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SURVEILLANCE REPORT

Surveillance of surgical site infections in Europe

2008–2009

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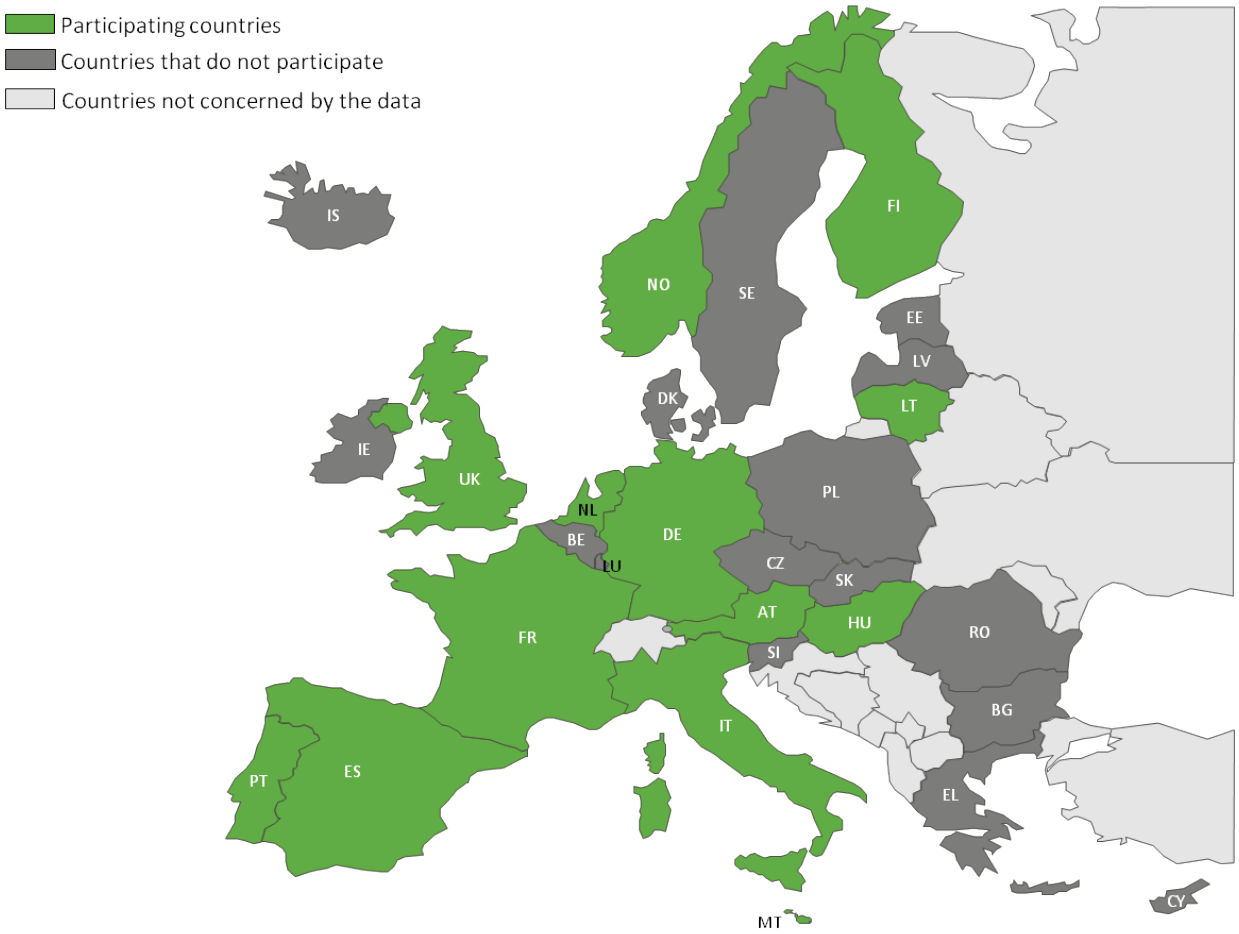
Abbreviations and acronyms

ASA	American Society of Anesthesiologists
CABG	Coronary artery bypass graft
CDC	US Centers for Disease Control and Prevention
CHOL	Cholecystectomy
COLO	Colon surgery
CSEC	Caesarean section
ECDC	European Centre for Disease Prevention and Control
HAI	Healthcare-Associated Infections
HAI-Net	Healthcare-Associated Infections Surveillance Network
HELICS	Hospitals in Europe Link for Infection Control through Surveillance
HPRO	Hip prosthesis
ICU	Intensive Care Unit
IPSE	Improving Patient Safety in Europe
KPRO	Knee prosthesis
LAM	Laminectomy
MRSA	Meticillin-resistant *Staphylococcus aureus*
NHSN	National Healthcare Safety Network (formerly NNIS)
SSI	Surgical site infection
TESSy	The European Surveillance System

Country participation 2008–2009

Figure 1. Countries participating in surveillance of surgical site infections, HAI-Net, 2008–2009



List of national institutions and organisations participating in surveillance of surgical site infections, HAI-Net 2008–2009

Country	Network acronym	Network name	Network website	Coordination
Austria	ANISS	Austrian Nosocomial Infection Surveillance System (ANISS)	http://www.meduniwien.ac.at/hp/krankenhaushygiene/forschung-lehre/aniss-surveillance/	Medical University of Vienna
Finland	SIRO	Finnish Hospital Infection Programme (SIRO)	http://www.ktl.fi/portal/suomi/osastot/infe/tutkimus/sairaalainfektioiden_seuranta__siro/	National Public Health Institute (KTL), Helsinki
France	RAISIN	Réseau d'Alerte, d'Investigation et de Surveillance des Infections Nosocomiales (RAISIN)	www.invs.sante.fr/raisin	Institut de Veille Sanitaire (InVS), Saint Maurice
Germany	KISS	German Nosocomial Infection Surveillance System (KISS)	http://www.nrz-hygiene.de/en/nrz/welcome/	National Reference Centre for Nosocomial Infection Surveillance, Charité Medical University, Berlin
Hungary	NNSR	National Nosocomial Surveillance System (NNSR)	www.oek.hu/oek.web	Department of Hospital Epidemiology and Hygiene, National Centre for Epidemiology, Budapest
Italy			http://asr.regione.emilia-romagna.it/wcm/asr/	Regional Health Authority of Emilia-Romagna, Bologna
Lithuania			http://www.hi.lt/content/G0_hosp_inf.html	Institute of Hygiene, Vilnius
Malta				Mater Dei Hospital, Msida
Netherlands	PREZIES	Prevention of Nosocomial Infection through Surveillance (PREZIES)	www.prezies.nl	National Institute for Public Health and Environment (RIVM), Bilthoven The Dutch Institute for Healthcare Improvement (CBO), Utrecht
Norway	NOIS	Norwegian Surveillance system for Hospital-associated infections (NOIS)	www.fhi.no	Norwegian Institute of Public Health (FHI), Oslo
Portugal				Ministry of Health, Lisbon
Spain			www.iscii.es	Institute of Health Carlos III, Madrid
UK-England	SSISS		www.hpa.org.uk/infections/topics_az/hai/default.htm	Health Protection Agency (HPA), London
UK-Northern Ireland			http://www.publichealth.hscni.net/directorate-public-health/health-protection/healthcare-associated-infectionsantimicrobial-resistance	Public Health Agency (PHA), Belfast
UK-Scotland	SSHAIP	The Scottish Surveillance of Healthcare Associated Infection Programme (SSHAIP),	www.hps.scot.nhs.uk/haiic/sshaip/index.aspx	Health Protection Scotland, Glasgow
UK-Wales	WHAIP	Welsh Healthcare Associated Infection Programme (WHAIP)	www.wales.nhs.uk/sites3/home.cfm?orgid=379	National Public Health Service (NHS) Wales

Country codes of participating countries

AT	Austria
DE	Germany
ES	Spain
FI	Finland
FR	France
HU	Hungary
IT	Italy
LT	Lithuania
MT	Malta
NL	Netherlands
NO	Norway
PT	Portugal
UK	United Kingdom

Executive summary

Each year in the EU, approximately four million patients acquire healthcare-associated infections (HAI) and approximately 37 000 of them die as the direct result of the infection. Surgical site infections (SSI) are among the most common HAI and are associated with longer post-operative hospital stays, additional surgical procedures, treatment in an intensive care unit, and often higher mortality. All patients undergoing surgery are at risk of complications, including SSI. This report presents the results of SSI surveillance in Europe for 2008–2009, as well as the results of trend analysis for 2006–2009. Data for 2008 and 2009 were received from 16 networks in 13 European countries (12 EU Member States and one EEA country) and included 655 637 surgical operations reported by 1 785 hospitals.

Coronary artery bypass graft (CABG)

A total of 35 864 CABG operations and 1 175 (3.3%) SSI were reported within 30 days after the operation. Of these, 578 (49%) were superficial incisional SSI, 408 (35%) were deep incisional SSI, 177 (15%) were organ/space SSI and 12 (1%) were of unknown type. Sixty-one percent of SSI were detected during hospitalisation. The incidence density was 1.8 in-hospital SSI per 1 000 post-operative patient-days. The majority of reported microorganisms were gram-positive cocci (63%) followed by Enterobacteriaceae (21%). The overall CABG trend analysis in countries contributing data for all years 2006–2009 showed a statistically significant increase for the cumulative incidence and incidence density, however the trend was explained by the increase of superficial incisional SSI only.

Cholecystectomy (CHOL)

A total of 63 202 CHOL operations and 896 (1.4%) SSI were reported within 30 days of the operation. Of these, 533 (59%) were superficial incisional SSI, 215 (24%) were deep incisional SSI, 136 (15%) were organ/space SSI and for 12 (1%) the type of SSI was unknown. Fifty-seven percent of SSI were detected during hospitalisation. The incidence density was 1.6 in-hospital SSI per 1 000 post-operative patient-days. The most frequently isolated microorganisms were Enterobacteriaceae (50%) followed by gram-positive cocci (37%). The overall CHOL trend analysis in countries contributing data for all years 2006–2009 showed no significant trends.

Colon surgery (COLO)

A total of 40 858 COLO operations and 3 964 (9.7%) SSI were reported within 30 days of the operation. Of these, 1 963 (50%) were superficial incisional SSI, 1 182 (30%) were deep incisional SSI, 764 (19%) were organ/space SSI and 55 (1%) were of unknown type. Eighty-six percent of SSI were detected during hospitalisation. The incidence density was 6.4 in-hospital SSI per 1 000 post-operative patient-days. Enterobacteriaceae (46%) were the most frequently reported microorganisms followed by gram-positive cocci (32%). The overall COLO trend analysis in countries contributing data for all years 2006–2009 showed no significant trends.

Caesarean section (CSEC)

A total of 132 044 CSEC operations and 4 732 (3.6%) SSI were reported within 30 days of the operation. Of these, 4 052 (86%) were superficial incisional SSI, 461 (10%) were deep incisional SSI, 174 (4%) were organ/space SSI and 45 (1%) were of unknown type. Twenty-seven percent of SSI were detected during hospitalisation. The incidence density was 1.2 in-hospital SSI per 1 000 post-operative patient-days. The most frequently isolated microorganisms were gram-positive cocci (59%) followed by Enterobacteriaceae (31%). The overall CSEC trend analysis in countries contributing data for all years 2006–2009 showed a significant increase in the cumulative incidence of SSI, but a decreasing trend for the incidence density of SSI. Both trends persisted after exclusion of superficial incisional SSI from the analysis.

Hip prosthesis (HPRO)

A total of 217 425 HPRO operations and 2 522 (1.2%) SSI were reported within one year of the operation. Of these, 1 056 (42%) were superficial incisional SSI, 986 (39%) were deep incisional SSI, 453 (18%) were organ/space SSI and 17 (1%) were of unknown type. Forty-six percent of SSI were detected during hospitalisation. The incidence density was 0.5 in-hospital SSI per 1 000 post-operative patient-days. Gram-positive cocci (70%) were the most frequently reported microorganisms, followed by Enterobacteriaceae (16%). The overall HPRO trend analysis in countries contributing data for all years 2006–2009 showed a statistically significant decrease of both the cumulative incidence and the incidence density of SSI. However, both trends disappeared when superficial incisional SSI were excluded from the analysis, indicating that only superficial incisional SSI contributed to the trends.

Knee prosthesis (KPRO)

A total of 156 561 KPRO operations and 1 247 (0.8%) SSI were reported within one year of the operation. Of these, 653 (52%) were superficial incisional SSI, 357 (29%) were deep incisional SSI, 213 (17%) were organ/space SSI and 24 (2%) were of unknown type. Only 27% of SSI were detected during hospitalisation. The incidence density was 0.2 in-hospital SSI per 1 000 post-operative patient-days. The most frequently reported microorganisms were gram-positive cocci (74%) followed by Enterobacteriaceae (11%). The overall HPRO trend analysis in countries contributing data for all years 2006–2009 showed a statistically significant decrease of both the cumulative incidence and the incidence density of SSI. However, as in HPRO, only superficial incisional SSI contributed to the decrease.

Laminectomy (LAM)

A total of 9 683 LAM operations and 125 (1.3%) SSI were reported within 30 days of the operation. Of these, 61 (49%) were superficial incisional SSI, 36 (29%) were deep incisional SSI, 26 (21%) were organ/space SSI and 2 (2%) were of unknown type. Forty-nine percent of SSI were detected during hospitalisation. The incidence density was 1.0 in-hospital SSI per 1 000 post-operative patient-days. The most frequently reported microorganisms were gram-positive cocci (71%) followed by Enterobacteriaceae (18%). The overall LAM trend analysis in countries contributing data for all years 2006–2009 showed no significant trends.

In conclusion, the results of SSI surveillance presented in this report represent an essential contribution to our knowledge of SSI in participating European countries for the period 2008–2009. The number of reported operations increased and between 2004 and 2009 the percentage of missing values for the variables essential for performing inter-hospital and inter-country comparisons (e.g. date of discharge from the hospital) decreased. This provided a basis for improved data analysis and better interpretation of results. However, the number of participating countries did not increase compared to 2004, probably reflecting the need for human and financial resources at hospital and national/regional level to set up HAI surveillance networks. Efforts are therefore still needed to extend the surveillance of SSI to other EU Member States. ECDC will continue to provide support for setting up national surveillance networks by making available a free software package for network coordination centres and hospitals, by organising training courses on HAI surveillance and by performing on-demand country visits for technical support on HAI surveillance.

Introduction

History

The European Council Recommendation of 9 June 2009 on patient safety, including the prevention and control of healthcare-associated infections (HAI) (2009/C 151/01)[1], recommends 'performing the surveillance of the incidence of targeted infection types' and 'using, where appropriate, surveillance methods and indicators as recommended by ECDC and case definitions as agreed upon at Community level in accordance with the provisions of Decision No 2119/98/EC[2].'

The Hospitals in Europe Link for Infection Control through Surveillance (HELICS) network was created in 2000 in the context of Decision 2119/98/EC, as a network for the surveillance of healthcare-associated infections (HAI) and funded by the European Commission's Directorate-General for Health and Consumers (DG SANCO). From 2000 to 2002, HELICS standardised the European methodology for the surveillance of surgical site infections (SSI) and nosocomial infections in intensive care units. From 2003 onwards, the HELICS project collected data from national networks for the surveillance of HAI. In 2005, HELICS surveillance became a part of the Improving Patient Safety in Europe (IPSE) network, which from 2005 to 2008 was the dedicated European surveillance network for the surveillance of HAI. The scope of the IPSE network was the development of the existing national surveillance initiatives and other approaches for supporting infection control efforts in Europe. In July 2008, the coordination of HAI surveillance in Europe was transferred from the IPSE network to ECDC and the surveillance network became the Healthcare-Associated Infections Surveillance Network (HAI-Net)[3]. In 2009 and 2010, ECDC continued surveillance of SSI following the former IPSE/HELICS protocol and methods until this type of surveillance was fully integrated into The European Surveillance System (TESSy) in October 2010. More information about HAI-Net is available on the ECDC HAI-Net website[3].

Objectives

The objectives of European surveillance of SSI are:

- to work towards comparable surveillance methods and analyse inter-country differences;
- to draw up European reference tables for inter-hospital comparisons of risk-adjusted SSI rates;
- to contribute to the extension of SSI surveillance in the European Union (EU);
- to follow up and report on long-term trends in SSI rates throughout the EU and in the Member States, as well as trends in the occurrence of microorganisms associated with SSI, including trends in antimicrobial resistance.

The aim of this report is to present the results of SSI surveillance in Europe for 2008–2009, as well as the results of analysis of trends for 2006–2009.

Data collection and technical notes

Data collection 2008–2009

Surveillance data of SSI in 2008 (with partial follow-up for orthopaedic operations until 31 December 2009) were collected by ECDC from Member States in January–February 2010 following the procedures of the former HELICS/IPSE network. Surveillance data of SSI in 2009 (with partial follow-up for orthopaedic operations until 31 December 2010) were collected using ECDC's TESSy system, after the integration of the HAI surveillance dataset in October 2010. These data were collected by ECDC from Member States between 15 January 2011 and 31 March 2011. Corrections were made possible until 15 June 2011, after which data collection was closed.

Methodology

Data on surveillance of SSI were collected in hospitals using a patient-based methodology according to the HELICS-SSI protocol[4] for 2008 data and the new HAISSI protocol v1.02[5] for 2009. This new protocol is based on the HELICS-SSI protocol and provides standard case definitions, data collection procedures and reporting procedures for hospitals that participate in national/regional surveillance of SSI across Europe.

The HAISSI protocol includes seven types of operation: coronary artery bypass graft (CABG), cholecystectomy (CHOL), colon surgery (COL), Caesarean section (CSEC), hip prosthesis (HPRO), knee prosthesis (KPRO) and laminectomy (LAM). The case definitions for specific types of SSI (i.e. superficial incisional, deep and organ/space) and other definitions (e.g. risk index, wound contamination class, ASA score, duration of operation) are described in the HAISSI protocol v1.02.

Data analysis

The approach to SSI surveillance taken by HAISSI protocol is to enhance comparability of results by targeting selected types of operations and collecting data that enable adjustment for variation in case-mix. Adjustment for case-mix is based on a risk index developed by the National Healthcare Safety Network (NHSN, US CDC, Atlanta, Georgia, USA), formerly the National Nosocomial Infections Surveillance (NNIS) System[6,7]. The NHSN risk index is built from three variables: wound class, duration of operation and ASA score. One point is added to the NHSN risk index when wound class is reported as 'contaminated' or 'dirty', when the duration of operation is greater than the NNIS 75th percentile duration for same type of operation, and if the ASA score is greater than 2. For each operation, the NHSN risk index therefore varies from 0 to 3 depending on how many of the risk factors are present.

For each type of operation, two indicators are used to express the incidence of SSI:

- the cumulative incidence of SSI;
- the incidence density of SSI.

The cumulative incidence of SSI is the crude percentage of operations resulting in a SSI. The incidence density of SSI is the number of SSI per 1 000 post-operative days in the hospital and is the preferred measure for comparison of incidence of SSI between countries since it only uses observations during the hospital stay for both the numerator and the denominator. This indicator is therefore not influenced by variations in the length of post-operative hospital stay or in the intensity of post-discharge case-finding. However, the incidence density of SSI can only be calculated if the date of discharge from the hospital is known and this indicator is less appropriate for procedures for which very few infections occur while the patient is still in the hospital. This indicator may also overadjust when the length of post-operative hospital stay is very long (e.g. a small number of patients each contributing for a large number of days) because the probability of detecting an SSI is not the same for each day following the operation (see general discussion).

Intra-country trends for the cumulative incidence of SSI and for the incidence density of SSI between 2006 and 2009 were analysed by Poisson regression. Both trend analyses were adjusted for the NHSN risk index. In addition, trend analysis of the SSI incidence density was adjusted for length of post-operative stay in the hospital and only used SSI detected before discharge from the hospital. Trend analyses for individual countries were performed for countries that contributed data for at least three years during the period 2006–2009. Overall EU trends were only calculated to include countries that contributed data for all four years.

The internal data quality for missing and unknown values, discordant values or impossible dates (e.g. discharge date before operation date) was checked at the time of data submission using former HELICS procedures for 2008 data, and during upload in TESSy, with an additional manual quality check for 2009 data. The results of these checks were fed back to Member States, which submitted updates and corrections when available. An analysis of the remaining missing values after correction by Member States is provided in Annex 1. The percentage of missing values is influenced by the fact that some of the variables in the HAISSI protocol were not included in national surveillance protocols in the participating countries.

Interpretation of the results

Interpretation of the results, especially inter-country comparisons of the cumulative incidence of SSI, should be made with caution. Inter-country differences can often be explained by one or several of the following factors; some of which are being accounted for or adjusted for in this report:

Factors that are adjusted or accounted for when using the indicator 'incidence density of in-hospital SSI per 1 000 post-operative patient-days':

- Differences in post-discharge surveillance methods, e.g. in England, post-discharge surveillance only started with SSI detected at re-admission in 2009.
- Differences in length of post-operative hospital stay between countries and hospitals, and variations over time in the average post-operative length of hospital stay within the same country or hospital. Indeed, infections are more likely to be detected in the hospital than in the community, after discharge from the hospital.
- Follow-up of orthopaedic operations (HPRO and KPRO) until one year after the operation. Although this is part of the case definition of SSI, it is not consistently implemented in all participating countries (e.g. France). Similarly, one-year follow-up data were not available for all operations/hospitals within a country at the time of data collection. SSI detected between 30 days and one year of follow-up represented 12% of all SSI reported in HPRO and KPRO and this percentage varied from 2% to over 30% depending on the country.

Factors that can be partially adjusted or accounted for during analysis:

- Differences in the mix of hospitals that participate each year. This can be adjusted for in the analysis, provided that participating countries always use the same hospital identification number from one year to another, as specified in the HAISSI protocol.
- Differences in patient case-mix and mix of operation types. These differences are partly taken into account by the variables collected following the HAISSI protocol, such as the variables used to calculate the NHSN risk index and the ICD-9-CM code (optional) which provides more details on the operations within a given type of operation. For instance, some countries perform more total HPRO operations and less partial HPRO operations; the latter having a higher intrinsic risk of infection.
- Different interpretations of the case definitions, resulting in variations in the percentage of superficial incisional SSI as part of the total reported SSI. This problem can be partially accounted for by only looking at the incidence of deep incisional SSI and organ/space SSI for which inter-hospital and inter-country variations in the interpretation are expected to be lower. However, exclusion of superficial incisional SSI means that the analysis only considers a smaller number of infections and therefore increases the width of 95% confidence intervals around the indicator.

