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SURVEILLANCE REPORT

Incidence and attributable mortality of healthcare-associated infections in intensive care units in Europe

2008-2012

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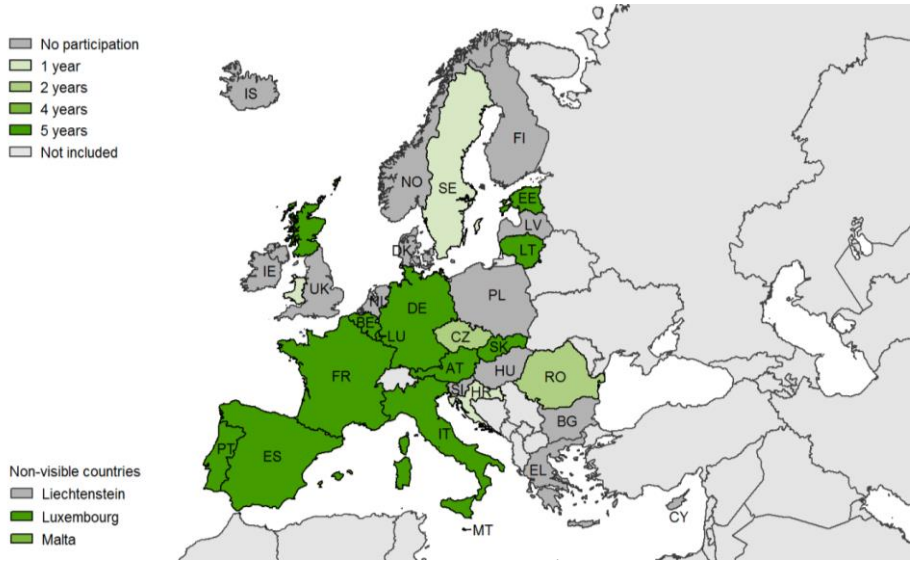
Abbreviations

AMR	Antimicrobial resistance
APACHE score	Acute physiology, age, chronic health evaluation score
BSI	Bloodstream infection
CDC	Centers for Disease Control and Prevention, United States
CFU	Colony forming units
CI	Confidence interval
CAUTI	Catheter-associated urinary tract infection
CLABSI	Central line-associated bloodstream infection
CRI	Catheter-related infection
CVC	Central vascular catheter
ENVIN	Estudio Nacional de Vigilancia de Infección Nosocomial en Servicios de Medicina Intensiva, Spain
ESICM	European Society of Intensive Care Medicine
GiViTI	Gruppo Italiano per la Valutazione Degli Interventi in Terapia Intensiva, Italy
HAI	Healthcare-associated infection
HAI-Net	Healthcare-Associated Infection surveillance Network, ECDC
HELICS	Hospitals in Europe Link for Infection Control through Surveillance
ICU	Intensive care unit
IPSE	Improving Patient Safety in Europe
KISS	Krankenhaus Infections Surveillance System, Germany
MS	Member States
NHSN	National Healthcare Safety Network (formerly NNIS), CDC
NI	Nosocomial infection
PN	Pneumonia
RAISIN	Réseau d'Alerte, d'Investigation et de Surveillance des Infections Nosocomiales, France
SAPS	Simplified acute physiology score
SEMICYUC	Sociedad Española de Medicina Intensiva, Crítica y Unidades Coronarias, Spain
SPIN-UTI	Sorveglianza attiva Prospettica delle Infezioni Nosocomiali nelle Unità di Terapia Intensiva, Italy
SSI	Surgical site infection
SSTI	Skin and soft tissue infection
TESSy	The European Surveillance System
UC	Urinary catheter
UTI	Urinary tract infection
WBC	White blood cells

Country participation 2008–2012

Figure 1. Countries participating and number of years of participation in surveillance of healthcare-associated infections in intensive care units in Europe, HAI-Net, 2008–2012 (data submitted until June 2014)



Country codes of participating countries

AT	Austria
BE	Belgium
CZ	Czech Republic
DE	Germany
EE	Estonia
ES	Spain
FR	France
HR	Croatia
IT	Italy
LT	Lithuania
LU	Luxembourg
MT	Malta
PT	Portugal
RO	Romania
SE	Sweden
SK	Slovakia
UK	United Kingdom

Table 1. List of participating national and regional institutions coordinating national/regional surveillance of healthcare-associated infections in intensive care units, HAI-Net 2008–2012

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, Department of Infection Control and Hospital Epidemiology
Belgium	Service infections liées aux soins & antibiorésistance / Dienst zorginfecties & antimicrobiële resistentie, Belgium (NSIH-ICU)	Service infections liées aux soins & antibiorésistance / Dienst zorginfecties & antimicrobiële resistentie	www.nsih.be	Scientific Institute of Public Health, Brussels
Croatia				University Hospital Center Zagreb
Czech Republic	CZ-HAI-Net	Czech HAI Network	http://www.szu.cz/narodni-referencni-centrum-pro-infekce-spojene-se-zdravotni	National Reference Centre for HAI, Centre for Epidemiology and Microbiology, National Institute of Public Health, Prague
Estonia			www.esid.ee	Estonian Society for Infectious Diseases (ESID)
France	Réseau d'Alerte, d'Investigation et de Surveillance des Infections Nosocomiales, France (REA-RAISIN)	French HAI Early Warning, Investigation and Surveillance Network (Raisin)	www.invs.sante.fr/raisin	Institut de Veille Sanitaire (InVS), Saint Maurice
			http://cclin-sudest.chu-lyon.fr	South-East Interregional Infection Control Coordinating Centre (CClin Sud-Est)
Germany	KISS (ITS-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
Italy	SPIN-UTI	Italian Nosocomial Infection Surveillance in ICUs (SPIN-UTI)		Study Group of Hospital Hygiene (GISIO – SitI)
	GiViTI		http://www.giviti.marionegri.it/SorveglianzaInfezioni.asp	Italian Group for the Evaluation of Interventions in Intensive Care Medicine
	SNICh (National coordination)	Surveillance of healthcare-associated infections	http://assr.regione.emilia-romagna.it/it/aree_attivita/rischio-infettivo/progetti/sostegno-attivita-ccm	Regional Health Authority of Emilia-Romagna, Bologna
Lithuania			www.hi.lt/content/G0_hosp_inf.html	Institute of Hygiene, Vilnius
Luxembourg				Ministry of Health, Luxembourg
Malta				Mater Dei Hospital, Msida
Portugal	Programa de Prevenção e Controlo de Infeções e de Resistência aos Antimicrobianos, Portugal (HELICS-UCI)		www.dgs.pt/programa-de-prevencao-e-controlo-de-infecoes-e-de-resistencia-aos-antimicrobianos.aspx	Directorate-General of Health, Lisbon Portuguese national programme for prevention and control of infections and antimicrobial resistance (PPCIRA)
Romania		National Centre for Communicable Diseases Surveillance and Control	http://www.insp.gov.ro/cnscbt	National Institute of Public Health, Bucharest

Country	Network acronym	Network name	Network website	Coordination
Slovakia	NNSS	National nosocomial Surveillance system (NNSS)	http://www.epis.sk/	Regional Authority of Public Health in Trenčín, Trenčín
Spain	ENVIN-HELICS	National surveillance of nosocomial infections in intensive care medicine	http://hws.vhebron.net/envin-helics/	Infectious diseases working group of SEMICYUC. Hopital Val d'Hebron, Barcelona
Sweden	SIR	Swedish ICU Register	www.icuregswe.org www.folkhalsomyndigheten.se	Swedish ICU Registry (SIR) Public Health Agency of Sweden
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, Cardiff

Executive summary

Patients admitted to intensive care units (ICUs) are at high risk of acquiring infections because of their underlying illness and frequent exposure to invasive devices. Targeted surveillance of healthcare-associated infections (HAIs) in ICUs is an essential component of hospital infection prevention and control programmes, in particular when implemented as part of a national or regional surveillance network.

Participation in ICU surveillance in Europe has increased steadily from 897 ICUs in 13 countries in 2008 to 1 247 ICUs in 15 countries in 2012.

The three most frequent ICU-acquired infections, pneumonia, bloodstream infection and urinary tract infections, were included in the surveillance. Using matched cohort analysis, the total burden in ICUs in the EU/EEA countries of these three types of infections combined was estimated at 8 650 attributable deaths and 3.43 million extra days of ICU stay per year during 2008–2012. ICU-acquired infections thereby constitute a substantial burden in acute care hospitals in the EU/EEA with large public health and economic consequences.

Pneumonia

Pneumonia was reported in 6.1% patients staying more than two days in an ICU in 2008–2012, accounting for an estimated total of 157 014 patients with at least one ICU-acquired pneumonia in EU/EEA ICUs each year. The number of patients that die every year as the direct consequence of ICU-acquired pneumonia was estimated at 5 495 (attributable mortality of 3.5% [95% confidence interval 2.6–4.3%]). Patients with ICU-acquired pneumonia were estimated to stay on average 14 days longer in an ICU, accounting for an estimated total of 2.2 million days of excess ICU stay in EU/EEA acute care hospitals every year. The device-associated pneumonia rate decreased significantly from 13.6 to 10.2 intubation-associated pneumonia episodes per 1 000 intubation days in 2008 and 2012 respectively, with the strongest decrease in Spain, where it coincided with a coordinated prevention campaign. Microorganisms isolated in ICU-acquired pneumonia showed a significant increase of the percentage of *Enterobacteriaceae*, in particular of *Klebsiella* species and *E. coli.* Variations in diagnostic practices for pneumonia in ICUs influenced the comparability of pneumonia incidence rates between countries and highlighted the need for further standardisation of methods, training and validation.

Bloodstream infection

Bloodstream infection (BSI) was reported in 3.5% patients staying more than two days in an ICU in 2008–2012, accounting for an estimated total of 90 090 patients with at least one healthcare-associated bloodstream infection in EU/EEA ICUs each year. The attributable mortality of ICU-acquired bloodstream infection was estimated at 5.0% [95% confidence interval 3.9–6.2%], and the attributable excess length of ICU stay at 14 days, accounting for 4 505 deaths as the direct consequence of the infection and 1.26 million days of excess ICU stay in EU/EEA acute care hospitals every year. The primary bloodstream infection rate decreased significantly from 2.7 to 2.2 primary bloodstream infection episodes per 1 000 patient-days in 2008 and 2012 respectively, with the strongest decreases in Malta, Spain and UK-Scotland. The overall device-adjusted BSI rate decreased from 3.6 central line-associated bloodstream infection episodes per 1 000 central line days in 2008 to 3.0 in 2012. The incidence of secondary bloodstream infections remained stable during the same period. Microorganisms isolated in ICU-acquired bloodstream infections showed a significant increase of the percentage of *Klebsiella* species and a significant decrease of the percentage of Gram-positive bacteria.

Urinary tract infection

Urinary tract infection was reported in 3.2% patients staying more than two days in an ICU in 2008—2012, accounting for an estimated total of 82 368 patients with at least one healthcare-associated urinary tract infection in EU/EEA ICUs each year. Patients with urinary tract infections did not have a higher mortality in matched cohort analysis, but 1.06 million days of excess ICU stay were estimated to occur each year in the EU/EEA as the consequence of ICU-acquired urinary tract infections. The urinary tract infection rate decreased significantly from 4.1 to 3.4 urinary tract infection episodes per 1 000 patient-days in 2008 and 2012 respectively, with the strongest decreases in France. The catheter-associated urinary tract infection rate decreased from 4.9 per 1 000 urinary catheter days in 2008 to 4.1 per 1 000 urinary catheter days in 2008 in 2012. The distribution of microorganisms isolated in ICU-acquired urinary tract infections remained stable from 2008–2012.

Antimicrobial resistance

Antimicrobial resistance data in ICU-acquired infections showed increasing trends in non-susceptibility to third-generation cephalosporins and to carbapenems in *Enterobacteriaceae*, and a significant decreasing trend in oxacillin resistance in *S. aureus* (MRSA).

Conclusion and recommendations

The report provides a comprehensive update of the epidemiology of pneumonia, bloodstream infections and urinary tract infections European ICUs as well as important reference data for European ICUs performing surveillance of ICU-acquired infections, allowing them to compare and interpret results from local surveillance using the ECDC HAI-Net surveillance protocol. It also provides for the first time estimates of attributable mortality and excess length of stay due to these infections in European ICUs.

Recommendations of this report include the integration of structure and process indicators of key evidence-based HAI prevention measures in the HAI-Net ICU protocol, further extension of surveillance of ICU-acquired infections to all EU/EEA Member States and initiatives to increase data validity and comparability through further harmonisation of surveillance methods, training and validation of ICU surveillance data.

Introduction

Background

Patients admitted to intensive care units (ICUs) are at higher risk of acquiring infections because of their underlying illness and frequent exposure to invasive devices. In the ECDC point prevalence survey of healthcare-associated infections (HAIs) and antimicrobial use in acute care hospitals, 19.5% of ICU patients had at least one HAI compared with an average of 5.2% for all other specialties combined [1]. ICU patients accounted for 5.0% of the total hospital population, but for 16.5% of all patients with an HAI. A large proportion of these HAIs are acquired during the ICU stay.

Although participation in a network for surveillance of ICU-acquired infections has been recognised as one of the priority components of HAI prevention and control programmes at the ICU level for decades, about half of EU/EEA Member States still do not have ICU surveillance networks in place. The European Council recommendation of 9 June 2009 on patient safety, including the prevention and control of healthcare-associated infections (HAIs) (2009/C 151/01) [2], also recommended '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' [3].

The Hospitals in Europe Link for Infection Control through Surveillance (HELICS) network was created in 2000 in the context of Decision 2119/98/EC [3], as a network for the surveillance of HAIs and funded by the European Commission's Directorate-General for Health and Consumers. From 2000 to 2002, HELICS standardised the European methodology for the surveillance of surgical site infections and of nosocomial infections in ICUs [4]. From 2003 onwards, the HELICS project collected data from national networks for the surveillance of HAIs. 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 HAIs. The scope of the IPSE network was the development of existing national surveillance initiatives and other approaches for supporting infection control efforts in Europe. In July 2008, the coordination of surveillance of HAI in Europe was transferred to ECDC and the surveillance network became the Healthcare-Associated Infections surveillance Network (HAI-Net). In 2009 and 2010, ECDC continued HAI surveillance following the former IPSE/HELICS protocol and methods until the full integration of this type of surveillance into The European Surveillance System (TESSy) in October 2010. More information about HAI-Net is available on the ECDC HAI-Net website [5].

Objectives

The main objectives of the European HAI surveillance are to:

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

The primary aim of this report is to present the results of the surveillance of healthcare-associated infections in intensive care units in Europe from 2008 until 2012, and to provide estimates of the attributable mortality and excess length of stay in patients with ICU-acquired infections.

Data collection and technical notes

Data collection

Data on surveillance of infections acquired in ICUs were collected in hospitals according to the HELICS-ICU protocol [4] and procedures for 2008 data and according to the ECDC protocol 'Surveillance of healthcare-associated infections in intensive care units HAIICU protocol v1.1' [6] for 2009 to 2012. Data were submitted until April 2014. Corrections were made possible until 30 June 2014, after which time the data collection was closed. Follow-up data for patients admitted in 2012 in the patient-based surveillance went until July 2013.

Methodology

Standard and light protocol

The ECDC HAI-Net ICU protocol is based on - and very similar to - the HELICS-ICU protocol from which it adopted HAI case definitions, data collection and reporting procedures for ICUs participating in the national/regional surveillance of infections acquired in ICUs across Europe.

As for other surveillance modules of HAI-Net, there are two versions of the protocol for surveillance of HAI in intensive care units as part of HAI-Net ICU: a patient-based ('standard') protocol and a unit-based ('light') protocol. In patient-based surveillance, denominator data include risk factors for risk adjusted inter-hospital comparisons and are collected for each patient, infected or not. In unit-based surveillance, aggregated denominator data are collected for the entire ICU.

Inclusion criteria

Inclusion criteria, risk factors and case definitions of ICU-acquired infections are described in the protocol [6]. Patients staying less than three days in an ICU are excluded in both protocol versions. One record per infection is collected together with antimicrobial resistance markers for isolated microorganisms. Infections occurring after 48 hours in an ICU are considered as ICU-acquired. In practice, all infections with onset from day three onwards in an ICU (whereby the day of admission to an ICU is counted as day 1) should be reported.

The minimal requirement for HAI-Net surveillance of ICU-acquired infections is to include bloodstream infection (BSI) and/or pneumonia. Urinary tract infections (UTIs) and vascular catheter-related infections (CRIs) may be added optionally.

Case definitions

Pneumonia is defined according to clinical criteria (X-rays, fever >38°C, leukocytosis > 12000 WBC/mm3, purulent sputum) and further sub-categorised in 5 categories according to the level of microbiological confirmation: PN1, minimally contaminated lower respiratory tract sample with quantitative culture (10^4 CFU/ml for broncheoalveolar lavage, 10^3 CFU/ml for protected brush samples or distal protected aspirate); PN2, non-protected sample (endotracheal aspirate, ETA) with quantitative culture (10^6 CFU/ml); PN3, alternative microbiological criteria (e.g. positive blood culture); PN4, sputum bacteriology or non-quantitative ETA; and PN5, no microbiological documentation, clinical signs and symptoms only.

BSI is defined as a positive blood culture of a recognised pathogen or the combination of clinical symptoms (fever > 38°C, chills, hypotension) and two positive blood cultures of a common skin contaminant from two separate blood samples drawn within 48 hours. A primary BSI was defined as a BSI for which the origin (source) was either a catheter (microbiologically confirmed or clinical signs disappear after catheter removal) or for which the origin was unknown (clinically confirmed unknown origin or missing BSI origin).

UTI is defined as either (a) a microbiologically confirmed symptomatic UTI (UTI-A) whereby the presence of at least one sign or symptom coincides with a positive urine culture (defined as >= 10^5 microorganisms per ml of urine with no more than two species of microorganisms), or (b) a non-microbiologically confirmed symptomatic UTI (UTI-B), whereby the presence of at least two signs or symptoms coincide with other criteria, e.g. a positive dipstick for leukocyte esterase and/or nitrate (see protocol for details of case definitions).

For microbiological results, the protocol includes two lists of microorganism codes. The enlarged list includes 147 codes and specifies genus and species for a selection of the most important (either by frequency of occurrence or by their public health importance) nosocomial pathogens, while grouping rare microorganisms in larger categories. The minimal list of microorganisms only includes 31 codes and mostly only specifies the genus (except for *Staphylococcus aureus*, coagulase-negative staphylococci, *Pseudomonas aeruginosa* and *Stenotrophomonas maltophilia*). Germany only reported microorganisms according to this minimal list of codes. The Italy-GiViTI network only adopted the minimal list in 2011, microbiological results from before 2011 were excluded.

An HAI was defined as device-associated when the relevant device was used (even intermittently) in the 48 hours (two days) before onset of infection for pneumonia (intubation) and BSI (central vascular catheter) or in the seven days before onset of a UTI (urinary catheter). In patient-based data, missing information on device use prior to the onset of the infection was derived from exposure data. Pneumonia with intubation use in the two days before the infection date were classified as device-associated; however, when intubation started on the day of infection, it was not counted as exposure prior to the infection onset because mechanical ventilation may have been started as treatment of the respiratory insufficiency resulting from the pneumonia. A central line-associated bloodstream infection (CLABSI) was defined as a primary BSI with use of a central vascular catheter in the 48 hours or two days before the onset of the infection. For the calculation of device-associated BSI rates, CLABSIs were used rather than catheter-related BSIs only. The reason for this is that CLABSIs are more internationally

used, e.g. by the National Healthcare Safety Network (NHSN), Centers for Disease Control and Prevention (CDC), Atlanta, United States. However, despite the use of a similar definition, comparison of CLABSI rates in this report with international data should be performed with caution because in ECDC surveillance, patients staying less than three days in the ICU are excluded whereas these patients are included in unit-based NHSN/CDC ICU surveillance.

Data analysis

Exclusion criteria, recoding of variables and data cleansing

To improve comparability of the data and adherence with the protocol specifications, the following data were excluded from the analysis:

- ICUs with less than 20 patients in the surveillance database were excluded for percentile distributions.
- Patients staying less than three days in the ICU were excluded from all patient-based databases.
- Patients staying more than 365 days in the ICU (<0.01%) and patients with missing discharge dates were excluded from all patient-based databases.
- Duplicate patient records (same ICU, patient counter and ICU admission date) were deleted
- Exclusion of infections:
  - infections with date of onset on day one and day two of the ICU stay,
  - infection records with missing infection site or missing infection date,
  - duplicate infection records (same patient, infection site and infection date)
- Exclusion of microorganisms:
  - duplicate microorganisms,
  - for country databases where more than three microorganisms per infection were allowed, the following algorithm was used to remove the 4th (and possibly 5th) microorganism if three other valid microorganisms were already recorded:
    - i removal of' empty' codes (NONID, NOEXE, STERI). If after this correction there were still infection records with more than 3 microorganisms
    - ii removal of 'other' code categories (e.g. BCTTOT, ETBTOT etc.)
    - iii removal of non-specified genera if combined with more specific code (e.g. STANSP when STAAUR was reported as well in the same infection)
    - iv removal of *Candida* species for infection types other than BSI,
    - v removal of coagulase-negative staphylococci for infection types other than BSI,
    - vi removal of other possible skin contaminants and 'non-nosocomial' microorganisms: *Corynebacterium* spp., *Haemophilus* spp., streptococci
    - vii removal of enterococci
    - viii removal of less frequent *Enterobacteriaceae*.

Some other inclusion criteria, standardised data management and analyses procedures are to be considered:

- Catheter-related infections with positive blood cultures (CRI3) were included in the analysis as BSIs, since these infections are also BSIs by definition. When a BSI was reported simultaneously in the same patient (case definition code BSI), the two BSIs were considered as duplicates if their date of onset was the same or almost the same (+/- 2 days). Local catheter-related infections (CRI1) and generalised catheter-related infections without positive blood culture (CRI2) were not included in the report because these optional infection types were only consistently reported by five countries.
- When the origin of BSIs differed in duplicate bloodstream infections, the origin (source) of the BSI was replaced according to following order of priority: catheter-related > secondary origin (pulmonary tract infection > urinary tract infection > surgical site infection > digestive tract infection> skin and soft tissue infection > other infection) > unknown origin > missing origin.
- Pneumonia reported as PN5 with at least one valid microorganism was recoded to PN4.
- Antimicrobial resistance data were de-duplicated to keep one antimicrobial susceptibility result per bug-drug combination and per infection type and patient (ICU stay).
- Exposure data:
  - The HELICS-ICU data format for day-by-day exposure data did not allow for making the difference between whether exposure data were missing and whether the invasive device was not used. Missing exposure data were considered as no exposure for data collected and reported according to the HELICS-ICU protocol. This was corrected in the ECDC HAI-Net ICU protocol and patients without exposure data for which the presence of exposure was reported as 'unknown' were excluded for the calculation of the device utilisation rates, i.e. the number of device days per 100 patient-days.

