.2%	1.8%	44.4%	9.1%	13.5%	0.0%	12.5%	30.0%
– *Acinetobacter baumannii*	0.7%	1.6%	0.0%	9.7%	1.6%	44.4%	9.1%	5.4%	0.0%	12.5%	0.0%
– *Acinetobacter calcoaceticus*	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Acinetobacter lwoffi*	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%
– *Acinetobacter* sp., other	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	5.4%	0.0%	0.0%	0.0%
– *Acinetobacter* sp., not specified	0.0%	0.4%	2.7%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	30.0%
Pseudomonas aeruginosa	10.3%	12.3%	10.0%	13.4%	14.8%	0.0%	22.7%	8.1%	12.2%	20.8%	10.0%
Stenotrophomonas maltophilia	0.0%	1.8%	1.4%	1.0%	1.5%	0.0%	4.5%	5.4%	2.4%	0.0%	0.0%
Pseudomonadaceae family, other	0.0%	0.5%	0.0%	0.8%	0.7%	0.0%	4.5%	0.0%	0.0%	0.0%	0.0%
– *Burkholderia cepacia*	0.0%	0.1%	0.0%	0.5%	0.1%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
– Pseudomonadaceae family, other	0.0%	0.4%	0.0%	0.2%	0.5%	0.0%	3.0%	0.0%	0.0%	0.0%	0.0%
– Pseudomonadaceae family, not specified	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Haemophilus species	0.7%	0.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus influenzae*	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus parainfluenzae*	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus* sp., not specified	0.7%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oth. gram-negative bacilli, non-enterobacteriaciaea	0.0%	0.3%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Achromobacter* species	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Alcaligenes* species	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

	AT	BE	DE	ES	FR	HR	IT	LT	LU	PT	SK
– Other gram-negative bacilli, non-Enterobacteriaciaea	0.0%	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Anaerobes	**2.8%**	**2.1%**	**0.5%**	**1.0%**	**3.6%**	**0.0%**	**1.5%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Bacteroides species	0.0%	1.3%	0.5%	0.3%	2.7%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
– *Bacteroides fragilis*	0.0%	0.9%	0.0%	0.3%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Bacteroides* sp., other	0.0%	0.0%	0.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Bacteroides* species, not specified	0.0%	0.4%	0.5%	0.0%	0.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
Other anaerobes	2.8%	0.9%	0.0%	0.7%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Clostridium difficile*	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Clostridium* sp., not specified	0.7%	0.3%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Propionibacterium* species	1.4%	0.0%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Prevotella* species	0.0%	0.1%	0.0%	0.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other anaerobes	0.0%	0.4%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Anaerobes, not specified	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Fungi, yeasts, parasites	**19.3%**	**8.3%**	**8.8%**	**11.1%**	**13.1%**	**0.0%**	**18.2%**	**10.8%**	**9.8%**	**0.0%**	**0.0%**
Candida species	19.3%	8.0%	7.7%	11.1%	13.1%	0.0%	18.2%	10.8%	9.8%	0.0%	0.0%
– *Candida albicans*	11.7%	4.5%	7.7%	6.9%	8.1%	0.0%	16.7%	0.0%	7.3%	0.0%	0.0%
– *Candida glabrata*	0.0%	2.0%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Candida tropicalis*	0.0%	0.6%	0.0%	0.5%	0.0%	0.0%	0.0%	10.8%	0.0%	0.0%	0.0%
– *Candida parapsilosis*	0.0%	0.6%	0.0%	1.7%	0.0%	0.0%	0.0%	0.0%	2.4%	0.0%	0.0%
– *Candida* sp., other	0.0%	0.1%	0.0%	0.3%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– *Candida* sp., not specified	7.6%	0.1%	0.0%	0.7%	0.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
Other fungi/yeasts,/parasites	0.0%	0.3%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Other yeasts	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Fungi/parasites, not specified	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Viruses	**3.4%**	**0.0%**	**0.1%**	**0.0%**	**0.2%**	**0.0%**	**1.5%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
– Adenovirus	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Cytomegalovirus (CMV)	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
– Influenza virus	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Respiratory syncytial virus (RSV)	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
– Virus, not specified	1.4%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

** Coagulase-negative staphylococci (CNS) percentages are relative to the total number of isolates, other percentages are relative to the total excluding CNS.*

d) Microorganisms isolated in ICU-acquired urinary tract infections

Table 116: Microorganisms isolated in ICU-acquired urinary tract infections by year