Factors that cannot be adjusted or accounted for during analysis:

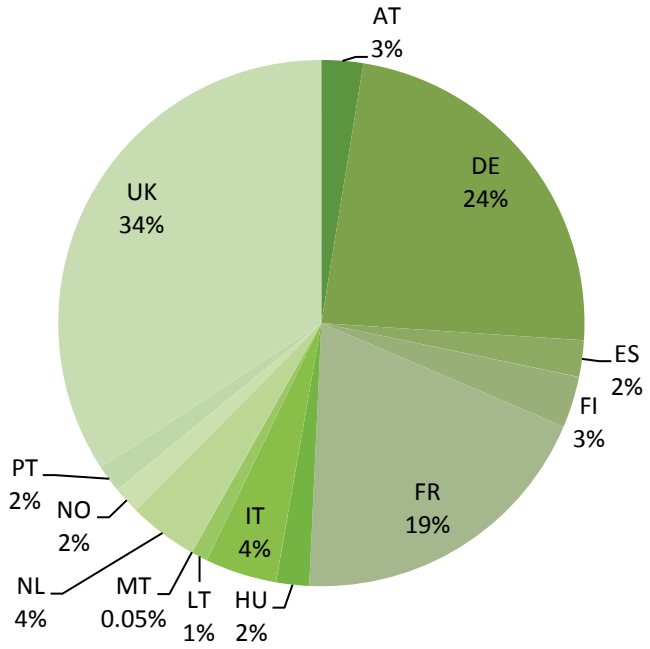
- Missing data. For example missing components of the NHSN risk index or ICD-9-CM codes, compromise the performance of the risk adjustment or stratified analysis. Similarly, missing discharge dates cause the incidence density to be calculated for a subpopulation of the reported interventions only.
- Selection bias due to participation of hospitals that are not representative of hospitals in the country, e.g. hospitals that are known to have a problem with the prevention of SSI. This is mainly a problem in countries with a low level of hospital participation in national SSI surveillance.
- Differences in surveillance sensitivity and specificity due to other factors such as differences in training of surveillance methods, differences in in-hospital case finding methods, or national organisational aspects such as mandatory participation in national SSI surveillance, with or without public disclosure of SSI indicators.
- Small numbers of reported operations and SSI resulting in a high level of uncertainty due to chance. To express this uncertainty, 95% confidence intervals are provided in this report. For example, if three SSI are reported for a total of 100 consecutive operations during a three-month period, the cumulative incidence of SSI is 3.0% with a 95% confidence interval of [0.6–8.5%], indicating that if the surveillance had been repeated 100 times under similar conditions, in 95 of these 100 surveillance periods, the cumulative incidence of SSI could have been any percentage between the lower and the upper limit of the confidence interval and this only due to chance. For the remaining five instances, the cumulative incidence would show even more extreme values outside of the confidence interval. For this reason, it is recommended that SSI surveillance is performed continuously or at least for longer periods each year.

Main results of surgical site infection (SSI) surveillance

Participation

Data for 2008 and 2009 were received from 16 networks in 13 countries (12 EU countries and one EEA country) and included 655 637 surgical operations (Table 3.1 and Figure 1). In total, 1 427 and 1 407 hospitals participated in surveillance of SSI, reporting a total of 315 935 and 339 702 operations in 2008 and in 2009 respectively. The number of reported operations increased by 18% in 2008 compared to 2007 and by an additional 7% in 2009 compared to 2008. Although the number of reported operations increased 2.8 times between 2004 – the first year following publication of the standardised European surveillance protocol – and 2009, the number of countries reporting SSI surveillance data remained similar with 12 countries in 2004 and 13 in 2009. United Kingdom (four separate surveillance networks in England, Northern Ireland, Scotland and Wales) contributed 34% of the total operations reported in 2008–2009, whereas Germany accounted for 24% and France 19% (Figure 2). The United Kingdom's contribution to the total operations increased from 27% in 2004 to 36% in 2009 after the introduction of the mandatory surveillance for SSI after orthopaedic surgery in this country in 2004. Malta submitted data for the first time in 2010 (2008 data).

Figure 2. Distribution of operations reported to the European SSI surveillance scheme by participating country, EU/EEA, 2008–2009



Main results

The types of surgical operations reported by country and year are presented in Table 3.1 and in Figure 3.1 respectively. Hip prosthesis (HPRO) was the most frequently reported type of operation in European surveillance of SSI, representing 33% of operations in 2008–2009, followed by knee prosthesis (KPRO, 24%), Caesarean section (CSEC, 20%), cholecystectomy (CHOL, 10%), colon surgery (COLO, 6%), coronary artery bypass graft (CABG, 5%) and laminectomy (LAM, 1%).

Figure 3.1. Distribution of operations reported to the European SSI surveillance scheme by operation type, EU/EEA participating countries, 2004–2009

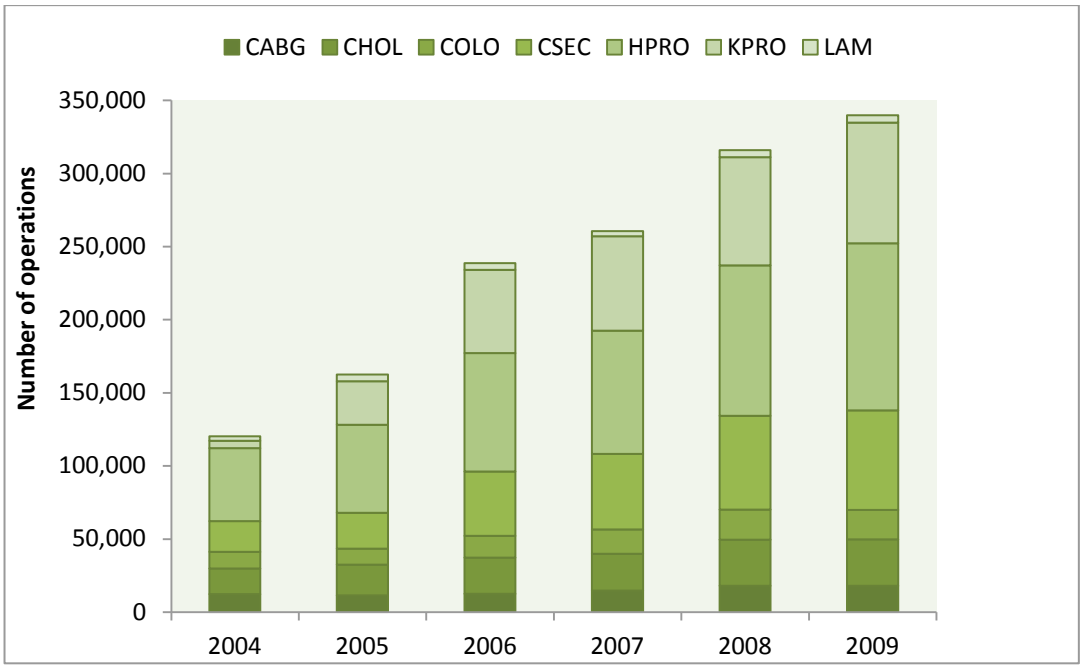


Table 3.1. Number of reported operations by country and type of operation, 2008–2009

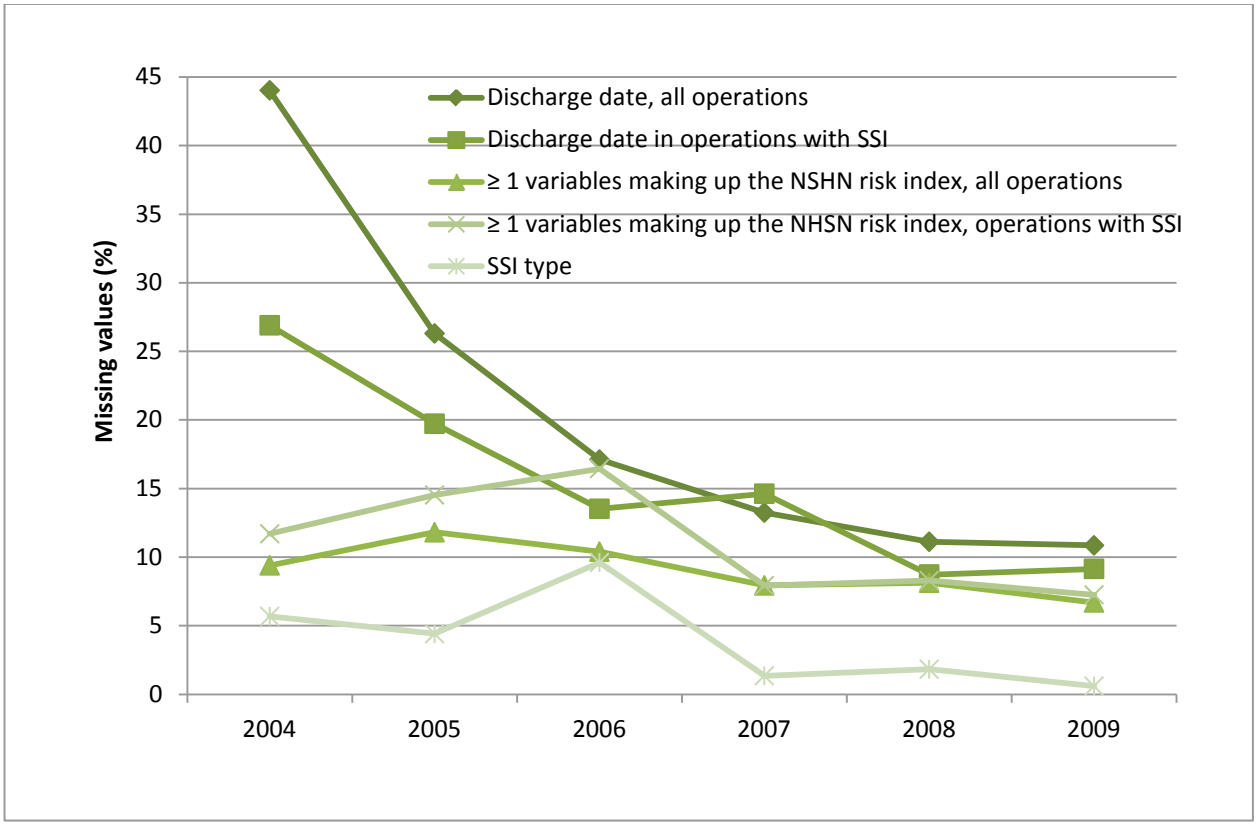
Country	Number of reported surgical operations, by type of operation							
	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM	Total
Austria	249	631	479	6 639	8 160	517	37	16 712
Finland					11 716	8 890		20 606
France	2 088	21 486	11 811	31 395	38 916	18 381	2 471	126 548
Germany	18 084	18 987	12 540	21 019	50 762	27 886	4 782	154 060
Hungary	429	4 133	319	6 500	1 054	550	334	13 319
Italy	928	6 678	3 884	11 926	3 077	1 394	958	28 845
Lithuania	1 086	1 642	542	2 284	577	408		6 539
Malta	349							349
Netherlands		2 715	2 362	3 098	11 625	7 600	120	27 520
Norway	1 464	758	219	4 141	4 423			11 005
Portugal	78	3 694	1 493	3 361	1 481	584	268	10 959
Spain	1 129	2 478	2 211	2 162	3 614	2 403	713	14 710
United Kingdom*	9 980		4 998	39 519	82 020	87 948		224 465
EU/EEA	**35 864**	**63 202**	**40 858**	**132 044**	**217 425**	**156 561**	**9 683**	**655 637**

CABG=Coronary artery bypass graft, CHOL=Cholecystectomy, COLO=Colon surgery, CSEC=Caesarean section, HPRO=Hip prosthesis, KPRO=Knee prosthesis, LAM=Laminectomy.

*Data from UK England for CABG, COLO, HPRO & KPRO, UK Northern Ireland for CSEC, HPRO & KRPO, UK Scotland for CSEC, HPRO & KRPO and UK Wales for CSEC, HPRO & KRPO.

The percentage of missing values for the variables that are essential for performing inter-hospital and inter-country comparisons (i.e. discharge date, NHSN risk index and type of SSI – see 'Data collection and technical notes') decreased dramatically between 2004 and 2009 (Figure 3.2). The lowest percentage was for 2009 data collected for the first time through ECDC's TESSy system. From 2006 onwards, the percentage of missing values was similar for operations with SSI and operations without SSI (Figure 3.2), indicating that bias when calculating the adjusted SSI rates is probably limited and only related to the exclusion of the sub-sample of operations with missing values for both the numerator and the denominator (e.g. 11% of all operations for the incidence density of SSI in 2008–2009).

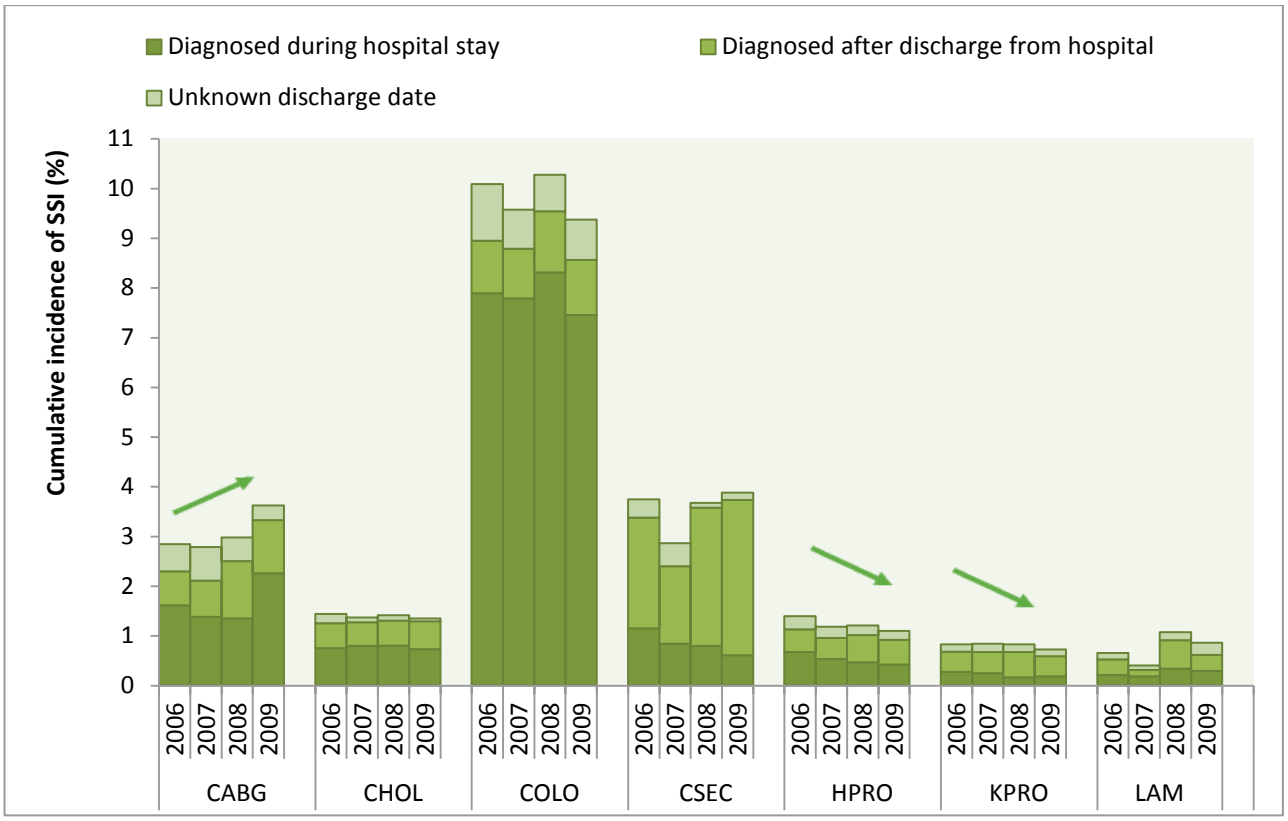
Figure 3.2. Percentage of missing values for the main variables used in the adjustment of SSI rates, 2004–2009



As expected, the overall cumulative incidence of SSI in 2008–2009 was highest in COLO (9.7%) and lowest in KPRO (0.8%). The incidence density was also highest in COLO (6.5 SSI per 1 000 post-operative patient-days) and lowest in KPRO (0.2 in-hospital SSI per 1 000 post-operative patient-days).

In accordance with general ECDC surveillance analysis practice and taking into account improvements in data quality (Figure 3.2), trends for the cumulative incidence and the incidence density of SSI were only analysed for the last four years of surveillance (2006-2009), and for countries that had contributed data for at least three of these years. Overall risk-adjusted trends were analysed for countries that contributed data for all four years (Figure 3.3). A significant increase in both the cumulative incidence and incidence density of SSI was observed for CABG ($p<0.001$), but these trends were not observed when superficial SSI were excluded and only deep incisional and organ/space SSI were included in the analysis. For CSEC, a significant increase was observed for the cumulative incidence of SSI ($p<0.001$), but a decreasing trend was observed for the incidence density of SSI ($p<0.001$). Both trends were also observed after exclusion of superficial SSI following CSEC. In HPRO and KPRO, the cumulative incidence and the incidence density of SSI decreased significantly between 2006 and 2009 ($p<0.001$, except cumulative incidence of SSI after KPRO: $p<0.05$), but these trends were not confirmed when superficial SSI were excluded. For CHOL, COLO and LAM, no significant trends were observed, irrespective of whether superficial SSI were excluded. Details for each type of operation are given in the following chapters.

Figure 3.3. Distribution of cumulative incidence for SSI by year and operation type, EU/EEA countries contributing data for all years, 2006–2009



Countries participating in all four years: CABG: AT, DE, ES, FR, LT, NO, UK (England); CHOL: AT, DE, ES, FR, HU, LT, NL, NO, PT; COLO: AT, DE, ES, FR, HU, LT, NL, PT, UK (England); CSEC: AT, DE, ES, FR, HU, NL, NO, PT, UK (Scotland and Wales); HPRO: AT, DE, ES, FI, FR, HU, NL, NO, PT, UK (England, Northern Ireland, Scotland and Wales).

Arrows indicate a significant trend for both cumulative incidence and incidence density ($p<0.001$ for CABG and HPRO and $p<0.05$ for KPRO).

Note: Post-discharge surveillance methods and practices differ considerably among countries.

Coronary artery bypass graft (CABG)

Key points

- 35 864 CABG operations were reported for 2008–2009;
- The cumulative incidence of SSI was 3.3% [Inter-country range: 0%–5.7%] in 2008–2009;
- The incidence density of SSI was 1.8 [Inter-country range: 0–2.8] in-hospital SSI per 1 000 post-operative patient-days in 2008–2009.

Results

A total of 35 864 CABG operations and 1 175 SSI subsequent to the operation, were reported to ECDC for 2008 and 2009. The characteristics of the patients with CABG operations are summarised in Table 4.1. SSI were detected in 3.3% [Inter-country range: 0%–5.7%] of CABG operations (cumulative incidence) within 30 days of surgery (Table 4.2). The cumulative incidence of SSI was 3.2% [95% CI: 2.7%–3.7%] in CABG operations with chest incision only (n=5 625 operations) and 3.2% [95% CI: 3.0%–3.4%] in CABG with chest and donor site incisions (n=28 028 operations). For the latter, only SSI at the chest incision site were recorded according to the European surveillance protocol (HAISSI protocol v1.01).

Sixty-one per cent of SSI were diagnosed in hospitals, whereas 39% were detected after discharge. The percentage of SSI detected after discharge ranged from 19% (64 of 341 SSI) in the UK to 95% (79 of 83 SSI) in Norway (Figure 4.1).

Although the SSI case definition specifies that only infections reported within a time frame of 30 days of surgery must be included, 126 (9.7%) of 1 301 SSI in CABG operations were reported after 30 days. These infections were excluded from further data analysis according to the current protocol (HAISSI protocol v1.02).

The percentile distribution of the cumulative incidence of SSI in hospitals reporting at least 20 operations (n= 141 hospital-years) is given by NHSN risk index in Table 4.3. The mean of hospital cumulative incidences was 3.5 SSI per 100 operations, with 10% of the hospitals reporting a cumulative incidence of SSI of more than 7.0%. The cumulative incidence by NHSN risk index (database mean) varied from 2.6% for CABG operations with a risk index of 0 to 4.4% for CABG operations with a risk index of 2 or 3 (Table 4.3).

The percentile distribution of the SSI incidence density in hospitals reporting at least 20 operations with a known discharge date (n=126 hospital-years) is given by NHSN risk index in Table 4.4. The mean of incidence densities in participating hospitals was 1.7 in-hospital SSI per 1 000 post-operative patient-days, with 10% of the hospitals reporting an incidence density equal or greater than 3.8 in-hospital SSI per 1 000 post-operative patient-days. The incidence density of SSI by NHSN risk index (database mean) ranged from 0.9 in-hospital SSI per 1 000 post-operative patient-days for CABG operations with a risk index of 0 to 2.7 in-hospital SSI per 1 000 post-operative patient-days for CABG operations with a risk index of 2 or 3 (Table 4.4).

The distribution of SSI by type showed that 578 (49%) were superficial incisional SSI, 408 (35%) were deep incisional SSI, 177 (15%) were organ/space SSI and for 12 (1%) SSI the type was unknown (Figure 4.2).

Microbiological data were available for 52.6% of 1 080 SSI in eight countries reporting microbiological data for SSI in CABG (Annex 2, Table A2.1). A total of 693 microorganisms were reported (Annex 2, Table A2.2). Of these, 471 (63.1%) were gram-positive cocci. Coagulase-negative staphylococci were predominant (32.8 %) followed by *Staphylococcus aureus* (22.2%). Of the latter, 32 out of 102 (31%) tested isolates were meticillin-resistant *S. aureus* (MRSA). Enterobacteriaceae represented 20.5% of all microorganisms, followed by non-fermentative gram-negative bacilli (7.9%).

Trends, 2006-2009

Intra-country trends for SSI cumulative incidence during the period 2006-2009 are shown in Figure 4.1. Poisson regression trend analysis of SSI cumulative incidence (adjusting for NHSN risk index) showed a statistically significant increasing trend in the UK (data from England only), which was confirmed by the trend analysis of SSI incidence density ($p < 0.001$). Furthermore, the incidence density trend analysis also showed a moderately significant increasing trend for Germany ($p < 0.05$) and a moderately decreasing trend for Lithuania ($p < 0.05$). The overall trend analysis for CABG in countries contributing data for all four years showed a statistically significant increase (Figure 3.3), but this trend disappeared, both for the cumulative incidence and the incidence density, when superficial incisional SSI were excluded from the analysis. The percentage of superficial incisional SSI reported for CABG increased from 36% in 2006–2007 to 46% in 2008–2009 ($p<0.001$).