  - The number of device days for each exposure episode was calculated as [end date – start date + 1]. Device days 'outside' the ICU (before ICU admission or after ICU discharge) were excluded from the analysis. Overlapping exposure episodes for intubation and urinary catheters were corrected prior to analysis (exclusion of overlapping days). In addition, multiple central vascular catheters (CVCs) on one day were counted as one CVC day.
- Data from different data sources within one country (Italy: SPIN-UTI and GiViTI networks; United Kingdom: UK-Scotland and UK-Wales) were analysed separately because of large differences between the surveillance protocols (e.g. different inclusion criteria, different completeness for risk factors data, different levels of detail, e.g. for microorganism codes), and because the participation (reporting of data to TESSy) by the different networks differed throughout the five-year period.
- Data from Germany were included for the analysis of microorganisms, but excluded for all analyses on HAI incidence because denominator data from Germany cannot be compared with other countries. Unlike the HAI-Net protocol, the German protocol includes patients staying less than three days in the aggregated denominator data, and additional denominator data (number of admissions and number of patient-days) for patients staying more than two days only are not provided. Therefore, German denominator data are inflated compared with other EU countries and incidences, even if device-adjusted, cannot be compared: patients staying only one or two days in the ICU contribute an important amount of days to the denominator, while by definition they do not contribute any ICU-acquired infection to the numerator.

Statistical analysis

Relationships between two dichotomous variables were examined using the chi-square test and crude odds ratios with 95% confidence intervals. Categorical variables were examined using logistic regression and Pearson's chi-square for heterogeneity. The analysis of continuous variables was done using linear regression and/or quantile regression, as appropriate. The correlation between two continuous variables was examined using the Pearson and Spearman correlation coefficients.

Trends were analysed for a cohort of ICUs participating at least three years during the five-year period, i.e. ICUs for which the same hospital code and ICU code was reported during at least 3 years. Trends for overall mean HAI rates by country were analysed using Poisson regression, with clustered sandwich estimator of the variance to correct for the fact that observations for one ICU from one year to another are not independent from each other, ICU days or device days (as appropriate) were entered as denominator and year as independent variable. Trends for means of ICU means were examined using linear regression and trends for medians with quantile regression.

Attributable in-hospital mortality and excess length of ICU stay in patients with a HAI was analysed using a retrospective matched cohort analysis with 1:1 propensity score matching, as recommended for observational studies [7]. The propensity scores for the prediction of ICU-acquired pneumonia, bloodstream infection and urinary tract infection were derived from multiple logistic regression models similar to those developed earlier on HAI-Net ICU data [8]. Several models were tested for each outcome variable. Each model-derived propensity score was validated on 30 subsamples of the total patient-based database and the model with the best goodness of fit and discrimination (assessed by the area under ROC curve) was selected for matching. Priority was given to goodness of fit over discrimination. Patients with missing outcome data, device exposure data and four key risk factors (SAPS II score, impaired immunity, trauma and antimicrobial use on ICU admission) were excluded from analysis. Attributable mortality and excess length of stay were also analysed by origin of bloodstream infection. For less frequent subcategories of secondary bloodstream infection, one of the earlier mentioned four risk factors was allowed to be missing in order to increase sample size. For the analysis of each subtype of BSI, other BSIs were excluded from the 'non-case' group. In addition to matching on propensity score, patients with and without a HAI were matched on hospital, i.e. they had to be admitted to the same hospital. Statistical differences after matching were examined using McNemar's chi-square for differences of proportions and Wilcoxon's signed rank test for differences of medians. Attributable length of stay in patients with ICU-acquired infections was calculated as the median of the paired differences of the length of stay.

Burden estimates for Europe were calculated using national denominator data reported in the ECDC PPS 2011-2012, the proportion of ICU patients and the number of ICU beds reported in the ECDC PPS sample. ICU beds represented 5.0% of the total number of beds in the ECDC PPS hospital data, and ICU patients represented 5.2% of the total patient sample [1]. The denominator for the number of patients staying more than two days in the ICU was derived from data reported by 42 ICUs in seven countries that reported denominators both for patients staying more than two days and for all patients in HAI-Net ICU surveillance. From these data, the average percentage of patients staying more than two days was estimated at 57.2% (95% confidence interval 52.0% - 62.4%). The total number of ICU admissions in European acute care hospitals was thus estimated at 4.5 million admissions per year, with 57.2% patients (2 574 000) staying more than two days in the ICU, in approximately 7 000 European acute care hospitals (84.6% of the total) that reported at least one ICU bed in the ECDC PPS.

Results

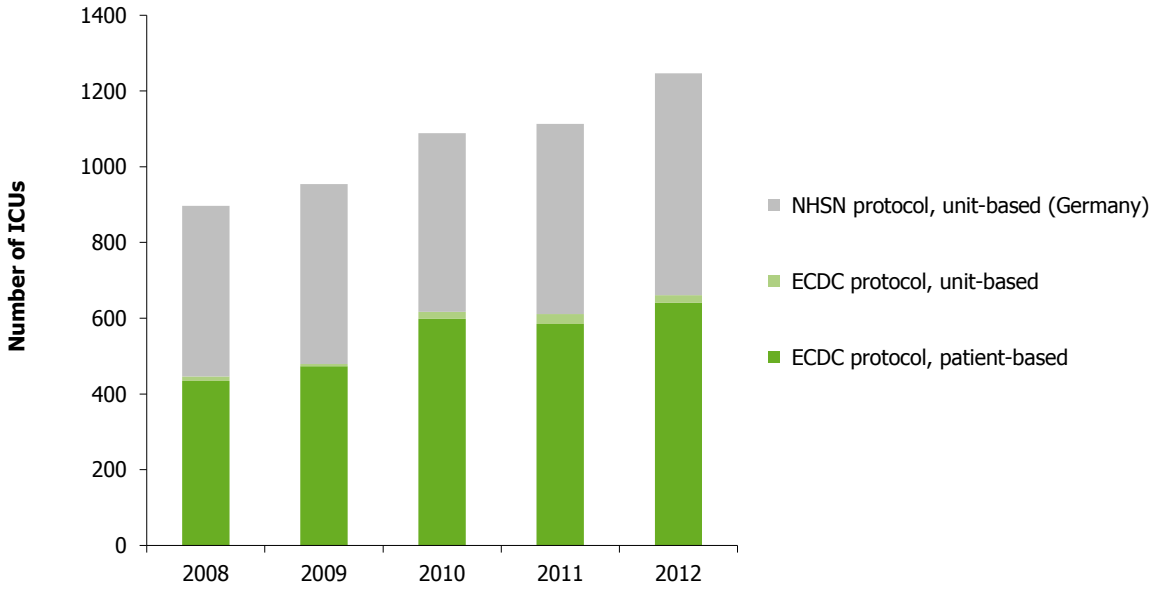
Participation

The number of ICUs included in the surveillance of HAIs in ICUs increased from 897 ICUs (737 hospitals) in 13 countries in 2008 to 1 247 ICUs (1 045 hospitals) in 15 countries in 2012 (Figure 2.). Countries joining the HAI-Net ICU surveillance module after 2004 were Slovakia (2005), Italy (SPIN-UTI network, 2006; GiViTI network, 2010), Estonia (2006), Croatia (2008), Malta (2009), UK-Scotland (2009), Sweden (2010), Czech Republic (2011), Romania (2011) and UK-Wales (2011).

Data for 2008–2012 included in this report were provided by a total of 1 363 different hospitals and 1 723 different ICUs from 17 EU/EEA countries, contributing to 5 301 ICU surveillance years (Table 2). Of the ICUs, 23.6% (n=406) participated for only one surveillance year, 18.2% (n=314) two years, 15.4% (n=266) three years, 12.5% (n=216) four years and 30.2% (n=521) participated all five years. Data from ICUs participating for three years or more (n=1 003 ICUs, 58.2%) were included for trend analyses. All ICUs participating for three years or more were included for trend analysis of microorganism distributions, but German ICUs were excluded for trend analyses of HAI incidence rates because of differences in the German surveillance protocol (see Methods). Finally, data from 5 227 ICU years from 1 695 ICUs providing data for at least 20 patients were included for the analysis of percentile distributions.

Eight countries (Austria, France, Italy, Lithuania, Luxembourg, Portugal, Spain, United Kingdom) provided patient-based data (for patients staying more than two days in the ICU), three countries (Belgium, Estonia and Slovakia) reported both patient-based and unit-based data, and the remaining six countries (Croatia, Czech Republic, Germany, Malta, Romania and Sweden) only provided unit-based data. In each of Italy and the United Kingdom, data were provided by two different networks (SPIN-UTI and GiViTI networks in Italy, UK-Scotland and UK-Wales in United Kingdom). Malta and the Czech Republic only reported infection data on BSIs and Sweden only reported data on pneumonia. In UK-Wales (2011 data), it was unclear which infection types were included by the different ICUs, therefore only demographic results were reported in this report.

Figure 2. Number of ICUs included in the European surveillance of ICU-acquired infections, 2004-2012



Data source: ECDC, HAI-Net ICU.
NHSN: National Healthcare Safety Network, Centers for Disease Control and Prevention (CDC), Atlanta, United States; ICU, intensive care unit

Table 2. Participation in the European surveillance of ICU-acquired infections by country/network, 2008–2012

Country/network	Number of ICUs					No. of ICU years	No. of ICU patients	No. of ICU patient - days	Type of protocol
	2008	2009	2010	2011	2012				
Austria	37	37	66	25	28	193	39 139	396 234	P
Belgium	20	21	22	20	14	97	26 817	211 754	P/U
Croatia	8	0	0	0	0	8	621	4 022	U
Czech Republic	0	0	0	11	3	14	2 262	26 408	U
Estonia	1	1	1	5	6	14	2 306	25 703	P/U
France	174	176	181	184	196	911	132 718	1 534 408	P
Germany [a]	451	475	472	502	586	2 486	2 098 971	7 841 316	U
Italy	24	26	121	101	143	415	57638	586 581	P
Italy-GiViTI	0	0	94	74	116	284	51 785	529 878	P
Italy-SPIN-UTI	24	26	27	27	27	131	5 853	56 703	P
Lithuania	9	28	26	28	31	122	11 488	94 301	P
Luxembourg	8	8	8	8	10	42	13 487	127 281	P
Malta	0	1	1	1	1	4	3 105	25 626	U
Portugal	28	27	23	27	27	132	17 470	209 046	P
Romania	0	0	0	8	12	20	9 827	68 928	U
Slovakia	5	6	7	9	9	36	1 540	14 562	P/U
Spain	130	147	151	168	180	776	127 733	1081813	P
Sweden	0	0	10	0	0	10	2 993	22815	U
United Kingdom	2	1	1	16	1	21	25 687	222619	P
UK-Scotland [b]	2	1	1	1	1	6	21 304	173152	P
UK-Wales	0	0	0	15	0	15	4 383	49467	P
EU/EEA	897	954	1 090	1 113	1 247	5,301	2 573 802	12 493 417	P/U
EU/EEA without Germany [a]	446	479	618	611	661	2,815	474 831	4 652 101	P/U

Data source: ECDC, HAI-Net ICU 2008–2012.
N, number; ICU, intensive care unit; Type of protocol: P, patient-based; U, unit-based, P/U, both patient-based and unit-based
[a] Germany: NHSN/CDC unit-based protocol including patients staying less than 3 days in the ICU;
[b] Data from UK-Scotland (2009-2011) did not include separate hospital or ICU codes, therefore the number of ICUs is not correct.

Characteristics of patients and ICUs

Mixed or polyvalent ICUs represented 60% of the total number of ICUs, surgical ICUs 15% and medical ICUs 9%. Neurosurgical units represented 1.9%, paediatric units 1.5%, coronary care units 1.2%, burn units 0.4% and other types 2.8%. For 7.4% of the ICUs, the unit type was unknown. The median ICU size was 10 beds (25th percentile 8–75th percentile 12 beds]). The median percentage of patients with intubation was 47% (Table 3). The median length of stay in the ICU (median of ICU means) for patients staying more than 2 days was 10 days (mean of ICU means 10.5 days), varying between seven days in Romania to 13 days in the Czech Republic. In Germany, where patients staying less than three days are included in the denominator, the median length of stay was four days (see Methods).

Table 3. Characteristics of ICUs by country/network, unit-based and patient-based surveillance, 2008–2012

Country/ network	No. of ICU-years [a]	ICU type (%)				ICU size (number of beds)	Percentage Intubated patients	Length of stay (days)
		Mixed	Surgical	Medical	Other/ unknown	Median [IQR]	Median [IQR]	Median [IQR]
Austria	188	3	52	15	30	6 [6-8]	71 [46-82]	11 [8-12]
Belgium	97	38	1	3	58	9 [6-12]	32 [23-48]	8 [7-9]
Croatia	8	13	25	13	50	8 [8-9]	39 [23-70]	7 [6-7]
Czech Republic	14	50	21	7	21	8 [6-9]	-	13 [12-15]
Estonia	14	79	14	0	7	24 [16-32]	66 [60-84]	12 [10-13]
France	910	61	8	7	23	10 [8-14]	66 [54-75]	12 [10-14]
Germany	2 480	54	21	14	11	11 [9-14]	37 [25-52]	4 [3-5]
Italy-GiViTI	284	80	10	0	11	6 [5-8]	75 [61-85]	10 [8-12]
Italy-SPIN-UTI	104	65	15	4	15	8 [6-12]	84 [50-95]	10 [7-13]
Lithuania	106	50	6	6	39	10 [6-15]	45 [25-64]	8 [7-9]
Luxembourg	42	86	0	0	14	12 [6-18]	32 [19-42]	9 [8-11]
Malta	4	100	0	0	0	20 [20-20]	47 [47-47]	8 [8-9]
Portugal	132	67	8	2	24	8 [6-10]	82 [75-90]	12 [10-13]
Romania	20	55	10	0	35	23 [12-34]	48 [23-67]	7 [6-8]
Slovakia	36	100	0	0	0	10 [5-10]	77 [71-91]	9 [7-12]
Spain	757	86	3	3	9	12 [9-18]	40 [29-58]	8 [7-10]
Sweden	10	70	0	10	20	8 [6-12]	47 [33-53]	8 [6-8]
UK-Scotland	6	0	0	0	100	-	77 [72-79]	8 [8-9]
UK-Wales	15	100	0	0	0	11 [7-20]	36 [26-38]	11 [9-13]
EU/EEA	**5 227**	**60**	**15**	**9**	**15**	**10 [8-14]**	**47 [30- 67]**	**7 [4-10]**
EU/EEA excluding Germany [b]	**2 747**	**66**	**10**	**5**	**20**	**10 [7-14]**	**61 [39-77]**	**10 [8-12]**

Data source: ECDC, HAI-Net ICU 2008–2012.
[a] Number of ICU-years with at least 20 patients reported in 2008–2012; [b] Excluding Germany, i.e. including only countries/networks that included patients staying more than 2 days in the ICU; median (50th percentile): 50% of the ICUs have a lower (or equal) value, 50% of the ICUs have a higher (or equal) value; IQR=interquartile range (25th percentile – 75th percentile); - = no data provided

Table 4 shows the demographic characteristics and risk factors on admission of ICU patients in countries reporting patient-based data in 2008–2012. On average, 15.3% of the patients staying more than two days died in the ICU, ranging from 8.7% in Luxembourg to 18.1% in France. The mean ICU mortality prediction score SAPS II (Simplified Acute Physiology Score) was 37.8 (median and interquartile range 36 [25-49]). Thirty-seven per cent of the patients were admitted directly to the ICU from the community. Surgical patients represented 39% of the total. The percentage of patients receiving systemic antimicrobials in the 48 hours before or after admission was 41.5%, ranging from 19.5% in Luxembourg to 80.9% in Slovakia.

Table 4. Characteristics of ICU patients in countries/networks that provided patient-based data, 2008–2012: patient demographics and risk factors on admission for patients staying more than two days in the ICU

Country/network	No. of patients	Median age (years)	Male gender (%)	ICU mortality (%)	Median SAPS II score	Patients from community (%)	Admission type (%)				Trauma (%)	Acute coronary care (%)	Impaired immunity (%)	Antibiotics at admission (%)
							Medical	Scheduled surgery	Urgent surgery	Unknown (not in total)				
Austria	39 139	68	59.0	11.7	34	17.2	50.9	27.1	22	0.7	11.4	2.2	0.2	47.9
Belgium	17 178	72	59.8	10.9	31	35.7	60.8	28.6	10.6	0.5	6.5	24.4	6.1	41.8
Estonia	2 213	65	60.4	11.6	39	28.5	46.9	22.4	30.8	0.1	14.2	21.6	9.8	69.1
France	132 718	66	61.6	18.2	41	53.6	67.6	14.0	18.4	0.3	9.0	-	14.5	56.2
Italy-GiViTI	51 785	69	58.8	16.5	37	20.8	50.4	23.2	26.4	0.0	14.1	-	1.4	-
Italy-SPIN-UTI	5 853	70	61.4	18.1	35	23.9	51.2	31.4	17.3	0.9	4.0	13.5	3.9	60.1
Lithuania	11 488	63	56.8	16.2	30	26.6	51.7	28.7	19.5	0.4	7.9	18.8	11.5	25.8
Luxembourg	13 487	69	53.6	8.7	31	44.5	68.9	19.2	11.9	0.1	3.7	-	0.5	21.6
Portugal	17 470	66	63.5	17.6	44	34.5	61.9	11.8	26.3	0.0	13.8	-	12.1	51.8
Slovakia	1 510	62	61.2	22.8	52	34.7	62.9	10.1	27.0	0.7	23.5	16.3	16.1	80.7
Spain	127 733	65	65.1	13.5	30	49.9	68.3	18.7	13	1.5	7.2	20.1	8.2	21.4
UK-Scotland	21 304	62	56.4	16.0	43	26.1	59.3	14.6	26.1	11.6	7.9	4.9	4.9	76.3
UK-Wales	4 383	67	55.2	-	-	-	-	-	-	-	-	-	-	-
EU/EEA	**446 261**	**66**	**61.4**	**15.3**	**36**	**40.7**	**62.7**	**18.9**	**18.4**	**2.2**	**9.1**	**15.7**	**8.5**	**42.5**

Data source: ECDC, HAI-Net ICU 2008–2012. UK: United Kingdom; SAPS: Simplified Acute Physiology Score; SAPS II values for Austrian ICUs were only available for 2008-2010 (change to SAPS 3 score in the national surveillance protocol since 2011)

Invasive device use in the ICU is shown in Table 5. The percentage of patients with at least one day of intubation (with or without mechanical ventilation) was 59.4%. In patients staying more than two days in the ICU, a central vascular catheter was in place for at least one day in 70.6%, a urinary catheter in 80.3% and parenteral nutrition was administered to 18.1% of patients.

Table 5. Characteristics of ICU patients in countries/networks that provided patient-based data, 2008–2012: use of invasive devices

Country/network	Intubation		Central vascular catheter		Urinary catheter		Parenteral nutrition	
	%	Device days/100 patient-days	%	Device days/100 patient- days	%	Device days/100 patient- days	%	Device days/100 patient- days
Austria	63.2	57.5	81.7	87.2	78.6	77.5	-	-
Belgium	46.9	39.8	70.0	72.8	78.1	80.4	-	-
Estonia	75.2	69.9	79.7	81.8	94.2	89.8	39.9	26.5
France	65.4	60.7	64.6	66.4	84.7	81.7	-	-
Italy-GiViTI	74.1	65.5	77.9	82.6	-	-	30.2	27.5
Italy-SPIN-UTI	74.1	61.3	75.8	75.9	81.9	75.5	26.7	27.0
Lithuania	52.3	40.9	69.6	68.9	83.7	77.6	34.7	23.4
Luxembourg	31.0	32.1	49.8	56.4	68.2	69.3	-	-
Portugal	83.9	72.6	90.9	85.8	96.8	93.2	-	-
Slovakia	87.2	77.5	73.4	72.2	95.6	92.7	-	-
Spain	44.9	46.6	68.5	74.5	74.7	79.8	13.1	14.4
UK-Scotland	73.9	65.4	78.6	65.4	-	-	19.8	13.3
UK-Wales	34.9	27.0	65.1	32.7	-	-	-	-
EU/EEA [(a)]	**59.3**	**56.1**	**70.6**	**72.9**	**80.4**	**81.0**	**18.1**	**17.5**

Data source: ECDC, HAI-Net ICU 2008–2012. [(a)] EU/EEA database mean (patient-based data only); - no data (not included in surveillance protocol)

In the cohort of 528 ICUs participating at least three years in patient-based surveillance from 2008 to 2012, the main case-mix indicators remained stable throughout the period (Table 6). Statistical analysis showed no significant trends.

Table 6. Evolution of selected patient case-mix indicators in ICUs that participated in at least 3 years during 2008–2012 (n=528 ICUs)

	2008	2009	2010	2011	2012
Mean length of stay (days)	10.0	10.2	9.8	9.7	9.7
Median SAPS II score	36	37	36	36	37
ICU mortality (%)	15.0	15.7	15.2	15.1	15.4
Intubation-days / 100 patient-days	55.8	55.6	56.0	56.8	55.1
CVC-days / 100 patient-days	73.8	72.8	72.8	73.3	72.6

Data source: ECDC, HAI-Net ICU 2008–2012.
CVC: central vascular catheter; SAPS: Simplified Acute Physiology Score; Austrian ICUs were excluded for median SAPS II score because of a change to SAPS 3 score in the national surveillance protocol since 2011

Pneumonia

Key points

- Pneumonia was reported in 6.1% patients (n=27 687) staying more than two days in the ICU in 2008–2012, accounting for an estimated total of 157 014 patients with at least one healthcare-associated pneumonia in EU/EEA ICUs each year, 5 495 deaths as the direct consequence of the pneumonia and 2.2 million days of excess ICU stay in the EU/EEA.
- The median device-associated pneumonia rate decreased significantly from 10.9 to 8.4 intubation-associated pneumonia episodes per 1 000 intubation days in 2008 and 2012, respectively, with the strongest decrease in Spain.
- Microorganisms isolated in ICU-acquired pneumonia showed a significant increase of the percentage of *Enterobacteriaceae*, in particular of *Klebsiella* species and *E. coli.*
- Variations in diagnostic practices for pneumonia in the ICU were still important, influencing the comparability of pneumonia incidence rates between countries and highlighting the need for further standardisation of methods and training.

Incidence of pneumonia

Pneumonia was reported in 6.1% patients (n=27 705) staying more than two days in the ICU in 2008–2012, varying between 1.6% in Luxembourg and 10.2% in Estonia (Table 7). A total of 32 220 pneumonia episodes were reported in these 27 705 patients (on average 1.16 pneumonia episodes per infected patient), of which 90.2% were intubation-associated (i.e. with presence of intubation in the 48 hours before onset). In patient-based data, the cumulative incidence of pneumonia in patients with at least one day of intubation before the onset of the infection was 9.5%, ranging from 3.8% in UK-Scotland to 13.2% in France.