	2004	2005	2006	2007	TOTAL
Total N of isolates	**3 628**	**4 743**	**4 781**	**5 212**	**18 364**
Gram-positive cocci	**26.0%**	**24.6%**	**23.7%**	**23.0%**	**24.2%**
Staphylococcus aureus	1.9%	1.5%	1.3%	1.2%	1.5%
Coagulase-negative staphylococci	4.1%	3.1%	3.2%	2.9%	3.3%
– *Staphylococcus epidermidis*	1.5%	1.2%	1.0%	0.8%	1.1%
– *Staphylococcus haemolyticus*	0.1%	0.2%	0.3%	0.2%	0.2%
– Other coagulase-negative staphylococci (CNS)	0.4%	0.3%	0.4%	0.2%	0.3%
– Coagulase-neg. staphylococci, not specified	1.7%	1.2%	1.2%	1.1%	1.3%
– *Staphylococcus* sp., not specified	0.4%	0.3%	0.4%	0.6%	0.4%
Enterococcus species	19.1%	19.2%	18.7%	18.2%	18.8%
– *Enterococcus faecalis*	4.9%	6.3%	5.5%	5.9%	5.7%
– *Enterococcus faecium*	1.9%	1.3%	1.4%	1.5%	1.5%
– *Enterococcus* sp., other	0.2%	0.3%	0.5%	0.2%	0.3%
– *Enterococcus* sp., not specified	12.2%	11.3%	11.4%	10.5%	11.3%
Streptococcus species	0.7%	0.6%	0.4%	0.6%	0.6%
– *Streptococcus agalactiae* (b)	0.1%	0.2%	0.2%	0.1%	0.1%
– Other haemol. Streptococcae (c, g)	0.0%	0.0%	0.0%	0.0%	0.0%
– *Streptococcus* sp., other	0.4%	0.4%	0.2%	0.4%	0.3%
– *Streptococcus* sp., not specified	0.2%	0.0%	0.0%	0.1%	0.1%
Other gram-positive cocci	0.2%	0.1%	0.1%	0.1%	0.1%
Gram-negative cocci	**0.1%**	**0.1%**	**0.0%**	**0.0%**	**0.1%**
Moraxella catharralis	0.0%	0.0%	0.0%	0.0%	0.0%
Moraxella sp., not specified	0.0%	0.1%	0.0%	0.0%	0.0%
Neisseria sp., not specified	0.0%	0.0%	0.0%	0.0%	0.0%
Gram-negative cocci, other	0.0%	0.1%	0.0%	0.0%	0.0%
Gram-positive bacilli	**0.3%**	**0.2%**	**0.3%**	**0.3%**	**0.3%**
Corynebacterium species	0.3%	0.1%	0.2%	0.2%	0.2%
Lactobacillus species	0.0%	0.0%	0.1%	0.1%	0.0%
Gram-negative bacilli, Enterobacteriaceae	**38.0%**	**40.8%**	**43.0%**	**42.0%**	**41.1%**
Escherichia coli	22.5%	24.1%	25.4%	25.2%	24.4%
Enterobacter species	4.5%	4.8%	4.7%	4.8%	4.7%
– *Enterobacter aerogenes*	0.8%	1.0%	0.6%	0.8%	0.8%
– *Enterobacter cloacae*	1.7%	1.5%	2.4%	2.1%	1.9%
– *Enterobacter agglomerans*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Enterobacter* sp., other	0.1%	0.1%	0.1%	0.3%	0.2%
– *Enterobacter* sp., not specified	2.0%	2.2%	1.6%	1.7%	1.9%
Klebsiella species	4.9%	5.2%	6.1%	5.7%	5.5%
– *Klebsiella pneumoniae*	1.5%	1.4%	2.5%	1.8%	1.8%
– *Klebsiella oxytoca*	0.7%	0.6%	0.8%	0.9%	0.8%
– *Klebsiella* sp., other	0.3%	0.5%	0.5%	0.4%	0.4%
– *Klebsiella* sp., not specified	2.3%	2.7%	2.3%	2.6%	2.5%
Proteus species	3.3%	3.7%	3.6%	3.4%	3.5%
– *Proteus mirabilis*	1.5%	1.9%	1.8%	1.7%	1.7%
– *Proteus vulgaris*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Proteus* sp., other	0.1%	0.1%	0.2%	0.1%	0.1%
– *Proteus* sp., not specified	1.7%	1.7%	1.6%	1.6%	1.6%
Citrobacter species	1.2%	1.2%	1.2%	1.3%	1.2%