Discussion

The data should, however, be interpreted with caution. In 2008–2009, 1 175 SSI were reported in 35 864 CABG operations within 30 days of the operation. A relatively high percentage (9.7%) of SSI occurred after the 30 days

included in the case definition. One possible reason is that many patients with CABG have sternal wires, which are considered as implants by some national surveillance protocols, meaning that a follow-up period of one year is applied for CABG. The overall increasing trend in the cumulative incidence and incidence density for SSI in CABG (Figure 3.3) can be explained by an increase in the reporting of superficial SSI, both before and after discharge, possibly indicating an increase in the surveillance sensitivity for this type of operation. Another factor to take into account is that less CABG procedures have been performed in recent years because of new non-surgical techniques, thus leaving only the most severe patients to undergo surgery. As a consequence, current adjustment with the NHSN risk index may not be sufficient to take this change in patient case-mix into account in the trend analysis.

Coronary Artery Bypass Graft (CABG)

Table 4.1 Characteristics of patients with CABG operations, 2008–2009 (n=35 864 operations)

Characteristics	Value
Sex ratio (M:F)	3.7
Median age (years)	69
Post-operative case fatality (%)	2.4
Contaminated or dirty operations (%)	0.1
Median duration of operation (min)	193
Median length of post-operative stay (days)	9
Urgent operations (%)	6.1
Antibiotic prophylaxis (%)	96.6

Table 4.2. Cumulative incidence of SSI (diagnosed within 30 days of surgery) and incidence density of SSI (diagnosed during hospital stay within 30 days of surgery) after CABG operations by country, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with a known discharge date (3)	No. (sum) of post-operative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 post-operative patient-days) [95% CI] (5)
Austria	249	12	4.8 [2.5–8.4]	249	3 656	7	1.9 [0.8–3.9]
France	2 088	73	3.5 [2.7–4.4]	2 088	23 316	44	1.9 [1.4–2.5]
Germany	18 084	525	2.9 [2.7–3.2]	13 391	160 685	220	1.4 [1.2–1.6]
Hungary	429	8	1.9 [0.8–3.7]	429	4 113	5	1.2 [0.4–2.8]
Italy	928	37	4.0 [2.8–5.5]	916	9 302	17	1.8 [1.1–2.9]
Lithuania	1 086	40	3.7 [2.6–5.0]	1 085	16 367	29	1.8 [1.2–2.5]
Malta	349	5	1.4 [0.5–3.3]	349	2 776	1	0.4 [0.0–2.0]
Norway**	1 464	83	5.7 [4.5–7.0]	1 464	10 188	4	0.4 [0.1–1.0]
Portugal	78	0	0.0 [0.0–4.7]*	78	671	0	0.0 [0–5.5]*
Spain	1 129	51	4.5 [3.4–5.9]	1 080	13 985	34	2.4 [1.7–3.4]
UK***	9 980	341	3.4 [3.1–3.8]	9 980	100 153	277	2.8 [2.5–3.1]
EU/EEA	**35 864**	**1 175**	**3.3 [3.1–3.5]**	**31 109**	**345 212**	**638**	**1.8 [1.7–2.0]**

(1) Only SSI diagnosed within 30 days of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations; (3) Operations with missing discharge date are excluded; (4) Only in-hospital diagnosed infections occurring within 30 days of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient days. *One-sided confidence interval. ** Data from Norway include 8% patient-diagnosed infections *** Data from UK England only.

Table 4.3. Percentile distribution of cumulative incidences of SSI in CABG operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of operations	Number of SSI (2)	Cumulative incidence of SSI (per 100 operations) (3)	Mean and percentile distribution of cumulative incidences of SSI in hospitals					
					Mean (4)	P10	P25	P50	P75	P90
0	93	1 571	41	2.6	0.2	0	0	0	0	0.4
1	136	28 842	937	3.3	2.5	0	0.8	1.9	3.3	6.0
2 and 3	122	3 122	136	4.4	0.7	0	0	0	1.0	1.9
Unknown	52	2 206	56	2.5	0.7	0	0	0	1.1	1.9
Overall	141	35 741	1 170	3.3	3.5	0	1.6	2.8	4.8	7.0

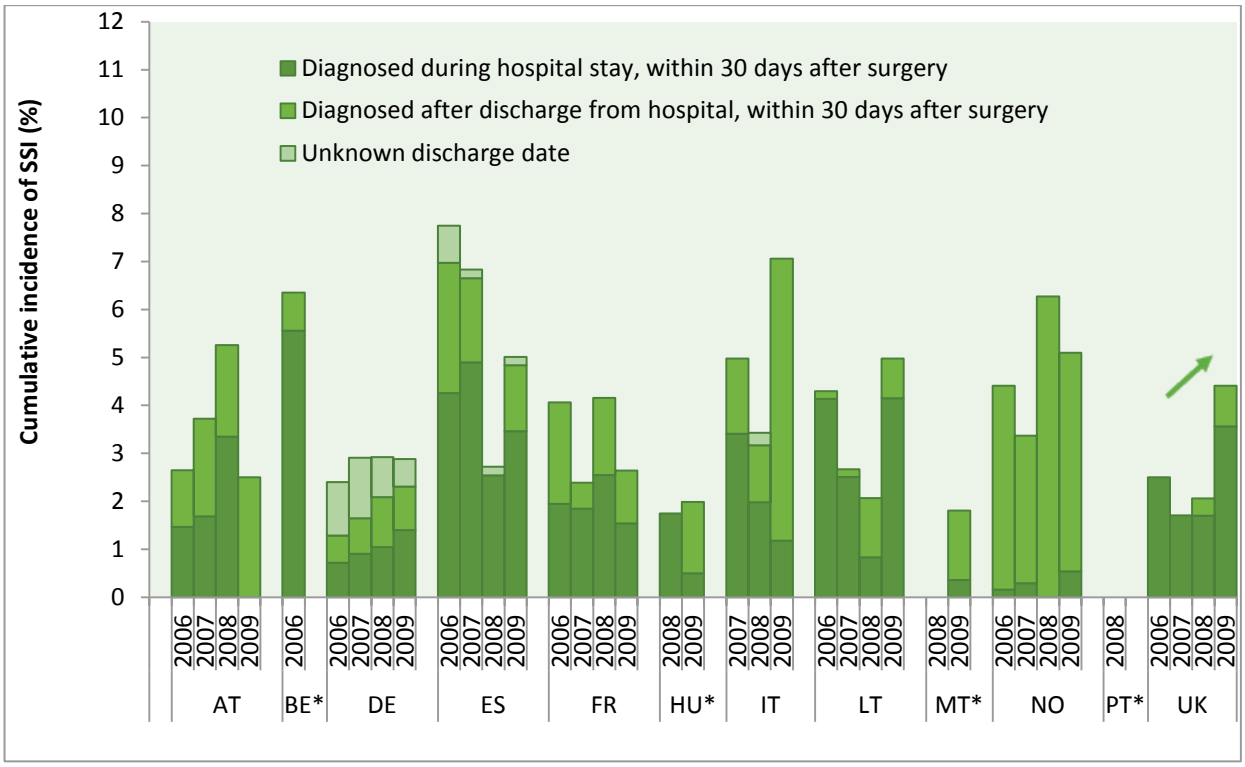
(1) Hospitals with less than 20 operations in a single year are excluded; (2) Number of SSI reported within 30 days of the operation; (3) Cumulative incidence of SSI = (Number of SSI × 100)/Number of operations, database mean; (4) Mean of cumulative incidences by hospital.

Table 4.4. Percentile distribution of incidence densities of SSI in CABG operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital years (1)	Number of post-operative patient-days (2)	Number of in-hospital SSI (3)	Incidence density of SSI (per 1 000 post-operative patient-days) (4)	Mean and percentile distribution of incidence densities of SSI in hospitals					
					Mean (5)	P10	P25	P50	P75	P90
0	81	13 489	12	0.9	1.4	0	0	0	0	0
1	121	274 778	501	1.8	1.9	0	0	0.9	2.5	4.0
2 and 3	107	33 338	90	2.7	2.8	0	0	0	2.5	5.6
Unknown	49	22 322	34	1.5	2.5	0	0	0	1.8	11.2
Overall	126	343 927	637	1.8	1.7	0	0	1.2	2.4	3.8

(1) Hospitals with less than 20 operations with a known discharge date in a single year are excluded; (2) Number of post-operative patient-days = sum of post-operative patient-days (date of discharge - date of operation+1); (3) Number of SSI reported within 30 days of the operation and before discharge from the hospital (SSI reported after discharge from hospital or with an unknown discharge date are excluded); (4) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days; (5) Mean of incidence densities by hospital.

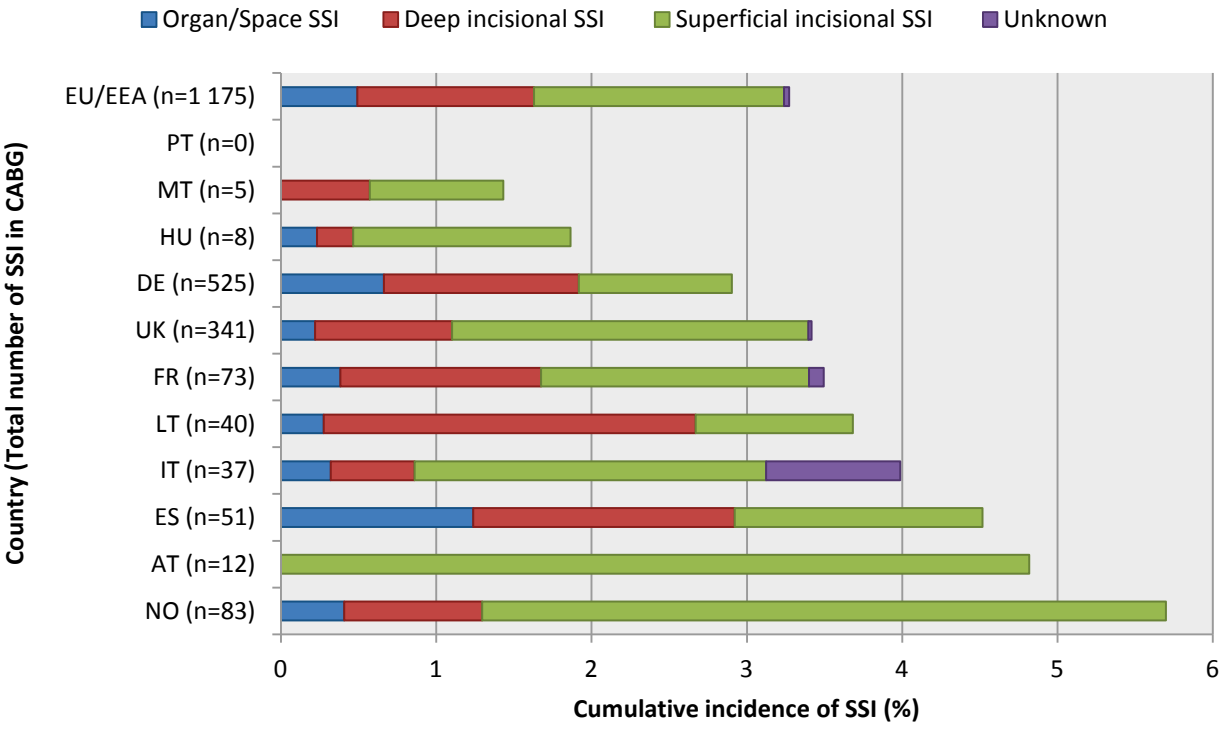
Figure 4.1. Distribution of cumulative incidence of SSI in CABG operations by country, 2006–2009



*Trend analysis was not performed for countries reporting data for less than three years.

The arrow indicates a significant increasing trend for both cumulative incidence and incidence density ($p < 0.001$).
Note: Post-discharge surveillance methods and practices differ considerably among countries.

Figure 4.2. Cumulative incidence of SSI in CABG operations by type of SSI and country, 2008–2009



Cholecystectomy (CHOL)

Key points

- A total of 63 202 CHOL operations were reported for 2008–2009;
- The cumulative incidence of SSI was 1.4% [Inter-country range: 0.5%–5.9%] in 2008–2009;
- The incidence density of SSI was 1.6 [Inter-country range: 0.9–6.1] in-hospital SSI per 1 000 post-operative patient-days in 2008–2009.

Results

For 2008 and 2009, 63 202 CHOL operations and 896 subsequent SSI were reported to ECDC. The characteristics of the patients with CHOL operations are summarised in Table 5.1. SSI were detected in 1.4% [Inter-country range: 0.5%–4.9%] of CHOL operations (cumulative incidence) within 30 days of surgery (Table 5.2). The cumulative incidence of SSI was 4.2% [95% CI: 3.8%–4.6%] in non endoscopic CHOL operations (with laparotomy) (n=9 137 operations) and 0.9% [95% CI: 0.8%–1.0%] in endoscopic CHOL operations (using laparoscopy) (n=53 149 operations).

Fifty-seven per cent of SSI were diagnosed during hospital stay whereas 43% were detected after discharge. The percentage of SSI detected after discharge ranged from 0% (none of eight SSI) in Lithuania to 86% (66 of 77 SSI) in the Netherlands (Figure 5.1).

Although the SSI case definition specifies that only infections reported within a time frame of 30 days after surgery must be included, 16 (2%) of 917 SSI in CHOL operations were reported after 30 days. In addition, the date of infection was unknown in 13 (1.5%) of 917 SSI in CHOL operations. These infections were excluded from further data analysis according to the current protocol (HAISSI protocol v1.02).

The percentile distribution of the cumulative incidence of SSI in hospitals reporting at least 20 operations (n=722 hospital-years) is given by NHSN risk index in Table 5.3. The mean of hospital cumulative incidences was 1.4 SSI per 100 operations, with 10% of the hospitals reporting a cumulative incidence of SSI of more than 4.0%. The cumulative incidence by NHSN risk index (database mean) varied from 0.9% for CHOL operations with a risk index of 0, to 4.5% for CHOL operations with a risk index of 2 or 3 (Table 5.3).

The percentile distribution of the incidence density of SSI in hospitals reporting at least 20 operations with a known discharge date (n=684 hospital-years) is given by NHSN risk index in Table 5.4. The mean of incidence densities in these hospitals was 1.2 in-hospital SSI per 1 000 post-operative patient-days, with 10% of the hospitals reporting an incidence density equal to or greater than 4.8 in-hospital SSI per 1 000 post-operative patient-days. The incidence density of SSI by NHSN risk index (database mean) ranged from 0.8 in-hospital SSI per 1 000 post-operative patient-days for CHOL operations with a risk index of 0, to 3.5 in-hospital SSI per 1 000 post-operative patient-days for CHOL operations with a risk index of 2 or 3 (Table 5.4).

The distribution of SSI by type showed that 533 (59%) were superficial incisional SSI, 215 (24%) were deep incisional SSI, 136 (15%) were organ/space SSI and for 12 (1%) SSI the type was not known (Figure 5.2).

Microbiological data were available for 37.9% of 844 SSI in eight countries reporting microbiological data for SSI in CHOL (Annex 2, Table A2.1). A total of 400 microorganisms were reported (Annex 2, Table A2.2). Of these, 199 (49.8%) were gram-negative bacilli (Enterobacteriaceae) and 147 (36.8%) were gram-positive cocci. The predominant type was *Escherichia coli* (25.3%), followed by Enterococci (17.5%) and *S. aureus* (10.5%). Of the latter, 10 out of 18 (55.5%) tested isolates were MRSA. Enterobacteriaceae were the predominant microorganisms after non-endoscopic CHOL, whereas gram-positive cocci were the main causative microorganisms after endoscopic CHOL operations.

Trends, 2006–2009

Intra-country trends for the cumulative incidence of SSI for 2006–2009 are shown in Figure 5.1. Poisson regression trend analysis of SSI cumulative incidence (adjusting for NHSN risk index) showed a statistically significant decreasing trend in Portugal and Lithuania ($p < 0.05$), but these trends were not observed for the incidence density of SSI. The overall trend analysis for CHOL in countries contributing data for all four years showed no significant trends (Figure 3.3).

Discussion

The data should, however, be interpreted with caution. The intensity of post-discharge surveillance (highest in the Netherlands and Norway) influences the cumulative incidence of SSI in CHOL operations, for which the average length of post-operative stay is short, with a median of four days (Table 5.1). As expected, there was a lower cumulative incidence (0.9%) of SSI in laparoscopic CHOL operations compared to non-endoscopic CHOL operations (4.2%).

Cholecystectomy (CHOL)

Table 5.1. Characteristics of patients with CHOL operations, 2008–2009 (n=63 202 operations)

Characteristics	Value
Sex ratio (M:F)	0.5
Median age (years)	57
Post-operative case fatality (%)	0.6
Contaminated or dirty operations (%)	14.1
Median duration of operation (min)	60
Median length of post-operative stay (days)	4
Urgent operations (%)	9.7
Antibiotic prophylaxis (%)	58.7

Table 5.2. Cumulative incidence of SSI (diagnosed within 30 days of surgery) and incidence density of SSI (diagnosed during hospital stay within 30 days of surgery) after CHOL operations by country, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with a known discharge date (3)	No. (sum) of post-operative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 post-operative patient-days) [95% CI] (5)
Austria	631	7	1.1 [0.4–2.3]	624	3 866	6	1.6 [0.6–3.4]
France	21 486	191	0.9 [0.8–1.0]	21 452	108 131	101	0.9 [0.8–1.1]
Germany	18 987	254	1.3 [1.2–1.5]	13 739	81 163	147	1.8 [1.5–2.1]
Hungary	4 133	63	1.5 [1.2–2.0]	4 130	19 723	48	2.4 [1.8–3.2]
Italy	6 678	118	1.8 [1.5–2.1]	6 112	29 774	43	1.4 [1.0–1.9]
Lithuania	1 642	8	0.5 [0.2–1.0]	1 642	8 599	8	0.9 [0.4–1.8]
Netherlands	2 715	77	2.8 [2.2–3.5]	2 715	7 918	11	1.4 [0.7–2.5]
Norway*	758	45	5.9 [4.3–7.6]	757	3 837	7	1.8 [0.7–3.8]
Portugal	3 694	40	1.1 [0.8–1.5]	3 693	12 524	24	1.9 [1.2–2.9]
Spain	2 478	93	3.8 [3.0–4.6]	2 406	13 165	80	6.1 [4.8–7.5]
EU/EEA	**63 202**	**896**	**1.4 [1.3–1.5]**	**57 270**	**288 700**	**475**	**1.6 [1.5–1.8]**

(1) Only SSI diagnosed within 30 days of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations; (3) Operations with missing discharge date are excluded; (4) Only in-hospital diagnosed infections occurring within 30 days of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days. *Data from Norway include 42% patient-diagnosed infections.

Table 5.3. Percentile distribution of cumulative incidences of SSI in CHOL operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of operations	Number of SSI (2)	Cumulative incidence of SSI (per 100 operations) (3)	Mean and percentile distribution of cumulative incidences of SSI in hospitals					
					Mean (4)	P10	P25	P50	P75	P90
0	695	35 580	311	0.9	0.6	0	0	0	0.2	2.2
1	686	13 529	262	1.9	0.4	0	0	0	0	1.8
2 and 3	543	4 214	190	4.5	0.4	0	0	0	0	1.6
Unknown	214	5 242	72	1.4	0.4	0	0	0	0	1.4
Overall	722	58 565	835	1.4	1.4	0	0	0	2.2	4.0

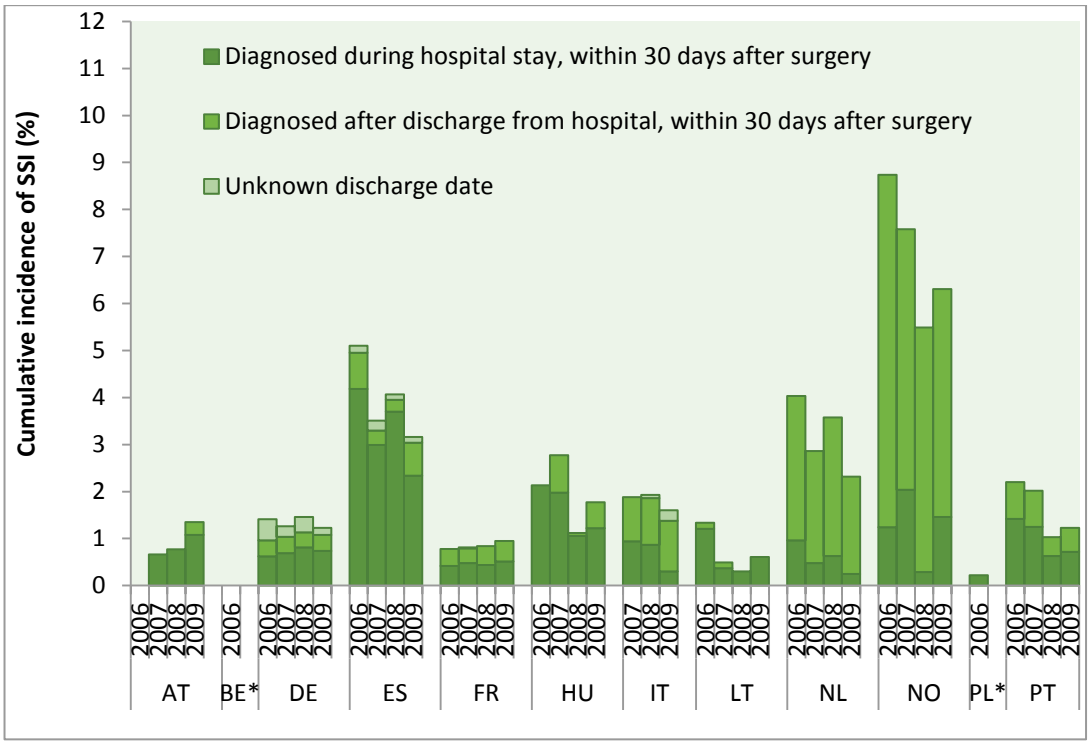
(1) Hospitals with less than 20 operations in a single year are excluded; (2) Number of SSI reported within 30 days of the operation; (3) Cumulative incidence of SSI = (Number of SSI × 100)/Number of operations, database mean; (4) Mean of cumulative incidences by hospital.