Table 7. Cumulative incidence and incidence density of ICU-acquired pneumonia and device-associated pneumonia rate by country/network, patient-based and unit-based surveillance, 2008–2012

Country/network	No. of patients with PN	Cumulative incidence of PN (%)	No. of PN episodes	PN episodes per 1 000 patient-days	No. of IAP episodes	No. IAP/1 000 intubation-days [a]	
						Mean [b]	Median (IQR) [c]
Austria	1 540	5.7	2 152	7.6	2 148	12.8	9.8 (4.7-16.8)
Belgium	2 329	8.7	2 764	13.1	1 999	14.6	9.9 (2.0-22.5)
Croatia	22	3.5	22	5.5	17	19.9	15.6 (11.8-24.1)
Estonia	236	10.2	257	10.0	236	13.3	15.6 (6.8-23.0)
France	12 069	9.1	14 310	9.3	12 699	13.7	12.2 (7.9-17.6)
Italy-GiViTI	2 822	5.4	2 823	5.3	2 590	7.5	5.9 (2.8-9.0)
Italy-SPIN-UTI	483	8.3	574	10.1	564	15.7	10.3 (0.0-21.7)
Lithuania	514	4.5	554	5.9	476	12.7	3.4 (0.0-21.3)
Luxembourg	213	1.6	215	1.7	186	4.6	3.6 (0.7-5.9)
Portugal	1 589	9.1	1 802	8.6	1 741	11.5	10.3 (6.2-16.1)
Romania	418	4.3	418	6.1	370	11.0	2.7 (0.0-12.5)
Slovakia	144	9.4	146	9.9	129	11.4	9.0 (3.0-14.8)
Spain	4 634	3.6	5 445	5.0	5 269	10.5	8.2 (3.8-15.3)
Sweden	52	1.7	52	2.3	52	5.6	3.2 (1.2-5.3)
UK-Scotland	622	2.9	667	3.9	554	5.4	5.6 (5.4-10.8)
EU/EEA	**27 687**	**6.1**	**32 198**	**7.3**	**29 028**	**11.4**	**9.5 (4.5-16.0)**

Data source: ECDC, HAI-Net ICU 2008–2012.
PN: (ICU-acquired) pneumonia, IAP: intubation-associated pneumonia; No.: number (a) Device-associated pneumonia rate: number of intubation-associated pneumonia episodes per 1000 intubation days; intubation-days were approximated by the number of patient-days × percentage of intubated patients for unit-based (light) data (correlation coefficient between true rate and approximated rate: 0.92); (b) Mean=overall mean by country; (c) Median of all ICU years in 2008–2012; (b), (c) ICU years with less than 20 patients and ICUs with missing denominator data excluded; IQR: interquartile range (percentile 25 – percentile 75); ICUs with missing percentage intubated patients were excluded for the number of IAP episodes and the IAP rate (Belgium: 7 ICUs, Croatia: 4 ICUs), but not for the cumulative incidence and the PN incidence per 1000 patient-days;

The overall pneumonia incidence rate was 7.3 pneumonia episodes per 1 000 patient-days (country/network range 1.7 – 13.1). The median pneumonia incidence rate by ICU in ICUs reporting at least 20 patients (unit-based and patient-based data combined) was 5.6 per 1 000 patient-days and varied from 2.0 per 1 000 patient-days in ICUs with less than 30% intubation to 7.2 per 1 000 patient-days in ICUs with at least 60% of patients with intubation (Table 8).

Table 8. Percentile distribution of the incidence rate of ICU-acquired pneumonia, by percentage of patients under intubation in the ICU, ICUs that reported on less than 20 patients excluded, 2008–2012

Percentage patients with intubation	Number of ICU years	Number of patient-days	No. of PN episodes (N PNs)	No. PNs/ 1000 patient-days	Mean of ICU means	P10	P25	P50	P75	P90
<30%	382	476 059	1 585	3.3	3.4	0.0	0.0	2.0	5.2	8.5
30-59%	914	1 321 446	8 005	6.1	6.2	0.9	2.3	4.9	8.9	13.1
>=60%	1 344	2 554 634	20 800	8.1	8.5	1.5	3.9	7.3	11.9	17.1
All ICUs	2 640	4 352 139	30 389	7.0	7.0	0.1	2.5	5.7	9.8	15.1

Data source: ECDC, HAI-Net ICU 2008–2012.
PN: pneumonia; No. PNs: number of pneumonia episodes; P: percentile (percentile distribution for ICUs including at least 20 patients); Incidence rate of pneumonia: number of pneumonia episodes × 1000 / number of patient-days (incidence density)

The median intubation-associated pneumonia (IAP) rate in ICUs reporting at least 20 patients per year in 2008–2012 was 9.5 intubation-associated pneumonia episodes per 1 000 intubation days, the lowest was in Romania and highest was in Croatia and Estonia (Table 7). In 25 per cent of European ICUs, the IAP rate was lower than 4.5 and in the highest 25 per cent of ICUs, the rate was higher than 16.0 intubation-associated pneumonia episodes per 1 000 intubation days. The IAP rate decreased from 13.6 to 10.2 intubation-associated pneumonia episodes per 1 000 intubation days in 2008 and 2012 respectively ($p<0.001$). Significant decreases of the IAP rate were observed for ICUs with regular participation in Spain, Portugal, UK-Scotland and for the EU overall (Table 9).

Table 9. Trends of the intubation-associated pneumonia rate by country/network, 2008–2012

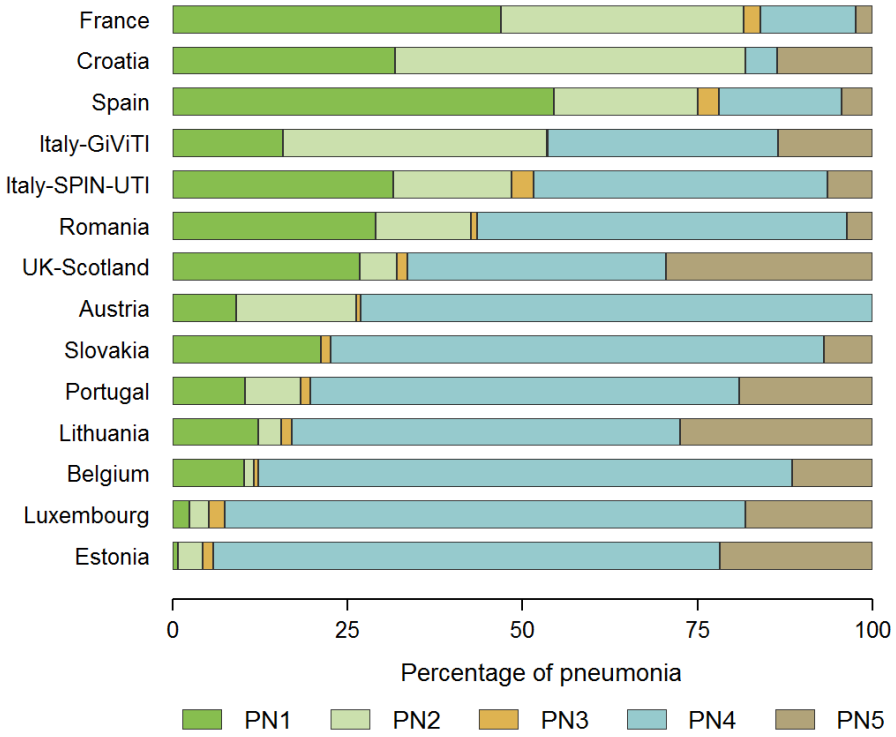
Country - Network	2008	2009	2010	2011	2012	2008–2012	Trends, 2008–2012	Average annual change 2008–2012	p for trend
Croatia	19.9					19.9		-	n.a.
Italy-SPIN-UTI	15.1	12.4	18.2	14.9	18.1	15.7		0.99	n.s.
Belgium	16.5	17.6	12.2	13.5	15.1	14.6		-0.77	n.s.
France	13.5	13.7	13.4	13.9	13.7	13.7		0.05	n.s.
Estonia	7.5	3.2	23.0	18.1	10.6	13.3		2.10	<0.05
Austria	13.5	16.2	11.9	11.0	10.6	12.8		-1.07	n.s.
Lithuania	5.5	10.8	11.7	12.8	18.0	12.7		2.68	n.s.
Portugal	13.9	13.0	10.4	10.0	10.2	11.5		-1.06	<0.01
Slovakia	17.6	11.1	10.9	7.3	11.4	11.4		-1.61	n.s.
EU/EEA	**13.6**	**13.1**	**10.7**	**10.8**	**10.2**	**11.4**		**-1.03**	**<0.001**
Romania				5.9	11.5	11.0		-	n.a.
Spain	14.6	11.6	11.2	9.4	7.4	10.5		-1.68	<0.001
Italy-GiViTI			7.2	7.4	7.8	7.5		0.28	n.s.
Sweden			5.6			5.6		-	n.a.
UK-Scotland	9.3	13.0	5.6	5.4	3.4	5.4		-1.94	<0.001
Luxembourg	6.8	3.4	3.9	4.9	3.9	4.6		-0.42	n.s.

Data source: ECDC, HAI-Net ICU 2008–2012.
Intubation-associated pneumonia rate: number of intubation-associated pneumonia episodes × 1000 / number of intubation days; intubation days for unit-based data (light protocol) estimated from percentage of intubated patients; only ICUs reporting at least 20 patients included (n=860 ICUs, 2623 ICU years); Trend analysis (p for trend): only including ICUs participating at least 3 years from 2008–2012 (cohort, n=521 ICUs); n.s. not significant; n.a. not applicable; UK-Scotland: individual ICU codes not provided, p-value given for all ICUs combined

Diagnosis of ICU-acquired pneumonia

Microbiological confirmation of pneumonia by either semi-quantitative culture of invasive samples (bronchoalveolar lavage, protected brush, etc.) or by quantitative culture of non-protected respiratory samples (endotracheal aspirate) was done most frequently in France, Croatia, Spain and Italy (Figure 3). The percentage of pneumonia documented by (semi-) quantitative microbiological results (PN1 and PN2) was 62.0% from 2008–2012 (excluding Germany and Sweden where the diagnostic subcategories are not all collected) and did not vary significantly across the years. The percentage of pneumonia not documented by any microbiological results was 6.6%.

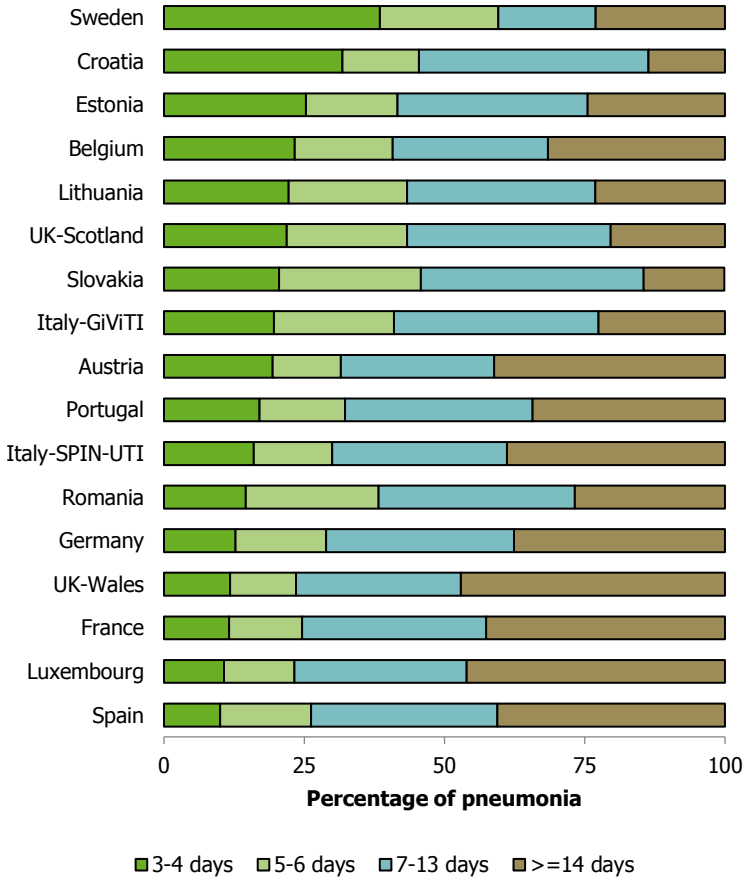
Figure 3. Diagnostic category of ICU-acquired pneumonia by country/network, 2008–2012 (n=32 146 pneumonia episodes)



Data source: ECDC, HAI-Net ICU 2008–2012.
PN1, Pneumonia documented by invasive diagnostic sample with semi-quantitative culture; PN2, Pneumonia documented by endotracheal aspirate with quantitative culture; PN3, Pneumonia documented by alternative microbiological results, e.g. positive blood culture; PN4, Pneumonia documented by qualitative microbiological results; and PN5, Clinical pneumonia without microbiological results. Germany and Sweden were excluded because diagnostic subcategories of the case definition were not collected.

The median time from ICU admission to onset of pneumonia was 10 days and varied between six days in Sweden to 13 days in Luxembourg. Early onset pneumonia starting on day three or day four represented more than 13.9% of the 52 847 reported pneumonia episodes in 2008–2012 (all networks included), varying from 10.0% in Spain to 38.5% in Sweden (Figure 4).

Figure 4. Time from ICU admission to onset of pneumonia by country/network, 2008–2012 (n=52 847 pneumonia episodes)



Data source: ECDC, HAI-Net ICU 2008–2012.

Microorganisms

The most frequently isolated microorganisms in ICU-acquired pneumonia episodes were *Pseudomonas aeruginosa* (17.4%), *Staphylococcus aureus* (15.1%), *Escherichia coli* (9.8%) and *Klebsiella* species (9.5%). The percentage of *Klebsiella* species varied from 7.0% in France to 32.2% in Slovakia (Table 10). *Klebsiella pneumoniae* represented 70.8% of the latter in networks specifying microorganisms at the species level (all but Germany and Italy-GiViTI) (Table A.1.3). *Acinetobacter* species, 83.1% of which was reported as *A. baumannii*, accounted for more than 10% of isolated microorganisms in pneumonia in Croatia, Italy, Lithuania, Portugal, Romania and Spain. *Enterobacter* species, with 33.2% *E. aerogenes* and 61.6% *E. cloacae*, was more frequently reported in Belgium. The high percentage of *Candida* species reported by ICUs in Austria, Germany, Slovakia and UK-Scotland may indicate different diagnostic practices for ICU-acquired pneumonia in these countries or reflect differences in reporting this microorganism, which is often isolated in respiratory samples but only rarely involved in the pathogenesis of pneumonia. Less frequently reported microorganisms reported in ICU-acquired pneumonia were *Haemophilus* species (3.2%), *Proteus* species (2.6%), *Streptococcus* species (2.5%), *Citrobacter* species (1.7%), *Aspergillus* species (1.0%), *Morganella* species (0.5%) and *Moraxella* species (0.3%).

The distribution of microorganisms varied strongly according to the day of onset of the pneumonia in the ICU (Table A.1.1). *Staphylococcus aureus*, *Streptococcus* species and *Haemophilus* species were more prevalent in early onset than in late onset pneumonia, while the opposite was true for *Enterococcus* species, *Pseudomonas aeruginosa*, *Acinetobacter* species and *Stenotrophomonas maltophilia*. Differences between microbiologically confirmed pneumonia (especially PN1 and PN2) and pneumonia documented by qualitative microbiology (PN4) were less important (Table A.1.2). However, it should be noted that inter-country differences in the use of microbiological confirmation techniques influence the distribution of microorganisms by diagnostic category.

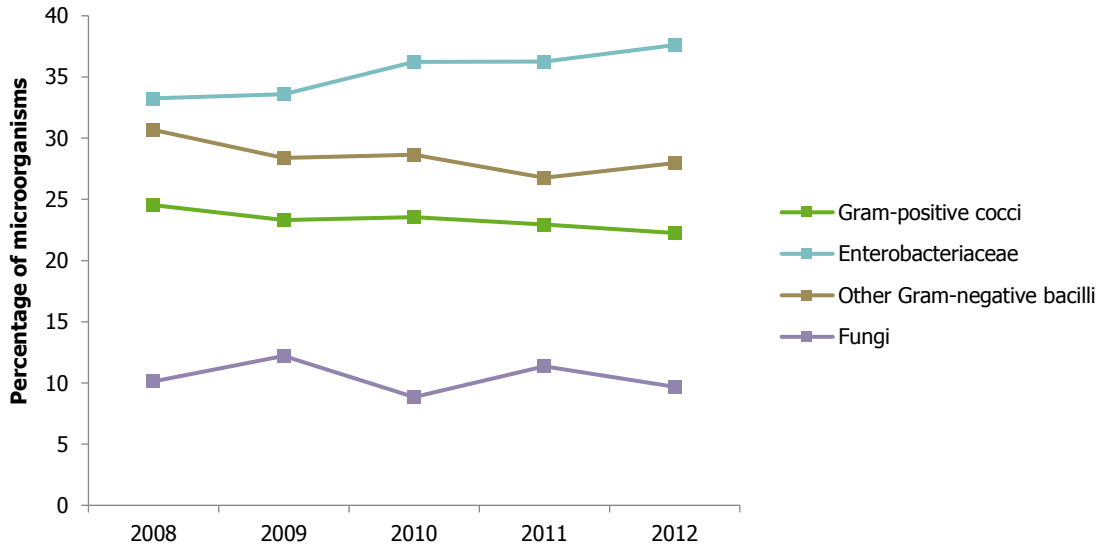
Table 10. Relative frequency (%) of the ten most frequently isolated microorganisms in ICU-acquired pneumonia by country/network, 2008–2012 (n=58 171 isolates)

Country/network	Number of isolates	*Pseudomonas aeruginosa*	*Staphylococcus aureus*	*Escherichia coli*	*Klebsiella* species	*Candida* species	*Enterobacter* species	*Acinetobacter* species	*Stenotrophomonas maltophilia*	*Enterococcus* species	*Serratia* species
Austria	2 981	21.0	8.7	6.5	10.5	16.2	7.0	1.3	3.8	4.9	2.9
Belgium	3 130	18.0	8.3	10.5	8.8	1.6	11.5	1.4	6.3	2.5	3.9
Croatia	27	14.8	14.8	18.5	11.1	0.0	3.7	14.8	0.0	3.7	0.0
Estonia	247	23.9	10.5	8.5	12.6	7.7	8.9	3.6	2.8	0.8	0.8
France	17 012	20.8	16.9	9.7	7.0	4.9	7.6	2.4	3.5	1.5	2.9
Germany	23 395	12.8	15.7	11.5	10.4	13.3	6.9	1.7	3.5	5.3	3.7
Italy-GiViTI*	2 163	16.6	16.3	7.5	16.6	4.7	4.4	13.9	2.4	2.6	2.3
Italy-SPIN-UTI	619	21.2	9.4	8.6	11.0	3.4	4.8	20.2	4.8	3.2	1.8
Lithuania	635	13.4	10.1	6.9	18.7	4.9	4.6	15.6	1.3	2.7	3.5
Luxembourg	235	23.0	6.8	7.2	15.7	6.8	7.2	0.9	5.5	3.4	3.8
Portugal	1 701	24.8	19.8	5.8	8.9	3.8	5.7	12.9	3.5	0.7	2.3
Romania	415	19.0	18.8	4.3	18.8	0.5	1.7	25.8	0.5	2.9	1.4
Slovakia	174	22.4	4.0	8.0	32.2	10.9	1.7	9.2	0.6	1.7	1.1
Spain	5 656	22.1	14.1	7.2	7.8	5.3	6.3	10.2	5.2	2.3	3.4
Sweden	91	9.9	28.6	5.5	13.2	6.6	7.7	1.1	4.4	1.1	2.2
UK-Scotland	615	9.4	16.9	10.7	12.2	10.4	7.3	1.5	5.0	1.0	4.4
EU/EEA	**59 114**	**17.4**	**15.1**	**9.8**	**9.5**	**8.6**	**7.1**	**4.0**	**3.8**	**3.4**	**3.3**

**Italy-GiViTI network: only 2011 and 2012 data included because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011.*
Data source: ECDC, HAI-Net ICU 2008–2012.

In the cohort of ICUs with frequent participation, the percentage of *Enterobacteriaceae* as a total of microorganisms isolated in ICU-acquired pneumonia increased significantly from 33.3% in 2008 to 37.6% in 2012 ($p<0.001$) (Figure 5). In parallel, there was a moderate decrease in the percentage of gram-positive bacteria ($p<0.05$) and other Gram-negative bacilli ($p<0.01$), while the percentage of fungi remained stable. The increase of the percentage of *Enterobacteriaceae* was mainly due to an increase of the percentage of *Klebsiella* species (increase of 8.2% in 2008 to 9.5% in 2012, $p<0.001$) and of *E. coli* (9.3% to 10.7%, $p<0.01$). In networks specifying microorganisms at the species level, the percentage of *K. pneumoniae* within *Klebsiella* species increased from 64.8% in 2008 to 75.1% in 2012 ($p<0.05$), parallel to the increase in carbapenem-resistance in these bacteria (see chapter on antimicrobial resistance).

Figure 5. Trends of microorganism groups isolated in ICU-acquired pneumonia in a cohort of 913 ICUs with at least 3 participations from 2008–2012 (n=48 573 microorganisms)



Data source: ECDC, HAI-Net ICU 2008–2012.
Data from the Italy-GiViTI network were excluded from the trend analysis. Main Enterobacteriaceae: E. coli, Klebsiella *species.* Enterobacter *species,* Serratia *species,* Proteus *species,* Citrobacter *species,* Morganella *species; Main other Gram-negative bacilli:* P. aeruginosa, A. baumannii, S. maltophilia, Haemophilus *species,* Burkholderia *species; Main Gram-positive bacteria:* S. aureus, Enterococcus *species,* Streptococcus *species.*

Attributable mortality and length of stay

Mortality and length of stay data were available for 427 389 patients included in patient-based surveillance from 2008 to 2012 in 863 ICUs in 11 European countries. ICU-acquired pneumonia was reported in 6.0% patients. The crude (unadjusted) mortality in the ICU was 14.4% in patients without pneumonia and 32.1% in patients with pneumonia. The median length of ICU stay (unadjusted) was five days in patients without pneumonia and 25 days in patients with pneumonia. Attributable in-hospital mortality and excess length of ICU stay in patients with pneumonia was analysed using a retrospective matched cohort analysis with 1:1 propensity score matching (see methods). Patients with incomplete risk factor data were excluded because the propensity score could not be computed, leaving 347 034 patients (of which 21 389 patients with pneumonia) for analysis.

Matching was successful for 20 693 patients with pneumonia (96.7%). The main demographic characteristics and risk factors were comparable in both cohorts (Table 11). The matching variables (pneumonia propensity score and hospital) were not statistically different between both cohorts.