	2004	2005	2006	2007	TOTAL
– *Citrobacter freundii*	0.4%	0.4%	0.4%	0.4%	0.4%
– *Citrobacter koseri* (ex. *Diversus*)	0.2%	0.3%	0.3%	0.4%	0.3%
– *Citrobacter* sp., other	0.0%	0.0%	0.1%	0.0%	0.0%
– *Citrobacter* sp., not specified	0.6%	0.5%	0.5%	0.5%	0.5%
Serratia species	0.7%	0.6%	0.8%	0.6%	0.7%
– *Serratia marcescens*	0.1%	0.1%	0.1%	0.1%	0.1%
– *Serratia* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– *Serratia* sp., not specified	0.6%	0.5%	0.6%	0.5%	0.6%
Other Enterobacteriaceae	1.0%	1.1%	1.2%	1.1%	1.1%
– *Hafnia* species	0.0%	0.0%	0.1%	0.1%	0.1%
– *Morganella* species	0.7%	0.7%	0.8%	0.6%	0.7%
– *Providencia* species	0.1%	0.0%	0.1%	0.0%	0.1%
– *Salmonella* sp., other	0.0%	0.0%	0.0%	0.0%	0.0%
– Other enterobacteriaceae	0.0%	0.0%	0.0%	0.0%	0.0%
– Enterobacteriaceae, not specified	0.2%	0.3%	0.1%	0.3%	0.2%
Gram-negative bacilli, other	**16.3%**	**16.3%**	**14.6%**	**16.2%**	**15.8%**
Acinetobacter species	0.8%	1.1%	0.9%	1.2%	1.0%
– *Acinetobacter baumannii*	0.5%	0.9%	0.5%	1.0%	0.8%
– *Acinetobacter lwoffi*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Acinetobacter* sp., not specified	0.3%	0.2%	0.3%	0.2%	0.2%
Pseudomonas aeruginosa	14.7%	14.5%	13.1%	14.4%	14.2%
Stenotrophomonas maltophilia	0.4%	0.4%	0.3%	0.4%	0.4%
Pseudomonadaceae family, other	0.2%	0.2%	0.1%	0.1%	0.2%
– *Burkholderia cepacia*	0.1%	0.1%	0.1%	0.0%	0.0%
– Pseudomonadaceae family, other	0.1%	0.1%	0.1%	0.0%	0.1%
– Pseudomonadaceae family, not specified	0.0%	0.1%	0.0%	0.0%	0.0%
Haemophilus species	0.0%	0.0%	0.1%	0.0%	0.0%
– *Haemophilus influenzae*	0.0%	0.0%	0.0%	0.0%	0.0%
– *Haemophilus* sp., not specified	0.0%	0.0%	0.1%	0.0%	0.0%
Oth. gram-negative bacilli, non-Enterobacteriaciaea	0.2%	0.0%	0.0%	0.1%	0.1%
– *Achromobacter* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Aeromonas* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Alcaligenes* species	0.1%	0.0%	0.0%	0.0%	0.0%
– *Campylobacter* species	0.0%	0.0%	0.0%	0.0%	0.0%
– *Flavobacterium* species	0.0%	0.0%	0.0%	0.0%	0.0%
– Other gram-negative bacilli, non-Enterobacteriaciaea	0.0%	0.0%	0.0%	0.0%	0.0%
Anaerobes	**0.0%**	**0.1%**	**0.0%**	**0.1%**	**0.0%**
Other anaerobes	0.0%	0.1%	0.0%	0.1%	0.0%
– *Clostridium* sp., not specified	0.0%	0.0%	0.0%	0.0%	0.0%
– *Propionibacterium* species	0.0%	0.0%	0.0%	0.1%	0.0%
– Other anaerobes	0.0%	0.1%	0.0%	0.0%	0.0%
– Anaerobes, not specified	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria	**0.1%**	**0.0%**	**0.0%**	**0.1%**	**0.1%**
Mycobacterium, atypical	0.0%	0.0%	0.0%	0.0%	0.0%
Mycoplasma species	0.0%	0.0%	0.0%	0.0%	0.0%
Chlamydia species	0.0%	0.0%	0.0%	0.0%	0.0%
Other bacteria, not specified	0.1%	0.0%	0.0%	0.1%	0.0%
Fungi, yeasts, parasites	**19.3%**	**18.1%**	**18.5%**	**18.3%**	**18.5%**
Candida species	16.1%	15.8%	16.7%	16.7%	16.4%
– *Candida albicans*	12.4%	11.4%	12.5%	11.8%	12.0%
– *Candida glabrata*	0.1%	0.1%	0.5%	0.4%	0.3%
– *Candida tropicalis*	0.1%	0.0%	0.2%	0.2%	0.1%

	2004	2005	2006	2007	TOTAL
– *Candida parapsilosis*	0.1%	0.0%	0.2%	0.3%	0.2%
– *Candida* sp., other	1.0%	2.2%	1.9%	1.8%	1.8%
– *Candida* sp., not specified	2.3%	2.2%	1.4%	2.2%	2.0%
Other parasites	3.2%	2.3%	1.8%	1.6%	2.1%
– Other yeasts	0.2%	0.3%	0.2%	0.3%	0.2%
– Fungi, not specified	0.0%	0.1%	0.0%	0.1%	0.0%
– Fungi/parasites, not specified	3.1%	1.9%	1.6%	1.2%	1.9%
Viruses	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**

e) Risk factors of ICU-acquired infections

Table 117: Univariate risk factor analysis, pneumonia

Variable	N	N PN	% PN	OR	(95% CI)
Intrinsic risk factors at ICU admission					
Age					
– < 20y	1 299	82	6.3	1.0	-
– 20–39y	5 550	474	8.5	1.4	(1.1–1.8)
– 40–59y	14 146	1 052	7.4	1.2	(0.9–1.5)
– 60–69y	11 164	775	6.9	1.1	(0.9–1.4)
– 70–74y	6 991	484	6.9	1.1	(0.9–1.4)
– 75–79y	9 091	601	6.6	1.1	(0.8–1.3)
– ≥ 80y	7 630	359	4.7	0.7	(0.6–0.9)
Gender					
– Female	21 444	1 113	5.2	1.0	-
– Male	34 442	2 729	7.9	1.6	(1.5–1.7)
SAPS II score					
– < 15	5 864	97	1.7	1.0	-
– 15–24	9 499	281	3.0	1.8	(1.4–2.3)
– 25–34	11 902	631	5.3	3.3	(2.7–4.1)
– 35–44	9 832	817	8.3	5.4	(4.4–6.7)
– 45–54	7 111	745	10.5	7.0	(5.6–8.6)
– 55–64	4 322	481	11.1	7.5	(6.0–9.3)
– 65–74	2 278	330	14.5	10.1	(8.0–12.7)
– ≥ 75	2 178	204	9.4	6.1	(4.8–7.9)
Patient origin					
– Ward	2 5411	1 607	6.3	1.0	-
– ICU	2 297	222	9.7	1.6	(1.4–1.8)
– Community	26 249	1 873	7.1	1.1	(1.1–1.2)
– LTCF	1 485	123	8.3	1.3	(1.1–1.6)
– Unkown/missing	493	24	4.9	0.8	(0.5–1.1)
Hospital stay before ICU admission					
– 0–1d	19 049	1 076	5.7	1.0	-
– 2–7d	5 052	263	5.2	0.9	(0.8–1.1)
– 8–14d	1 955	127	6.5	1.2	(1.0–1.4)
– ≥ 15d	2 284	153	6.7	1.2	(1.0–1.4)
Type of admission					
– Medical	35 605	2 319	6.5	1.0	-
– Surgery-scheduled	9 663	375	3.9	0.6	(0.5–0.6)
– Surgery-unscheduled	9 458	960	10.2	1.6	(1.5–1.8)
– Unkown	1 209	195	16.1	2.8	(2.4–3.2)
Multiple trauma					
– No	48 944	3 085	6.3	1.0	-
– Yes	5 451	672	12.3	2.1	(1.9–2.3)
Immune deficiency					
– No	49 674	3 256	6.6	1.0	-
– Yes	4 518	451	10.0	1.6	(1.4–1.8)
Acute coronary care					
– No	22 769	1 432	6.3	1.0	-
– Yes	4 835	98	2.0	0.3	(0.3–0.4)
Antimicrobials <>48h around admission					
– No	30 512	1 554	5.1	1.0	-
– Yes	24 640	2 214	9.0	1.8	(1.7–2.0)