Table 5.4. Percentile distribution of incidence densities of SSI in CHOL operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of post-operative patient-days (2)	Number of in-hospital SSI (3)	Incidence density of SSI (per 1 000 post-operative patient-days)(4)	Mean and percentile distribution of incidence densities of SSI in hospitals					
					Mean (5)	P10	P25	P50	P75	P90
0	657	132 493	102	0.8	0.6	0	0	0	0	1.4
1	648	74 255	154	2.0	1.3	0	0	0	0	4.7
2 and 3	504	36 607	129	3.5	2.6	0	0	0	0	8.3
Unknown	211	21 298	48	2.3	1.2	0	0	0	0	1.6
Overall	684	264 653	433	1.6	1.2	0	0	0	1.1	4.8

(1) Hospitals with less than 20 operations with a known discharge date in a single year are excluded; (2) Number of post-operative patient-days = sum of post-operative patient-days (date of discharge - date of operation+1); (3) Number of SSI reported within 30 days of the operation and before discharge from the hospital (SSI reported after discharge from hospital or with an unknown discharge date are excluded); (4) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days; (5) Mean of incidence densities by hospital.

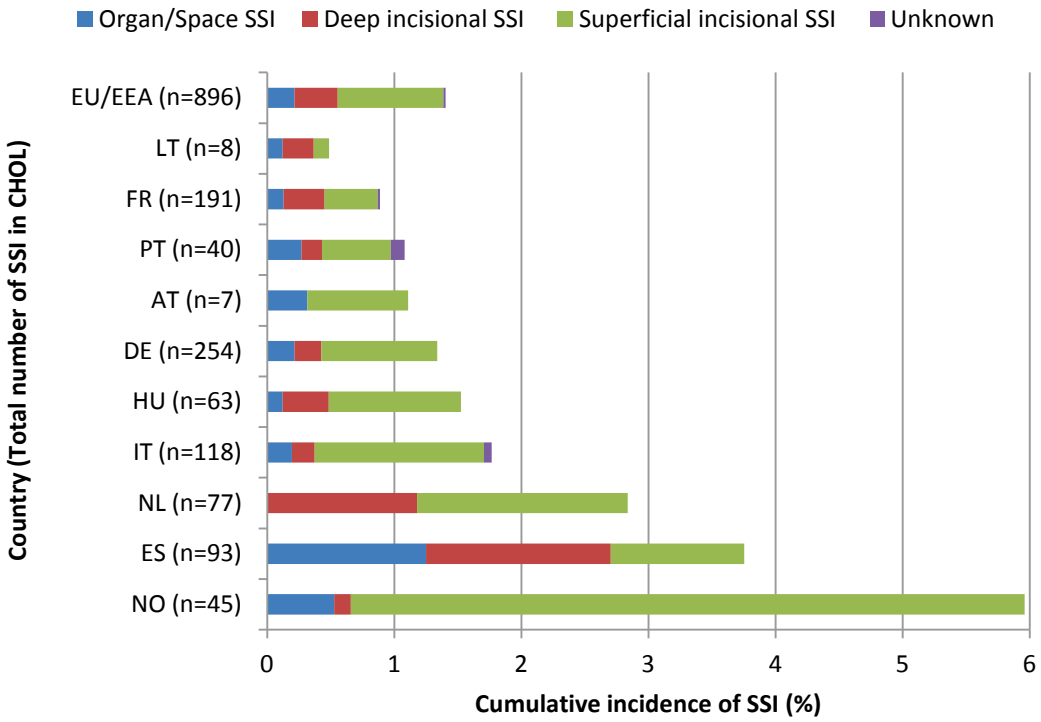
Figure 5.1. Distribution of cumulative incidence of SSI in CHOL operations by country, 2006–2009



* Trend analysis was not performed for countries reporting data for less than three years.

Note: Post-discharge surveillance methods and practices differ considerably between countries.

Figure 5.2. Cumulative incidence of SSI in CHOL operations by type of SSI and country, 2008–2009



Colon surgery (COLO)

Key points

- A total of 40 858 COLO operations were reported for 2008–2009;
- The cumulative incidence of SSI was 9.7% [Inter-country range: 7.9%–20.3%] in 2008–2009;
- The incidence density of SSI was 6.4 [Inter-country range: 4.2–13.5] in-hospital SSI per 1 000 post-operative patient-days in 2008–2009.

Results

A total of 40 858 COLO operations, and 3 964 SSI subsequent to the operation, were reported to ECDC for 2008 and 2009. The characteristics of the patients with COLO operations are summarised in Table 6.1. SSI were detected in 9.7% [Inter-country range: 7.9%–20.3%] of COLO operations (cumulative incidence) within 30 days of surgery (Table 6.2). The cumulative incidence of SSI was 10.5% [95% CI: 10.1%–10.8%] in non -endoscopic COLO operations (with laparotomy) (n=31 887 operations) and 6.8% [95% CI: 6.3%–7.4%] in endoscopic COLO operations (using laparoscopy) (n= 8 322 operations).

Eighty-six per cent of SSI were diagnosed in hospitals, whereas 14% were detected after discharge. The percentage of SSI detected after discharge ranged from 2% (1 of 56 SSI) in Lithuania to 65% (17 of 26 SSI) in Norway (Figure 6.1).

The percentile distribution of the cumulative incidence of SSI in hospitals reporting at least 20 operations (n=501 hospital-years) is given by NHSN risk index in Table 6.3. The mean of hospital cumulative incidences was 9.9 SSI per 100 operations, with 10% of the hospitals reporting an SSI cumulative incidence of more than 20.8%. The cumulative incidence by NHSN risk index (database mean) varied from 7.2% for COLO operations with a risk index of 0, to 13.7% for COLO operations with a risk index of 2 or 3 (Table 6.3).

The percentile distribution of SSI incidence density in hospitals reporting at least 20 operations with a known discharge date (n=457 hospital-years) is given by NHSN risk index in Table 6.4. The mean of incidence densities in participating hospitals was 6.1 in-hospital SSI per 1 000 post-operative patient-days, with 10% of the hospitals reporting an incidence density equal or greater than 13.5 in-hospital SSI per 1 000 post-operative patient-days. The incidence density of SSI by NHSN risk index (database mean) ranged from 5.3 in-hospital SSI per 1 000 post-operative patient-days for COLO operations with a risk index of 0, to 7.8 in-hospital SSI per 1 000 post-operative patient-days for COLO operations with a risk index of 2 or 3 (Table 6.4).

The distribution of SSI by type showed that 1 963 (50%) were superficial incisional SSI, 1 182 (30%) were deep incisional SSI, 764 (19%) were organ/space SSI and for 55 (1%) SSI the type was unknown (Figure 6.2).

Microbiological data were available for 46.8% of 3 938 SSI in ten countries reporting microbiological data for SSI in COLO (Annex 2, Table A2.1). A total of 2 888 microorganisms were reported (Annex 2, Table A2.2). Gram-negative bacilli (Enterobacteriaceae), the major component of the intestinal microflora, were predominant (46.2%), followed by gram-positive cocci (31.7%). Although *S. aureus* represented only 5.1% of isolated gram-positive cocci, 47 out of 70 (67.1%) *S. aureus* isolates were MRSA. Non-fermentative gram-negative bacilli and anaerobes represented 8.6% and 6.3% isolated microorganisms, respectively.

Trends, 2006–2009

Intra-country trends for the cumulative incidence of SSI for 2006–2009 are shown in Figure 6.1. Poisson regression trend analysis of SSI cumulative incidence (adjusting for NHSN risk index) showed a statistically significant decreasing trend in France ($p < 0.001$) and Italy ($p < 0.05$), which was also observed for the incidence density of SSI (France: $p < 0.001$ and Italy: $p < 0.05$). For Portugal, a significant decreasing trend was only observed for the cumulative incidence of SSI ($p < 0.05$). Significant increasing trends of both the cumulative incidence and the incidence density of SSI were observed for Austria ($p < 0.05$) and Hungary ($p < 0.05$). For Germany, a significant increasing trend was only observed for the cumulative incidence of SSI ($p < 0.05$). The overall trend analysis for COLO in countries contributing data for all four years showed no significant trends (Figure 3.3).

Discussion

The data should be interpreted with caution. COLO is the type of surgery with the highest cumulative incidence of SSI, sometimes exceeding 15% in certain countries and hospitals. Microbiological data shows that in most cases the isolated microorganisms reflected the intestinal microflora. As expected, a lower percentage (6.8%) of SSI occurred in endoscopic COLO operations than in non-endoscopic COLO operations (10.5%).

Colon surgery (COLO)

Table 6.1. Characteristics of patients with COLO operations, 2008–2009 (n= 40 858 operations)

Characteristics	Value
Sex ratio (M:F)	1
Median age (years)	69
Post-operative case fatality (%)	3.9
Contaminated or dirty operations (%)	34.6
Median duration of operation (min)	137
Median length of post-operative stay (days)	11
Urgent operations (%)	10.5
Antibiotic prophylaxis (%)	84.6

Table 6.2. Cumulative incidence of SSI (diagnosed within 30 days of surgery) and incidence density of SSI (diagnosed during hospital stay within 30 days of surgery) after COLO operations by country, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with a known discharge date (3)	No. (sum) of post-operative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 post-operative patient-days) [95% CI] (5)
Austria	479	57	11.9 [9.0–15.4]	415	5 35	51	8.9 [6.6–11.7]
France	11 811	930	7.9 [7.4–8.4]	11 746	149 211	719	4.8 [4.5–5.2]
Germany	12 540	1 104	8.8 [8.3–9.3]	9 317	134 149	811	6.0 [5.6–6.5]
Hungary	319	46	14.4 [10.6–19.2]	319	3 438	42	12.2 [8.8–16.5]
Italy	3 884	328	8.4 [7.6–9.4]	3 433	47 447	236	5.0 [4.4–5.7]
Lithuania	542	56	10.3 [7.8–13.4]	542	7 516	55	7.3 [5.5–9.5]
Netherlands	2 362	365	15.5 [13.9–17.1]	2 360	33 227	282	8.5 [7.5–9.5]
Norway*	219	26	11.9 [7.8–17.4]	219	2 153	9	4.2[1.9–7.9]
Portugal	1 493	125	8.4 [7.0–10.0]	1 493	14 459	120	8.3 [6.9–9.9]
Spain	2 211	448	20.3 [18.4–22.2]	2 022	29 268	395	13.5 [12.2–14.9]
UK**	4 998	479	9.6 [8.7–10.5]	4 998	60 656	422	7.0 [6.3–7.7]
EU/EEA	**40 858**	**3 964**	**9.7 [9.4–10.0]**	**36 864**	**487 259**	**3 142**	**6.4 [6.2–6.7]**

(1) Only SSI diagnosed within 30 days of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations; (3) Operations with missing discharge date are excluded; (4) Only in-hospital diagnosed infections occurring within 30 days of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days.
* Data from Norway include 27% patient diagnosed infections; ** Data from UK England only.

Table 6.3. Percentile distribution of cumulative incidences of SSI in COLO operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of operations	Number of SSI (2)	Cumulative incidence of SSI (per 100 operations) (3)	Mean and percentile distribution of cumulative incidences of SSI in hospitals					
					Mean(4)	P10	P25	P50	P75	P90
0	463	9 663	700	7.2	2.2	0	0	0.8	3.3	6.1
1	485	13 916	1 327	9.5	3.9	0	0	3.0	5.8	9.1
2 and 3	466	8 884	1 215	13.7	3.4	0	0	2.0	4.9	8.7
Unknown	185	3 093	301	9.7	2.5	0	0	0	2.1	6.1
Overall	501	35 556	3 543	10.0	9.9	0	3.6	8.4	14.2	20.8

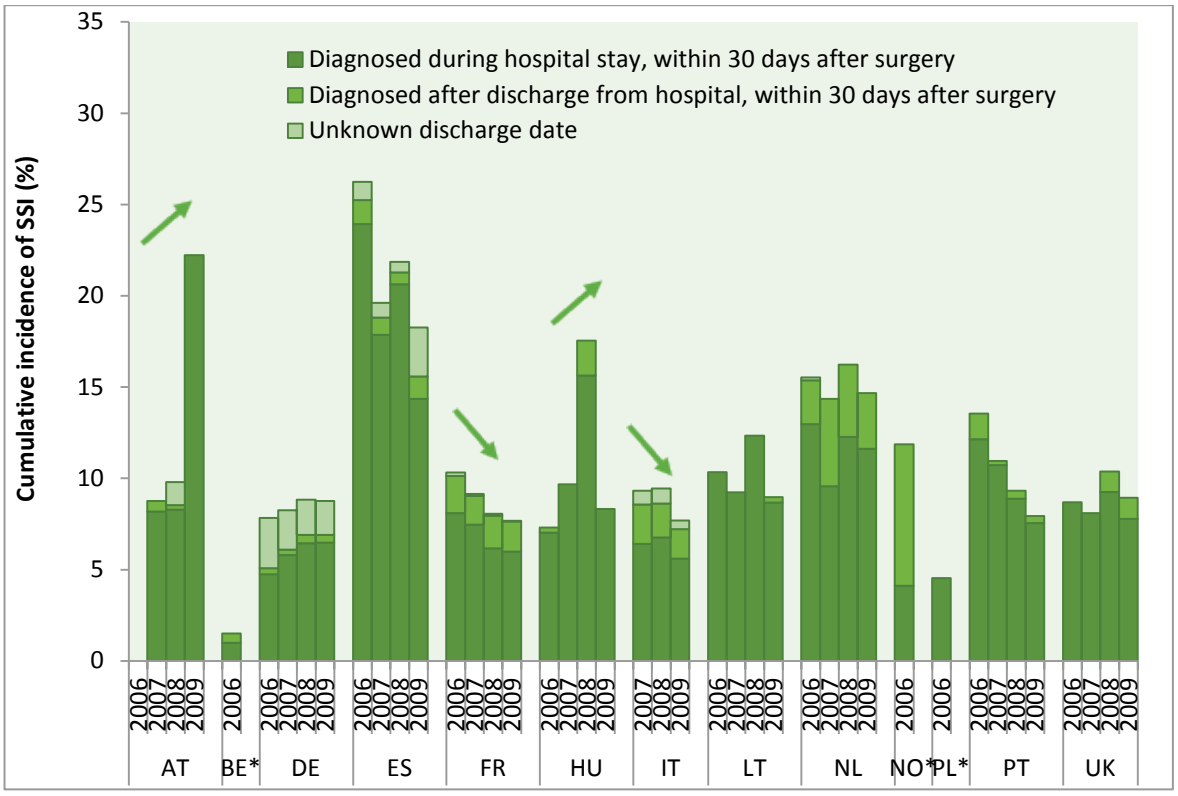
(1) Hospitals with less than 20 operations in a single year are excluded; (2) Number of SSI reported within 30 days of the operation; (3) Cumulative incidence of SSI = (Number of SSI × 100)/Number of operations, database mean; (4) Mean of cumulative incidences by hospital.

Table 6.4. Percentile distribution of incidence densities of SSI in COLO operations at participating hospitals by NHSN risk index, 2008-2009

NHSN risk index	Number of hospital-years (1)	Number of post-operative patient-days (2)	Number of in-hospital SSI (3)	Incidence density of SSI (per 1 000 post-operative patient-days)(4)	Mean and percentile distribution of incidence densities of SSI in hospitals					
					Mean (5)	P10	P25	P50	P75	P90
0	420	98 850	521	5.3	4.3	0	0	0	6.8	13.4
1	441	162 003	1 033	6.4	5.9	0	0	4.5	9.2	13.8
2 and 3	422	124 211	973	7.8	7.4	0	0	4.8	11.4	19.3
Unknown	176	36 074	274	7.6	6.2	0	0	0	7.7	19.9
Overall	457	421 138	2 801	6.7	6.1	0	2.0	4.9	8.8	13.5

(1) Hospitals with less than 20 operations with a known discharge date in a single year are excluded; (2) Number of post-operative patient-days = sum of post-operative patient-days (date of discharge - date of operation+1); (3) Number of SSI reported within 30 days of the operation and before discharge from the hospital (SSI reported after discharge from hospital or with an unknown discharge date are excluded); (4) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days; (5) Mean of incidence densities by hospital.

Figure 6.1. Distribution of cumulative incidence of SSI in COLO operations by country, 2006–2009

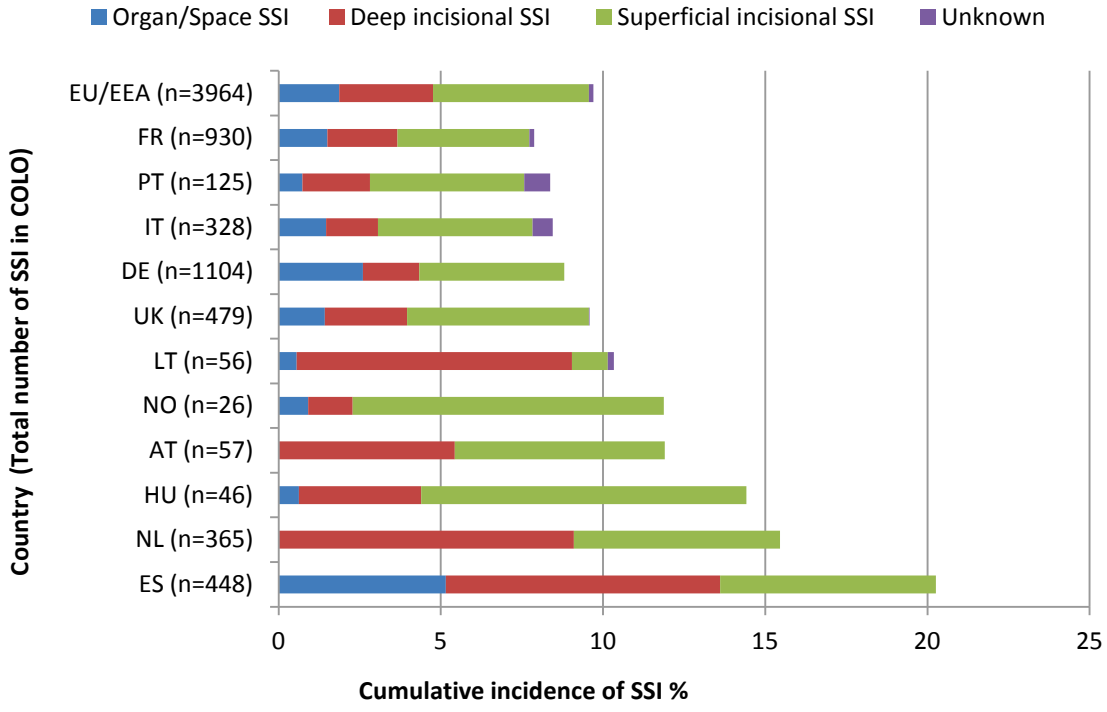


* Trend analysis was not performed for countries reporting data for less than three years.

The arrows indicate significant trends for both cumulative incidence and incidence density ($p < 0.001$ for France and $p < 0.05$ for Italy, Austria and Hungary). The apparent decreasing trend for Portugal was not statistically significant (small sample size).

Note: Post-discharge surveillance methods and practices differ considerably among countries.

Figure 6.2. Cumulative incidence of SSI in COLO operations by type of SSI and country, 2008–2009



Caesarean section (CSEC)

Key points

- A total of 132 044 CSEC operations were reported for 2008–2009;
- The cumulative incidence of SSI was 3.6% [Inter-country range: 0.2%–8.2%] in 2008–2009;
- The incidence density of SSI was 1.2 [Inter-country range: 0.1–3.1] in-hospital SSI per 1 000 post-operative patient-days in 2008–2009.

Results

A total of 132 044 CSEC operations, and 4 732 SSI subsequent to the operation, were reported to ECDC. Characteristics of the patients with CSEC operations are summarised in Table 7.1. SSI were detected in 3.6% [Inter-country range: 0.2%–8.2%] of CSEC operations (cumulative incidence) within 30 days of surgery (Table 7.2).

Twenty-seven per cent of SSI were diagnosed in hospitals, whereas 73% were detected after discharge. The percentage of SSI detected after discharge ranged from 4% (1 of 28 SSI) in Lithuania to 88% (2 769 of 3 148 SSI) in the UK (Figure 7.1).

The percentile distribution of the SSI cumulative incidence in hospitals reporting at least 20 operations (n=773 hospital-years) is given by NHSN risk index in Table 7.3. The mean of hospital cumulative incidences was 2.6 SSI per 100 operations, with 10% of the hospitals reporting a cumulative incidence of SSI of more than 7.6%. The cumulative incidence by NHSN risk index (database mean) varied from 3.5% for CSEC operations with a risk index of 0, to 3.8% for CSEC operations with a risk index of 2 or 3 (Table 7.3).

The percentile distribution of the incidence density of SSI in hospitals reporting at least 20 operations with a known discharge date (n= 741 hospital-years) is given by NHSN risk index in Table 7.4. The mean of incidence densities in participating hospitals was 1.1 in-hospital SSI per 1 000 post-operative patient-days, with 10% of the hospitals reporting an incidence density equal to or greater than 3.5 in-hospital SSI per 1 000 post-operative patient-days. The incidence density of SSI by NHSN risk index (database mean) ranged from 1.2 in-hospital SSI per 1 000 post-operative patient-days for CSEC operations with a risk index of 0, to 3.2 in-hospital SSI per 1 000 post-operative patient-days for CSEC operations with a risk index of 2 or 3 (Table 7.4).

The distribution of SSI by type showed that 4 052 (86%) were superficial incisional SSI, 461 (10%) were deep incisional SSI, 174 (3%) were organ/space SSI and for 45 (1%) SSI, the type was unknown (Figure 7.2).

Microbiological data were available for 24.7% of 1 171 SSI in nine countries reporting microbiological data for SSI in CSEC (Annex 2, Table A2.1). A total of 340 microorganisms were reported (Annex 2, Table A2.2). One hundred and ninety-nine of 340 (58.5%) isolated microorganisms were gram-positive cocci and of these, 85 (25.0%) were *S. aureus.* Eight out of 43 (18.6%) *S. aureus* isolates were MRSA. Gram-negative bacilli (Enterobacteriaceae) and non-fermentative gram-negative bacilli represented 30.6% and 4.4% of isolated microorganisms respectively.