After matching, ICU mortality was 32.8% in patients with pneumonia and 29.3% in matched patients without pneumonia, resulting in an attributable mortality of 3.5% (95% confidence interval 2.6-4.3%; McNemar's chi-square $p<0.001$). The median length of ICU stay was 11 days in patients without and 26 days in patients with pneumonia. In patients who survived, the median length of ICU stay was 12 days and 27 days respectively. The attributable excess length of ICU stay for patients with pneumonia was calculated as the median of the differences in length of stay per matched pair and was 14 days (95% confidence interval 14-14 days; interquartile range [IQR] 6-27 days; Wilcoxon signed rank test $p<0.001$).

Table 11. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with ICU-acquired pneumonia

	Pneumonia	
	No	Yes
Number of patients	20 693	20 693
Median age	66	65
Gender (% male)	70.1	71.0
Median propensity score	184	184
Median intubation days before onset*	8	8
Median length of stay (days) before onset*	11	9
Median SAPS II score	47	46
Trauma patient (%)	15.2	16.0
Impaired immunity (%)	13.4	12.5
Admission type:		
Medical (%)	64.9	65.2
Scheduled surgical (%)	10.4	10.3
Urgent surgery (%)	24.0	24.1
ICU mortality (%)	**29.3**	**32.8**
Median length of stay (days)	**11**	**26**
Median length of stay in survivors (days)	12	27

**Length of stay and intubation days before onset of infection in patients with pneumonia*
Data source: ECDC, HAI-Net ICU 2008–2012.

In order to assess the influence of secondary BSIs on the attributable mortality of pneumonia, a second matched cohort analysis was performed for pneumonia without secondary BSI (Table A.2.1, Table A.2.2). BSI episodes with origin of pulmonary infection (code `S-PUL') and with date of onset from three days before to five days after the onset of pneumonia in the same patient were considered, leading to the exclusion of 5.2% of pneumonia. Matching was successful for 96.8% of pneumonia without secondary BSI. The crude mortality was significantly higher in patients with pneumonia with secondary BSI (43.0%) than in patients with pneumonia without secondary BSI (31.5%, $p<0.001$). After matching, ICU mortality was 32.1% in patients with pneumonia without BSI and 28.9% in matched patients without pneumonia, resulting in an attributable mortality of 3.3% (95% confidence interval 2.3-4.2%; McNemar's chi-square $p<0.001$). The attributable excess length of ICU stay for patients with pneumonia without secondary BSI was 14 days (interquartile range 6-27 days; Wilcoxon signed rank test $p<0.001$). Thus, even though a difference in crude mortality was observed, attributable mortality and excess length of stay in ICU-acquired pneumonia were not dependent on the occurrence of a secondary BSI in our analysis.

With a cumulative incidence of 6.1% in patients staying more than two days in the ICU, the total number of ICU patients that acquired at least one pneumonia in the ICU each year (in 2008–2012) was estimated at 157 014 patients, of which 5 495 (3.5%, 95% confidence interval 4 082-6 752) died as the direct consequence of the healthcare-associated pneumonia in the ICU. In addition, patients acquiring healthcare-associated pneumonia in the ICU accounted for an estimated 2.20 million extra days in ICUs every year in EU/EEA hospitals.

Bloodstream infections

Key points

- Bloodstream infection (BSI) was reported in 3.5% patients staying more than two days in the ICU from 2008–2012, accounting for an estimated total of 90 090 patients with at least one healthcare-associated bloodstream infection in EU/EEA ICUs each year, 4 505 deaths as the direct consequence of the infection and 1.26 million days of excess ICU stay in the EU/EEA.
- The origin of BSI was catheter-related in 40.3% cases (microbiologically confirmed or based on clinical evidence), secondary to another infection site in 34.1% and of unknown origin in 25.6% cases.
- The primary BSI rate decreased significantly from 2.7 to 2.2 primary bloodstream infection episodes per 1000 patient-days in 2008 and 2012 respectively, with the strongest decreases in Malta, Spain and UK-Scotland.
- Microorganisms isolated in ICU-acquired bloodstream infections showed a significant increase of the percentage of *Klebsiella* species and a significant decrease of the percentage of Gram-positive bacteria.

Incidence of bloodstream infections

BSIs (including catheter-related infections with positive blood culture reported as CRI3) were reported in 3.5% of patients staying more than two days in the ICU in 2008–2012 (Table 12). The overall BSI incidence rate was 4.1 BSI episodes per 1 000 patient-days and varied between 0.7 in Croatia to 6.6 in Czech Republic. The median BSI incidence rate by ICU (unit-based and patient-based data combined) in ICUs reporting at least 20 patients was 3.1 BSI episodes per 1 000 patient-days and varied from 1.6 per 1000 patient-days in ICUs with less than 30% intubation to 3.7 per 1000 patient-days in ICUs with at least 60% of patients with intubation (Table 13). Primary BSIs (catheter-related BSIs and BSIs of unknown origin) represented 60.8% of all BSIs (see below). The overall primary BSI incidence rate was 2.5 primary BSI episodes per 1000 patient-days and ranged from 0.7 in Croatia to 5.7 in Czech Republic (Table 12, Table 14.).

The central line-associated BSI (CLABSI) rate could be calculated for patient-based data only. The overall CLABSI rate was 3.3 CLABSI episodes per 1000 central vascular catheter (CVC) days, lowest in Luxembourg and highest in the SPIN-UTI network in Italy. The median CLABSI rate by ICU varied between 0.0 in Lithuania (where in 69.8% of the ICU years no CLABSI was reported) and 3.3 in Slovakia. In patient-based data, the CLABSI rate by country and year was strongly correlated with the primary BSI incidence density rate (Spearman correlation coefficient 0.95), therefore trend analysis is given for the primary BSI incidence rate in order not to exclude countries and ICUs performing light surveillance.

Table 12. Cumulative incidence, incidence density and device-associated bloodstream infection rate by country/network, patient-based and unit-based surveillance combined, 2008–2012

Country/network	No. of patients with BSI (a)	Cumulative incidence of BSIs (%)	No. of BSI episodes	No. of BSI episodes per 1000 patient-days	No. of primary BSI episodes per 1000 patient-days (b)	No. of CLABSI episodes (c)	No. CLABSIs/1000 CVC days (d)	
							Mean (e)	Median (IQR) (f)
Austria	1 070	3.9	1265	4.5	2.4	685	2.7	1.3 (0.0-3.7)
Belgium	647	2.4	708	3.3	2.2	385	2.8	2.2 (0.9-3.7)
Croatia	3	0.5	3	0.7	0.7	3		
Czech Republic	156	6.9	175	6.6	5.7	149		
Estonia	90	3.9	100	3.9	2.2	57	3.0	2.6 (1.3-3.8)
France	5 072	3.8	5 747	3.7	2.1	3 064	3.0	2.3 (0.9-4.3)
Italy-GiViTI	2 076	4.0	2 273	4.3	2.5	1 302	3.0	1.9 (0.8-3.9)
Italy-SPIN-UTI	278	4.7	333	5.9	5.0	271	6.3	1.5 (0.0-8.8)
Lithuania	251	2.2	264	2.8	2.3	215	3.4	0.0 (0.0-2.3)
Luxembourg	203	1.5	220	1.7	1.2	148	2.1	1.9 (0.8-2.8)
Malta	117	3.8	123	4.8	3.3	12		
Portugal	880	5.0	1 029	4.9	2.8	584	3.3	2.4 (1.2-4.4)
Romania	151	1.5	151	2.2	1.6	104		
Slovakia	70	4.5	70	4.8	4.1	58	5.2	3.3 (0.0-8.2)
Spain	4 453	3.5	5 284	4.9	2.9	3 026	3.8	2.8 (0.9-4.9)
UK-Scotland	484	2.3	516	3.0	3.0	469	4.2	4.4 (3.5-5.3)
EU/EEA	**16 001**	**3.5**	**18 261**	**4.1**	**2.5**	**10 532**	**3.3**	**2.2 (0.5-4.5)**

Data source: ECDC, HAI-Net ICU 2008–2012.
(a) Number of patients with at least one bloodstream infection (BSI), reported as BSI and/or as catheter-related infection with positive blood culture (CRI3); (b) Primary bloodstream infections: catheter-related BSIs + BSIs of unknown origin, excluding BSIs secondary to other infection sites; (c) CLABSI: central line-associated bloodstream infection, primary BSI with CVC use within 48 hours or two days before onset; (d) No. CLABSIs: Number of CLABSI episodes; CVC: central vascular catheter; CLABSI rate was only calculated for patient-based data; (e) Mean=overall mean by country; (f) Median: median of rates by ICU, excluding ICUs with less than 20 reported patients; IQR: interquartile range of rates by ICU: 25th percentile – 75th percentile.

Table 13. Percentile distribution of the incidence rate of ICU-acquired bloodstream infections, by percentage of patients with intubation in the ICU, 2008–2012

Percentage patients with intubation	Number of ICU years	Number of patient-days	No. of BSI episodes (N BSIs)	No. BSIs/ 1000 patient-days	Mean of ICU means	P10	P25	P50	P75	P90
<30%	380	472 137	1 189	2.5	2.4	0.0	0.0	1.6	3.7	5.9
30-59%	908	1 312 318	4 724	3.6	3.6	0.0	1.3	2.9	5.0	7.4
>=60%	1 343	2 551523	9 732	3.8	4.5	0.7	1.9	3.7	6.0	9.3
All ICUs	2 631	4 335 978	15 645	3.6	3.9	0.0	1.4	3.1	5.4	8.2

Data source: ECDC, HAI-Net ICU 2008–2012.

Percentage of patients with intubation: used as indicator of ICU case-mix severity for stratification; BSI: bloodstream infection; BSIs: BSI episodes; P=percentile; Incidence rate of bloodstream infections: number of BSI episodes × 1000 / number of patient-days (incidence density)

The overall primary BSI incidence rate decreased from 2.7 to 2.3 primary BSI episodes per 1 000 patient-days in 2008 and 2012, respectively and from 2.7 to 2.2 in the cohort of 528 ICUs with regular participation (p for trend = 0.001). Significantly decreasing trends of the primary BSI incidence rate were observed in Belgium, Malta, Portugal, Spain and UK-Scotland, while in Estonia a moderate increase occurred (Table 14.). The median of the primary BSI incidence rate by ICU decreased from 1.8 to 1.5 primary BSI episodes per 1 000 patient-days. In patient-based data, the overall central line-associated BSI rate largely followed the same trends as the primary BSI incidence rate and decreased from 3.6 CLABSI episodes per 1 000 CVC days in 2008 to 3.0 in 2012 (p for trend = 0.001) and the median CLABSI rate by ICU decreased from 2.4 CLABSI episodes per 1 000 CVC days in 2008 to 2.0 in 2012 (p for trend by quantile regression <0.05). The overall incidence rate of secondary bloodstream infections remained stable during the period and was 1.7 secondary BSI episodes per 1 000 patient-days in 2008 and 1.6 secondary BSI episodes per 1 000 patient-days in 2009, 2010, 2011 and 2012. No significant trend was observed for secondary BSIs in any of the participating networks.

Table 14. Trends of the annual incidence rate of primary bloodstream infections (per 1 000 patient-days) in ICUs reporting at least 20 patients per country/network, 2008–2012

Country - Network	2008	2009	2010	2011	2012	2008–2012	Trends, 2008–2012	Average annual change 2008–2012	p for trend
Czech Republic				5.8	5.2	5.7		-	n.a.
Italy-SPIN-UTI	5.1	3.6	5.6	6.1	5.5	5.2		0.34	n.s.
Slovakia	5.3	5.6	4.9	2.8	2.8	4.1		-0.83	n.s.
Malta		6.7	3.9	2.3	0.6	3.3		-2.00	<0.001
UK-Scotland	5.2	4.3	3.4	2.6	1.9	3.0		-0.81	<0.001
Spain	3.8	3.3	2.5	2.7	2.5	2.9		-0.33	<0.001
Portugal	2.8	3.9	3.0	2.6	2.0	2.8		-0.28	<0.01
Italy-GiViTI			2.8	2.2	2.5	2.5		-0.14	n.s.
EU/EEA	**2.7**	**2.7**	**2.5**	**2.5**	**2.2**	**2.5**		**-0.12**	**<0.01**
Austria	2.5	2.2	2.9	2.4	2.2	2.4		-0.06	n.s.
Lithuania	1.7	3.7	2.7	1.6	2.0	2.4		-0.16	n.s.
Belgium	3.1	2.2	2.3	1.9	1.4	2.2		-0.37	<0.01
Estonia	0.8	0.6	4.1	3.3	1.6	2.2		0.44	<0.05
France	2.1	2.2	2.0	2.3	2.2	2.1		0.02	n.s.
Romania				0.6	1.8	1.6		-	n.a.
Luxembourg	1.3	1.2	1.3	1.1	1.1	1.2		-0.04	n.s.
Croatia	0.7					0.7		-	n.a.

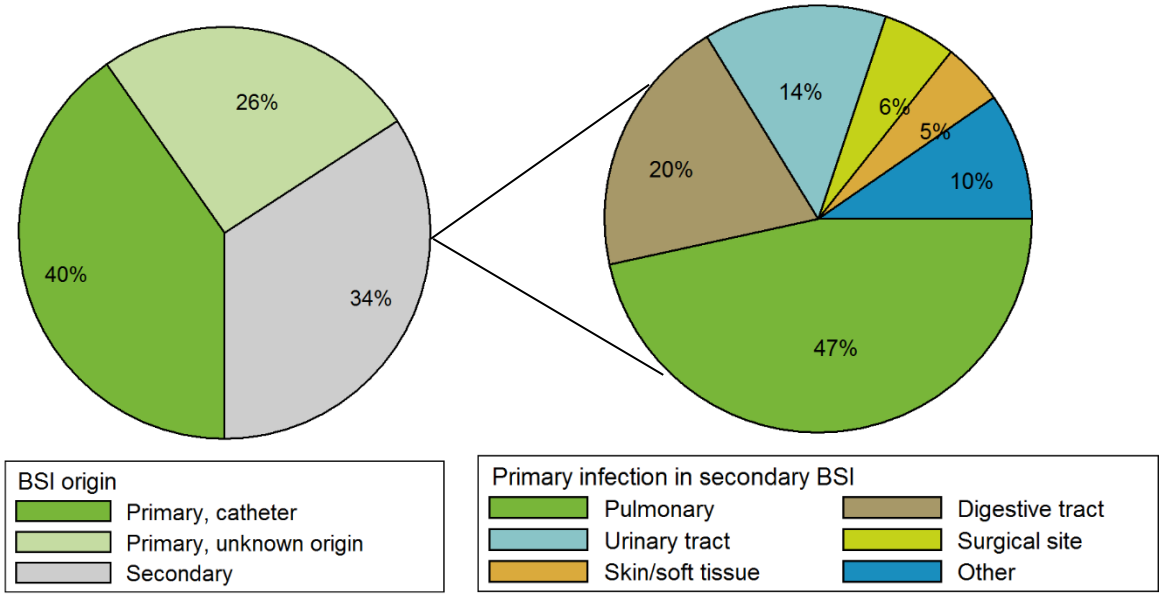
Data source: ECDC, HAI-Net ICU 2008–2012.

Incidence rate of primary bloodstream infections: number of primary BSI episodes × 1000 / number of patient-days (incidence density); only ICUs reporting at least 20 patients included (n=879 ICUs, 2668 ICU years); Trend analysis (p for trend): only including ICUs participating at least 3 years from 2008–2012 (cohort, n=526 ICUs, 2173 ICU years); n.s. not significant; n.a. not applicable; UK-Scotland: individual ICU codes not provided, p value given for all ICUs combined; UK-Scotland: origin of BSI not provided (except if reported as CRI3), therefore all BSIs were included as primary BSI (unknown origin); Malta: origin of BSI not provided in 2009.

Characteristics of bloodstream infections

Overall, 40.3% of the bloodstream infections were reported as catheter-related (microbiologically confirmed or based on clinical evidence), 34.1% were secondary to another infection site and 25.6% cases were of unknown origin (of which 71.9% of clinically verified unknown origin and 28.1% with missing data). For cases where the bloodstream infection was secondary, the primary infection site was pulmonary in 46.6% cases, the gastrointestinal tract in 19.7% cases, the urinary tract in 13.9% cases, a surgical site in 5.6% cases, skin and soft tissue in 4.7% cases and other or unknown site in 9.6% cases (Figure 6).

Figure 6. Origin of ICU-acquired bloodstream infections, 2008–2012 (n=26 306 bloodstream infections)



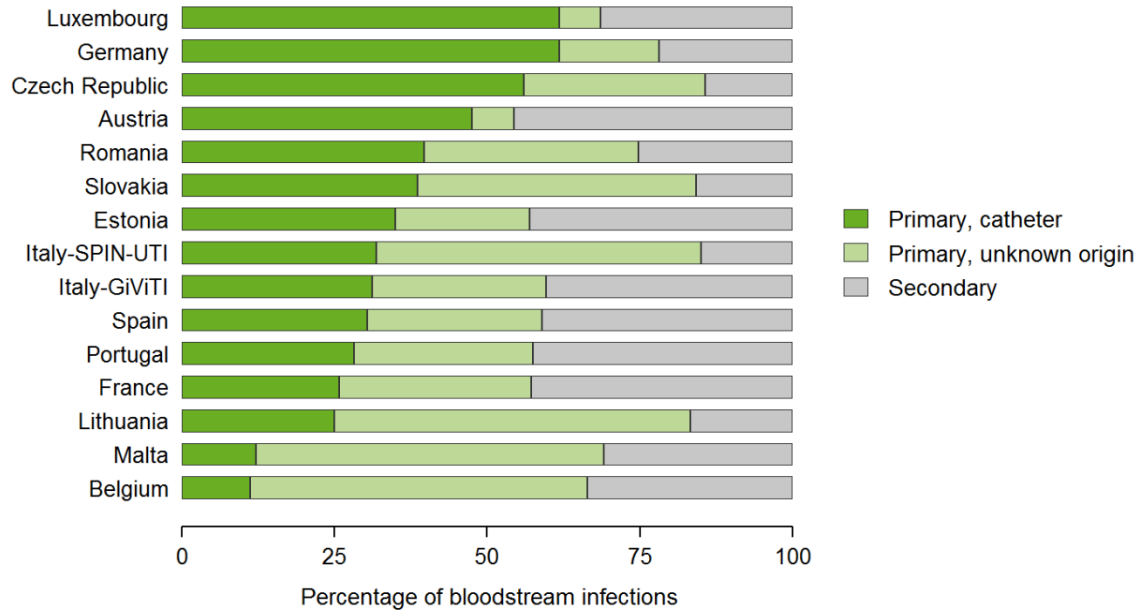
Data source: ECDC, HAI-Net ICU 2008–2012.

The large majority (97.1%) of catheter-related BSIs were related to a central venous catheter. Arterial catheters were reported as the origin of BSI in 2.1% of catheter-related BSIs and only 0.9% of catheter-related BSIs was related to a peripheral catheter.

There were large variations in the distribution of the origin of BSIs by country/network. The percentage of secondary BSIs varied between 14.3% in Czech Republic and 45.6% in Austria (Table 7). Within primary BSIs (catheter-related BSIs and BSIs of unknown origin), the percentage of catheter-related bloodstream infections ranged from 16.8% in Belgium to 90.1% in Luxembourg (Figure 7). Microbiologically-confirmed catheter-related infections (CRI3, optional in protocol) were reported separately by Czech Republic, Estonia, France, Italy, Lithuania, Romania, Slovakia and UK-Scotland, and were categorised as catheter-related BSI. Central line-associated bloodstream infections (primary BSI with CVC use within 48 hours or two days before onset) represented 62.7% of all bloodstream infections and 95.2% of primary BSIs. The percentage of microbiologically-confirmed catheter-related BSIs (CRI3) among all catheter-related BSIs varied from 7.7% in Slovakia to 100% in Czech Republic.

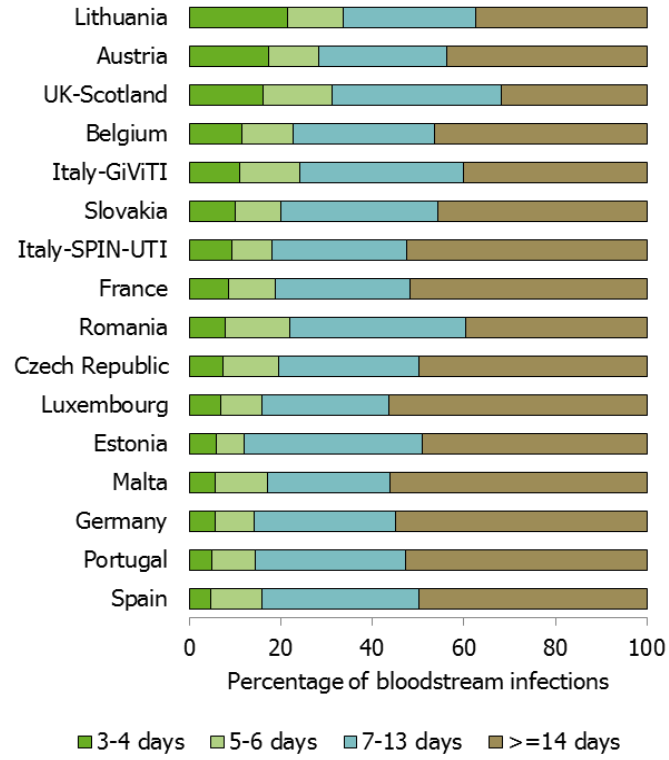
The median time from ICU admission to onset of BSI was 14 days, slightly longer for catheter-related BSI (15 days) than for secondary BSI (13 days) or BSI of unknown origin (13 days). The median was lowest in UK-Scotland (nine days) and highest in Luxembourg (16.5 days). The percentage of early onset ICU-acquired BSI (onset on day three or four) was 7.7% overall and varied from 4.7% in Spain to 21.6% in Lithuania (Figure 8).

Figure 7. Origin of bloodstream infections by country/network, 2008–2012 (n=26 058 bloodstream infections)



Data source: ECDC, HAI-Net ICU 2008–2012. UK-Scotland was excluded because origin of BSI was not provided: 13.5% of BSIs in UK-Scotland was reported as microbiologically confirmed catheter-related BSI (CRI3), the origin for other BSIs was missing and was categorised as unknown origin for incidence analysis; Croatia and UK-Wales were excluded because of small number of BSIs (n<10); Malta: high percentage of unknown origin due to missing BSI origin data in 2009. Primary BSI=catheter-related BSI + BSI of unknown origin.

Figure 8. Time from ICU admission to onset of bloodstream infection by country/network, 2008–2012 (n=26 058 BSI episodes)



Data source: ECDC, HAI-Net ICU 2008–2012. Croatia and UK-Wales excluded because of small number of BSIs (<10).