Variable	N	N PN	% PN	OR	(95% CI)
Surgery in previous 30 days					
Coronary surgery					
– No	22 949	1 484	6.5	1.0	-
– Yes	413	15	3.6	0.6	(0.3–0.9)
Other cardiac surgery					
– No	21 539	1 427	6.6	1.0	-
– Yes	1 823	72	4.0	0.6	(0.5–0.7)
Other thoracic surgery					
– No	23 092	1 476	6.4	1.0	-
– Yes	270	23	8.5	1.4	(0.9–2.1)
Other vascular surgey					
– No	22 973	1 483	6.5	1.0	-
– Yes	389	16	4.1	0.6	(0.4–1.0)
Neurosurgery					
– No	22 467	1 417	6.3	1.0	-
– Yes	895	82	9.2	1.5	(1.2–1.9)
Other surgery					
– No	20 642	1 326	6.4	1.0	-
– Yes	2 720	173	6.4	1.0	(0.8–1.2)
Glasgow score, estimated (SAPS II)					
– 15	4 296	119	2.8	1.0	-
– 10–14	1 262	73	5.8	2.2	(1.6–2.9)
– <10	1 728	136	7.9	3.0	(2.3–3.9)
Glasgow score, measured					
– 15	846	22	2.6	1.0	-
– 10-14	644	29	4.5	1.8	(1.0–3.1)
– <10	516	72	14.0	6.1	(3.7–9.9)
Day-by-day exposure					
Intubation days before PN					
– 0d	25 181	276	1.1	1.0	-
– 1–2d	8 734	215	2.5	2.3	(1.9–2.7)
– 3–4d	6 300	709	11.3	11.4	(9.9–13.2)
– 5–6d	3 766	563	15.0	15.9	(13.7–18.4)
– 7–13d	6 741	1168	17.3	18.9	(16.5–21.6)
– ≥ 14d	5 213	918	17.6	19.3	(16.8–22.1)
CVC days before PN					
– 0d	18 142	348	1.9	1.0	-
– 1–6d	20 170	1 367	6.8	3.7	(3.3–4.2)
– 7–13d	10 382	1 176	11.3	6.5	(5.8–7.4)
– ≥ 14d	6 795	941	13.9	8.2	(7.2–9.3)
Naso-intestinal tube days without feeding before PN					
– 0d	14 862	347	2.3	1.0	-
– 1–6d	7 310	609	8.3	3.8	(3.3–4.4)
– 7–13d	2 141	292	13.6	6.6	(5.6–7.8)
– ≥ 14d	1 450	202	13.9	6.8	(5.6–8.1)
Naso-intestinal tube days with feeding before PN					
– 0d	20 215	552	2.7	1.0	-
– 1–6d	3 459	530	15.3	6.5	(5.7–7.3)
– 7–13d	2 044	274	13.4	5.5	(4.7–6.4)
– ≥ 14d	1 587	164	10.3	4.1	(3.4–4.9)
Parenteral feeding days before PN					
– 0d	18 292	856	4.7	1.0	-

Variable	N	N PN	% PN	OR	(95% CI)
– 1–6d	4 450	336	7.6	1.7	(1.5–1.9)
– 7–13d	1 772	143	8.1	1.8	(1.5–2.1)
– ≥ 14d	1 245	114	9.2	2.1	(1.7–2.5)
Non-invasive ventilation days before PN					
– 0d	21 122	1 172	5.6	1.0	-
– 1–6d	3312	181	5.5	1.0	(0.8-1.2)
– 7–13d	643	43	6.7	1.2	(0.9-1.7)
– ≥ 14d	219	15	6.9	1.3	(0.7-2.1)
Reintubation before PN					
0	30 373	1975	6.5	1.0	-
1	2082	463	22.2	4.1	(3.7-4.6)