Trends, 2006–2009

Intra-country trends for the SSI cumulative incidence during the period 2006–2009 are shown in Figure 7.1. Poisson regression trend analysis of the cumulative incidence and the incidence density of SSI (adjusting for NHSN risk index) showed a statistically significant decreasing trend for Austria, Germany and France ($p < 0.05$). A significant decreasing trend of the SSI incidence density only was observed in the Netherlands ($p < 0.05$) and in the UK ($p < 0.001$), whereas in Italy and Portugal only the cumulative incidence of SSI showed a significant decreasing trend ($p < 0.05$). The overall trend analysis for CSEC in countries contributing data for all four years showed a significant increase in the cumulative incidence of SSI ($p<0.001$), but a decreasing trend for the incidence density of SSI ($p<0.001$) (Figure 3.3). Both trends persisted after exclusion of superficial incisional SSI from the analysis. The percentage of SSI detected after discharge in these countries increased from 66% in 2006–2007 to 81% in 2008–2009 ($p<0.001$).

Discussion

The data should, however, be interpreted with caution. There are large inter-country differences in the percentage of SSI following CSEC reported after hospital discharge, reflecting differences in national surveillance methods. For this reason, inter-country comparisons should only be attempted to compare the incidence density of in-hospital SSI, and this despite the fact that the length of hospital stay after CSEC is short and that most SSI following CESC occur after discharge from the hospital. The opposite trends observed for the SSI cumulative incidence versus the SSI incidence density in countries contributing CSEC data for all four years may indicate an increasing intensity in the post-discharge surveillance from 2006 to 2009 for this group of countries as a whole.

Caesarean Section (CSEC)

Table 7.1. Characteristics of patients with CSEC operations, 2008–2009 (n= 132 044 operations)

Characteristics	Value
Sex ratio (M:F)	0
Median age (years)	31
Post-operative case fatality (%)	0.1
Contaminated or dirty operations (%)	2.9
Median duration of operation (min)	37
Median length of post-operative stay (days)	5
Urgent operations (%)	47.2
Antibiotic prophylaxis (%)	85.4

Table 7.2. Cumulative incidence of SSI (diagnosed within 30 days of surgery) and incidence density of SSI (diagnosed during hospital stay within 30 days of surgery) after CSEC operations by country, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with a known discharge date (3)	No. (sum) of post-operative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 post-operative patient-days) [95% CI] (5)
Austria	6 639	44	0.7 [0.5–0.9]	6 639	47 119	27	0.6 [0.4-0.8]
France	31 395	501	1.6 [1.5–1.7]	31 357	221 669	188	0.9 [0.7-1.0]
Germany	21 019	114	0.5 [0.4–0.7]	14 896	98 730	38	0.4 [0.3-0.5]
Hungary	6 500	143	2.2 [1.9–2.6]	6 497	37 884	106	2.8 [2.3-3.4]
Italy	11 926	247	2.1 [1.8–2.3]	9 358	53 612	43	0.8 [0.6-1.1]
Lithuania	2 284	28	1.2 [0.8–1.8]	2 284	13 951	27	1.9 [1.3-2.8]
Netherlands	3 098	38	1.2 [0.9–1.7]	3 095	14 461	5	0.3 [0.1-0.8]
Norway*	4 141	309	7.5 [6.7–8.3]	4 140	22 418	34	1.5 [1.0-2.0]
Portugal	3 361	8	0.2 [0.1–0.5]	3 361	14 420	1	0.1 [0.0-0.4]
Spain	2 162	48	2.2 [1.6–2.9]	2 135	12 172	38	3.1 [2.2-4.3]
UK**	39 519	3 252	8.2 [7.9–8.5]	38 843	177 474	379	2.1 [1.9-2.4]
EU/EEA	**132 044**	**4 732**	**3.6 [3.5–3.7]**	**122 605**	**713 910**	**886**	**1.2 [1.2-1.3]**

(1) Only SSI diagnosed within 30 days of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations; (3) Operations with missing discharge date are excluded; (4) Only in-hospital diagnosed infections occurring within 30 days of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/ Number of post-operative patient-days.

* Data from Norway include 29% patient diagnosed infections; **Combined data from UK Northern Ireland, UK Scotland and UK Wales (for detailed data per parts of the UK, see addendum).

Table 7.3. Percentile distribution of cumulative incidences of SSI in CSEC operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of operations	Number of SSI (2)	Cumulative incidence of SSI (per 100 operations) (3)	Mean and percentile distribution of cumulative incidences of SSI in hospitals					
					Mean (4)	P10	P25	P50	P75	P90
0	766	104 366	3 626	3.5	2.1	0	0	0.6	2.7	6.3
1	699	15 769	585	3.7	0.3	0	0	0	0.3	1.3
2 and 3	186	786	30	3.8	0.1	0	0	0	0	0.1
Unknown	369	9 294	394	4.2	0.3	0	0	0	0	1.1
Overall	773	130 215	4 635	3.6	2.6	0	0	1.0	3.1	7.6

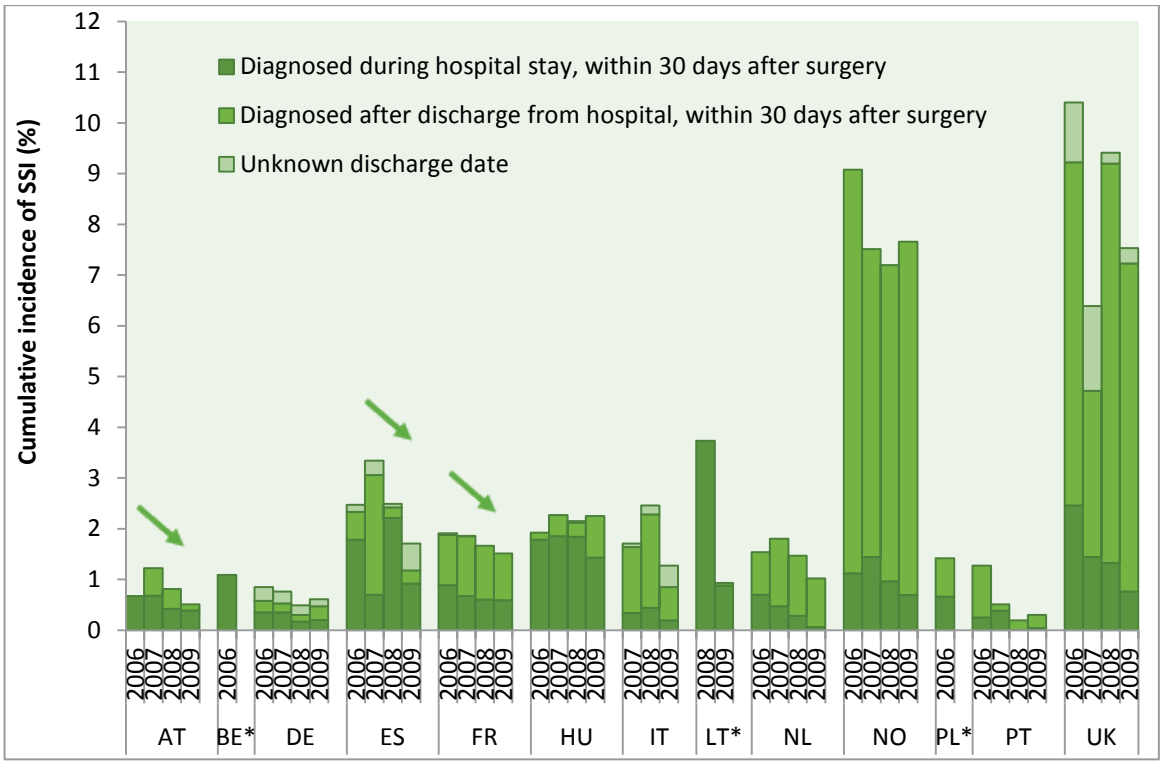
(1) Hospitals with less than 20 operations in a single year are excluded; (2) Number of SSI reported within 30 days of the operation; (3) Cumulative incidence of SSI = (Number of SSI × 100)/Number of operations, database mean; (4) Mean of cumulative incidences by hospital.

Table 7.4. Percentile distribution of incidence densities of SSI in CSEC operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of post-operative patient-days(2)	Number of in-hospital SSI (3)	Incidence density of SSI (per 1 000 post-operative patient-days)(4)	Mean and percentile distribution of incidence densities of SSI in hospitals					
					Mean(5)	P10	P25	P50	P75	P90
0	734	561 953	662	1.2	1.0	0	0	0	1.2	3.5
1	668	85 979	118	1.3	1.5	0	0	0	0	2.7
2 and 3	169	4 337	14	3.2	6.8	0	0	0	0	0
Unknown	358	48 019	81	1.7	1.2	0	0	0	0	0
Overall	741	700 288	875	1.2	1.1	0	0	0	1.4	3.5

(1) Hospitals with less than 20 operations with a known discharge date in a single year are excluded; (2) Number of post-operative patient-days=sum of post-operative patient-days (date of discharge - date of operation+1); (3) Number of SSI reported within 30 days after the operation and before discharge from the hospital (SSI reported after discharge from hospital or with an unknown discharge date are excluded); (4) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days; (5) Mean of incidence densities by hospital.

Figure 7.1. Distribution of cumulative incidence of SSI in CSEC operations by country, 2006-2009

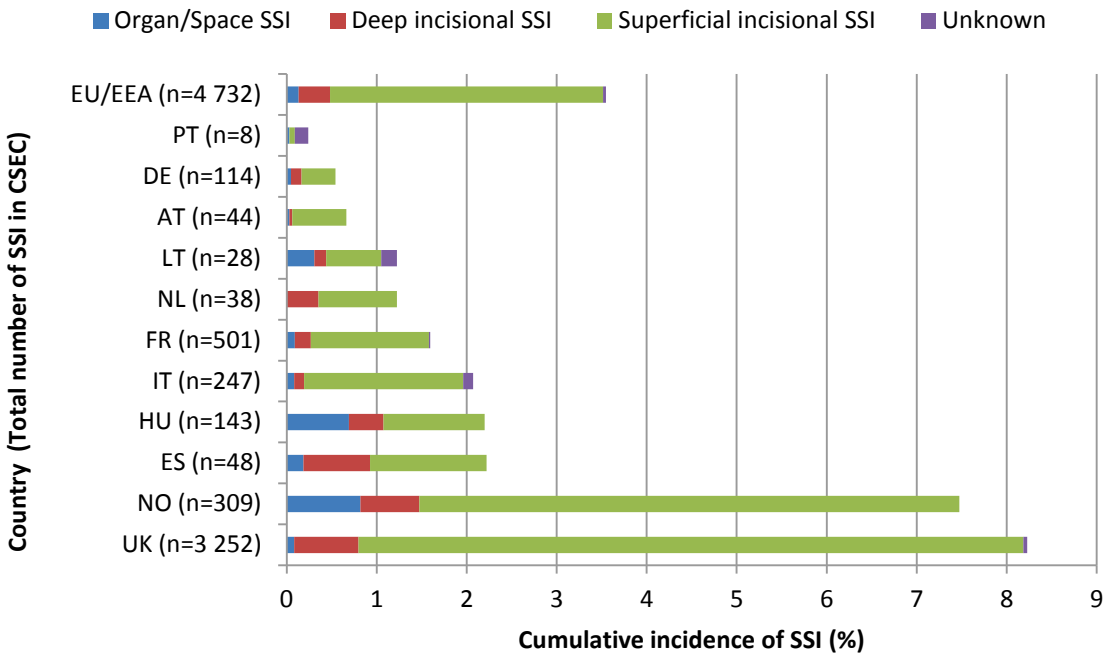


* Trend analysis was not performed for countries reporting data for less than three years.

The arrows indicate significant decreasing trends for both cumulative incidence and incidence density ($p < 0.05$).

Note: Post-discharge surveillance methods and practices differ considerably between countries.

Figure 7.2. Cumulative incidence of SSI in CSEC operations by type of SSI and country, 2008–2009



Hip prosthesis (HPRO)

Key points

- A total of 217 425 HPRO operations were reported for 20082009;
- The cumulative incidence of SSI was 1.2% [Inter-country range: 0.7%–4.5%] in 2008–2009;
- The incidence density of SSI was 0.5 [Inter-country range: 0.2–1.6] in-hospital SSI per 1 000 post-operative patient-days in 2008–2009.

Results

A total of 217 425 HPRO operations and 2 522 SSI subsequent to the operation, were reported to ECDC for 2008 and 2009. The characteristics of the patients with HPRO operations are summarised in Table 8.1. SSI were detected in 1.2% [Inter-country range: 0.7%–4.5%] of HPRO operations (cumulative incidence) within one year of surgery (Table 8.2). The cumulative incidence of SSI for total hip replacement (ICD-9-CM code 81.51, n= 136 903) was 0.9% [95%CI: 0.8%–0.9%], whereas it was 3.0% [95%CI: 2.6%–3.3%] for partial hip replacement (ICD-9-CM code 81.52, n= 11 055). For revision of hip replacement (ICD-9-CM code 81.53, n= 7 121), the cumulative incidence of SSI was 1.8% [95%CI: 1.5%–2.2%].

Forty-six per cent of SSI were diagnosed in hospitals, whereas 54% were detected after discharge. The percentage of SSI detected after discharge ranged from 25% (4 of 16 SSI) in Hungary to 80% (142 of 178 SSI) in Norway (Figure 8.1). Not all countries perform post-discharge surveillance up to one year following HPRO operations as indicated in the European surveillance protocol (HAISSI protocol v1.1).

The percentile distribution of the cumulative incidence of SSI in hospitals reporting at least 20 operations (n=1 504 hospital-years) is given by NHSN risk index in Table 8.3. The mean of hospital cumulative incidences was 1.3 SSI per 100 operations, with 10% of the hospitals reporting a cumulative incidence of SSI of more than 3.6%. The cumulative incidence by NHSN risk index (database mean) varied from 0.7% for HPRO operations with a risk index of 0, to 2.7% for HPRO operations with a risk index of 2 or 3 (Table 8.3).

The percentile distribution of the incidence density of SSI in hospitals reporting at least 20 operations with a known discharge date (n=1 405 hospital-years) is given by NHSN risk index in Table 8.4. The mean of incidence densities in participating hospitals was 0.5 in-hospital SSI per 1 000 post-operative patient-days, with 10% of the hospitals reporting an incidence density equal to or greater than 1.9 in-hospital SSI per 1 000 post-operative patient-days. The incidence density of SSI by NHSN risk index (database mean) ranged from 0.3 in-hospital SSI per 1 000 post-operative patient-days for HPRO operations with a risk index of 0, to 1.3 in-hospital SSI per 1 000 post-operative patient-days for HPRO operations with a risk index of 2 or 3 (Table 8.4).

The distribution of SSI by type showed that 1 056 (41%) were superficial incisional SSI, 986 (39%) were deep incisional SSI, 453 (18%) were organ/space SSI and for 27 (1%) SSI the type was unknown (Figure 8.2).

Microbiological data were available for 51.4% of 2 137 SSI in ten countries reporting microbiological data for SSI in HPRO (Annex 2, Table A2.1). A total of 1 327 microorganisms were reported (Annex 2, Table A2.2). Gram-positive cocci were the primary cause of SSI (70.4%) and of these, *S. aureus* represented 36.9 %, followed by coagulase-negative staphylococci (17.9 %). Approximately one third of tested *S. aureus* isolates were MRSA (35.4%). gram-negative bacilli (Enterobacteriaceae) and non-fermentative gram-negative bacilli represented 16.4% and 6.0% of isolated microorganisms respectively.

Trends, 2006–2009

Intra-country trends for the cumulative incidence of SSI for 2006–2009 are shown in Figure 8.1.

Poisson regression trend analysis of the cumulative incidence and the incidence density of SSI (adjusting for NHSN risk index) showed a statistically significant decreasing trend in France ($p < 0.001$) and in Hungary ($p < 0.05$). An increasing trend in Italy ($p < 0.05$) and Portugal ($p < 0.05$) and a decreasing trend in Germany ($p < 0.05$) and Finland ($p < 0.001$) were observed for SSI cumulative incidence but this was not confirmed by incidence density analysis. In the UK, only a significant decreasing trend of incidence density of SSI was observed ($p < 0.001$). The overall trend analysis for HPRO in countries contributing data for all four years showed a statistically significant decrease in both the cumulative incidence as the incidence density of SSI (Figure 3.3). However, both trends disappeared when superficial incisional SSI were excluded from the analysis. The percentage of superficial incisional SSI in HPRO decreased from 48% in 2006–2007 to 41% in 2008–2009 ($p<0.001$).

Discussion

The cumulative incidence of SSI in HPRO was generally low in all countries but higher in countries with more effective post-discharge surveillance. Differences in the sensitivity of the post-discharge surveillance in HPRO may be partially due to differences in national recommendations for the follow-up of HPRO until one year after the

operation. In addition, at the time of data collection one-year follow-up data were not available for all operations or hospitals within a country. Interestingly, the risk of infection was higher for partial hip replacement than for total hip replacement, which may be the result of differences in the intrinsic risk of the procedure related to the indication – i.e. degenerative hip disorders such as arthrosis in total hip replacement (sex ratio M:F=0.67; mean age=68.7 years) versus hip fracture in partial hip replacement (sex ratio M:F=0.37; mean age=81.3 years). The overall decrease in the cumulative incidence and incidence density of SSI after HPRO (Figure 3.3) has previously been reported (see Chapter 2.6 ECDC Annual Epidemiological Report 20108), but was less pronounced in this report that only covered the period 2006–2009 for trend analyses. The decrease observed from 2006 to 2009 and shown in this report was independent of the intensity of post-discharge surveillance, but was explained by the decrease in the percentage of superficial incisional SSI, possibly indicating an overall decrease in the sensitivity of the SSI surveillance after HPRO between 2006 and 2009. The data should, however, be interpreted with caution.

Hip Prosthesis (HPRO)

Table 8.1. Characteristics of patients with HPRO operations, 2008–2009 (n=217 425 operations)

Characteristics	Value
Sex ratio (M:F)	0.6
Median age (years)	72
Post-operative case fatality (%)	0.7
Contaminated or dirty operations (%)	0.3
Median duration of operation (min)	76
Median length of post-operative stay (days)	8
Urgent operations (%)	7.6
Antibiotic prophylaxis (%)	95.2

Table 8.2. Cumulative incidence of SSI (diagnosed within one year of surgery) and incidence density of SSI (diagnosed during hospital stays within one year of surgery) after HPRO operations by country, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with a known discharge date (3)	No. (sum) of post-operative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 post-operative patient-days) [95% CI] (5)
Austria	8 160	119	1.5 [1.2–1.7]	8 107	107 047	67	0.6 [0.4–0.8]
Finland	11 716	184	1.6 [1.4–1.8]	3 057	15 503	16	1.0 [0.6–1.7]
France	38 916	279	0.7 [0.6–0.8]	38 869	415 279	95	0.2 [0.2–0.3]
Germany	50 762	544	1.1 [1.0–1.2]	30 641	409 498	263	0.6 [0.6–0.7]
Hungary	1 054	16	1.5 [0.9–2.5]	1 052	12 369	12	1.0 [0.5–1.7]
Italy	3 077	65	2.1 [1.6–2.7]	2 376	31 360	14	0.4 [0.2–0.7]
Lithuania	577	5	0.9 [0.3–2.0]	574	5 925	3	0.5 [0.1–1.5]
Netherlands	11 625	252	2.2 [1.9–2.5]	11 619	86 061	76	0.9 [0.7–1.1]
Norway*	4 423	201	4.5 [3.9–5.2]	4 422	33 781	35	1.0 [0.7–1.4]
Portugal	1 481	36	2.4 [1.7–3.4]	1 481	17 679	14	0.8 [0.4–1.3]
Spain	3 614	121	3.3 [2.8–4.0]	3 469	34 953	56	1.6 [1.2–2.1]
UK**	82 020	700	0.9 [0.8–0.9]	81 018	642 452	309	0.5 [0.4–0.5]
EU/EEA	217 425	2 522	1.2 [1.1–1.2]	186 685	1 811 907	960	0.5 [0.5–0.6]

(1) Only SSI diagnosed within one year of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations. Note: Some countries do not recommend follow-up until one year and post-discharge surveillance methods and practices differ considerably between countries; (3) Operations with missing discharge date are excluded; (4) Only in-hospital diagnosed infections occurring within one year of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days.

* Data from Norway include 13% patient diagnosed infections ** Combined data from UK England, UK Northern Ireland, UK Scotland and UK Wales (for detailed data on each part of the UK, see addendum).

Table 8.3. Percentile distribution of cumulative incidences of SSI in HPRO operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of operations	Number of SSI (2)	Cumulative incidence of SSI (per 100 operations) (3)	Mean and percentile distribution of cumulative incidences of SSI in hospitals					
					Mean (4)	P10	P25	P50	P75	P90
0	1 476	122 282	909	0.7	0.5	0	0	0	0.4	1.7
1	1 475	68 301	1 141	1.7	0.6	0	0	0	0.7	2.0
2 and 3	1 010	7 984	214	2.7	0.2	0	0	0	0	0.5
Unknown	596	14 234	187	1.3	0.3	0	0	0	0	0.6
Overall	1 504	212 801	2 451	1.2	1.3	0	0	0.4	1.9	3.6

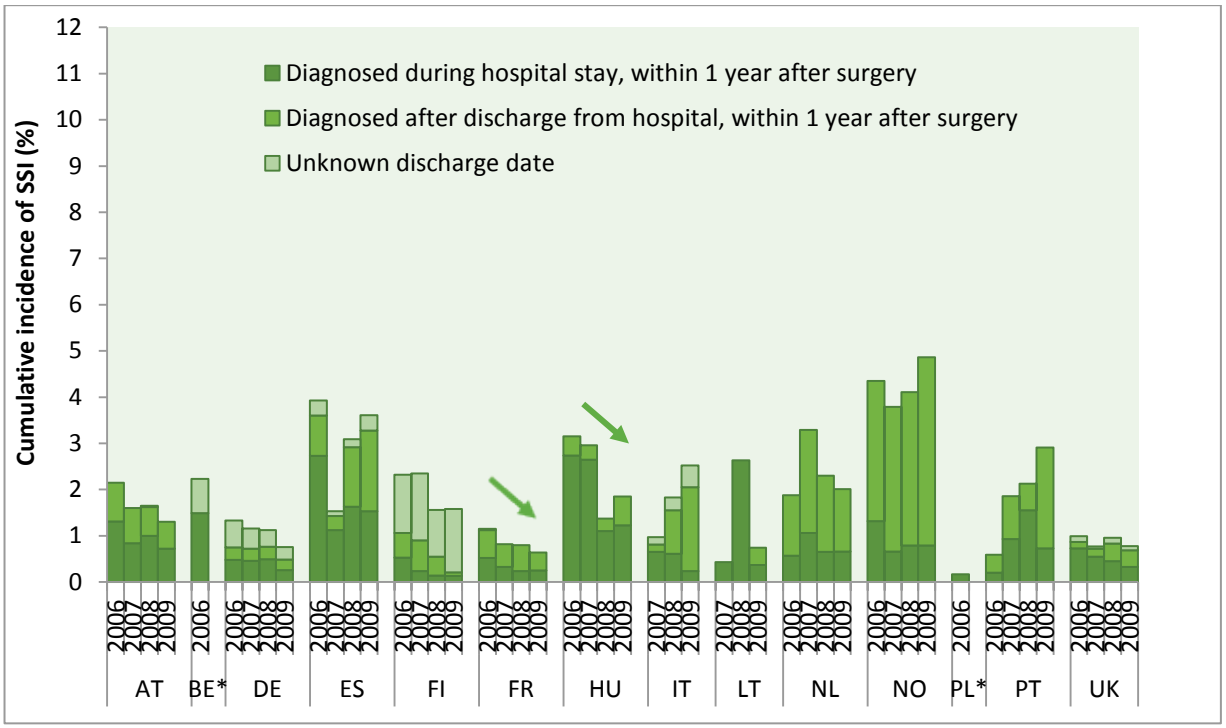
(1) Hospitals with less than 20 operations in a single year are excluded; (2) Number of SSI reported within one year of the operation; (3) Cumulative incidence of SSI = (Number of SSI × 100)/Number of operations, database mean; (4) Mean of cumulative incidences by hospital.