Microorganisms

The most frequently isolated microorganisms in ICU-acquired bloodstream infections were coagulase-negative staphylococci (25.6%), with a more than tenfold difference between 3.6% in Malta and 43.6% in Austria (Table 15). *Enterococcus* spp. represented 12.6% of the total and *Staphylococcus aureus* 10.9%, again with large variations between countries. *Klebsiella* species was the second most frequently isolated organism in Slovakia (23.8%) and also represented more than 10% of isolates in Czech Republic, Estonia, Italy, Lithuania, Luxembourg and Romania. *Acinetobacter* species was more frequently reported (>5%) in Estonia, Italy, Lithuania, Portugal, Romania, Slovakia and Spain. The percentage of *Candida* species varied between 0% in Romania and Slovakia to 14.4% in Luxembourg, with the largest percentage for *Candida* species other than *C. albicans* in Belgium (Table A.1.6).

Table 15. Relative frequency (%) of the ten most frequently isolated microorganisms in ICU-acquired bloodstream infections by country/network, 2008–2012 (n=27 805 isolates)

Country-network	Number of isolates	Coagulase-negative staphylococci	*Enterococcus* species	*Staphylococcus aureus*	*Candida* species	*Pseudomonas aeruginosa*	*Klebsiella* species	*Escherichia coli*	*Enterobacter* species	*Acinetobacter* species	*Serratia* species
Austria	1 425	43.6	10.5	5.8	11.6	5.5	4.1	3.7	2.8	0.6	1.3
Belgium	746	18.5	14.1	6.8	10.6	9.1	9.1	9.8	7.4	0.9	3.9
Czech Republic	211	39.3	12.8	6.2	11.4	3.3	11.8	5.2	2.4	1.9	2.4
Estonia	108	20.4	15.7	4.6	11.1	9.3	11.1	2.8	8.3	6.5	2.8
France	6 309	21.2	8.4	12.7	8.1	10.0	6.4	9.8	7.9	1.2	1.8
Germany	8 853	28.1	17.7	14.5	7.9	4.1	5.5	6.5	3.9	1.0	1.9
Italy-GiViTI	1 938	15.3	8.6	10.5	6.2	11.0	16.5	6.1	5.0	10.3	3.1
Italy-SPIN-UTI	318	29.9	11.9	4.4	8.8	9.1	11.0	3.8	2.2	12.6	1.3
Lithuania	255	29.8	9.0	7.1	2.0	5.5	10.2	5.1	5.1	11.4	2.7
Luxembourg	229	15.3	17.5	6.6	14.4	8.7	11.8	11.8	7.4	0.0	0.9
Malta	139	3.6	16.5	10.8	6.5	29.5	9.4	1.4	7.2	0.7	2.9
Portugal	1 111	18.5	10.0	13.2	8.0	11.7	9.5	5.5	6.8	5.7	3.6
Romania	135	9.6	5.9	26.7	0.0	9.6	17.8	5.9	2.2	16.3	2.2
Slovakia	84	19.0	7.1	3.6	0.0	23.8	23.8	6.0	3.6	7.1	0.0
Spain	5 453	28.9	11.7	5.0	8.7	10.0	8.3	6.3	5.2	5.6	2.5
UK-Scotland	491	22.0	11.2	15.5	7.7	3.3	8.1	10.4	5.1	0.8	3.7
EU/EEA	**27 805**	**25.6**	**12.6**	**10.9**	**8.2**	**7.9**	**7.6**	**7.1**	**5.3**	**3.1**	**2.2**

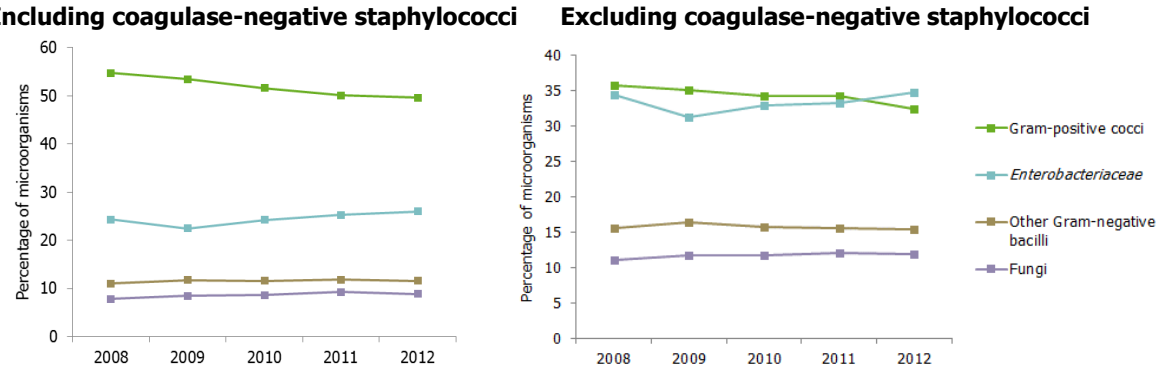
*Data source: ECDC, HAI-Net ICU 2008–2012. *Italy-GiViTI network: only 2011 and 2012 data included because* Candida *spp.,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011.*

Variations of the distribution of microorganisms by day of onset of BSI were similar as in pneumonia, but with an increase of the percentage of *Klebsiella* species in late-onset BSI in addition to the increase of the percentage of non-fermenting Gram-negative bacteria and *Enterococcus* spp. (Table A.1.4).

The distribution of microorganisms varied strongly according to the origin of the BSIs (**Error! Reference source not found.**). Gram-positive cocci represented 61.1% microorganisms in catheter-related BSIs, 55.7% in primary BSIs of unknown origin and 34.0% in secondary BSIs. Gram-negative bacteria were more prevalent in secondary BSIs, with 34.2% *Enterobacteriaceae* and 19.4% other Gram-negative bacilli (mainly *P. aeruginosa* and *Acinetobacter* spp.) compared to 18.2% and 7.9%, respectively in catheter-related BSIs and 24.0% and 10.2%, respectively in BSIs of unknown origin.

In the cohort of ICUs with frequent participation, the percentage of Gram-positive bacteria as a total of microorganisms isolated in ICU-acquired BSIs decreased significantly from 54.7% in 2008 to 49.6% in 2012 ($p<0.001$) (**Error! Reference source not found.**). A significant decrease was observed both for coagulase-negative staphylococci ($p<0.001$) and other Gram-positive bacteria ($p<0.05$). In parallel, there was an increase in the percentage of *Enterobacteriaceae* ($p<0.05$), which was mainly due to an increase of the percentage of *Klebsiella* species (increase of 6.6% in 2008 to 7.4% in 2012, $p<0.05$). There was no significant increase of the relative frequency of *E. coli*, nor of that of other microorganisms.

Figure 9. Trends of microorganism groups isolated in ICU-acquired bloodstream infections in a cohort of 898 ICUs with at least 3 participations from 2008–2012, including (left, n=22 324 microorganisms) and excluding (right, n=16 374 microorganisms) coagulase-negative staphylococci



Data source: ECDC, HAI-Net ICU 2008–2012.

Attributable mortality and length of stay

Out of 427 389 patients included in patient-based surveillance from 2008 to 2012, 15 145 (3.5%) acquired at least one ICU-acquired bloodstream infection during their stay. The crude (unadjusted) mortality in the ICU was 14.7% in patients without BSI and 34.0% in patients with BSI. The median length of ICU stay (unadjusted) was five days in patients without BSI and 26 days in patients with BSI.

Attributable in-hospital mortality and excess length of ICU stay in patients with BSI was analysed using a retrospective matched cohort analysis with 1:1 propensity score matching (see Methods). Patients with incomplete risk factor data were excluded, leaving 345 680 patients (of whom 12 650 patients with BSI) for analysis. Matching was successful for 12 295 out of 12 650 patients with bloodstream infection (97.2%). The main demographic characteristics and risk factors were comparable in both cohorts (**Error! Reference source not found.**). The matching variables, BSI propensity score and hospital, were not statistically different between both cohorts.

Table 16. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with ICU-acquired bloodstream infection

	Bloodstream infection	
	No	Yes
Number of patients	12 295	12 295
Median age (years)	66	65
Gender (% male)	67.9	68.3
Median propensity score	158	158
Median CVC days before onset*	12	11
Median intubation days before onset*	10	10
Median length of stay (days) before onset*	14	13
Median SAPS II score	45	46
Trauma patient (%)	13.2	13.1
Impaired immunity (%)	14.0	14.0
Admission type:		
Medical (%)	64.2	63.6
Scheduled surgery (%)	10.5	11.1
Urgent surgery (%)	24.3	24.7
ICU mortality	**29.6**	**34.6**
Median length of stay (days)	**14**	**27**
Median length of stay in survivors (days)	14	27.5

*Data source: ECDC, HAI-Net ICU 2008–2012. *Length of stay, central vascular catheter days and intubation days before onset of infection in patients with bloodstream infection*

ICU mortality was 34.6% in patients with BSI and 29.6% in matched patients without BSI. The attributable mortality was 5.0% (95% confidence interval 3.9-6.2%; McNemar's chi-square p<0.001). The median length of ICU stay was 14 days in patients without and 27 days in patients with BSI. In patients who survived, the median length of ICU stay was also 14 days and 27 days, respectively. The attributable excess length of ICU stay for patients with BSI was calculated as the median of the differences in length of stay per matched pair and was 14 days (95% confidence interval 13-14 days; interquartile range 6-28 days; Wilcoxon signed rank test p<0.001).

Attributable mortality varied according to the origin of the BSI (Table 17, Table A.2.1, Table A.2.3-Table A.2.13). Attributable mortality in primary bloodstream infections was 2.1% (95% confidence interval 0.7-3.6%), higher in primary BSI of unknown origin (4.7%) and non-significant in microbiologically confirmed or clinically ascertained catheter-related BSIs. In central line-associated BSIs (primary BSI with CVC use within 48 hours before onset), attributable mortality was estimated at 2.3% (95% confidence interval 0.7-3.6%). In secondary BSIs, the excess mortality was 8.7% (95% confidence interval 6.8-10.5%), with the highest values in BSIs secondary to surgical site infections (14.5%), digestive tract infections (12.3%) and pulmonary infections (10.0%).

Table 17. Overview of results of matched cohort analyses for the assessment of attributable mortality in patients with ICU-acquired bloodstream infection, by BSI origin, HAI-Net ICU 2008–2012

ICU-acquired infection type	Number of matched cases	Mortality (%)					
		Before matching		Matched		Attributable mortality (95% CI)	p-value (1)
		non-cases	cases	non-cases	cases		
Bloodstream infection, all	**12295**	**14.6**	**34.8**	**29.6**	**34.6**	**5.0 (3.9-6.2)**	**<0.001**
Primary BSI	**7298**	**14.6**	**32.1**	**29.9**	**32.0**	**2.1 (0.7-3.6)**	**<0.01**
Catheter-related BSI	3668	14.6	29.0	29.9	29.0	-0.9 (-3.0-1.2)	NS
BSI of unknown origin	3642	14.6	35.3	30.5	35.2	4.7 (2.5-6.8)	<0.001
Central line associated BSI (CLABSI)	6831	14.6	32.7	30.4	32.7	2.3 (0.7-3.8)	<0.01
Secondary BSI	**5063**	**14.6**	**38.6**	**30.0**	**38.6**	**8.7 (6.8-10.5)**	**<0.001**
Secondary to pulmonary infection	2019	14.6	41.1	31.1	41.1	10.0 (7.1-13.0)	<0.001
Secondary to digestive tract infection	1404	14.6	42.5	30.3	42.6	12.3 (8.8-15.9)	<0.001
Secondary to urinary tract infection	643	14.7	30.3	27.5	30.2	2.6 (-2.2-7.5)	NS
Secondary to surgical site infection	379	14.7	37.0	22.2	36.7	14.5 (8.1-21.0)	<0.001
Secondary to skin/soft tissue infection	313	14.7	33.4	25.6	33.5	8.0 (0.6-15.4)	<0.05
Secondary to other/unknown infection	592	14.7	31.7	28.9	31.6	2.7 (-2.4-7.8)	NS

Data source: ECDC, HAI-Net ICU 2008–2012. Total (1): Number of patients after exclusion of patients with missing risk factors. For less frequent secondary BSI subtypes, one missing risk factor out of four (SAPS II score, impaired immunity, trauma and antimicrobial treatment on admission) was allowed to increase sample size. N cases, %: number and percentage of patients with at least one BSI. N matched: number of cases for which 1:1 propensity score matching with a non-case was successful. P-value (2): McNemar chi square p-value. Primary BSIs: sum of BSIs for which the origin was reported to be catheter-related and BSIs for which the origin was unknown. Central line-associated BSI (CLABSI): primary BSI with central vascular catheter use within 48 hours or two days before BSI onset.

Length of stay was significantly higher in all subcategories of BSI, varying between 12 days (IQR [5-25]) in catheter-related BSIs to 18 days (IQR [8-28] in BSIs secondary to surgical site infections (Table A.2.1).

With a cumulative BSI incidence of 3.5% in patients staying more than two days in European ICUs, the total number of ICU patients that acquired at least one BSI in the ICU each year in 2008–2012 was estimated at 90 090 patients, of which 4 505 (5.0%, 95% confidence interval 3 514-5 586) died as the direct consequence of the healthcare-associated BSI in the ICU. Finally, patients acquiring healthcare-associated BSIs in the ICU accounted for an estimated 1.26 million extra days of ICU stay every year in EU/EEA hospitals in 2008–2012.

Urinary tract infections

Key points

- Urinary tract infection (UTI) was reported in 3.2% patients staying more than two days in an ICU in 2008–2012, accounting for an estimated total of 82 368 patients with at least one healthcare-associated urinary tract infection in EU/EEA ICUs each year. Patients with urinary tract infections did not have a higher mortality in matched cohort analysis, but 1.06 million days of excess ICU stay were estimated to occur each year in the EU/EEA as the consequence of ICU-acquired urinary tract infections.
- The UTI rate decreased significantly from 4.1 to 3.4 urinary tract infection episodes per 1 000 patient-days in 2008 and 2012 respectively, with the strongest decreases in France. The catheter-associated urinary tract infection rate decreased from 4.9 per 1 000 urinary catheter days in 2008 to 4.1 per 1 000 urinary catheter days in 2012.
- The distribution of microorganisms isolated in ICU-acquired urinary tract infections remained stable during the period 2008–2012.

Incidence of urinary tract infections

Urinary tract infections s are an optional infection type in HAI-Net ICU surveillance and were only reported by 14 surveillance networks in 13 countries (with comparable denominator data in all countries except Germany). In 12 197 (3.2%) out of 380 451 patients staying more than two days in the ICU from 2008-2012, at least one UTI was reported (Table 18). A total of 13 713 UTI episodes was reported in 12 197 patients with UTI, or an average of 1.12 UTIs per infected patient. The overall UTI incidence rate was 3.6 UTI episodes per 1 000 patient-days and varied between 0.7 in Croatia to 9.0 in Slovakia. The median UTI incidence rate by ICU (unit-based and patient-based data combined) in ICUs reporting at least 20 patients was 2.5 UTI episodes per 1 000 patient-days and varied from 1.3 per 1 000 patient-days in ICUs with less than 30% intubation to 2.8 per 1 000 patient-days in ICUs with at least 60% of patients with intubation (Table 19).

Table 18. Cumulative incidence, incidence density and device-associated urinary tract infection rate by country/network, patient-based and unit-based surveillance combined, 2008–2012

Country – network	No. of patients with UTI (a)	Cumulative incidence of UTIs (%)	No. of UTI episodes	No. of UTI episodes per 1 000 patient-days	No. of CAUTI episodes (b)	No. CAUTIs/1 000 UC days (c)	
						Mean (d)	Median (IQR) (e)
Austria	1 484	5.4	1 985	7.0	1968	8.4	5.3 (1.1-13.0)
Belgium	220	1.7	233	2.1	202	2.2	1.2 (0.0-2.7)
Croatia	3	0.5	3	0.7	3	-	-
Estonia	68	2.9	71	2.8	69	2.7	1.8 (1.3-2.1)
France	5349	4.0	5877	3.8	5598	4.5	3.6 (1.7-6.4)
Italy-GiViTI	616	3.6	616	3.4	-	-	-
Italy-SPIN-UTI	154	2.6	168	3.0	167	4.2	1.6 (0.0-4.8)
Lithuania	230	2.0	236	2.5	232	3.2	0.0 (0.0-2.3)
Luxembourg	212	1.6	221	1.7	214	2.4	1.8 (0.4-3.1)
Portugal	315	1.8	345	1.7	345	1.8	1.3 (0.0-2.8)
Romania	123	1.3	123	1.8	105	-	-
Slovakia	127	8.2	131	9.0	130	9.8	4.4 (0.0-14.3)
Spain	3296	2.6	3704	3.4	3 555	4.1	3.2 (1.4-5.5)
EU/EEA	**12 197**	**3.2**	**13 713**	**3.6**	**12 588**	**4.5**	**3.0 (1.0-5.8)**

Data source: ECDC, HAI-Net ICU 2008–2012.

(a) Number of patients with at least one urinary tract infection (UTI); (c) CAUTI: catheter-associated UTI; (c) N CAUTIs: Number of CAUTI episodes; UC: urinary catheter; CAUTI rate was only calculated for patient-based data; (d) Mean=overall mean by country; (e) Median: median of ICU means, excluding ICUs with less than 20 reported patients; IQR: interquartile rage: 25th percentile – 75th percentile.

Table 19. Percentile distribution of the incidence rate of ICU-acquired urinary tract infections, by percentage of patients with intubation in the ICU, 2008–2012

Percentage patients with intubation	Number of ICU years	Number of patient-days	N of UTI episodes (N UTIs)	N UTIs/ 1000 patient-days	Mean of ICU means	P10	P25	P50	P75	P90
<30%	354	431 592	949	2.2	2.0	0.0	0.0	1.3	3.0	5.0
30-59%	849	1 197 112	4 093	3.4	3.2	0.0	1.0	2.6	4.6	7.2
>=60%	1 192	2 086 943	8 496	4.1	4.0	0.0	1.1	2.8	5.6	9.1
All ICUs	2 395	3 715 647	13 538	3.6	3.5	0.0	0.8	2.5	4.8	7.9

Data source: ECDC, HAI-Net ICU 2008–2012.

Percentage of patients with intubation: used as indicator of ICU case-mix severity for stratification; UTI: urinary tract infection; UTIs: UTI episodes; P=percentile; Incidence rate of urinary tract infections: number of UTI episodes × 1000 / number of patient-days (incidence density)

The large majority of UTIs (96.1%) were associated with the use of a urinary catheter. The overall device-adjusted UTI rate in patient-based data was 4.5 catheter-associated UTI episodes (CAUTIs) per 1 000 urinary catheter (UC) days, varying between 1.8 CAUTIs per 1 000 UC days in Portugal to 9.8 CAUTIs per 1 000 UC days in Slovakia. The median CAUTI rate by ICU in ICUs reporting at least 20 patients was 3.0 CAUTIs per 1 000 UC days. In 25% of ICUs the rate was lower than 1.0, in 25% it was higher than 5.8 CAUTIs per 1 000 UC days. In patient-based data, the CAUTI rate by country and year was strongly correlated with the UTI incidence rate per 1 000 patient-days (Spearman correlation coefficient 0.98), therefore trend analysis is given for the UTI incidence rate in order not to exclude countries and ICUs performing light surveillance.

The overall UTI incidence rate decreased from 4.1 to 3.4 UTI episodes per 1 000 patient-days in 2008 and 2012 respectively and from 4.1 to 3.5 in the cohort of 456 ICUs with regular participation (p for trend = 0.001). A significant decreasing trend of the UTI incidence rate was observed in France, while in Luxembourg a significant increase was observed (Table 20). In the Italian SPIN-UTI network, the median of the UTI incidence rate by ICU decreased significantly (p<0.05), but not the overall average. The decrease of the UTI rate in Slovakia was statistically significant when all ICUs were included in the trend analysis, but not if only cohort ICUs were included, suggesting that differences in participating ICUs from one year to another account for the observed trends in this country. In patient-based data, the overall catheter-associated UTI rate decreased from 4.9 CAUTI episodes per 1 000 urinary catheter days in 2008 to 4.1 in 2012 (p for trend <0.001).

Table 20. Trends of the annual crude incidence rate of urinary tract infections (per 1 000 patient-days) in ICUs reporting at least 20 patients per country/network, 2008–2012

Country - Network	2008	2009	2010	2011	2012	2008–2012	Trends, 2008–2012	Average annual change 2008–2012	p for trend
Slovakia	14.3	12.6	7.1	6.7	6.8	9.0		-2.22	n.s. (a)
Austria	7.3	7.7	6.8	7.4	5.9	7.0		-0.31	n.s.
France	4.6	4.4	3.5	3.4	3.4	3.8		-0.33	<0.001
EU/EEA	**4.1**	**4.0**	**3.5**	**3.4**	**3.4**	**3.6**		**-0.20**	**<0.01**
Spain	3.6	3.6	3.2	3.3	3.5	3.4		-0.04	n.s.
Italy-GiViTI			3.4			3.4		-	n.a.
Italy-SPIN-UTI	3.3	4.2	2.5	1.9	3.1	3.0		-0.20	n.s. (b)
Estonia	8.4	1.8	14.5	3.3	1.5	2.8		-1.22	n.s.
Lithuania	1.5	2.0	2.9	2.4	3.5	2.5		0.43	n.s. (a)
Belgium	2.1	1.9	2.1	2.1	2.2	2.1		0.05	n.s.
Romania				0.7	2.0	1.8		-	n.a.
Luxembourg	1.0	1.3	0.9	2.1	3.1	1.7		0.51	<0.01
Portugal	0.9	2.0	2.2	1.8	1.4	1.7		0.08	n.s.
Croatia	0.7					0.7		-	n.a.

Data source: ECDC, HAI-Net ICU 2008–2012.