Table 118: Univariate risk factor analysis, bloodstream infections

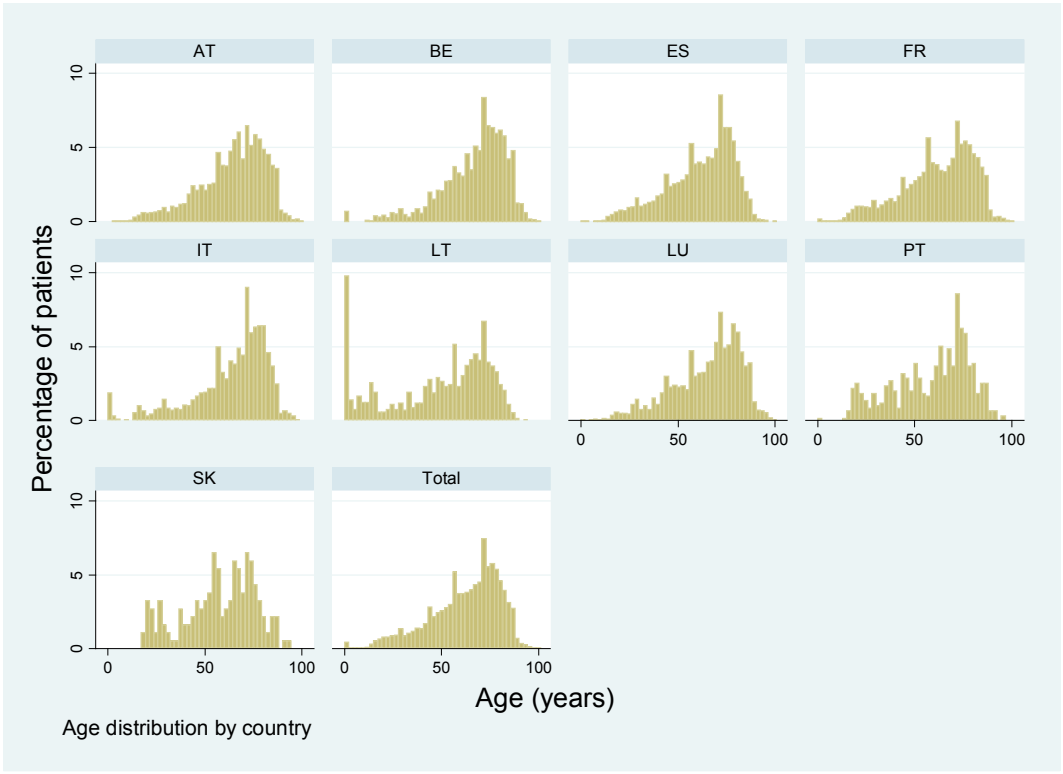
Variable	N	N BSI	% BSI	OR	(95% CI)
Age					
– <20y	1 299	44	3.4	1.0	-
– 20–39y	5 550	240	4.3	1.3	(0.9–1.8)
– 40–59y	14 146	593	4.2	1.3	(0.9–1.7)
– 60–69y	11 164	481	4.3	1.3	(0.9–1.8)
– 70–74y	6 991	264	3.8	1.1	(0.8–1.5)
– 75–79y	9 091	337	3.7	1.1	(0.8–1.5)
– ≥ 80y	7 630	170	2.2	0.7	(0.5–0.9)
Gender					
– F	21 444	672	3.1	1.0	-
– M	34 442	1 465	4.3	1.4	(1.3–1.5)
SAPS II score					
– < 15	5 864	61	1.0	1.0	-
– 15–24	9 499	150	1.6	1.5	(1.1–2.1)
– 25–34	11 902	384	3.2	3.2	(2.4–4.2)
– 35–44	9 832	414	4.2	4.2	(3.2–5.5)
– 45–54	7 111	413	5.8	5.9	(4.5–7.7)
– 55–64	4 322	259	6.0	6.1	(4.6–8.0)
– 65–74	2 278	166	7.3	7.5	(5.6–10.1)
– ≥ 75	2 178	131	6.0	6.1	(4.5–8.3)
Patient origin					
– Ward	25 411	1 014	4.0	1.0	-
– ICU	2 297	141	6.1	1.6	(1.3–1.9)
– Community	26 249	920	3.5	0.9	(0.8–1.0)
– LTCF	1 485	50	3.4	0.8	(0.6–1.1)
– Unkown/missing	493	14	2.8	0.7	(0.4–1.2)
Hospital stay before ICU admission					
– 0–1d	19 049	694	3.6	1.0	-
– 2–7d	5 052	194	3.8	1.1	(0.9–1.2)
– 8–14d	1 955	93	4.8	1.3	(1.1–1.6)
– ≥ 15d	2 284	164	7.2	2.1	(1.7–2.4)
Type of admission					
– Medical	35 605	1 237	3.5	1.0	-
– Surgery-scheduled	9 663	220	2.3	0.7	(0.6–0.7)
– Surgery-unscheduled	9 458	545	5.8	1.7	(1.5–1.9)
– Unkown	1 209	137	11.3	3.6	(2.9–4.3)
Multiple trauma					
– No	48 944	1 774	3.6	1.0	-