Table 8.4. Percentile distribution of incidence densities of SSI in HPRO operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of post-operative patient-days (2)	Number of in-hospital SSI (3)	Incidence density of SSI (per 1 000 post-operative patient-days)(4)	Mean and percentile distribution of incidence densities of SSI in hospitals					
					Mean (5)	P10	P25	P50	P75	P90
0	1 377	943 717	299	0.3	0.4	0	0	0	0	1.1
1	1 376	614 703	444	0.7	0.7	0	0	0	0	2.0
2 and 3	920	77 520	99	1.3	1.1	0	0	0	0	0
Unknown	567	119 743	87	0.7	0.6	0	0	0	0	0
Overall	1 405	1 755 683	929	0.5	0.5	0	0	0	0.6	1.9

(1) Hospitals with less than 20 operations with a known discharge date in a single year are excluded; (2) Number of post-operative patient-days = sum of post-operative patient-days (date of discharge - date of operation+1); (3) Number of SSI reported within one year of the operation and before discharge from the hospital (SSI reported after discharge from hospital or with an unknown discharge date are excluded); (4) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days; (5) Mean of incidence densities by hospital.

Figure 8.1. Distribution of cumulative incidence of SSI in HPRO operations by country, 2006–2009

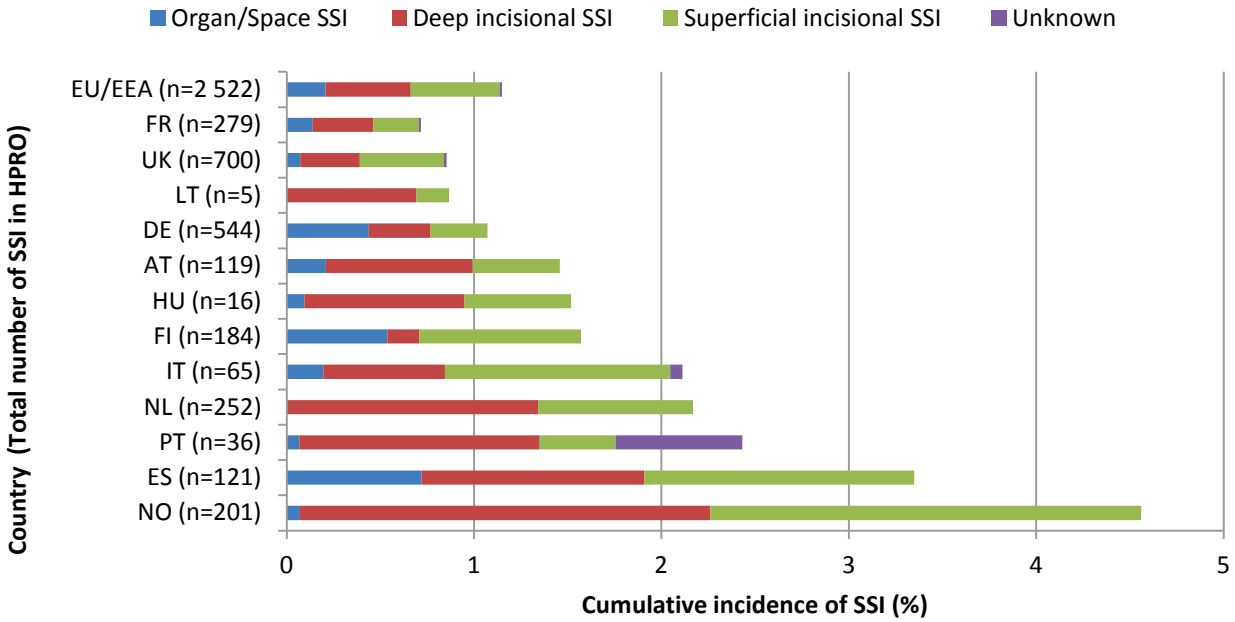


* Trend analysis was not performed for countries reporting data for less than three years.

The arrows indicate significant decreasing trends for both cumulative incidence and incidence density ($p < 0.001$ for France and $p < 0.05$ for Hungary).

Note: Some countries do not recommend follow-up until one year and post-discharge surveillance methods and practices differ considerably among countries.

Figure 8.2. Cumulative incidence of SSI in HPRO operations by type of SSI and country, 2008–2009



Knee prosthesis (KPRO)

Key points

- A total of 156 561 KPRO operations were reported for 2008-2009;
- The cumulative incidence of SSI was 0.8% [Inter-country range: 0.2%–3.4%] in 2008–2009;
- The SSI incidence density was 0.2 [Inter-country range: 0–1.0] in-hospital SSI per 1 000 post-operative patient-days in 2008–2009.

Results

A total of 156 561 KPRO operations, and 1 247 SSI subsequent to the operation, were reported to ECDC for 2008 and 2009. The characteristics of the patients with KPRO operations are summarised in Table 9.1. SSI were detected in 0.8% [Inter-country range: 0.2%–3.4%] of KPRO operations (cumulative incidence) within one year of surgery (Table 9.2). ICD-9-CM codes were available for 57.3% of the operations. The cumulative incidence of SSI was 0.65% [95% CI: 0.60%–0.71%] in total knee replacement (ICD-9-CM code 81.56, n=84 902 operations) and 1.5% [95% CI: 1.1%–1.9%] in knee replacement revisions (ICD-9-CM code 81.55, n=4 249 operations).

Twenty-seven per cent of SSI were diagnosed in hospitals, whereas 73% were detected after discharge. The percentage of SSI detected after discharge was above 70% in seven out of eleven countries (Figure 9.1).

The percentile distribution of the cumulative incidence of SSI in hospitals reporting at least 20 operations (n=991 hospital-years) is given by NHSN risk index in Table 9.3. The mean of hospital cumulative incidences was 0.8 SSI per 100 operations, with 10% of the hospitals reporting an SSI cumulative incidence of more than 2.3%. The cumulative incidence by NHSN risk index (database mean) varied from 0.6% for KPRO operations with a risk index of 0, to 1.9% for KPRO operations with a risk index of 2 or 3 (Table 9.3).

The percentile distribution of the incidence density of SSI in hospitals reporting at least 20 operations with a known discharge date (n=927 hospital-years) is given by NHSN risk index in Table 9.4. The mean of incidence densities in participating hospitals was 0.2 in-hospital SSI per 1 000 post-operative patient-days, with 10% of the hospitals reporting an incidence density equal to or greater than 0.8 in-hospital SSI per 1 000 post-operative patient-days. The incidence density of SSI by NHSN risk index (database mean) ranged from 0.2 in-hospital SSI per 1 000 post-operative patient-days for KPRO operations with a risk index of 0, to 0.6 in-hospital SSI per 1 000 post-operative patient-days for KPRO operations with a risk index of 2 or 3 (Table 9.4).

The distribution of SSI by type showed that 653 (52%) were superficial incisional SSI, 357 (29%) were deep incisional SSI, 213 (17%) were organ/space SSI and for 24 (2%) SSI the type was unknown (Figure 9.2).

Microbiological data were available for 38.7% of 1 022 SSI in eight countries reporting microbiological data for SSI in KPRO (Annex 2, table A2.1). A total of 454 microorganisms were reported (Annex 2, Table A2.2). Similar to HPRO, gram-positive cocci were the most common microorganisms associated with SSI following KPRO (73.6%) and of these, *S. aureus* represented 39.2%, followed by coagulase-negative staphylococci (20%). Approximately 40% of tested *S. aureus* isolates were MRSA. gram-negative bacilli (Enterobacteriaceae) and non fermentative gram-negative bacilli represented 11% and 4.8% of isolated microorganisms, respectively.

Trends, 2006–2009

Intra-country trends for the cumulative incidence of SSI for 2006–2009 are shown in Figure 9.1. Poisson regression trend analysis of the cumulative incidence and the incidence density of SSI (adjusting for NHSN risk index) showed a statistically significant decreasing trend in France for the cumulative incidence of SSI after KPRO ($p < 0.001$), but not for the incidence density of SSI. For the UK, a significant decreasing trend was only observed for SSI incidence density following KPRO ($p < 0.001$). The overall trend analysis for KPRO in countries contributing data for all four years showed a statistically significant decrease in both the cumulative incidence and the incidence density of SSI (Figure 3.3). However, both trends disappeared when superficial incisional SSI were excluded from the analysis. The percentage of superficial incisional SSI in KPRO decreased from 57% in 2006–2007 to 52% in 2008–2009 ($p<0.05$).

Discussion

The data should, however, be interpreted with caution. Since the median post-operative hospital stay is seven days, only a small number of SSI after KPRO were diagnosed before discharge (e.g. over 75% of hospitals did not detect any SSI before discharge) leading to a very low incidence of SSI. Therefore, the in-hospital incidence density of SSI might not be the most appropriate indicator to follow, even at national level, as it can result in large confidence intervals around the indicator. Thus, within a country, the cumulative incidence of SSI with one year follow-up is more appropriate for detecting small variations in the SSI incidence. For inter-country comparisons; however, comparability of the cumulative incidence for SSI is influenced by the intensity of post-discharge surveillance. For KPRO, the best performances of post-discharge surveillance were observed in Germany and Finland with more

than 5% of the SSI being detected between six months and one year of the operation). As in HPRO, an overall decreasing trend was observed in countries contributing KPRO data for all four years. However, even though the 2006–2009 decrease was independent of the intensity of post-discharge surveillance, it was explained by a reduction in the percentage of superficial incisional SSI, possibly indicating an overall decrease in the sensitivity of SSI surveillance after KPRO during 2006-2009.

Knee prosthesis (KPRO)

Table 9.1. Characteristics of patients with KPRO operations, 2008–2009 (n=156 561 operations)

Characteristics	Value
Sex ratio (M:F)	0.6
Median age (years)	71
Post-operative case fatality (%)	0.2
Contaminated or dirty operations (%)	0.2
Median duration of operation (min)	80
Median length of post-operative stay (days)	7
Urgent operations (%)	1.8
Antibiotic prophylaxis (%)	97.6

Table 9.2. Cumulative incidence of SSI (diagnosed within one year of surgery) and incidence density of SSI (diagnosed during hospital stay within one year of surgery) after KPRO operations by country, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with a known discharge date (3)	No. (sum) of post-operative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 post-operative patient-days) [95% CI] (5)
Austria	517	1	0.2 [0–1.1]	517	6 428	0	0 [0–0.6]*
Finland	8 890	195	2.2 [1.9–2.5]	2 579	12 537	4	0.3 [0.1–0.8]
France	18 381	61	0.3 [0.3–0.4]	18 334	193 281	19	0.1 [0.1–0.2]
Germany	27 886	185	0.7 [0.6–0.8]	17 998	238 124	47	0.2 [0.1–0.3]
Hungary	550	18	3.3 [1.9–5.2]	550	5 859	6	1.0 [0.4–2.2]
Italy	1 394	29	2.1 [1.4–3.0]	1 207	13 973	3	0.2 [0–0.6]
Lithuania	408	3	0.7 [0.2–2.1]	406	4 527	2	0.4 [0.1–1.6]
Netherlands	7 600	84	1.1 [0.9–1.4]	7 597	47 906	7	0.1 [0.1–0.3]
Portugal	584	10	1.7 [0.8–3.1]	584	6 530	2	0.3 [0–1.1]
Spain	2 403	81	3.4 [2.7–4.2]	2 341	20 638	20	1.0 [0.6–1.5]
UK*	87 948	580	0.7 [0.6–0.7]	87 825	633 383	168	0.3 [0.2–0.3]
EU/EEA	**156 561**	**1 247**	**0.8 [0.8–0.8]**	**139 938**	**1 183 186**	**278**	**0.2 [0.2–0.3]**

(1) Only SSI diagnosed within one year of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations. Note: Some countries do not recommend follow-up until up to one year and post-discharge surveillance methods and practices differ considerably between countries; (3) Operations with missing discharge date are excluded; (4) Only in-hospital diagnosed infections occurring within one year of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days. *One-sided confidence interval.

* Combined data from UK England, UK Northern Ireland, UK Scotland and UK Wales (for detailed data on each part of the UK, see addendum).

Table 9.3. Percentile distribution of cumulative incidences of SSI in KPRO operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of operations	Number of SSI (2)	Cumulative incidence of SSI (per 100 operations) (3)	Mean and percentile distribution of cumulative incidences of SSI in hospitals					
					Mean (4)	P10	P25	P50	P75	P90
0	977	93 211	571	0.6	0.4	0	0	0	0.2	1.1
1	973	41 015	469	1.1	0.3	0	0	0	0	0.9
2 and 3	658	5 115	95	1.9	0.1	0	0	0	0	0
Unknown	426	12 963	89	0.7	0.1	0	0	0	0	0.1
Overall	991	152 304	1 224	0.8	0.8	0	0	0	0.9	2.3

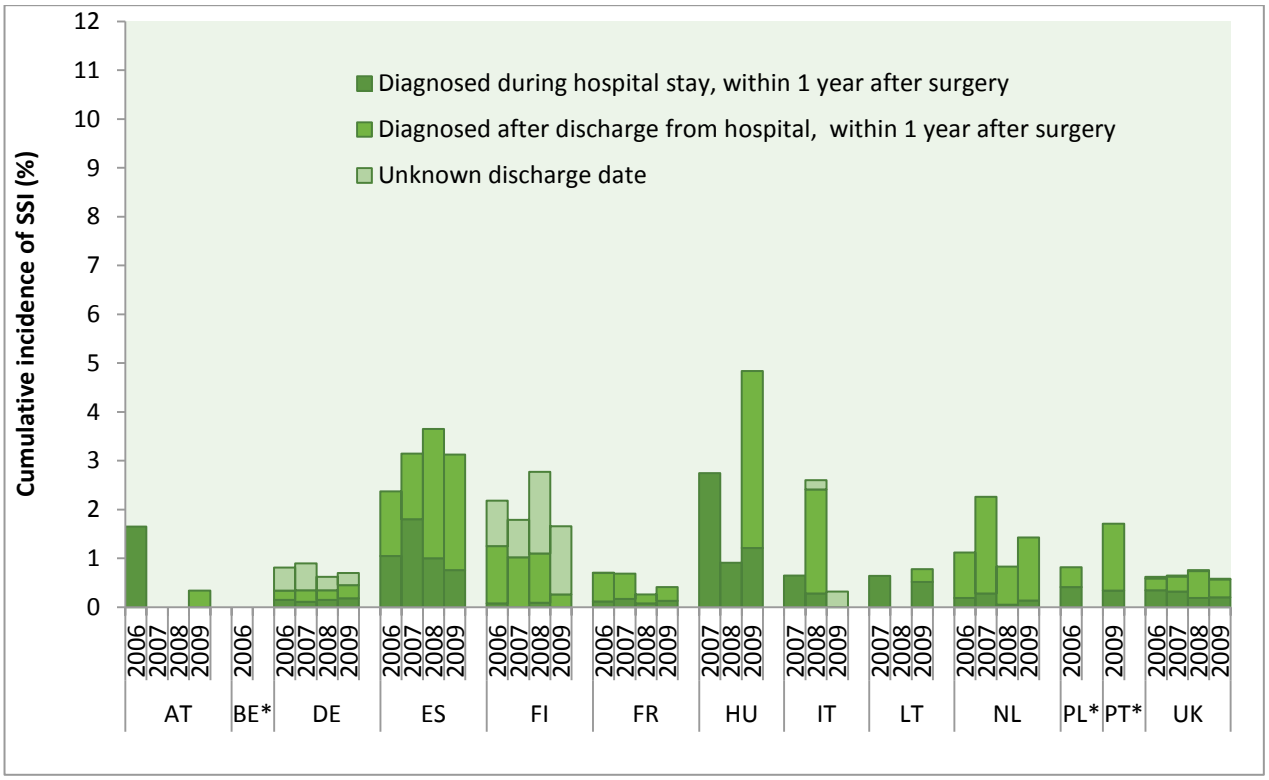
(1) Hospitals with less than 20 operations in a single year are excluded; (2) Number of SSI reported within one year of the operation; (3) Cumulative incidence of SSI = (Number of SSI × 100)/Number of operations, database mean; (4) Mean of cumulative incidences by hospital.

Table 9.4. Percentile distribution of SSI incidence densities in KPRO operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of post-operative patient-days (2)	Number of in-hospital SSI (3)	Incidence density of SSI (per 1 000 post-operative patient-days)(4)	Mean and percentile distribution of incidence densities of SSI in hospitals					
					Mean (5)	P10	P25	P50	P75	P90
0	913	668 702	104	0.2	0.1	0	0	0	0	0
1	909	325 722	119	0.3	0.3	0	0	0	0	0
2 and 3	601	43 086	26	0.6	0.7	0	0	0	0	0
Unknown	405	97 051	22	0.2	0.3	0	0	0	0	0
Overall	927	1 134 561	271	0.2	0.2	0	0	0	0	0.8

(1) Hospitals with less than 20 operations with a known discharge date in a single year are excluded; (2) Number of post-operative patient-days = sum of post-operative patient-days (date of discharge - date of operation+1); (3) Number of SSI reported within one year of the operation and before discharge from the hospital (SSI reported after discharge from hospital or with an unknown discharge date are excluded); (4) Incidence density = (Number of in-hospital SSI × 1 000)/Number of post-operative patient-days; (5) Mean of incidence densities by hospital.

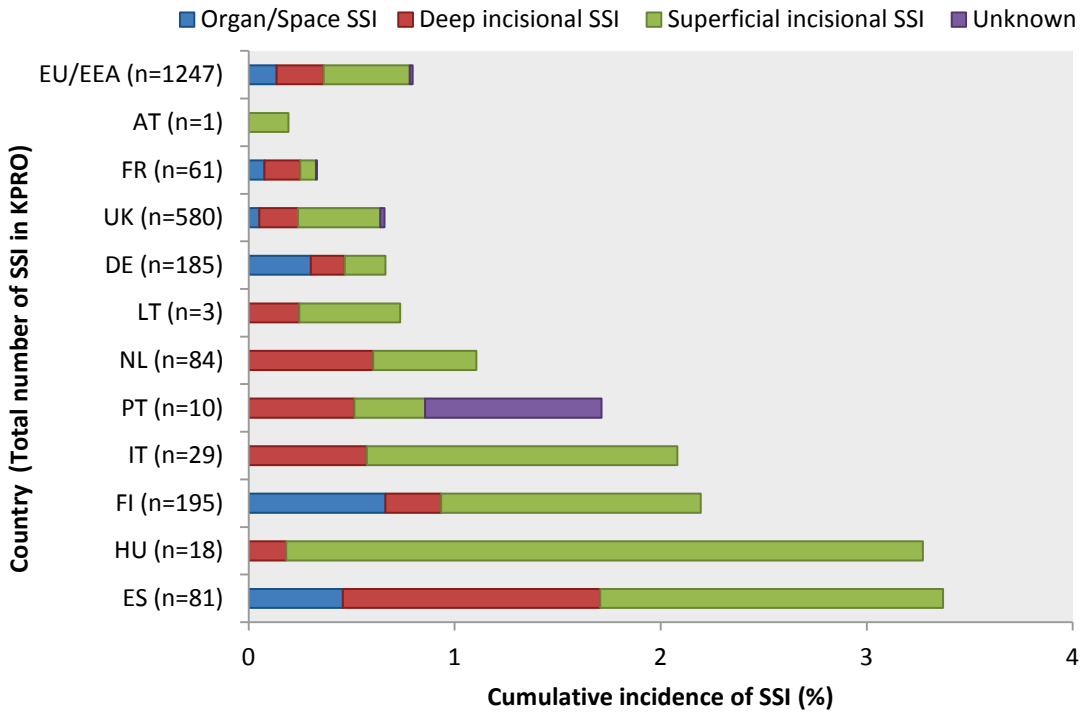
Figure 9.1. Distribution of cumulative incidence of SSI in KPRO operations by country, 2006–2009



* Trend analysis was not performed for countries reporting data for less than three years.

Note: Some countries do not recommend follow-up until up to one year and post-discharge surveillance methods and practices differ considerably among countries.

Figure 9.2. Cumulative incidence of SSI in KPRO operations by type of SSI and country, 2008–2009



Laminectomy (LAM)

Key points

- A total of 9 683 LAM operations were reported for 2008–2009;
- The cumulative incidence of SSI was 1.3% [Inter-country range: 0.4%–6.3%] in 2008–2009;
- The incidence density of SSI was 1.0 [Inter-country range: 0-5.8] in-hospital SSI per 1 000 post-operative patient-days in 2008–2009.

Results

A total of 9 683 LAM operations, and 125 SSI subsequent to the operation, were reported to ECDC for 2008 and 2009. The characteristics of the patients with LAM operations are summarised in Table 10.1. SSI were detected in 1.3% [Inter-country range: 0.4%–6.3%] of LAM operations (cumulative incidence) within 30 days of surgery (Table 9.2). In three countries reporting ICD-9-CM codes, laminectomy with excision of the intervertebral disc (ICD-9-CM code 80.51, (n=1016) represented 60% of LAM operations, followed by laminectomy for decompression of the spinal nerve root only (ICD-9-CM code 03.09, n=571, 34% of LAM operations), with similar SSI cumulative incidence for both types of LAM operations.

Forty-nine per cent of SSI were diagnosed in hospitals, whereas 51% were detected after discharge (Figure 10.1).