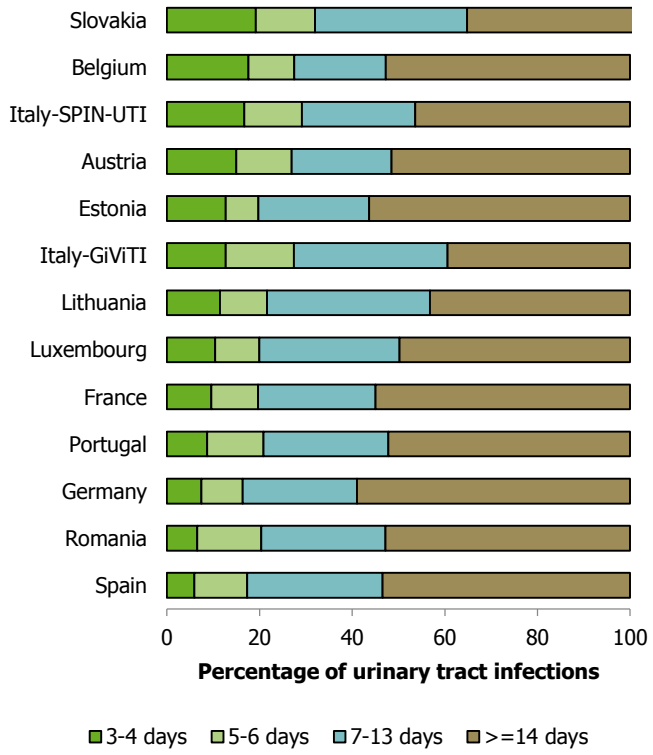
Incidence rate of urinary tract infections: number of UTI episodes × 1 000 / number of patient-days (incidence density); only ICUs reporting at least 20 patients included (n=826 ICUs, 2 480 ICU years); Trend analysis (p for trend): only including ICUs participating at least 3 years from 2008–2012 (cohort, n=455 ICUs, 1 984 ICU years); n.s. not significant; n.a. not applicable; (a) significant trend if all ICUs are included, but not for cohort ICUs only; (b) IT-SPIN-UTI network: significant decreasing trend of median UTI rate.

Characteristics of urinary tract infections

ICU-acquired urinary tract infections (UTIs) were microbiologically confirmed (case definition UTI-A) in 94.8% of cases and diagnosed based on other criteria (case definition UTI-B) in 5.2% of cases.

The median time from ICU admission to onset of urinary tract infections was 15 days and varied from 11 days in the two Italian networks, Lithuania and Slovakia to 16 days in Germany. The percentage of early onset ICU-acquired UTI (onset on day 3 or 4) was 9.5% overall and varied from 5.9% in Spain to 19.2% in Slovakia (Figure 10).

Figure 10. Time from ICU admission to onset of urinary tract infection by country/network, 2008–2012 (n=16 116 UTI episodes)



Data source: ECDC, HAI-Net ICU 2008–2012. Croatia excluded because of small number of UTIs (n=3)

Microorganisms

The most frequently isolated microorganism in ICU-acquired urinary tract infections was *Escherichia coli* (26.3%), varying between 9.6% in Romania and Slovakia and 32.4% in France (Table 21). *Candida* species was the second most frequent microorganism representing 17.5% of isolates, lowest in Romania (0%) and highest in Austria (28.7%). *Enterococcus* species represented 16.2% of the total and *Pseudomonas aeruginosa* 14.0%, again with large variations between countries. *Klebsiella* species represented 7.4% of UTI isolates overall but accounted for more than 20% of isolates in Estonia, Romania and Slovakia. *Acinetobacter* species was most frequently reported in Italy, Lithuania and Romania. The most frequent family of microorganisms isolated in UTIs were *Enterobacteriaceae*, representing 45.3% of all microorganisms.

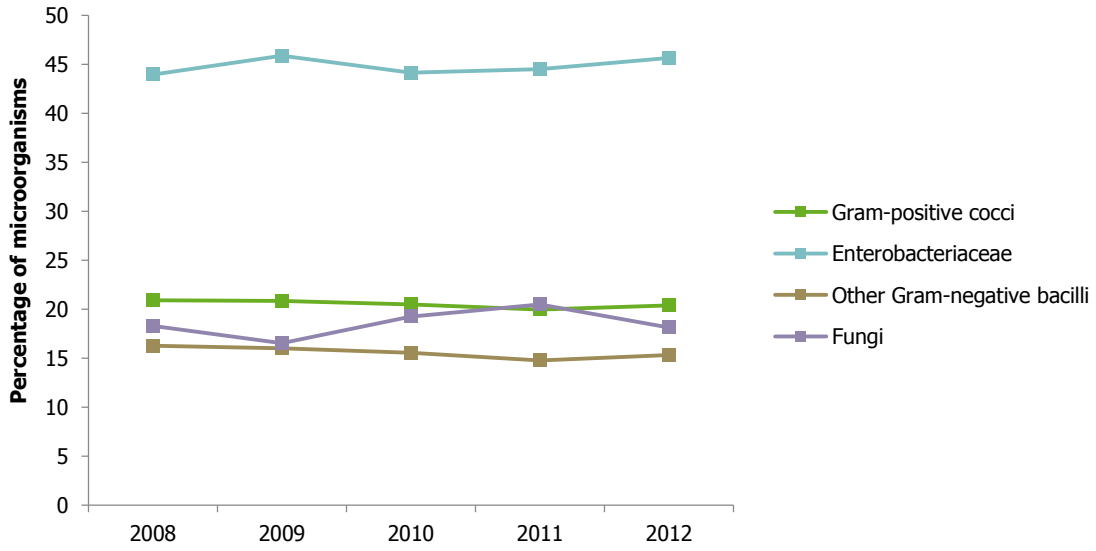
Table 21. Relative frequency (%) of the ten most frequently isolated microorganisms in ICU-acquired urinary tract infections by country/network, 2008–2012 (n=16 870 isolates)

Country - network	Number of isolates	*Escherichia coli*	*Candida* species	*Enterococcus* species	*Pseudomonas aeruginosa*	*Klebsiella* species	*Enterobacter* species	*Proteus* species	Coagulase-negative staphylococci	*Citrobacter* species	*Acinetobacter species*
Austria	2 338	15.1	28.7	19.3	14.5	5.0	3.0	2.6	6.3	0.7	0.5
Belgium	231	28.6	8.2	15.2	13.0	10.8	6.1	6.9	1.7	0.9	0.0
Estonia	70	18.6	20.0	21.4	8.6	21.4	4.3	1.4	1.4	0.0	1.4
France	6 488	32.4	13.6	12.9	14.3	6.7	5.5	3.6	2.3	2.0	0.5
Germany	2 654	27.4	9.0	23.2	14.1	8.0	5.0	4.8	1.4	1.4	0.3
Italy-SPIN-UTI	169	17.2	14.8	14.8	14.2	10.7	3.6	1.8	5.9	0.6	7.7
Lithuania	277	17.0	22.7	16.6	9.4	8.7	2.9	7.9	1.1	0.0	9.7
Luxembourg	271	26.9	8.9	25.8	15.1	8.1	5.9	2.6	1.1	1.5	0.0
Portugal	366	21.6	21.0	13.9	15.6	8.7	5.2	5.5	0.5	0.8	3.0
Romania	115	9.6	0.0	10.4	31.3	25.2	0.0	0.0	0.0	0.0	15.7
Slovakia	156	9.6	16.7	11.5	23.7	23.7	2.6	4.5	0.0	0.6	5.1
Spain	3 741	24.5	24.4	15.0	12.7	7.4	3.1	3.7	2.0	0.9	2.4
EU/EEA	**16 870**	**26.3**	**17.5**	**16.2**	**14.1**	**7.4**	**4.4**	**3.8**	**2.5**	**1.4**	**1.3**

Data source: ECDC, HAI-Net ICU 2008–2012.Croatia excluded because of small number of UTIs (n=3).

In the cohort of ICUs with regular participation, no significant trends were observed in the relative frequency of microorganism groups isolated in UTIs between 2008 and 2012 (Figure 11).

Figure 11. Trends of microorganism groups isolated in ICU-acquired urinary tract infections in a cohort of 772 ICUs with at least three participations from 2008–2012



Data source: ECDC, HAI-Net ICU 2008–2012.

Attributable mortality and length of stay

Data on UTIs were available for a total of 680 ICUs in patient-based surveillance from 2008 to 2012, including 329 286 patients, 11 123 (3.4%) of which acquired at least one ICU-acquired urinary tract infection during their stay. The crude (unadjusted) mortality in the ICU was 15.2% in patients without UTI and 24.0% in patients with UTI. The median length of ICU stay (unadjusted) was six days in patients without UTI and 26 days in patients with UTI.

Attributable in-hospital mortality and excess length of ICU stay in patients with a UTI was analysed using a retrospective matched cohort analysis with 1:1 propensity score matching (see methods). Patients with incomplete risk factor data were excluded, leaving 299 041 patients (of which 10 293 patients with UTI) for analysis (Table A.2.1).

Matching was successful for 10 098 out of 10 288 patients with urinary tract infection (98.2%). The main demographic characteristics and risk factors were comparable in both cohorts (Table 22). The matching variables, UTI propensity score and hospital, were not statistically different between both cohorts.

ICU mortality was 23.7 % in patients with a UTI and 22.9% in matched patients without a UTI. The difference of 0.8% was not statistically significant (95% confidence interval -0.3–2.0%; McNemar's chi-square p=0.156). The median length of ICU stay was 13 days in patients without and 26 days in patients with a UTI. In patients who survived, the median length of ICU stay was 12 days and 26 days, respectively. The attributable excess length of ICU stay for patients with a UTI was calculated as the median of the differences in length of stay per matched pair and was 13 days (95% confidence interval 13–13 days; interquartile range 5–28 days; Wilcoxon signed rank test p<0.001).

With a cumulative UTI incidence of 3.2% in patients staying more than two days in European ICUs, the total number of ICU patients that acquired at least one UTI in the ICU each year in 2008–2012 was estimated at 82 368 patients, none of which died as the direct consequence of the healthcare-associated UTI in the ICU. However, patients with ICU-acquired UTIs accounted for an estimated 1.07 million extra days of ICU stay every year in EU/EEA hospitals in 2008–2012.

Table 22. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with ICU-acquired urinary tract infection

	Urinary tract infection	
	No	Yes
Number of patients	10 098	10 098
Median age (years)	67	67
Gender (% male)	52.0	51.1
Median propensity score	143	143
Median urinary cath. days before onset*	12	12
Median length of stay (days) before onset*	13	13
Median SAPS II score	43	44
Trauma patient (%)	14.2	13.1
Impaired immunity (%)	11.2	11.4
Admission type:		
Medical (%)	66.6	68.1
Scheduled surgery (%)	10.1	9.8
Urgent surgery (%)	22.8	21.8
ICU mortality	**22.9**	**23.7**
Median length of stay (days)	**13**	**26**
Median length of stay in survivors (days)	12	26

Data source: ECDC, HAI-Net ICU 2008–2012.

**Length of stay and urinary catheter days before onset of infection in patients with urinary tract infection*

Antimicrobial resistance in ICU-acquired infections

Overall percentages of non-susceptible isolates in selected microorganisms associated with ICU-acquired infections in 2008–2012 were the following: 34.5% oxacillin resistance (MRSA) in *S. aureus* isolates, 3.3 % vancomycin resistance (VRE) in *Enterococcus species* isolates, 30.7% non-susceptibility to third-generation cephalosporins in *Enterobacteriaceae*, 33.5% non-susceptibility to carbapenems in *P. aeruginosa* and 78.8% in *Acinetobacter* species (Table 23). The percentage of non-susceptible isolates was often significantly higher in bloodstream infections. In the cohort of regularly participating ICUs, a significant decrease of the percentage MRSA and a significant increase of non-susceptibility to third-generation cephalosporins in *Enterobacteriaceae* was observed. The percentage of carbapenem non-susceptibility in *Acinetobacter baumannii* increased significantly until 2011 (p=0.019), but there was a moderate decrease in 2012 and the trend for 2008–2012 was not statistically significant (p=0.076).

Table 23. Markers of antimicrobial resistance in ICU-acquired infections by country/network, infection type and year, 2008–2012

	Meticillin-R *S. aureus* (MRSA)		Vancomycin-R *Enterococcus* spp.		3GC-NS *Enterobacteriaceae*		Carbapenem-NS *Pseudomonas* spp.		Carbapenem-NS *Acinetobacter* spp.	
	No. tested	% R	No. tested	% NS	No. tested	% NS	No. tested	% NS	No. tested	% NS
Country - network										
Austria	336	27.7	601	2.2	1 582	22.2	-	-	-	-
Belgium	298	23.5	154	4.5	938	35.0	494	36.2	39	2.6
Estonia	30	3.3	26	0.0	140	37.9	63	33.3	17	76.5
France	3 658	30.7	1 341	1.7	10 328	29.9	2 048	23.4	198	50.5
Italy-GiViTI	820	42.8	439	6.4	1 943	38.0	860	25.5	716	88.8
Italy-SPIN-UTI	59	54.2	79	5.1	254	58.7	125	40.0	136	89.0
Lithuania	75	17.3	7	-	28	53.6	-	-	-	-
Luxembourg	-	-	4	-	11	45.5	6	-	-	-
Malta	15	53.3	22	0.0	34	23.5	41	51.2	1	-
Portugal	444	64.4	130	19.2	592	32.3	408	41.9	204	90.2
Romania	118	78.0	7	-	64	78.1	48	58.3	106	95.3
Slovakia	10	40.0	11	0.0	160	81.3	80	67.5	26	61.5
Spain	957	31.2	1 135	2.1	3 842	28.6	1 952	42.0	875	77.6
Sweden	26	0.0	3	-	30	6.7	14	14.3	1	-
UK-Scotland	92	20.7	-	-	-	-	-	-	-	-
EU/EEA	**6 938**	**34.5**	**3 961**	**3.4**	**19 946**	**31.1**	**6 139**	**33.3**	**2 319**	**79.9**
Infection type										
Bloodstream	1 696	41.9	1 652	4.7	4 414	37.1	1 255	36.5	696	82.0
Pneumonia	5 089	31.9	616	4.4	9 828	31.8	3 982	32.7	1 471	78.8
Urinary tract	153	37.9	1 693	1.8	5 712	25.3	902	31.7	152	80.9
P-value		<0.001		<0.001		<0.001		<0.05		n.s.
Year, cohort ICUs only										
2008	995	36.3	552	2.0	2 826	24.3	533	39.6	215	66.5
2009	1 078	35.8	637	2.4	3 212	25.5	608	40.6	269	71.7
2010	1 253	33.4	749	2.5	3 559	27.7	793	38.0	387	86.0
2011	1 204	30.4	748	4.3	3 608	40.8	743	39.4	392	85.2
2012	1 035	30.2	744	2.8	3 641	36.5	677	40.6	276	79.7
P-value for trend		<0.001		n.s.		<0.001		n.s.		<0.05

Data source: ECDC, HAI-Net ICU 2008–2012. Results by country not shown if less than 10 isolates; NS: non-susceptible N=number, NS=non-susceptible, R=resistant, N tested: N of isolates with known susceptibility results, N NS=number of NS isolates (only resistant isolates for MRSA, VRE and VAN-R), %NS=N NS/N with known results, MRSA=meticillin-resistant Staphylococcus aureus*, VRE=vancomycin-resistant* Enterococcus *species, VAN=vancomycin, 3GC=Third-generation cephalosporin, CAR=carbapenem; Luxembourg (1 year AMR data) was excluded from all trend analysis; France and Austria were excluded for trend analysis of carbapenem susceptibility in* Pseudomonas *species and* Acinetobacter *species (Austria: no data available, France: data available since 2011). Carbapenem susceptibility in* Enterobacteriaceae *was added to the core antimicrobial markers in the HAI-Net ICU protocol in 2010. See Annex I (Table A.1.8 and Table A.1.9) for these markers and optional antimicrobial susceptibility results for 2008–2012.*

In countries that collected more detailed resistance data (Belgium, Estonia, Italy-SPIN-UTI network, Lithuania Malta, Portugal, Romania, Slovakia and Spain), the percentage of *Klebsiella* species isolates non-susceptible to carbapenems increased from 1.4% in 2008 to 10.0% in 2012 ($p<0.001$), mainly due to an increase of carbapenem non-susceptible *K. pneumoniae* isolates from 0.6% to 11.2% respectively ($p<0.01$). At the country level, the percentage of *Klebsiella* species as a total of all microorganisms in ICU-acquired infections was correlated with the percentage resistance of these microorganisms ($p<0.01$).

Among isolates that were tested for colistin susceptibility, colistin non-susceptibility was reported in 18.5% of *Enterobacteriaceae* (*Klebsiella* species 7.7%, *Klebsiella pneumoniae* 8.5%), 3.7% of *Acinetobacter* species, 2.4% of *P. aeruginosa* and 38.4% of *Stenotrophomonas maltophilia* isolates (Table A.1.8). Optional antimicrobial susceptibility testing results for antimicrobial agents of last resort (e.g. colistin), were often reported by fewer countries and the frequency of reporting was dependent on the susceptibility of first-line antimicrobials. Colistin susceptibility results for *Klebsiella* species were reported by all eight countries, but only two countries reported results for ten isolates or more (Italy-SPIN-UTI network and Slovakia). In addition, results were reported in 7.9% of carbapenem-susceptible *Klebsiella* species (colistin non-susceptible *Klebsiella* species 3.7%) and in 31.9% of carbapenem non-susceptible strains (colistin non-susceptible *Klebsiella* species 20.7%).

Combined antimicrobial non-susceptibility was computed for more frequently reported antimicrobial categories in Table A.1.9. After adjustment for days in the ICU before onset of infection, infection site, age, gender and country-network, combined antimicrobial non-susceptibility was significantly associated with mortality in the ICU in coagulase-negative staphylococci, *Enterococcus* species, *Enterobacteriaceae* (in particular *E. coli*, *Klebsiella* species and *Proteus* species), *Pseudomonas* species (of which 98.8% were *Pseudomonas aeruginosa*) and *Acinetobacter* species (of which 96.8% were *Acinetobacter baumannii*).

Discussion

In 2008, the ECDC HAI-Net surveillance of healthcare-associated infections in intensive care units succeeded the former HELICS/IPSE ICU surveillance that was implemented prospectively since 2004. The participation of ICUs and countries increased steadily from 2004 to 2012 and the number of participating ICUs more than doubled over this eight year period. In 2012, 16 national or regional surveillance networks from 15 EU Member States contributed data to the European surveillance. The ICU remains the epicentre of HAIs and antimicrobial resistance and while ICU patients only represent 5% of the total hospital population in EU/EEA hospitals, they accounted for 16.5% of all patients with an HAI in the ECDC point prevalence survey of healthcare-associated infections and antimicrobial use in 2011–2012 [1]. Numerous studies showed that surveillance of HAIs, in particular through participation in surveillance networks, is one of the most important local prevention measures for HAI prevention in hospitals [9]. Therefore, efforts to increase the creation of new ICU surveillance networks in EU/EEA Member States and increase the participation of ICUs in existing networks should be reinforced. Elements of the strategy to increase participation to ICU surveillance are; the promotion of the light version of the protocol to reduce the workload of data collection and reporting, the development of an ICU module in ECDC's free hospital software HelicsWin.Net [10], and a revision of the protocol to add value for HAI prevention to the surveillance by integrating structure and process indicators for HAI prevention in the ICU (note: the revised protocol and HelicsWin.Net ICU software were released in May 2015 and updated in 2017 [10-11]).

The overall incidence rates of ICU-acquired pneumonia and primary bloodstream infections decreased significantly from 2008 to 2012. Remarkably, only the incidence of primary BSIs (of which 95% are central line-associated BSIs) decreased, not the incidence of secondary BSIs. Indeed, mainly central line-associated bloodstream infections are a direct target for prevention, while the prevention of secondary BSIs require a bundle of infection control and prevention measures to prevent the different types of primary infections. In the ENVIN-HELICS network in Spain, a highly significant decrease was observed for both ICU-acquired primary bloodstream infections and pneumonia. These decreasing trends coincided with the implementation of the multifactorial national prevention programmes 'Bacteriemia Zero' and 'Neumonia Zero', coordinated by SEMICYUC, the Spanish scientific society for intensive care, and supported by the Spanish government [12-15]. These experiences support the hypothesis that the coordinated promotion of the implementation of evidence-based prevention bundles, with integration of selected evidence-based prevention indicators in the surveillance process, enhances HAI prevention at the national or network level.

The rise of multidrug-resistant Gram-negative *Enterobacteriaceae* in Europe, as described by several other sources such as the European Antimicrobial Resistance Surveillance Network (EARS-Net) [16], was confirmed by the HAI-Net ICU results. The relative frequency (percentage of all microorganisms) of *Enterobacteriaceae* increased significantly in both ICU-acquired pneumonia and bloodstream infections, with the strongest increase for *Klebsiella* spp. In parallel, the percentage of *Enterobacteriaceae* non-susceptible to third-generation cephalosporins, and the percentage of *Klebsiella pneumoniae* non-susceptible to carbapenems increased significantly. The increase of *Enterobacteriaceae* as percentage of all isolates in ICU-acquired infections appears therefore mainly to be due to increased antimicrobial resistance, probably related to the selection of these microorganisms through inappropriate antimicrobial use. Inversely, the percentage of Gram-positive bacteria decreased significantly in ICU-acquired pneumonia and bloodstream infections, paralleled by a significant decrease in the percentage of meticillin-resistant *S. aureus* (MRSA). Although the decrease of the MRSA percentage may be related to more appropriate antimicrobial use as well, the transmission of *S. aureus* (including MRSA) occurs mainly via the hands of the healthcare workers, and this decreasing trend may be a sign of an improved compliance with hand hygiene and other infection control measures in European ICUs.

To estimate the burden of healthcare-associated infections in European ICUs, we assessed the attributable mortality and excess length of stay for all three included infection types. Since patients with or without an ICU-acquired infection are very different with regard to underlying risk factors, their crude mortality and length of stay in the ICU cannot be compared directly. We therefore performed matched cohort studies using propensity score matching, which is one of the recommended methods in literature to address this question for observational studies [7]. The matched cohort method has the advantage of being more understandable to readers who are not specialised in advanced statistical methods, mainly because it allows demonstration that the HAI cohort was made comparable to the non-HAI cohort with regarding their baseline risk factors. However, methods that better take into account time-dependent confounding and competing risks (e.g. multistate models and marginal structural models) have been preferred or recommended over the 'classical' methods (even using propensity score matching) since the latter are considered to produce biased estimates by some investigators, especially for the attributable length of stay [17-25]. The results regarding attributable mortality and length of stay of ICU-acquired infections presented in this report should therefore be interpreted with caution and be considered as just one possible result of such analysis. They should be completed with and compared to estimates produced by one or more of the more advanced statistical models in order to gain more confidence around the estimates. These advanced statistical analyses, however, fall beyond the scope of this current report.

After matching, mortality was significantly higher in patients with pneumonia and bloodstream infections, but not in patients with urinary tract infections. The latter finding was not unexpected from a clinical point of view, even though to our knowledge this analysis is the first one in literature to address the attributable mortality question in urinary tract infections. The length of stay was significantly higher for all three infection types. We also analysed the impact of bloodstream infections by BSI origin. Secondary bloodstream infections, in particular BSIs secondary to surgical site infections, digestive tract infections and pulmonary infections, showed the highest attributable mortality (10% or more). The attributable mortality of primary and central line-associated BSIs was lower with values just over 2%, but still statistically significant. The subcategory of (microbiologically confirmed or clinically ascertained) catheter-related BSIs did not show a higher mortality compared to matched non-cases. These findings are consistent with previous studies that also found the highest excess mortality in secondary BSIs and lower or non-significant excess mortality in catheter-related BSIs [27-29]. The most likely reasons for the latter observation are that 1) pathogens involved in catheter-related BSIs are often less virulent coagulase-negative staphylococci (33.6%, see Table A.1.5) while secondary BSIs more frequently involve multidrug-resistant Gram-negative bacteria, 2) appropriate antimicrobial treatment is likely to be delayed in secondary BSIs, and 3) the source of the infection, the central vascular catheter, can often be removed in catheter-related BSI. Improvement of symptoms after catheter withdrawal is even part of the clinical definition of catheter-related BSI (if microbiological confirmation was not done, e.g., by catheter tip culture) and is likely one of the main differences between CRBs and other (non-CRB) CLABSIs.