Variable	N	N BSI	% BSI	OR	(95% CI)
– Yes	5 451	316	5.8	1.6	(1.4–1.9)
Immune deficiency					
– No	49 674	1 825	3.7	1.0	-
– Yes	4 518	262	5.8	1.6	(1.4–1.8)
Acute coronary care					
– No	22 769	1 039	4.6	1.0	-
– Yes	4 835	67	1.4	0.3	(0.2–0.4)
Antimicrobials <>48h around admission					
– No	30 512	882	2.9	1.0	-
– Yes	24 640	1 214	4.9	1.7	(1.6–1.9)
Surgery in previous 30 days:					
Coronary surgery					
– No	22 949	1 039	4.5	1.0	-
– Yes	413	8	1.9	0.4	(0.2–0.8)
Other cardiac surgery					
– No	21 539	1 009	4.7	1.0	-
– Yes	1 823	38	2.1	0.4	(0.3–0.6)
Other thoracic surgery					
– No	23 092	1 033	4.5	1.0	-
– Yes	270	14	5.2	1.2	(0.7–2.0)
Other vascular surgey					
– No	22 973	1 025	4.5	1.0	-
– Yes	389	22	5.7	1.3	(0.8–2.0)
Neurosurgery					
– No	22 467	985	4.4	1.0	-
– Yes	895	62	6.9	1.6	(1.2–2.1)
Other surgery					
– No	20 642	943	4.6	1.0	-
– Yes	2 720	104	3.8	0.8	(0.7–1.0)
Glasgow score, estimated (SAPS II)					
15	4 296	97	2.3	1.0	-
10–14	1 262	47	3.7	1.7	(1.2–2.4)
< 10	1 728	70	4.1	1.8	(1.3–2.5)
Glasgow score, measured					
15	846	13	1.5	1.0	-
10–14	644	11	1.7	1.1	(0.5–2.5)
< 10	516	31	6.0	4.1	(2.1–7.9)
Day-by-day exposure					
CVC days before BSI					
– 0d	18 537	222	1.2	1.0	-
– 1–2d	1 057	33	3.1	2.7	(1.8–3.9)
– 3–4d	11 371	227	2.0	1.7	(1.4–2.0)
– 5–6d	6 884	200	2.9	2.5	(2.0–3.0)
– 7–13d	10 298	672	6.5	5.8	(4.9–6.7)
– ≥ 14d	7 788	785	10.1	9.3	(7.9–10.8)
Intubation days before BSI					
– 0d	24 721	286	1.2	1.0	-
– 1-6d	17 924	485	2.7	2.4	(2.1–2.8)
– 7-13d	6 668	603	9.0	8.5	(7.4–9.8)
– ≥ 14d	6 176	729	11.8	11.4	(9.9–13.2)
Naso-intestinal tube days without feeding before BSI					
– 0d	14 838	328	2.2	1.0	-

Variable	N	N BSI	% BSI	OR	(95% CI)
– 1–6d	7 076	266	3.8	1.7	(1.5–2.0)
– 7–13d	2 168	223	10.3	5.1	(4.3–6.1)
– ≥ 14d	1 681	215	12.8	6.5	(5.4–7.8)
Naso-intestinal tube days with feeding before BSI					
– 0d	20 148	451	2.2	1.0	-
– 1–6d	3 204	233	7.3	3.4	(2.9–4.0)
– 7–13d	2 089	195	9.3	4.5	(3.8–5.4)
– ≥ 14d	1 864	182	9.8	4.7	(4.0–5.7)
Parenteral feeding days before BSI					
– 0d	18 252	520	2.9	1.0	-
– 1–6d	4 364	212	4.9	1.7	(1.5–2.0)
– 7–13d	1 835	153	8.3	3.1	(2.6–3.7)
– ≥ 14d	1 308	146	11.2	4.3	(3.5–5.2)
Non-invasive ventilation days before BSI					
– 0d	21 070	874	4.2	1.0	-
– 1–6d	3 303	111	3.4	0.8	(0.7–1.0)
– 7–13d	670	30	4.5	1.1	(0.7–1.6)
– ≥ 14d	253	13	5.1	1.3	(0.7–2.2)
ICU-acquired pneumonia					
– No	52 086	1 342	2.6	1.0	-
– Yes	3 849	797	20.7	9.9	(9.0–10.9)