According to the current protocol (HAISSI protocol v.1.02), only SSI reported within a time frame of 30 days following surgery must be included. Six (4.6%) of 132 SSI following LAM operations were reported after 30 days and these SSI infections were excluded from further data analysis.

The percentile distribution of the cumulative incidence of SSI in hospitals reporting at least 20 operations (n=95 hospital-years) is given by NHSN risk index in Table 10.3. The mean of hospital cumulative incidences was 1.8 SSI per 100 operations, with 10% of the hospitals reporting a cumulative incidence of SSI above 4.2%. The cumulative incidence by NHSN risk index (database mean) varied from 1.0% for LAM operations with a risk index of 0, to 3.7% for LAM operations with a risk index of 2 or 3 (Table 10.3).

Table 10.4 shows the percentile distribution of the SSI incidence density in hospitals reporting at least 20 operations with a known discharge date (n=88 hospital-years) given by NHSN risk index. The mean of incidence densities in participating hospitals was 1.1 in-hospital SSI per 1 000 post-operative patient-days, with 10% of hospitals reporting an incidence density equal to or greater than 4.2 in-hospital SSI per 1 000 post-operative patient-days. The incidence density of SSI by NHSN risk index (database mean) ranged from 0.9 in-hospital SSI per 1 000 post-operative patient-days for LAM operations with a risk index of 0, to 1.9 in-hospital SSI per 1 000 post-operative patient-days for LAM operations with a risk index of 2 or 3 (Table 10.4).

The distribution of SSI by type showed that 61 (49%) were superficial incisional SSI, 36 (29%) were deep incisional SSI, 26 (21%) were organ/space SSI and for two (2%) SSI the type was unknown (Figure 10.2).

Microbiological data were available for 38.6% of 101 SSI in six countries reporting microbiological data for SSI in LAM (Annex 2, Table A2.1). A total of 45 microorganisms were reported (Annex 2, Table A2.2). Most of the microorganisms were gram-positive cocci (71.1%), of which 40% were *S. aureus*. Thirty percent of the *S. aureus* isolates tested were MRSA. Enterobacteriaceae and non-fermentative gram-negative bacilli represented 17.8% and 4.4% of isolated microorganisms respectively.

Trends, 2006–2009

Intra-country trends for the cumulative incidence of SSI during the period 2006–2009 are shown in Figure 10.1. Poisson regression trend analysis of cumulative incidence and incidence density (adjusting for NHSN risk index) by country showed no significant increasing or decreasing trends. The overall trend analysis for LAM in countries contributing data for all four years showed no significant trends (Figure 3.3).

Discussion

The data should, however, be interpreted with caution. Similar to HPRO and KPRO, LAM is a 'clean' procedure with a low expected incidence of SSI. The higher cumulative incidence of SSI in LAM for Hungary could not be explained, either by more intensive post-discharge surveillance or by over-reporting of superficial incisional SSI (Figure 10.2). Data were only provided by two hospitals, which could result in selection bias.

Laminectomy (LAM)

Table 10.1. Characteristics of patients with LAM operations, 2008–2009 (n= 9 683 operations)

Characteristics	Value
Sex ratio (M:F)	1.1
Median age (years)	54
Post-operative case fatality (%)	0.4
Contaminated or dirty operations (%)	0.2
Median duration of operation (min)	75
Median length of post-operative stay (days)	6
Urgent operations (%)	6.1
Antibiotic prophylaxis (%)	88.1

Table 10.2. Cumulative incidence of SSI (diagnosed within 30 days of surgery) and incidence density of SSI (diagnosed during hospital stay within 30 days of surgery) after LAM operations by country, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with a known discharge date (3)	No. (sum) of post-operative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 post-operative patient-days) [95% CI] (5)
Austria	37	1	2.7 [0.1–15.1]	37	215	0	0 [0-17.2]*
France	2 471	37	1.5 [1.1–2.1]	2 460	17 494	14	0.8 [0.4-1.3]
Germany	4 782	24	0.5 [0.3–0.7]	3 172	21 302	4	0.2 [0.1-0.5]
Hungary	334	21	6.3 [3.9–9.6]	334	2 959	17	5.8 [3.3-9.2]
Italy	958	23	2.4 [1.5–3.6]	944	6 093	10	1.6 [0.8-3.0]
Netherlands	120	1	0.8 [0.0–4.6]	120	510	0	0 [0 -7.2] *
Portugal	268	1	0.4 [0.0–2.1]	268	1 338	0	0 [0 -2.8] *
Spain	713	17	2.4 [1.4–3.8]	650	4 486	8	1.8 [0.8-3.5]
EU/EEA	**9 683**	**125**	**1.3 [1.1–1.5]**	**7 985**	**54 397**	**53**	1.0 [0.7-1.3]

(1) Only SSI diagnosed within 30 days of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations; (3) Operations with missing discharge date are excluded; (4) Only in-hospital diagnosed infections occurring within 30 days of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days. *One-sided confidence interval.

Table 10.3. Percentile distribution of cumulative incidences of SSI in LAM operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of operations	Number of SSI (2)	Cumulative incidence of SSI (per 100 operations) (3)	Mean and percentile distribution of cumulative incidences of SSI in hospitals					
					Mean (4)	P10	P25	P50	P75	P90
0	89	5 977	60	1.0	0.6	0	0	0	0.8	2.9
1	87	1 973	42	2.1	0.8	0	0	0	1.2	2.7
2 and 3	56	242	9	3.7	0.3	0	0	0	0	1.2
Unknown	35	808	4	0.5	0.2	0	0	0	0	0.8
Overall	95	9 000	115	1.3	1.8	0	0	0.6	2.4	4.2

(1) Hospitals with less than 20 operations in a single year are excluded; (2) Number of SSI reported within 30 days of the operation; (3) Cumulative incidence of SSI = (Number of SSI × 100)/Number of operations, database mean; (4) Mean of cumulative incidences by hospital.

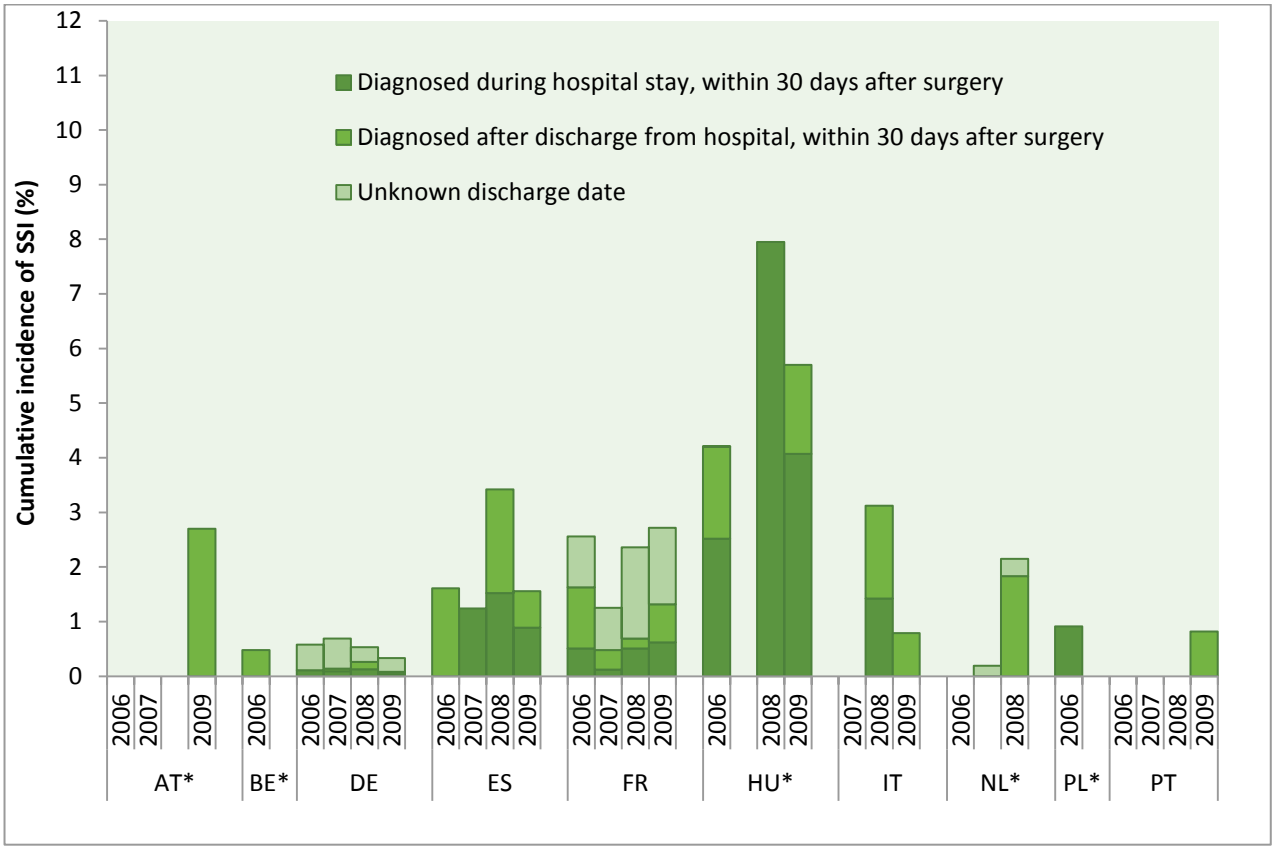
Table 10.4. Percentile distribution of SSI incidence densities in LAM operations at participating hospitals by NHSN risk index, 2008–2009

NHSN risk index	Number of hospital-years (1)	Number of post-operative patient-days (2)	Number of in-hospital SSI (3)	Incidence density of SSI (per 1 000 post-operative patient-days)(4)	Mean and percentile distribution of incidence densities of SSI in hospitals					
					Mean (5)	P10	P25	P50	P75	P90
0	82	29 127	26	0.9	1.2	0	0	0	0	3.2
1	80	12 531	17	1.4	1.2	0	0	0	0	4.5
2 and 3	49	2 586	5	1.9	1.0	0	0	0	0	3.5
Unknown	34	5 381	1	0.2	0.4	0	0	0	0	0
Overall	88	49 625	49	1.0	1.1	0	0	0	0	4.2

(1) Hospitals with less than 20 operations with a known discharge date in a single year are excluded; (2) Number of post-operative patient-days = sum of post-operative patient-days (date of discharge - date of operation+1); (3) Number of SSI reported within 30 days of the operation and before discharge from the hospital (SSI reported after discharge from hospital or with an unknown discharge date are excluded); (4) Incidence density = (Number of in-hospital SSI × 1000)/Number of post-operative patient-days; (5) Mean of incidence densities by hospital.

Laminectomy (LAM)

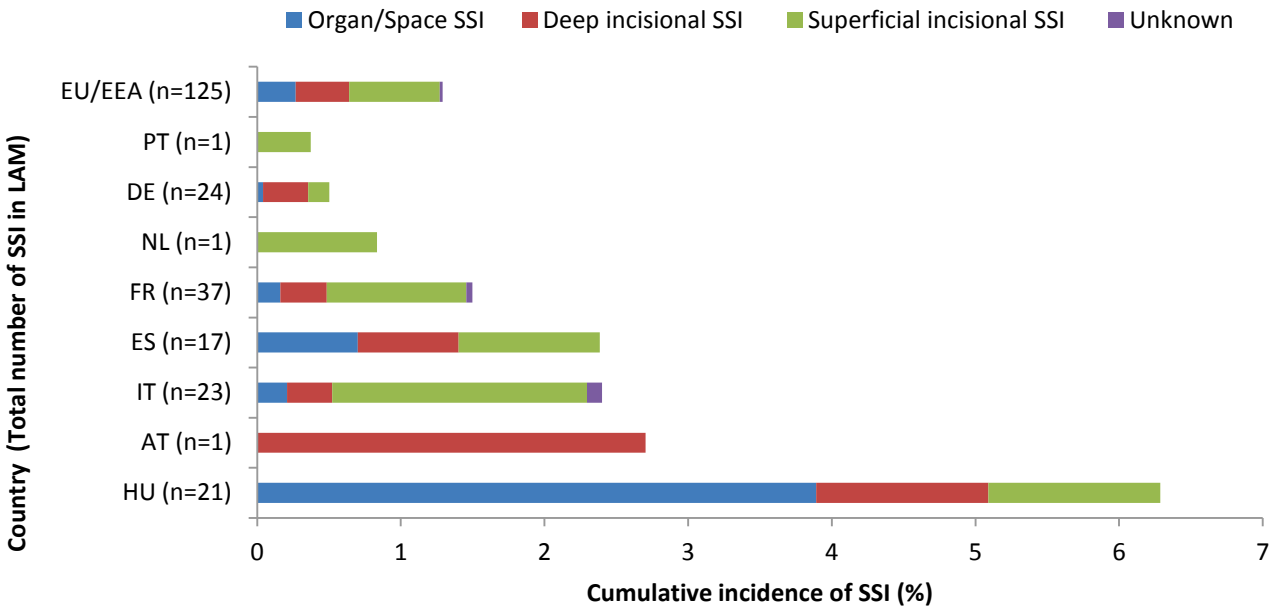
Figure 10.1. Distribution of cumulative incidence of SSI in LAM operations by country, 2006–2009



* Trend analysis was not performed for countries reporting data for less than three years.

Note: Post-discharge surveillance methods and practices differ considerably among countries.

Figure 10.2. Cumulative incidence of SSI in LAM operations by type of SSI and country, 2008–2009



General discussion and perspectives

In 2003, the HELICS network published the standardised European protocol for SSI surveillance. Since 2004, 14 EU Member States and one EEA country have been submitting data to the European surveillance scheme for SSI. In 2008–2009, a total of 655 637 operations were reported by these countries. The annual number of operations reported has increased steadily and in 2009 it was 2.8 times larger than in 2004. However, this increase was due to more comprehensive surveillance coverage in countries already participating (e.g. more likely in the UK due to the effect of mandatory SSI surveillance in orthopaedic surgery) rather than to an increase in the number of participating countries. In the last three years, two additional countries (Italy and Malta) started reporting SSI surveillance data; however, two other countries (Belgium and Poland) discontinued reporting data from 2007 onwards. Extension of SSI surveillance to all EU Member States therefore remains an important challenge for the future. To facilitate the creation of new surveillance networks and in agreement with Member States, ECDC developed a 'light' version of the HAISSI protocol[5] which was added in 2010. In this 'light' version, denominator data are aggregated by hospital and by operation type, thus eliminating the resource-intensive collection of data on risk factors for all operations, whether SSI occurred or not. Nevertheless, data collected under the 'light' protocol make it possible to account for differences in the intensity of post-discharge surveillance and in surveillance sensitivity of superficial incisional SSI during data analysis.

The results of the SSI surveillance from 2006 to 2009 showed a decrease in the incidence density of SSI after CSEC, HPRO and KPRO. The decrease in the two orthopaedic operation types (HPRO and KPRO) was explained by a decrease in only superficial incisional infections, but previous results showed that a large decrease in the incidence density of SSI in these types of operation already occurred in 2004 and 2005.[8] Therefore, the incidence densities of SSI were already low in 2006–2009 in hospitals participating in the surveillance. This means that, during 2006–2009, the low incidence densities of SSI were maintained for deep incisional and organ/space SSI and further improved for superficial incisional infections. These results show that continued participation of hospitals in the national networks for the surveillance of SSI contributes to the prevention of SSI in these hospitals.

The percentage of recorded operations with a missing discharge date decreased from 44% in 2004 to 11% in 2009. This may reflect the gradual transition of some countries from the NHSN protocol (US CDC), which does not require data on the date of hospital discharge, towards the European HAISSI surveillance protocol. It also suggests that hospitals in these countries recognise the added value of the European SSI indicators that eliminate the effect of variations in post-discharge surveillance and length of post-operative stay in hospital when performing inter-hospital and inter-country comparisons. For example in Germany, the percentage of records missing information on the discharge date decreased from 99% in 2004 to 31% in 2009. From 2007 onwards, the percentage of records with missing discharge date was similar for operations with and operations without SSI, indicating that bias when calculating the adjusted SSI indicators, such as the incidence density, is limited. As an alternative to the in-hospital incidence density, the cumulative incidence excluding SSI diagnosed after discharge from the hospital can also be used to eliminate the effect of post-discharge surveillance when performing inter-hospital and inter-country comparisons. However, comparisons based on the cumulative incidence of in-hospital SSI do not eliminate bias due to differences in length of post-operative hospital stay. Indeed, the longer the patient stays in the hospital, the higher the probability for the SSI to be diagnosed in the hospital. However, the added probability is not the same for each post-operative hospital day. As a consequence, the incidence density of in-hospital SSI may over-adjust if the post-operative hospital stay is very long and the cumulative incidence excluding SSI diagnosed after discharge would then be a useful alternative. Details for the latter indicator are not presented in this report, but could be deducted from the tables and the figures. Taking into account changes in the average length of post-operative hospital stay is important for some countries. For example in Norway, the cumulative incidence of SSI after HPRO, excluding post-discharge SSI, decreased from 1.3% in 2006 to 0.8% in 2009. However, the average length of post-operative hospital stay following HPRO decreased from 10.2 days in 2006 to 7.3 days in 2009, thus resulting in a stable in-hospital incidence density of SSI during this period.

Comparisons of SSI indicators among countries and among hospitals within a country must be performed with caution. The various factors that affect comparisons are outlined in the section 'Data collection and technical notes'. These factors are categorised depending on whether they can be totally, partially adjusted/accounted for during analysis or not at all. In particular, differences in post-discharge surveillance methods, the length of post-operative hospital stay and the sensitivity of reporting superficial incisional SSI often result in changes in the position of countries, and hospitals within a country, in the tables (results not shown).

To better understand the differences in post-discharge surveillance methods among countries and hospitals, a variable was added relating to the collection of information on these methods at hospital level in the 2010 HAISSI protocol. Future results will hopefully allow the European network to work towards more comparable post-discharge surveillance methods. In the meantime, the use of adjusted SSI indicators remains necessary and efforts should be made to reduce the percentage of missing values.

ECDC will continue to provide support for setting up national surveillance networks by making available a free software package for network coordination centres and hospitals, organising training courses on HAI surveillance and performing on-demand country visits to provide technical support on HAI surveillance.

Annex 1: Percentage and characteristics of the missing values

Table A1.1. Percentages of missing values by TESSy variable and year, HAI-Net, 2008–2009

Variable	Name of TESSy variable	Missing values (%), by year		
		2008*	2009†	2008-2009††
Gender	Gender	0.3	0.1	0.2
In-hospital outcome	OutcomeHospital	55.3	34.1	44.3
Date of operation	DateofOperation	0	0	0
Date of hospital admission	DateofHospitalAdmission	99.3	28.8	62.8
Date of hospital discharge	DateofHospitalDischarge	11.2	11.2	11.2
Date of last follow-up	DateofLastFollowup	58.5	37.2	47.5
Operation code	OPCode	0	0	0
ICD-9-CM code	ICD9CMCode	48.6	47.8	48.2
Endoscopic procedure	EndoscopicProc	1.5	2.3	1.9
Wound class	WoundClass	1.3	0.9	1.1
Duration of operation	OperationDUr	3.4	2.9	3.1
Urgent operation	UrgentOperation	26.5	23.9	25.2
ASA score	ASAClassification	5.7	4.0	4.8
Prophylaxis	Prophylaxis	72.4	55.4	63.6
Surgical site infection	SurgicalSiteInfection	0	0	0
Type of infection	SSIType	1.8	0.6	1.2
Presence of microorganisms	ResultIsolate	70.5	67	68.8

*2008: n=315 935 operations and n=7 322 SSI

† 2009: n=339 702 operations and n=7 261 SSI

†† 2008-2009: n=655 637operations and n=14 583 SSI

Table A1.2. Percentage of missing values for antimicrobial resistance data on bacteria associated with SSI, by operation type, 2008–2009

Bacterium, antimicrobial resistance	Missing values (%), by type of operation							
	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM	Total
S. aureus, meticillin resistance	33.8	57.1	52.7	49.4	57.3	64.0	44.4	53.7
E. coli, third-generation cephalosporin resistance	83.8	91.1	89.2	89.8	94.4	100	100	89.7
Enterococcus spp., vancomycin resistance	87.8	84.3	82.2	82.1	91.8	91.7	100	84.7
Klebsiella spp., third-generation cephalosporin resistance	79.2	91.4	91.2	100	100	100	(a)	91.2
P. aeruginosa, third-generation cephalosporin resistance	92.1	90.9	92.5	85.7	80.0	72.7	100	89.7
Enterobacter spp., third-generation cephalosporin resistance	83.7	82.8	90.8	100	94.1	78.6	50.0	88.7

a. Not applicable. No Klebsiella spp. isolate was reported in SSI following laminectomy.

Annex 2: Microorganisms isolated from surgical site infections

Table A2.1. Number of SSI with known microbiological results by type of operation, 2008–2009

	Number of reported surgical site infections, by operation type							
	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM	Total
Total number of SSI	1 175	896	3 964	4 732	2 522	1 247	125	14 583
Number of SSI with microbiological data	1 080(a)	844 (b)	3 938 (c)	1 171 (d)	2 137 (e)	1 022 (f)	101 (g)	10 293 (h)
Number of SSI with reported positive microbiological results	568	320	1 844	289	1 099	396	39	4 555
with one single micro-organism	471	255	1 072	247	907	350	33	3 335
with two micro-organisms	69	50	500	33	156	34	6	848
with three micro-organisms	28	15	272	9	36	12	0	372

a. DE (n=525), ES (n=51), FR (n=73), HU (n=8), IT (n=37), LT (n=40), MT (n=5), UK (n=341).
b. DE (n=254), ES (n=93), FR (n=191), HU (n=63), IT (n=118), LT (n=8), NL (n=77), PT (n=40).
c. AT (n=57), DE (n=1 104), ES (n=448), FR (n=930), HU (n=46), IT (n=328), LT (n=56), NL (n=365), PT (n=125), UK (n=479).
d. AT (n=44), DE (n=114), ES (n=48), FR (n=501), HU (n=143), IT (n=247), LT (n=28), NL (n=38), PT (n=8).
e. AT (n=119), DE (n=544), ES (n=121), FR (n=279), HU (n=16), IT (n=65), LT (n=5), NL (n=252), PT (n=36).
f. DE (n=185), ES (n=81), FR (n=61), HU (n=18), LT (n=3), NL (n=84), PT (n=10), UK (n=580).
g. DE (n=24), ES (n=17), FR (n=37), HU (n=21), NL (n=1), PT (n=1).
h. Sum for all types of operations in all countries (a)(b)(c)(d)(e)(f)(g).