In order to estimate the burden of ICU-acquired infections for the entire ICU population in EU/EEA hospitals, we needed to make a few assumptions which have many limitations. First, we assumed that the results of the HAI-Net ICU surveillance are representative for all European ICUs. This may not be completely true, since half of the EU/EEA countries do not perform ICU surveillance or at least did not report any data to ECDC. The situation in these countries with regard to the incidence or outcome of ICU-acquired infections may be different from that in participating countries. In addition, ICUs participating in the national/regional surveillance network may be different from those that do not participate, which may induce selection (attendant) bias especially in participating countries with low participation in the national/regional ICU surveillance network(s). A second assumption we needed to make was that the ECDC PPS sample was representative for all EU/EEA acute care hospitals, in particular for the estimation of the total number of ICU patients of 5% of all hospital discharges, i.e. 4.5 million patients per year (in approximately 7 000 hospitals). Since all EU/EEA countries except Liechtenstein participated in the ECDC PPS and since good representativeness was reached by two thirds of the countries, important bias of the ICU denominator estimates is less probable. However, the PPS data could not be used for the estimation of the number of ICU-acquired infections since infections reported in the ICU in the PPS are both acquired in the ICU and HAIs acquired in other wards in patients admitted to the ICU. Finally, the percentage of patients staying more than two days in the ICU of 57.2% (yielding 2 574 000 ICU patients for the whole EU/EEA) was based on a limited number of ICUs that provided complete ICU-based denominator data in the HAI-Net surveillance. Based on these denominators, the number of deaths attributable to HAIs in ICUs was estimated at 5 495 deaths for pneumonia and 4 505 deaths for bloodstream infections. Note that these numbers cannot just be summed up since in 13.5% of the patients, both infection types occurred during the same ICU stay, therefore the total number of attributable deaths from both types of infection was estimated at 8 650 per year. A similar correction needs to be performed when summing up the estimates of the excess ICU days, since 24.2% of the patients acquired at least one of the other infection types during the same ICU stay. The total number of extra ICU days attributable to all three HAI types combined can therefore be estimated at 3.43 million days or 0.7% of all annual patient-days in EU/EEA hospitals.

The HAI-Net surveillance data have many limitations. First, even though there has been a standardised European surveillance protocol since 2003 (HELICS-ICU protocol), the national surveillance protocols are not identical. If a country has a surveillance system based on the protocol of the National Healthcare Safety Network (NHSN) of the Centers for Disease Control and Prevention (CDC, Atlanta, USA), additional denominator data (number of admissions and patient-days) for patients staying more than two days should be collected in order to compare infection rates with those obtained from data collected following the ECDC protocol. Surveillance methods may also differ considerably between independent surveillance networks within the same country, such as between the GiViTI and SPIN-UTI networks in Italy. Furthermore, the participation of these different networks within one country often varied over the years, which is why their data were analysed and presented separately.

Comparability of the data is influenced by the persisting differences in diagnostic practices in European ICUs. Microbiological confirmation of pneumonia with semi-quantitative or quantitative cultures is still rarely performed in many countries. While this should theoretically have little influence on the number of reported pneumonia cases - since unconfirmed clinical pneumonia should be reported as well -, it may influence the identification of the correct microorganism(s) involved in the pathogenesis and therefore the appropriateness of the treatment and possibly infection prevention and control measures. Other differences in practices with regard to other diagnostic procedures, such as the frequency of performing chest X-rays for the diagnosis of pneumonia or of taking blood cultures for the diagnosis of bloodstream infections definitely influence the comparability of HAI rates, for the entire hospital and certainly in the ICU. Finally, even when the same standardised protocol is used, under- or over-reporting of HAIs may also occur as the result of 1) variations in the attitude towards systematically reporting infections starting on day three as ICU-acquired, 2) general concerns regarding the consequences of reporting HAIs (or not reporting HAIs), or 3) variations in surveillance skills and knowledge of the case definitions and the protocol. The use of the light surveillance protocol vs the standard patient-based protocol might influence results as well because of possible differences in case finding processes (despite similar inclusion criteria and definition of main indicators). To tackle these data quality issues and improve the comparability of data between ICUs and between countries, training in surveillance methods and validation of ICU surveillance data is required.

Conclusion and options for intervention

The current report showed the large burden of HAIs in ICUs, in terms of attributable mortality, prolongation of the ICU stay and numbers of HAI cases. At least 20% of HAIs are estimated to be preventable by sustained and multifaceted infection prevention and control programmes, including surveillance of HAIs [26,30]. The proportion preventable by employing current evidence-based strategies is the highest for device-associated infections and surgical site infections [31]. The independent preventive effect of surveillance of HAIs at the hospital level has first been shown in 1985 (SENIC study [30]) and has since then been corroborated by multiple studies, especially when surveillance is performed as part of a surveillance network, e.g. in Germany, The Netherlands, France and Belgium [32-36]. Indeed, feedback provided by the surveillance system allows hospitals to make risk-adjusted comparisons of local HAI rates and other epidemiological indicators in order to assess their own performance, identify priorities for prevention, implement or reinforce specific measures and follow-up their effect over time through continuous or regular periodic participation in the network. Given the evidence on the effect of surveillance on HAI prevention, ECDC included surveillance of HAIs as one of the key components in their evidence-based guidance for hospital infection control programmes [9]. Similarly and more recently, WHO also included HAI surveillance as one of the core components in their recommendations for effective infection prevention and control programmes [37,38]. In this report, we also observed decreasing trends in several countries for device-associated pneumonia and primary bloodstream infections (of which the majority are central line-associated) in ICUs with regular participation in the surveillance network. The strongest decreasing trends were observed in Spain, suggesting that the combination of continued surveillance efforts with a coordinated prevention programme within the surveillance network (based on bundles of preventive measures) is more effective in preventing HAIs at the network level than coordinated surveillance alone, with prevention guidelines developed and/or implemented independently.

Based on these observations, the following options for intervention can be suggested to enhance the prevention of ICU-acquired infections, and in particular the 'preventive power' of local surveillance implemented in the context of ICU surveillance networks:

- Surveillance of HAIs in ICUs should be combined with integrated monitoring of the implementation of evidence-based preventive measures. Agreed structure and process indicators to monitor these preventive measures should be developed and integrated in the surveillance protocol at local, national and EU level to allow hospitals and countries to follow-up and compare the implementation of these measures on a regular basis.
- The implementation of these preventive measures should be actively promoted and coordinated at the national or surveillance network level through sustained prevention campaigns.
- Beside strict compliance with standard hygienic precautions such as hand hygiene, emphasis should be given to the prevention of device-associated bloodstream infections and pneumonia, i.e. the promotion of best practice with regard to insertion and maintenance of central vascular catheters, and resp. mechanical ventilation. Additional contact precautions and antimicrobial stewardship need to be reinforced for the prevention of HAIs with multidrug-resistant pathogens, in particular carbapenem-resistant *Enterobacteriaceae* such as *K. pneumoniae* and non-fermenting Gram-negative bacteria such as *A. baumannii*.
- • All EU/EEA Member States should implement a surveillance network of HAIs in ICUs `using surveillance methods and indicators as recommended by ECDC and case definitions as agreed upon at Community level' [2]; existing networks with low participation should make efforts to increase the coverage of their surveillance networks.

ECDC together with EU/EEA Member States shall develop a strategy to accelerate the extension of the participation in HAI-Net ICU surveillance to all Member States and increase the coverage of existing surveillance networks. The following elements may be considered as part of this strategy:

- Prioritising prevention and surveillance of ICU-acquired infections as a part of prevention and control programmes at national and hospital level, including recommendations on organisational and structural arrangements, diagnostic and therapeutic procedures (for example antimicrobial stewardship), resource requirements, surveillance objectives and training.
- Involvement of the professional and scientific societies for intensive care medicine both at national level when this collaboration is not yet established and, at European level, with the European Society for Intensive Care Medicine (ESICM).
- Ensuring adequate resources for the coordination of HAI surveillance at national or regional level
- Estimating adequate numbers of intensive care staff and/or specialised infection control staff with time set aside for surveillance and HAI prevention tasks in hospitals, based on available evidence and good practice.
- Adaptation of the HAI-Net ICU surveillance protocol to include agreed structure and process indicators for HAI prevention in the ICU in order to increase the local added value of surveillance.

- Promotion of the unit-based (light) version of the surveillance protocol to reduce the workload of data collection and reporting, especially where ICU physicians are not involved in the data collection.
- ECDC making free multilingual software available for hospitals across Member States for entering and analysing surveillance data at the ICU or hospital level (HelicsWin.Net) as well as a software tool for surveillance coordination centres to provide timely feedback of surveillance results to participating ICUs.

Further options to improve the validity, comparability and robustness of HAI-Net ICU surveillance data include:

- Existing national and regional surveillance protocols should make adaptations when and where needed in order to make them fully compatible with the ECDC HAI-Net surveillance protocol, at least for the data collected in light version of the protocol; this includes the use of EU case definitions of healthcare-associated infections defined under Decision No 2119/98/EC, now replaced by Decision No 1082/2013/EU on serious cross-border threats to health [39, 40], the inclusion of both pneumonia and bloodstream infections and minimal antimicrobial resistance markers in the surveillance protocol and the exclusion of patients staying less than three days in the ICU from the denominator data. Countries starting up new ICU surveillance networks should take into account these minimal definitions and inclusion criteria of the HAI-Net ICU surveillance protocol when developing a national protocol.
- Diagnostic practices of HAIs in the ICU should be harmonised across countries taking into account national and international clinical guidelines. Special emphasis needs to be given to performing serial chest X-rays and microbiological confirmation by invasive diagnostic samples or quantitative cultures for the diagnosis of pneumonia. Differences in criteria for taking blood cultures influence the diagnosis and hence the reported incidence of bloodstream infections and large inter-country differences in the indication for culturing of CVC tips influence the proportion and therefore the reported incidence of catheter-related bloodstream infections.
- Training in HAI surveillance methods should be regularly organised for surveillance staff in hospitals and ICUs, in particular for the correct interpretation of HAI case definitions and of the key terms of the surveillance protocol, such as the definition of the term 'ICU-acquired' which implies systematic reporting of infections starting on day three of the stay of the ICU, even if the physician is convinced that the infection was acquired outside the ICU. In addition, ECDC should consider organising train-the-trainer courses at the EU level in order to ensure common training approaches by national surveillance coordinators.
- Validation studies should be organised using a standardised European protocol, to assess the sensitivity and specificity of the ICU surveillance data in participating countries, whereby external validation teams set up by the surveillance coordination centres visit a sample of participating ICUs and re-examine patient files for the presence of signs and symptoms of HAIs. In addition, given the workload of such field validation studies, a mechanism to support surveillance coordinating centres in organising them should be made available. Validation studies will allow better comparing of HAI rates between countries and ICUs, and identifying methodological issues that need to be addressed during training sessions.
- To follow-up the burden of HAIs in ICUs, additional data on attributable mortality in ICU-acquired infections should be collected. A methodology to collect these data in both light and standard ICU surveillance should be developed, in addition to the matched cohort analyses which were performed for the current report. This methodology should allow the estimation of attributable mortality by country, even in the absence of patient-based data. Moreover, other more advanced statistical modelling taking into account time-dependent bias and competing risks should be performed to improve the current estimates of attributable mortality and morbidity.

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Annex 1. Distribution of microorganisms

Table A.1.1. Distribution of microorganisms (%) isolated in pneumonia by date of onset of the infection in the ICU, 2008–2012

	Day 3-4	Day 5-6	Day 7-13	>= Day14	Total
Number of HAIs	7 127	8 031	17 025	19 694	51 877
HAIs with microorganism(s) (%)	80.7	84.6	87.4	91.4	87.6
Number of microorganisms	7 747	9 038	19 191	23 130	59 106
Gram-positive cocci (%)	29.5	26.3	21.9	21.7	23.5
Staphylococcus aureus	19.8	17.7	13.5	13.9	15.1
Coagulase-negative staphylococci	1.1	1.5	1.9	2.0	1.8
Streptococcus species	5.7	3.6	2.2	1.3	2.5
Enterococcus species	2.2	2.9	3.7	3.7	3.4
Other Gram-positive cocci	0.7	0.5	0.7	0.9	0.7
Gram-negative cocci (%)	0.7	0.6	0.4	0.2	0.4
Gram-positive bacilli (%)	0.2	0.4	0.2	0.3	0.3
Gram-negative bacilli, *Enterobacteriaceae* (%)	35.9	37.9	37.1	32.4	35.2
Citrobacter species	1.8	2.1	2.0	1.4	1.7
Enterobacter species	6.9	7.1	7.7	6.6	7.1
Escherichia coli	10.6	10.7	10.0	9.0	9.8
Klebsiella species	8.4	10.0	10.0	9.4	9.5
Proteus species	2.8	2.7	2.6	2.4	2.6
Serratia species	3.7	3.8	3.3	2.9	3.3
Other *Enterobacteriaceae*	1.8	1.5	1.5	0.9	1.3
Other Gram-negative bacilli (%)	21.9	22.3	26.9	35.3	28.8
Acinetobacter species	2.0	3.0	4.6	4.6	4.0
Pseudomonas aeruginosa	9.8	10.6	15.4	23.4	17.0
Stenotrophomonas maltophilia	1.6	2.2	3.4	5.4	3.8
Pseudomonadaceae family, other	0.3	0.4	0.5	0.7	0.5
Haemophilus species	7.9	5.9	2.8	0.9	3.2
Legionella species	0.1	0.0	<0.1	<0.1	<0.1
Other Gram-negative bacilli	0.3	0.3	0.3	0.3	0.3
Anaerobes (%)	0.1	0.1	0.1	0.1	0.1
Bacteroides species	0.1	0.1	<0.1	<0.1	<0.1
Clostridium difficile	0.0	0.0	0.0	<0.1	<0.1
Other anaerobes	<0.1	0.1	0.1	<0.1	0.1
Other bacteria (%)	1.4	1.3	1.0	0.7	1.0
Fungi or parasites (%)	10.0	10.9	11.9	8.9	10.3
Candida species	8.5	9.2	10.0	7.3	8.6
Aspergillus species	0.8	0.9	1.2	1.0	1.0
Other fungi or parasites	0.6	0.8	0.7	0.6	0.7
Virus (%)	0.2	0.3	0.4	0.4	0.3
Negative codes* (%)	15.1	12.0	10.1	6.8	9.8
Microorganism not identified	4.0	3.2	3.0	2.6	3.0
Examination not done	0.9	0.6	0.3	0.2	0.4
Sterile examination	0.9	0.8	0.9	0.5	0.7
Not (yet) available or missing	9.3	7.5	5.8	3.5	5.7

Data source: ECDC, HAI-Net ICU 2008–2012.
Distribution of microorganisms: percentage of total number of reported microorganisms, excluding negative codes;
**Distribution of negative codes: percentage of all reported codes; Italy-GiViTI network: only 2011 and 2012 data because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011*

Table A.1.2. Distribution of microorganisms (%) isolated in ICU-acquired pneumonia by diagnostic category, 2008–2012

	PN1	PN2	PN3	PN4	PN5	Total
Number of HAIs	11 220	7 546	621	9 390	1 780	30 557
HAIs with microorganism(s) (%)	95.9	98.0	89.0	96.6	0.0	90.9
Number of microorganisms	13 566	9 351	699	11 295	0	34 911
Gram-positive cocci (%)	24.3	23.8	31.2	21.0	.	23.3
Staphylococcus aureus	15.5	16.3	16.2	12.2	.	14.7
Coagulase-negative staphylococci	2.4	1.5	3.0	1.3	.	1.8
Streptococcus species	3.9	3.5	7.3	2.6	.	3.4
Enterococcus species	1.9	2.0	4.0	2.3	.	2.1
Other Gram-positive cocci	0.6	0.6	0.7	2.5	.	1.2
Gram-negative cocci (%)	0.8	0.7	0.4	0.6	.	0.7
Gram-positive bacilli (%)	0.5	0.4	0.7	0.2	.	0.4
Gram-negative bacilli, *Enterobacteriaceae* (%)	31.9	34.9	27.3	35.0	.	33.7
Citrobacter species	1.5	1.9	1.6	1.4	.	1.6
Enterobacter species	6.8	7.8	5.9	7.5	.	7.2
Escherichia coli	8.9	8.9	7.0	8.3	.	8.7
Klebsiella species	7.8	8.9	7.2	10.8	.	9.1
Proteus species	2.4	2.5	2.3	2.3	.	2.4
Serratia species	2.9	3.0	2.3	3.0	.	3.0
Other *Enterobacteriaceae*	1.8	1.9	1.1	1.6	.	1.7
Other Gram-negative bacilli (%)	34.5	34.0	30.5	35.1	.	34.5
Acinetobacter species	4.9	5.8	3.7	6.4	.	5.6
Pseudomonas aeruginosa	20.3	20.1	15.6	19.4	.	19.9
Stenotrophomonas maltophilia	4.0	3.5	2.1	4.3	.	3.9
Pseudomonadaceae family, other	0.6	0.4	0.3	1.3	.	0.8
Haemophilus species	4.2	3.8	8.2	3.2	.	3.9
Legionella species	<0.1	<0.1	0.3	<0.1	.	<0.1
Other Gram-negative bacilli	0.6	0.4	0.3	0.4	.	0.5
Anaerobes (%)	0.2	0.1	0.1	0.1	.	0.1
Bacteroides species	0.1	<0.1	0.0	<0.1	.	<0.1
Clostridium difficile	0.0	0.0	0.0	0.0	.	0.0
Other anaerobes	0.1	0.1	0.1	0.1	.	0.1
Other bacteria (%)	0.2	0.3	0.4	0.4	.	0.3
Fungi or parasites (%)	7.3	5.7	6.3	7.5	.	6.9
Candida species	6.1	4.7	3.7	5.8	.	5.6
Aspergillus species	1.0	0.5	2.1	1.5	.	1.1
Other fungi or parasites	0.2	0.4	0.4	0.1	.	0.2
Virus (%)	0.4	0.1	3.0	0.1	.	0.3
Negative codes* (%)	3.3	1.6	8.9	2.8	100.0	7.4
Microorganism not identified	1.6	0.8	6.0	1.1	24.0	2.4
Examination not done	0.0	<0.1	0.1	0.3	12.2	0.7
Sterile examination	1.3	0.6	2.2	0.4	10.1	1.3
Not (yet) available or missing	0.4	0.2	0.5	1.0	53.8	3.1

Data source: ECDC, HAI-Net ICU 2008–2012.

*Distribution of microorganisms: percentage of total number of reported microorganisms, excluding negative codes; *Distribution of negative codes: percentage of all reported codes; Germany and Sweden are excluded because subcategories of pneumonia case definition are not collected according to ECDC surveillance protocol; Italy-GiViTI network: only 2011 and 2012 data because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011.*

Table A.1.3. Detailed distribution of microorganisms (%) isolated in ICU-acquired pneumonia by country/network, 2008–2012

	EU/EEA	Austria	Belgium	Croatia	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain	Sweden	UK-Scotland	UK-Wales
Number of HAIs	51 884	2 152	2 764	22	257	14 310	20 639	1854	573	554	215	1 799	418	146	5 445	52	667	17
HAIs with microorganism(s) (%)	87.6	100.0	87.8	81.8	77.4	97.1	82.4	87.2	81.8	68.8	93.5	78.6	99.3	92.5	83.7	100.0	72.9	100.0
Number of microorganisms	59 114	2 981	3 130	27	247	17 012	23 395	2163	619	635	235	1 701	415	174	5 656	91	615	18
Gram-positive cocci	23.5	21.8	21.5	33.3	18.6	25.8	23.7	22.8	17.6	18.3	14.0	22.5	23.4	9.2	20.6	33.0	22.0	0.0
Staphylococcus aureus	15.1	8.7	8.3	14.8	10.5	16.9	15.7	16.3	9.4	10.1	6.8	19.8	18.8	4.0	14.1	28.6	16.9	0.0
Coagulase-negative staphylococci	1.8	0.9	1.0	11.1	0.8	2.4	1.7	1.8	3.7	2.0	1.3	0.5	1.7	1.7	1.7	0.0	0.0	0.0
Staphylococcus epidermidis	0.7	0.6	0.8	11.1	0.4	1.6	0.0	0.0	0.6	0.6	0.4	0.1	0.0	1.1	1.0	0.0	0.0	0.0
Staphylococcus haemolyticus	0.1	0.2	0.1	0.0	0.4	0.3	0.0	0.0	0.8	0.2	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Other coagulase-negative staphylococci	0.2	0.0	0.2	0.0	0.0	0.5	0.1	0.0	1.9	0.6	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0
Coagulase-neg. staphylococci, not specified	0.8	0.0	<0.1	0.0	0.0	0.0	1.6	1.8	0.3	0.6	0.0	0.0	1.7	0.6	0.4	0.0	0.0	0.0
Streptococcus species	2.5	3.7	2.9	3.7	6.5	4.4	1.1	1.6	0.8	3.3	2.6	1.4	0.0	1.1	2.5	3.3	3.7	0.0
Streptococcus pneumoniae	1.3	1.1	1.5	0.0	4.5	2.1	0.8	0.9	0.3	1.3	1.7	1.2	0.0	0.6	1.5	1.1	2.0	0.0
Streptococcus agalactiae (group B)	0.1	0.3	0.1	0.0	0.8	0.2	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.1	1.1	0.2	0.0
Streptococcus pyogenes (group A)	0.2	0.1	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Other haemol. streptococci (C, G)	0.1	0.5	<0.1	3.7	0.4	0.3	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Streptococcus species, other	0.5	0.0	1.1	0.0	0.4	1.2	0.0	0.0	0.0	0.8	0.4	0.1	0.0	0.6	0.7	0.0	0.5	0.0
Streptococcus species, not specified	0.3	1.7	0.2	0.0	0.4	0.5	0.0	0.7	0.5	0.2	0.0	0.0	0.0	0.0	0.1	1.1	1.0	0.0
Enterococcus species	3.4	4.9	2.5	3.7	0.8	1.5	5.3	2.6	3.2	2.7	3.4	0.7	2.9	1.7	2.3	1.1	1.0	0.0
Enterococcus faecalis	0.7	2.3	1.8	3.7	0.4	0.9	0.0	1.6	2.4	1.6	2.1	0.3	0.5	0.6	1.3	1.1	0.3	0.0
Enterococcus faecium	0.4	2.1	<0.1	0.0	0.0	0.4	0.0	0.8	0.5	0.3	1.3	0.3	0.0	0.6	0.8	0.0	0.3	0.0
Enterococcus species, other	<0.1	0.0	<0.1	0.0	0.0	<0.1	0.0	0.0	0.3	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Enterococcus species, not specified	2.3	0.5	0.6	0.0	0.4	0.2	5.3	0.1	0.0	0.6	0.0	0.0	2.4	0.6	0.2	0.0	0.3	0.0
Other Gram-positive cocci	0.7	3.5	6.7	0.0	0.0	0.5	0.0	0.5	0.5	0.2	0.0	0.1	0.0	0.6	0.0	0.0	0.3	0.0
Staphylococcus species, not specified	0.7	3.5	6.7	0.0	0.0	0.5	0.0	0.5	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Other Gram-positive cocci	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.6	0.0	0.0	0.0	0.0
Gram-negative cocci	0.4	0.3	1.4	0.0	0.8	0.9	0.0	0.0	0.0	0.6	0.4	0.1	0.0	0.6	0.3	1.1	1.8	0.0
Moraxella catarrhalis	0.1	0.0	1.3	0.0	0.8	0.0	0.0	0.0	0.0	0.2	0.4	0.1	0.0	0.0	0.2	1.1	0.5	0.0
Moraxella species, not specified	0.1	0.1	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.5	0.0	0.1	0.0	0.0	<0.1	0.0	0.7	0.0
Neisseria meningitidis	<0.1	0.1	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0