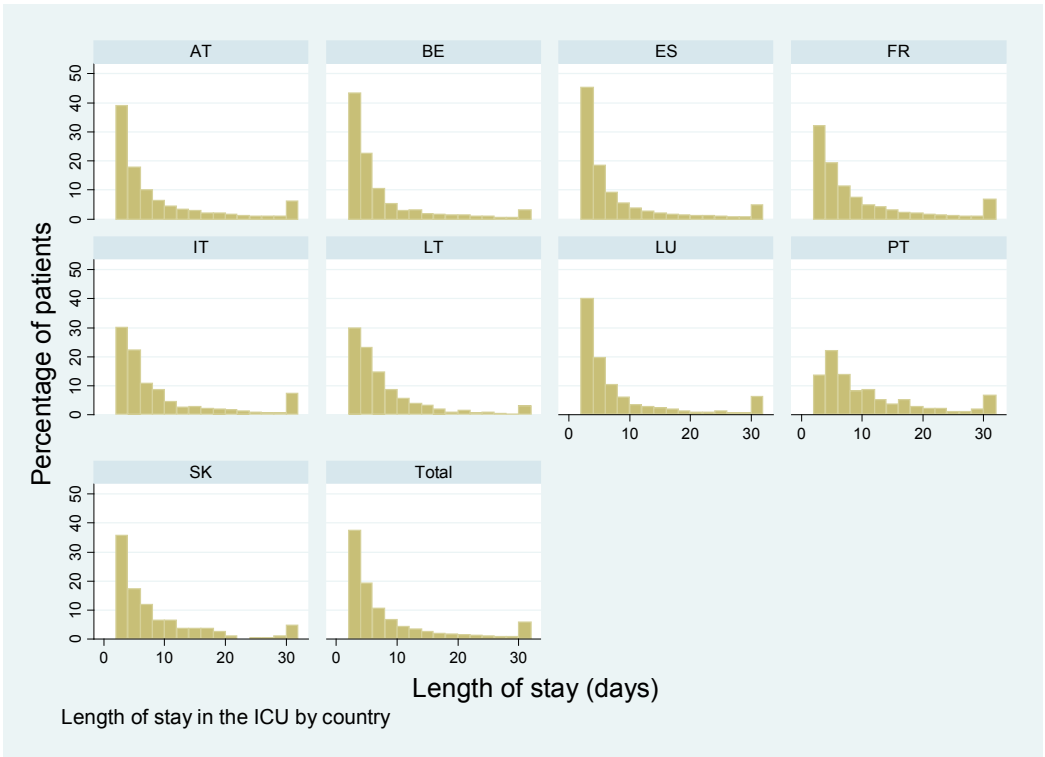
f) Patient characteristics in the ICU

Figure 67: Age distribution by country



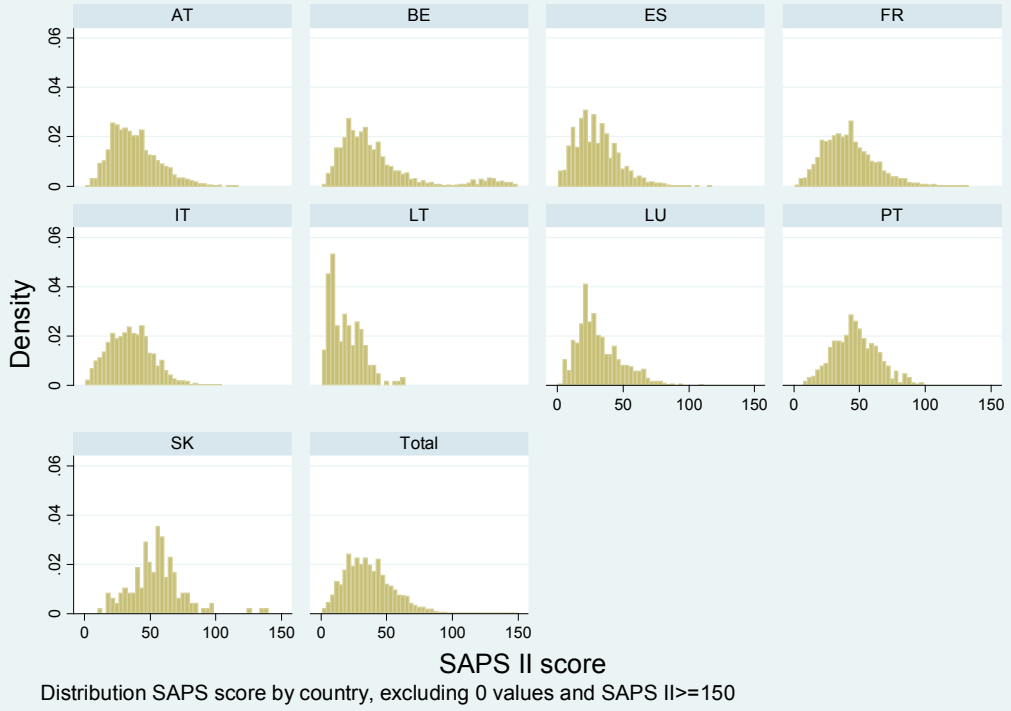
Age distribution by country

Figure 68: Distribution of length of stay in the ICU by country



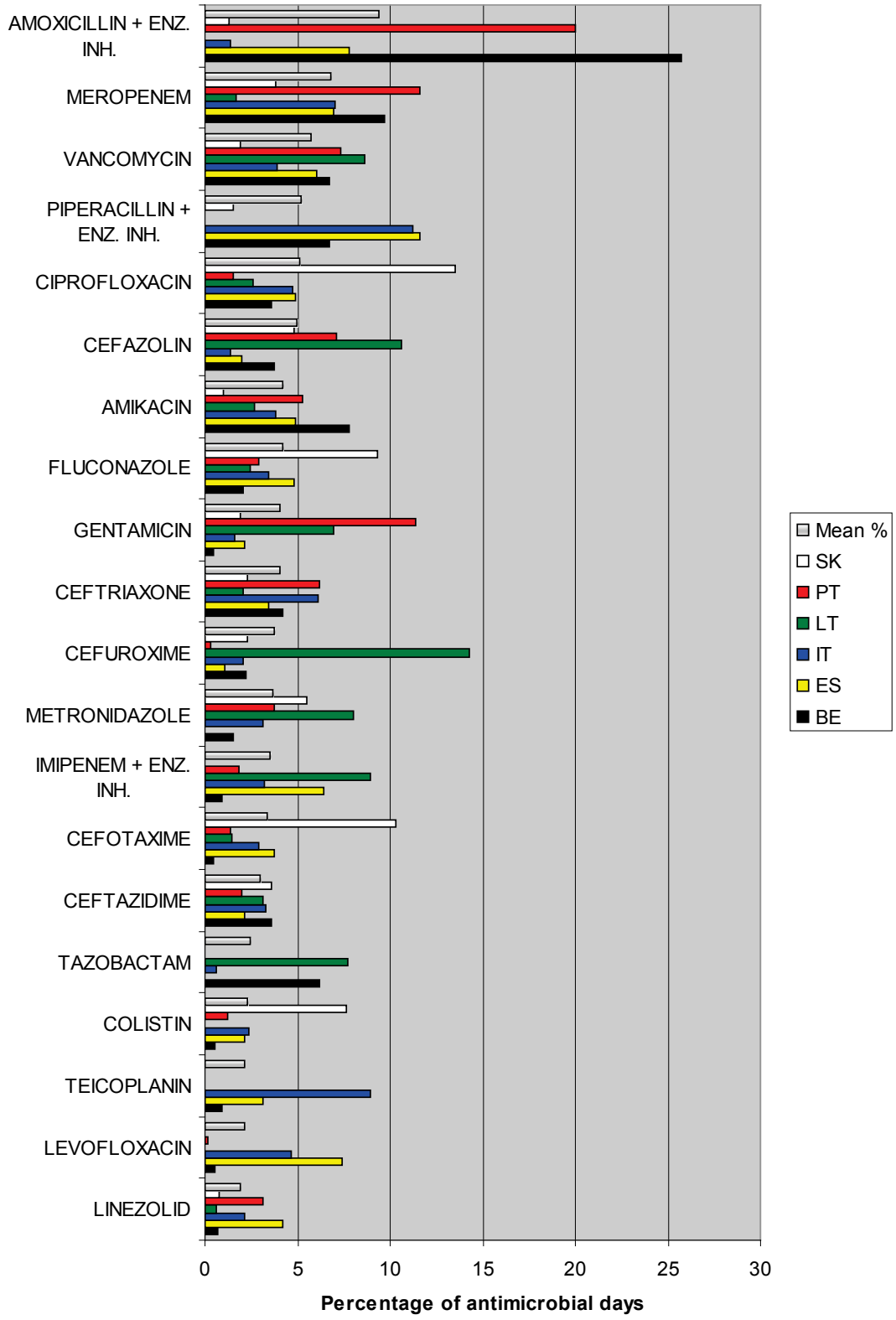
Length of stay in the ICU by country

Figure 69: Distribution of SAPS II score by country



g) Antimicrobial use in the ICU

Figure 70: Most frequently used antimicrobials (ATC5 level) by country, accounting for 80% of the total antimicrobial days in 220 ICUs from six EU countries, 2007



Annex 3: Healthcare-associated infection surveillance in Europe: participating countries and institutions

	Network acronym	Website	Coordination
Austria	ANISS	www.meduniwien.ac.at/hygiene/?c=aniss&s=krankenhaushygiene	Austrian Nosocomial Infection Surveillance System, Medical University of Vienna
Belgium	NSIH	www.iph.fgov.be/nsih	National Surveillance of Healthcare-associated infections and antimicrobial resistance, Scientific Institute of Public Health (IPH), Brussels
Croatia			Reference Centre for Hospital Infections, Zagreb
Finland	SIRO	www.ktl.fi/siro	Finnish Hospital Infection Programme (SIRO), National Public Health Institute (KTL), Helsinki
France	RAISIN	www.invs.sante.fr/raisin	Réseau d'Alerte, d'Investigation et de Surveillance des Infections Nosocomiales (RAISIN), under the auspices of the Insititut de Veille Sanitaire (InVS)
– FR-East	C.CLIN Est	www.cclin-est.org	
– FR-Paris-Nord	C.CLIN Paris-Nord	www.cclinparisnord.org	
– FR-South-east	C.CLIN Sud-Est	cclin-sudest.chu-lyon.fr	
– FR-South-west	C.CLIN Sud-Ouest	www.cclin-sudouest.com	
– FR-West	C.CLIN Ouest	www.cclinouest.com	