Table A2.2. Distribution of identified microorganisms in SSI for which at least one microorganism was reported, by operation type, pooled data from 10 countries, 2008–2009 (n=6 147)

	CABG	CHOL	COLO	CSEC	HPRO	KPRO	LAM	Total
Number of identified microorganisms	693	400	2 888	340	1 327	454	45	6 147
Gram-positive cocci (%)	63.1	36.8	31.7	58.5	70.4	73.6	71.1	48.8
Staphylococcus aureus	22.2	10.5	5.1	25.0	36.9	39.2	40.0	18.1
Coagulase-negative staphylococci	32.8	6.3	2.9	15.6	17.9	20.0	24.4	11.9
Enterococcus species	7.1	17.5	21.0	8.2	12.9	7.9	2.2	15.4
Streptococcus species	0.7	2.5	2.5	8.5	2.2	5.7	4.4	2.8
Other gram-positive cocci	0.3	0	0.1	1.2	0.5	0.7	0	0.3
Gram-negative cocci (%)	0	0	0	0	0	0	0	0.0
Gram-positive bacilli (%)	1.4	0.5	0.3	2.1	1.1	1.5	2.2	0.8
Gram-negative bacilli *Enterobacteriaceae* (%)	20.5	49.8	46.2	30.6	16.4	11.0	17.8	33.4
Escherichia coli	5.3	25.3	28.9	17.4	5.4	2.9	8.9	18.2
Citrobacter species	1.2	2.3	1.1	1.2	0.5	0	0	1.0
Enterobacter species	7.1	7.3	4.5	2.4	3.8	3.1	4.4	4.6
Klebsiella species	3.5	8.8	4.7	2.4	1.5	0.7	0	3.7
Proteus species	1.6	3.3	3.9	4.7	3.2	2.2	0	3.4
Serratia species	1.0	1.5	0.5	1.2	0.5	1.5	0	0.7
Other *Enterobacteriaceae*	0.9	1.5	2.6	1.5	1.5	0.7	4.4	1.9
Gram-negative non-fermentative bacilli (%)	7.9	3.8	8.6	4.4	6.0	4.8	4.4	7.1
Acinetobacter species	0.9	0.5	0.4	1.5	1.5	1.1	0	0.8
Haemophilus species	0.3	0	0.1	0.3	0	0	0	0.1
Pseudomonas aeruginosa	5.5	2.8	7.3	2.1	3.8	2.4	2.2	5.4
Pseudomonadaceae family, other	1.0	0	0.6	0.6	0.4	0.9	2.2	0.6
Stenotrophomonas maltophilia	0.3	0.5	0.1	0	0.4	0.2	0	0.2
Other gram-negative non-fermentative bacilli	0	0	0.1	0	0	0.2	0	0.1
Anaerobes (%)	0.6	4.5	6.3	2.9	1.2	1.5	0	3.9
Bacteroides species	0.3	1.5	5.0	1.2	0.4	0.4	0	2.7
Other anaerobes	0.3	3.0	1.3	1.7	0.8	1.1	0	1.2
Other bacteria (%)	4.6	1.3	3.8	0.9	4.8	7.3	2.2	4.1
Fungi, parasites (%)	1.9	3.5	2.8	0.6	0.2	0.2	2.2	1.9
Candida species	1.7	2.8	2.6	0.3	0.2	0.2	2.2	1.7
Other fungi / parasites	0.1	0.8	0.2	0.3	0	0	0	0.2

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Addendum

In the United Kingdom, surveillance of surgical site infections is coordinated at regional level (England, Northern Ireland, Scotland and Wales) by four independent surveillance networks. As a consequence, the data are collected following different protocols and uploaded to TESSy as four different and independent data sources.

In the main part of the report, ECDC included combined results for the United Kingdom. In this addendum, and as a courtesy to the United Kingdom, regional results from the four surveillance networks are presented separately.

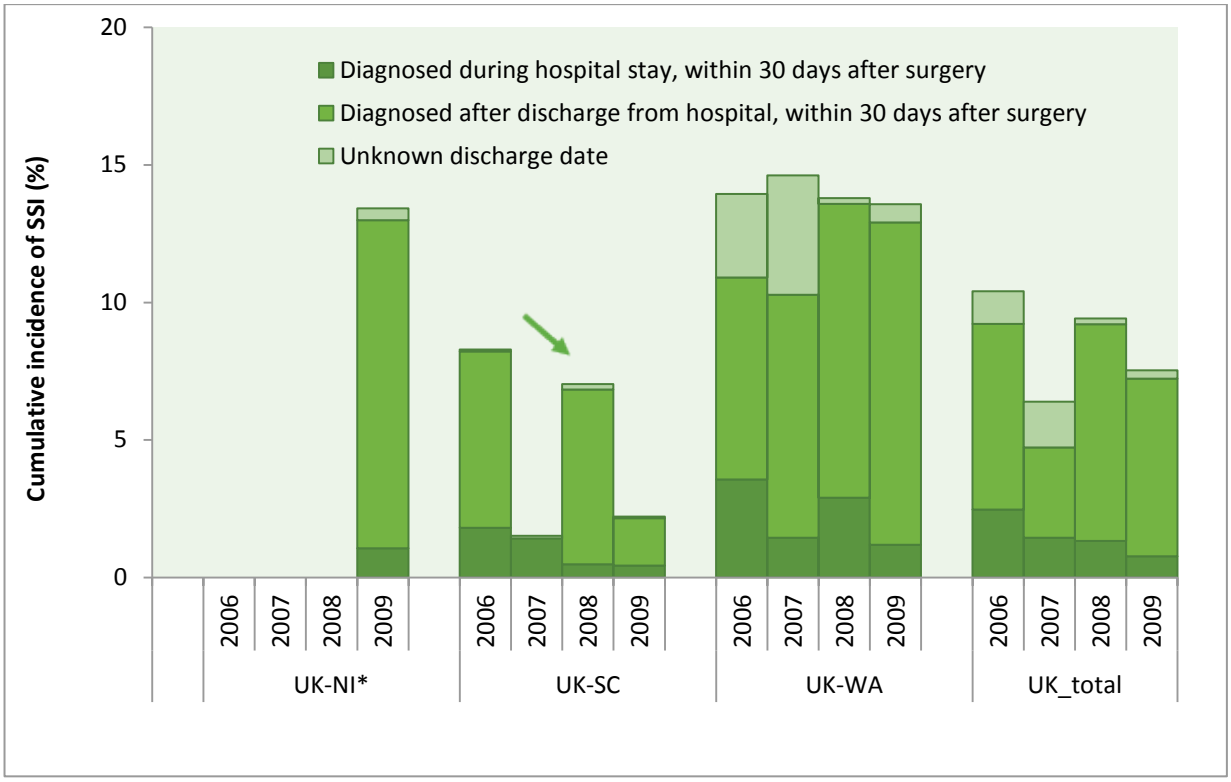
Caesarean Section (CSEC)

Table 7.2a. Cumulative incidence of SSI (diagnosed within 30 days of surgery) and incidence density of SSI (diagnosed during hospital stay within 30 days of surgery) after CSEC operations by country in UK, 2008-2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with known discharge date (3)	No. (sum) of postoperative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 postoperative patient-days) [95% CI] (5)
England	0						
Northern Ireland	5 291	710	13.4 [12.4–14.4]	4 980	21 117	56	2.7 [2.0–3.4]
Scotland	22 731	974	4.3 [4.0–4.6]	22 527	99 665	101	1.0 [0.8–1.2]
Wales	11 497	1 568	13.6 [13.0–14.3]	11 336	56 692	222	3.9 [3.4–4.5]
United Kingdom	**39 519**	**3 252**	**8.2 [7.9–8.5]**	**38 843**	**177 474**	**379**	**2.1 [1.9–2.4]**

(1) Only SSI diagnosed within 30 days of the operation are included; (2) Cumulative incidence SSI = (Number of SSI x 100)/Number of operations; (3) Operations with missing discharge dates are excluded; (4) Only in-hospital diagnosed infections occurring within 30 days of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/ Number of postoperative patient-days.

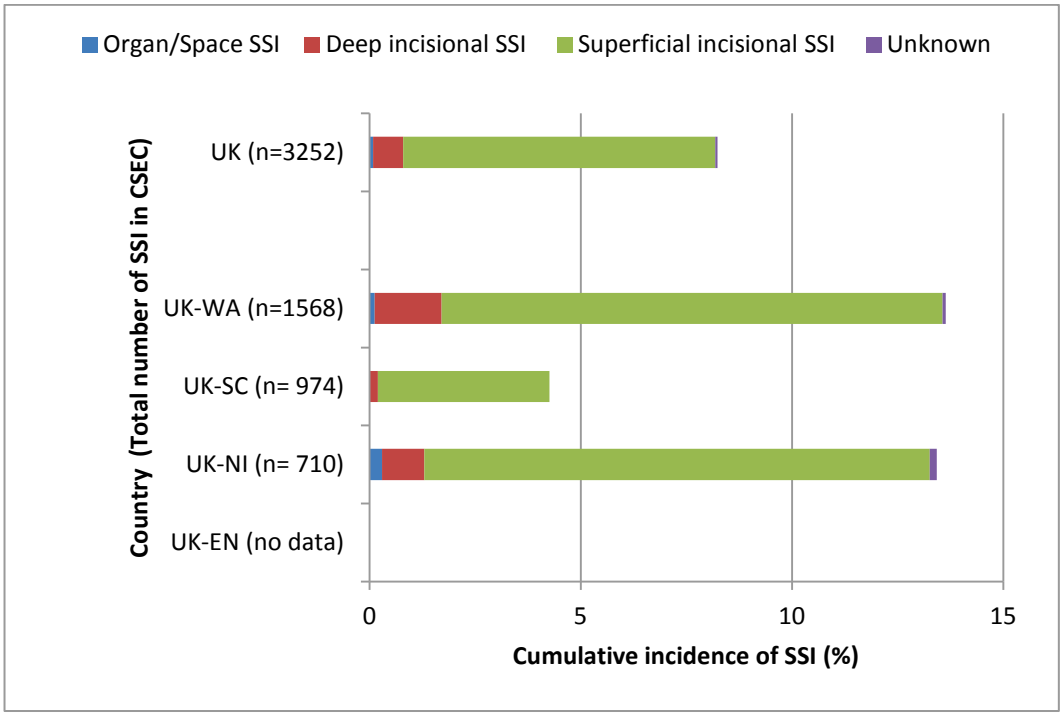
Figure 7.1a. Distribution of cumulative incidence of SSI in CSEC operations by country in UK, 2006–2009



* Trend analysis was not performed for countries reporting data for less than three years.

Note: From 1 April 2009, follow-up in Scotland changed from 30 days to 10 days (mandatory reporting).

Figure 7.2a. Cumulative incidence of SSI in CSEC operations by type of SSI and country in UK, 2008-2009



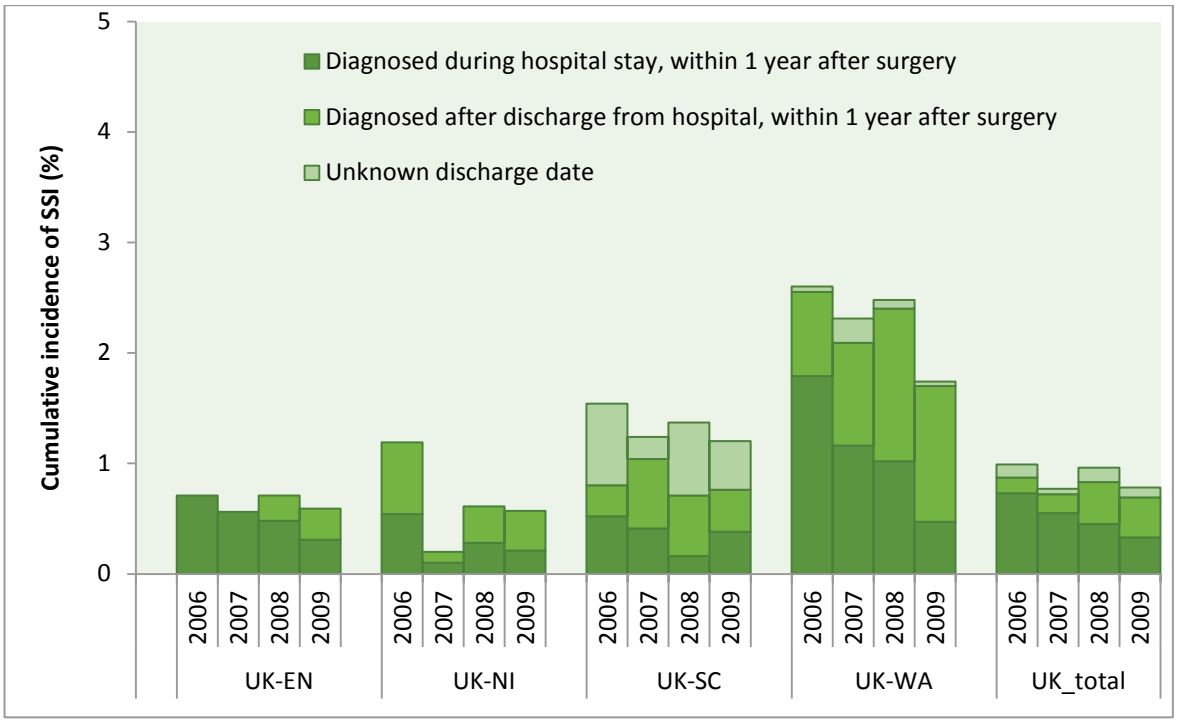
Hip prosthesis (HPRO)

Table 8.2a Cumulative incidence of SSI (diagnosed within one year of surgery) and incidence density of SSI (diagnosed during hospital stay within one year of surgery) after HPRO operations by country in UK, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with known discharge date (3)	No. (sum) of postoperative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 postoperative patient-days) [95% CI] (5)
England	57 247	368	0.6 [0.6–0.7]	57 246	447 566	220	0.5 [0.4–0.6]
Northern Ireland	3 738	20	0.5 [0.3–0.8]	3 712	22 325	7	0.3 [0.1–0.6]
Scotland	15 731	201	1.3 [1.1–1.5]	14 790	131 083	44	0.3 [0.2–0.5]
Wales	5 304	111	2.1 [1.7–2.5]	5 270	41 478	38	0.9 [0.6–1.3]
United Kingdom	**82 020**	**700**	**0.9[0.8–0.9]**	**81 018**	**642 452**	**309**	**0.5 [0.5–0.5]**

(1) Only SSI diagnosed within one year of the operation are included; (2) Cumulative incidence SSI = (Number of SSI × 100)/Number of operations. Note: Some countries do not recommend follow-up to one year and post-discharge surveillance methods and practices differ considerably between countries; (3) Operations with missing discharge dates are excluded; (4) Only in-hospital diagnosed infections occurring within one year of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of postoperative patient-days.

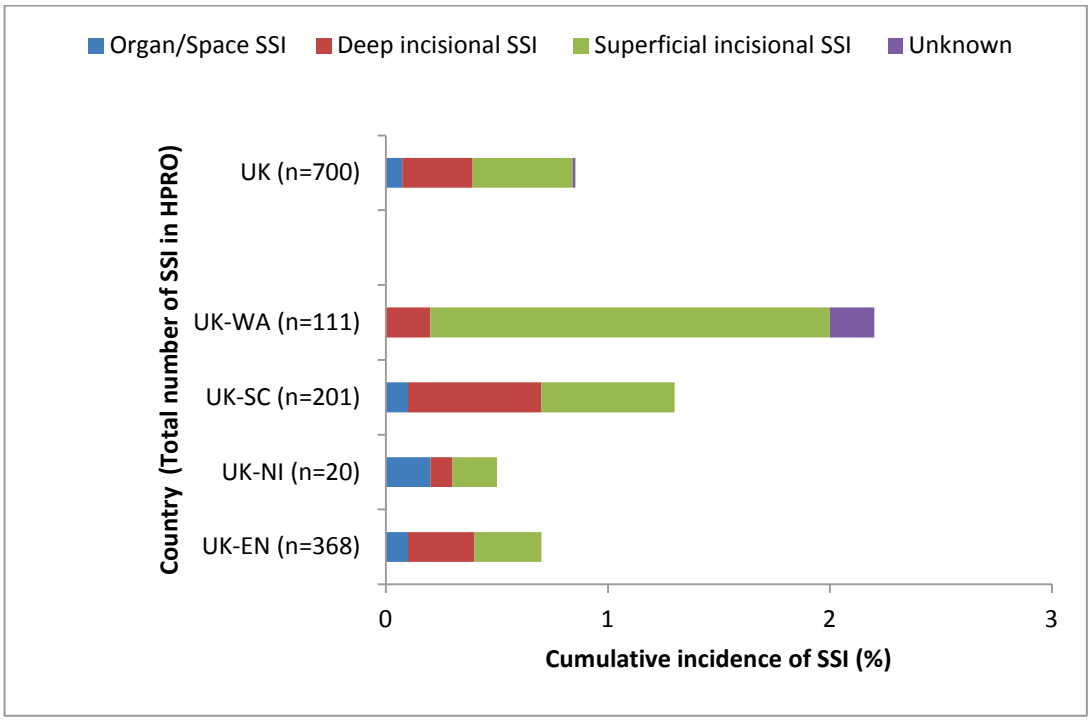
Figure 8.1a. Distribution of cumulative incidence of SSI in HPRO operations country in UK, 2006–2009



Note: Post-discharge surveillance methods and practices differ considerably among countries.

Scottish data with unknown discharge dates include SSI diagnosed during hospital stay that are only documented by a specific variable ('detection') in the national protocol.

Figure 8.2a. Cumulative incidence of SSI in HPRO operations by type of SSI and country in UK, 2008-2009



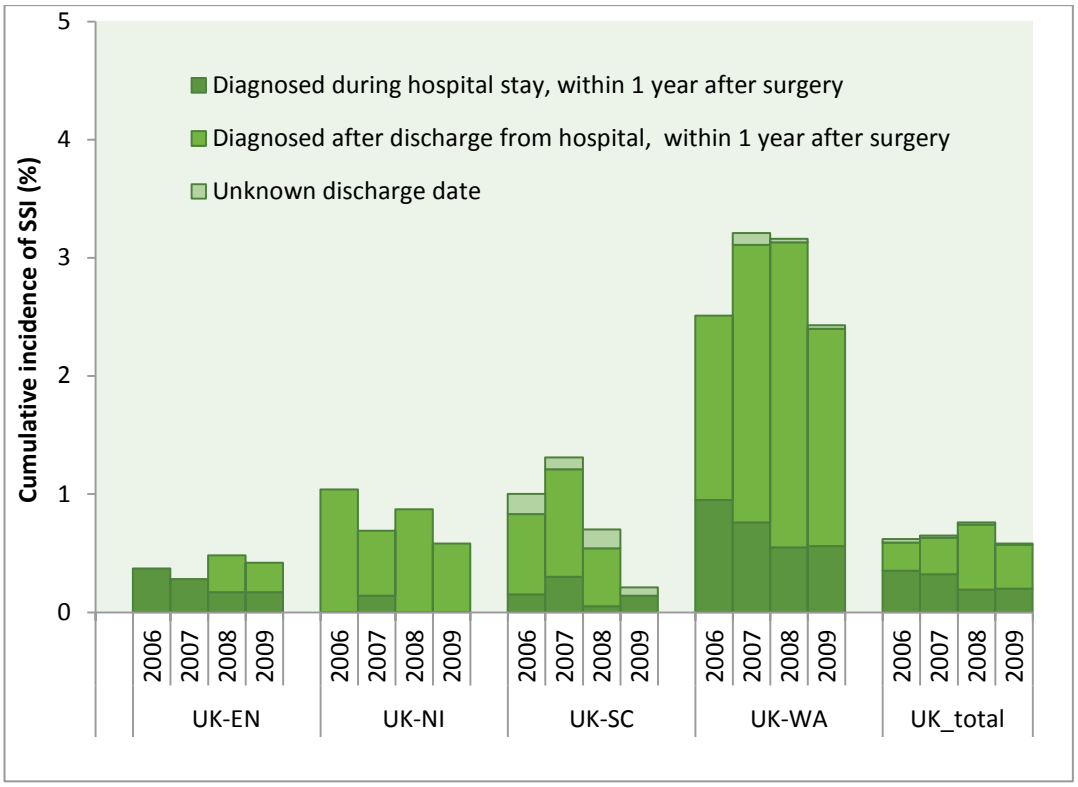
Knee Prosthesis (KPRO)

Table 9.2a. Cumulative incidence of SSI (diagnosed within one year of surgery) and incidence density of SSI (diagnosed during hospital stay within one year of surgery) after KPRO operations by country in UK, 2008–2009

Country	No. of operations	No. of SSI (1)	Cumulative incidence of SSI (per 100 operations) [95% CI](2)	No. of operations with known discharge date (3)	No. (sum) of postoperative patient-days	No. of in-hospital SSI (4)	Incidence density of SSI (per 1 000 postoperative patient-days) [95% CI] (5)
England	68 952	310	0.5 [0.4–0.5]	68 950	502 531	118	0.2 [0.2–0.3]
Northern Ireland	2 870	21	0.7 [0.5–1.1]	2 867	17 619	0	0.0 [0–0.2]*
Scotland	8 565	39	0.5 [0.3–0.6]	8 491	58 912	8	0.1 [0.1–0.3]
Wales	7 561	210	2.8 [2.4–3.2]	7 517	54 321	42	0.8 [0.6–1.0]
United Kingdom	**87 948**	**580**	**0.7[0.6–0.7]**	**87 825**	**633 383**	**168**	**0.3 [0.2–0.3]**

(1) Only SSI diagnosed within one year of the operation are included; (2) Cumulative incidence SSI = (Number of SSI ×100)/Number of operations. Note: Some countries do not recommend follow-up to one year and post-discharge surveillance methods and practices differ considerably between countries; (3) Operations with missing discharge dates are excluded; (4) Only in-hospital diagnosed infections occurring within one year of the operation are included. SSI reported after discharge from hospital or with an unknown discharge date are excluded; (5) Incidence density = (Number of in-hospital SSI × 1000)/Number of postoperative patient-days. *One-sided confidence interval.

Figure 9.1a. Distribution of cumulative incidence of SSI in KPRO operations by country in UK, 2006–2009



Note: Post-discharge surveillance methods and practices differ considerably between countries. Scottish data with unknown discharge dates include SSI diagnosed during hospital stay, that are only documented by a specific variable ('detection') in the national protocol.

Figure 9.2a. Cumulative incidence of SSI in KPRO operations by type of SSI and country in UK, 2008-2009