Germany	KISS	www.nrz-hygiene.de/surveillance/surveillance.htm	German Nosocomial Infection Surveillance System (KISS), National Reference Centre for Nosocomial Infection Surveillance, Charité Medical University, Berlin
Hungary	NNSR	www.oek.hu/oek.web	Nemzeti Nosocomiális Surveillance Rendszer (National Nosocomial Surveillance System) National Centre for Epidemiology, Budapest
Italy	SSI SPIN-UTI		Regional Health Authority of Emilia-Romagna, Bologna; ICU network: Gruppo Italiano Studio Igiene Ospedaliera (GISIO)
Lithuania		www.hi.lt => Hospitalinės infekcijos	Institute of Hygiene, Vilnius
Luxembourg	NOSIX	www.crp-sante.lu	Centre de Recherche Public de la Santé, Luxembourg
Netherlands	PREZIES	www.prezies.nl	Prevention of Nosocomial Infection through Surveillance (PREZIES), National Institute for Public Health and Environment (RIVM) and the Dutch Institute for Healthcare Improvement (CBO)
Norway	NOIS	www.fhi.no => NOIS	Norwegian Institute of Public Health (FHI), Oslo
Spain	ENVIN (ICU) SSI	www.iscii.es	Envin: Hopital Val d'Hebron, Barcelona; SSI surveillance by Carlos III Institute of Health, Madrid
UK-England	SSISS (SSI)	www.hpa.org.uk/infections/topics_az/hai/default.htm	Health Protection Agency (HPA), London

UK-Northern Ireland	HISC	www.hisc.n-i.nhs.uk	Northern Ireland Healthcare-associated Infection Surveillance Centre (HISC), Belfast
UK-Scotland	SSHAIP	www.hps.scot.nhs.uk/haiic/sshaip/index.aspx	The Scottish Surveillance of Healthcare Associated Infection Programme (SSHAIP), Health Protection Scotland, Glasgow
UK-Wales	WHAIP	www.wales.nhs.uk/sites3/home.cfm?orgid=379	Welsh Healthcare Associated Infection Programme (WHAIP), National Public Health Service (NHS) Wales