	EU/EEA	Austria	Belgium	Croatia	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain	Sweden	UK-Scotland	UK-Wales
Neisseria species, other	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.2	0.0
Neisseria species, not specified	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-negative cocci	<0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Gram-negative cocci, not specified	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
Gram-positive bacilli	0.3	0.4	0.2	3.7	0.0	0.5	0.1	0.0	0.8	0.5	0.0	0.0	0.2	0.0	0.3	0.0	0.3	0.0
Corynebacterium species	0.2	0.2	0.1	3.7	0.0	0.4	0.1	0.0	0.8	0.5	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0
Bacillus species	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Lactobacillus species	<0.1	0.0	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
Other Gram-positive bacilli	<0.1	<0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gram-positive bacilli, not specified	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Gram-negative bacilli, *Enterobacteriaceae*	35.2	30.3	42.5	33.3	35.2	34.3	37.8	33.4	29.1	39.5	43.0	26.4	30.6	46.0	29.4	31.9	37.2	0.0
Citrobacter species	1.7	1.0	2.1	0.0	1.6	2.0	2.0	0.8	0.3	0.9	1.7	1.1	0.2	0.0	1.3	0.0	0.3	0.0
Citrobacter freundii	0.4	0.7	1.2	0.0	0.8	0.7	0.0	0.0	0.2	0.5	1.3	0.8	0.0	0.0	0.6	0.0	0.2	0.0
Citrobacter koseri (e.g. *diversus*)	0.4	0.2	0.5	0.0	0.0	1.1	0.0	0.0	0.0	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Citrobacter species, other	0.1	0.0	0.1	0.0	0.8	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Citrobacter species, not specified	0.9	0.1	0.4	0.0	0.0	0.0	2.0	0.8	0.0	0.0	0.0	0.4	0.2	0.0	0.7	0.0	0.2	0.0
Enterobacter species	7.1	7.0	11.5	3.7	8.9	7.6	6.9	4.4	4.8	4.6	7.2	5.7	1.7	1.7	6.3	7.7	7.3	0.0
Enterobacter cloacae	2.6	4.9	6.4	0.0	7.3	4.8	0.0	0.0	4.2	0.8	5.5	3.4	0.7	0.6	3.7	6.6	3.7	0.0
Enterobacter aerogenes	1.4	1.8	4.7	0.0	0.8	2.6	0.0	0.0	0.6	0.6	1.7	2.2	0.0	0.6	2.1	1.1	0.2	0.0
Enterobacter sakazakii	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
Enterobacter species, other	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Enterobacter species, not specified	3.0	0.4	0.4	3.7	0.8	0.0	6.9	4.4	0.0	1.9	0.0	0.1	1.0	0.6	0.4	0.0	3.1	0.0
Escherichia coli	9.8	6.5	10.5	18.5	8.5	9.7	11.5	7.5	8.6	6.9	7.2	5.8	4.3	8.0	7.2	5.5	10.7	0.0
Klebsiella species	9.5	10.5	8.8	11.1	12.6	7.0	10.4	16.6	11.0	18.7	15.7	8.9	18.8	32.2	7.8	13.2	12.2	0.0
Klebsiella pneumoniae	3.4	7.5	4.7	11.1	7.7	4.9	0.0	0.0	9.9	15.3	11.5	7.0	15.2	29.3	6.0	7.7	6.0	0.0
Klebsiella oxytoca	1.2	2.3	3.9	0.0	4.5	1.9	0.0	0.0	0.8	3.1	3.8	1.5	0.2	0.6	1.6	5.5	2.0	0.0
Klebsiella species, other	0.1	0.0	0.1	0.0	0.4	0.2	0.0	0.0	0.2	0.3	0.4	0.0	0.0	0.0	<0.1	0.0	0.5	0.0
Klebsiella species, not specified	4.8	0.7	0.1	0.0	0.0	0.0	10.4	16.6	0.2	0.0	0.0	0.4	3.4	2.3	0.2	0.0	3.7	0.0
Proteus species	2.6	1.7	3.0	0.0	1.6	2.7	2.8	1.9	1.5	3.9	3.0	1.5	3.1	2.3	2.2	3.3	1.0	0.0
Proteus mirabilis	1.2	1.2	2.6	0.0	1.2	2.3	0.0	0.0	1.5	3.1	2.6	1.4	0.0	2.3	2.1	3.3	0.3	0.0
Proteus vulgaris	<0.1	0.0	0.4	0.0	0.4	0.0	0.0	0.0	0.0	0.6	0.4	0.1	0.0	0.0	<0.1	0.0	0.2	0.0

	EU/EEA	Austria	Belgium	Croatia	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain	Sweden	UK-Scotland	UK-Wales
Proteus species, other	0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Proteus species, not specified	1.2	0.5	0.0	0.0	0.0	0.0	2.8	1.9	0.0	0.2	0.0	0.1	3.1	0.0	0.0	0.0	0.5	0.0
Serratia species	3.3	2.9	3.9	0.0	0.8	2.9	3.7	2.3	1.8	3.5	3.8	2.3	1.4	1.1	3.4	2.2	4.4	0.0
Serratia marcescens	0.7	0.0	3.6	0.0	0.4	0.0	0.0	0.0	1.8	3.1	3.8	2.3	0.0	1.1	3.2	2.2	2.6	0.0
Serratia liquefaciens	<0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0
Serratia species, other	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Serratia species, not specified	2.6	2.9	<0.1	0.0	0.4	2.9	3.7	2.3	0.0	0.2	0.0	0.0	1.4	0.0	0.1	0.0	1.5	0.0
Other *Enterobacteriaceae*	1.3	0.6	2.7	0.0	1.2	2.3	0.7	0.0	1.1	0.9	4.3	1.1	1.0	0.6	1.2	0.0	1.3	0.0
Hafnia species	0.4	0.1	0.6	0.0	0.0	1.1	0.0	0.0	0.2	0.0	1.3	0.1	0.0	0.0	0.2	0.0	0.3	0.0
Morganella species	0.5	0.4	2.0	0.0	0.4	1.0	0.0	0.0	0.5	0.9	2.6	0.8	0.0	0.6	0.9	0.0	0.5	0.0
Providencia species	0.1	0.1	<0.1	0.0	0.0	0.1	0.0	0.0	0.5	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0
Salmonella Typhi or Paratyphi	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salmonella species, other	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
Salmonella species, not specified	0.2	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.3	0.0
Shigella species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other *Enterobacteriaceae*	<0.1	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Enterobacteriaceae, not specified	0.1	0.1	0.0	0.0	0.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-negative bacilli	28.8	29.1	29.5	29.6	37.2	32.0	20.2	35.8	47.3	35.9	32.3	44.9	45.3	33.3	42.3	27.5	26.5	55.6
Acinetobacter species	4.0	1.3	1.4	14.8	3.6	2.4	1.7	13.9	20.2	15.6	0.9	12.9	25.8	9.2	10.2	1.1	1.5	44.4
Acinetobacter baumannii	2.3	1.1	0.2	7.4	2.8	2.3	0.0	0.0	18.7	6.0	0.9	12.2	2.7	0.6	9.8	0.0	1.0	27.8
Acinetobacter calcoaceticus	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.0	0.0	2.3	<0.1	0.0	0.0	11.1
Acinetobacter haemolyticus	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	<0.1	0.0	0.0	0.0
Acinetobacter lwoffii	<0.1	0.0	<0.1	0.0	0.8	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Acinetobacter species, other	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
Acinetobacter species, not specified	1.6	0.2	1.2	7.4	0.0	0.0	1.7	13.9	0.6	7.1	0.0	0.6	23.1	5.7	0.2	1.1	0.5	0.0
Pseudomonas aeruginosa	17.0	20.4	16.0	11.1	23.1	20.6	12.8	16.6	20.7	13.1	23.0	23.0	18.1	22.4	21.5	9.9	7.3	0.0
Pseudomonadaceae family, other	0.2	0.0	1.7	0.0	0.4	0.2	0.0	0.0	0.5	0.0	0.0	0.1	0.0	0.0	0.5	0.0	0.5	0.0
Pseudomonadaceae family, not specified	0.1	0.6	0.3	3.7	0.4	0.0	0.0	0.0	0.0	0.3	0.0	1.6	1.0	0.0	0.0	0.0	1.6	0.0
Stenotrophomonas maltophilia	3.8	3.8	6.3	0.0	2.8	3.5	3.5	2.4	4.8	1.3	5.5	3.5	0.5	0.6	5.2	4.4	5.0	0.0
Burkholderia cepacia	0.2	0.4	0.2	0.0	0.0	0.1	0.1	0.0	0.3	0.2	0.0	0.5	0.0	0.0	0.4	0.0	0.2	0.0
Haemophilus species	3.2	2.4	3.1	0.0	6.5	4.6	2.1	2.9	0.6	2.4	3.0	3.2	0.0	0.6	4.0	12.1	9.4	0.0

	EU/EEA	Austria	Belgium	Croatia	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain	Sweden	UK-Scotland	UK-Wales
Haemophilus influenzae	0.9	0.0	3.1	0.0	6.1	0.0	0.0	2.9	0.6	2.4	2.1	3.0	0.0	0.6	3.7	12.1	6.0	0.0
Haemophilus parainfluenzae	<0.1	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.0	0.0	0.3	0.0	0.0	0.0
Haemophilus species, other	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0
Haemophilus species, not specified	2.3	2.4	0.0	0.0	0.0	4.6	2.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	3.3	0.0
Legionella species	<0.1	<0.1	<0.1	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Other Gram-negative bacilli	0.3	0.1	0.6	0.0	0.4	0.6	0.0	0.0	0.2	3.1	0.0	0.1	0.0	0.6	0.4	0.0	1.0	11.1
Achromobacter species	0.1	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	3.0	0.0	0.1	0.0	0.0	<0.1	0.0	0.2	0.0
Aeromonas species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	<0.1	0.0	0.2	0.0
Agrobacterium species	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
Alcaligenes species	0.1	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	5.6
Flavobacterium species	<0.1	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Gardnerella species	<0.1	0.0	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Helicobacter pylori	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pasteurella species	<0.1	0.0	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gram-negative bacilli, not specified	<0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.0	0.5	0.0
Other Gram-negative bacilli	0.1	0.0	0.1	0.0	0.4	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anaerobic bacilli	0.1	0.1	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.4	0.0	0.0	0.0	<0.1	0.0	0.0	11.1
Bacteroides species	<0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bacteroides fragilis	<0.1	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bacteroides species, other	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bacteroides species, not specified	<0.1	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Clostridium difficile	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other anaerobes	0.1	<0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	11.1
Clostridium species, other	<0.1	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Propionibacterium species	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prevotella species	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
Anaerobes, not specified	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
Other anaerobes	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other bacteria	1.0	0.4	0.2	0.0	0.0	0.1	2.0	1.9	0.5	0.3	0.0	0.5	0.0	0.0	0.1	0.0	0.2	11.1
Mycobacterium, atypical	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mycobacterium tuberculosis complex	<0.1	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0

	EU/EEA	Austria	Belgium	Croatia	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain	Sweden	UK-Scotland	UK-Wales
Chlamydia species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mycoplasma species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Actinomyces species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	11.1
Nocardia species	<0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	<0.1	0.0	0.0	0.0
Other bacteria	0.1	0.4	0.0	0.0	0.0	0.1	0.0	2.2	0.3	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.2	0.0
Other bacteria, not specified	0.8	0.0	0.1	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fungi	10.3	17.6	4.6	0.0	8.1	5.9	15.6	5.5	4.5	4.9	9.8	5.3	0.5	10.9	6.9	6.6	11.2	22.2
Candida species	8.6	16.2	1.6	0.0	7.7	4.9	13.3	4.7	3.4	4.9	6.8	3.8	0.5	10.9	5.3	6.6	10.4	0.0
Candida albicans	6.4	10.9	1.0	0.0	5.7	3.5	10.4	3.3	2.4	4.1	5.1	2.8	0.0	8.0	3.0	6.6	3.3	0.0
Candida glabrata	0.2	0.0	0.4	0.0	0.8	0.3	0.0	0.0	0.3	0.2	0.9	0.4	0.0	0.6	0.9	0.0	1.1	0.0
Candida krusei	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Candida parapsilosis	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Candida tropicalis	0.1	0.0	<0.1	0.0	0.4	0.2	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.6	0.5	0.0	0.2	0.0
Candida species, other	0.3	0.0	0.1	0.0	0.4	0.7	0.0	1.3	0.2	0.3	0.0	0.0	0.2	0.6	0.4	0.0	0.7	0.0
Candida species, not specified	1.5	5.4	0.1	0.0	0.4	0.0	2.9	0.1	0.3	0.3	0.9	0.4	0.2	1.1	0.3	0.0	5.2	0.0
Aspergillus species	1.0	1.3	2.7	0.0	0.4	0.6	1.0	0.7	0.5	0.0	3.0	1.4	0.0	0.0	1.5	0.0	0.2	22.2
Aspergillus fumigatus	0.4	0.0	2.4	0.0	0.4	0.5	0.0	0.0	0.3	0.0	2.1	1.2	0.0	0.0	0.9	0.0	0.0	0.0
Aspergillus niger	<0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	11.1
Aspergillus species, other	<0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	11.1
Aspergillus species, not specified	0.5	1.3	0.2	0.0	0.0	0.0	1.0	0.7	0.0	0.0	0.4	0.2	0.0	0.0	0.5	0.0	0.2	0.0
Other fungi or parasites	0.7	0.1	0.2	0.0	0.0	0.4	1.3	0.0	0.6	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.7	0.0
Other yeasts	0.1	0.0	<0.1	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fungi other	0.5	0.1	0.1	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0
Fungi, not specified	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Filaments other	<0.1	0.0	0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other fungi/parasites	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
Viruses	0.3	0.1	0.3	0.0	0.0	0.3	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.8	0.0
Adenovirus	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cytomegalovirus (CMV)	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.0	0.0
Hepatitis A virus	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Herpes simplex virus	0.1	<0.1	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0

	EU/EEA	Austria	Belgium	Croatia	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain	Sweden	UK-Scotland	UK-Wales
Influenza A virus	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Influenza virus, not specified	<0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	<0.1	0.0	0.0	0.0
Varicella-zoster virus	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Virus, not specified	0.2	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Other virus	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Negative codes	9.8	0.0	9.7	12.9	19.0	2.4	13.5	9.9	14.4	21.4	5.6	18.5	0.7	5.9	13.6	0.0	22.7	0.0
Micro-organism not identified	3.0	0.0	0.9	12.9	14.8	1.5	3.9	0.0	0.6	0.5	3.2	0.4	0.7	1.1	7.8	0.0	5.5	0.0
Examination not done	0.4	0.0	0.5	0.0	2.3	0.5	0.0	0.0	0.3	17.0	1.2	0.0	0.0	0.5	0.0	0.0	0.1	0.0
Sterile examination	0.7	0.0	1.0	0.0	1.0	0.4	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.5	5.6	0.0	0.8	0.0
Not (yet) available/missing	5.7	0.0	7.4	0.0	1.0	0.0	9.6	9.9	13.4	3.6	1.2	18.1	0.0	3.8	0.2	0.0	16.3	0.0

*Data source: ECDC, HAI-Net ICU 2008–2012. Distribution of microorganisms: percentage of total number of reported microorganisms, excluding negative codes; *Distribution of negative codes: percentage of all reported codes; Italy-GiViTI network: only 2011 and 2012 data because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011.*

Table A.1.4. Distribution of microorganisms (%) isolated in bloodstream infections by date of onset of the infection in the ICU, 2008–2012

	Day 3–4	Day 5–6	Day 7–13	>= Day14	Total
Number of HAIs	1 981	2 635	8 262	13 173	26 051
HAIs with microorganism(s) (%)	94.7	94.9	96	96.4	96
Number of microorganisms	2 094	2 798	8 832	14 077	27 801
Gram-positive cocci (%)	50.7	51.8	50.8	50.0	50.5
Staphylococcus aureus	15.8	14.9	10.2	9.8	10.9
Coagulase-negative staphylococci	18.6	21.2	25.0	24.5	23.8
Streptococcus species	3.4	2.6	1.4	0.8	1.3
Enterococcus species	10.0	11.6	12.5	13.2	12.6
Other Gram-positive cocci	2.9	1.5	1.8	1.7	1.8
Gram-negative cocci (%)	0.2	0.2	0.1	<0.1	0.1
Gram-positive bacilli (%)	0.8	0.6	0.5	0.3	0.4
Gram-negative bacilli, *Enterobacteriaceae* (%)	26.4	27.9	25.6	24.0	25.1
Citrobacter species	1.0	0.9	0.7	0.5	0.6
Enterobacter species	4.0	5.1	5.8	5.3	5.3
Escherichia coli	10.7	9.1	7.0	6.2	7.1
Klebsiella species	6.1	7.5	7.6	7.9	7.6
Proteus species	1.3	1.7	1.2	1.2	1.2
Serratia species	2.1	2.3	2.3	2.1	2.2
Other *Enterobacteriaceae*	1.2	1.4	1.1	0.8	1.0
Other Gram-negative bacilli	9.3	9.2	11.0	14.4	12.4
Acinetobacter species	1.9	2.3	3.5	3.2	3.1
Pseudomonas aeruginosa	6.0	5.1	6.2	9.4	7.7
Stenotrophomonas maltophilia	0.5	0.6	0.7	1.3	1.0
Pseudomonadaceae family, other	0.3	0.3	0.2	0.3	0.3
Haemophilus species	0.4	0.7	0.2	<0.1	0.2
Legionella species	<0.1	0.0	0.0	<0.1	<0.1
Other Gram-negative bacilli	0.2	0.1	0.2	0.1	0.2
Anaerobes (%)	1.9	1.6	1.1	1.1	1.2
Bacteroides species	1.1	1.1	0.8	0.8	0.9
Clostridium difficile	<0.1	0.0	<0.1	<0.1	<0.1
Other anaerobes	0.7	0.5	0.3	0.2	0.3
Other bacteria (%)	1.9	1.1	1.7	1.7	1.6
Fungi or parasites (%)	8.8	7.5	9.1	8.4	8.6
Candida species	8.6	7.1	8.8	8.0	8.2
Aspergillus species	0.0	0.1	<0.1	<0.1	<0.1
Other fungi or parasites	0.2	0.3	0.2	0.4	0.3
Virus (%)	0.1	<0.1	0.1	0.1	0.1
Negative codes* (%)	4.8	4.6	3.6	3.3	3.6
Microorganism not identified	2.1	2.9	2.6	2.2	2.4
Examination not done	<0.1	0.0	<0.1	<0.1	<0.1
Sterile examination	0.7	0.4	0.2	0.1	0.2
Not (yet) available or missing	1.9	1.3	0.8	0.9	1.0

*Data source: ECDC, HAI-Net ICU 2008–2012. Distribution of microorganisms: percentage of total number of reported microorganisms, excluding negative codes); *Distribution of negative codes: percentage of all reported codes; Italy-GiViTI network: only 2011 and 2012 data were included because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011.*

Table A.1.5. Distribution of microorganisms (%) isolated in ICU-acquired bloodstream infections by origin (source) of the bloodstream infection, 2008–2012

	Primary BSI				Secondary BSI							Total
	Catheter-related											
	All catheter-related BSIs	Microbiologically confirmed (CRI3)	Clinical/ unknown confirmation	Other primary BSIs (unknown origin)	All secondary BSIs	Pulmonary tract	Digestive tract	Urinary tract	Surgical site	Skin and soft tissue	Other	
Number of BSIs	**10 367**	1 843	8 524	**6 957**	**8 734**	4 043	1 764	1 217	473	418	819	**26 058**
BSIs with microorganism(s) (%)	**97.2**	98.9	96.9	**94.0**	**96.1**	95.1	97.9	96.1	98.1	98.8	94.7	**96.0**
Number of microorganisms	**11 166**	2 046	9 120	**7 214**	**9 425**	4 246	1 984	1 255	583	463	894	**27 805**
Gram-positive cocci (%)	**61.1**	53.9	62.7	**55.7**	**34.0**	31.3	35.6	24.6	36.7	50.3	45.6	**50.5**
Staphylococcus aureus	**11.9**	15.8	11.1	**9.3**	**10.9**	17.7	1.9	2.6	5.3	14.0	12.6	**10.9**
Coagulase-negative staphylococci	**33.4**	28.3	34.6	**28.6**	**8.9**	5.9	10.8	3.2	11.1	24.0	17.6	**23.8**
Streptococcus species	**0.7**	0.6	0.7	**2.2**	**1.5**	1.5	1.8	0.2	2.1	2.4	1.9	**1.3**
Enterococcus species	**13.4**	6.3	15.0	**13.2**	**11.2**	5.5	18.8	18.1	15.4	8.6	10.5	**12.6**
Other Gram-positive cocci	**1.7**	2.9	1.4	**2.5**	**1.4**	0.8	2.3	0.5	2.7	1.3	3.0	**1.8**
Gram-negative cocci (%)	**0.1**	0.2	<0.1	**0.1**	**0.1**	<0.1	0.2	0.2	0.0	0.2	0.2	**0.1**
Gram-positive bacilli (%)	**0.3**	0.3	0.4	**0.7**	**0.4**	0.2	0.7	0.0	1.2	0.9	0.6	**0.4**
Gram-negative bacilli, *Enterobacteriaceae* (%)	**18.2**	22.9	17.2	**24.0**	**34.2**	33.8	31.7	48.4	31.6	25.5	27.4	**25.1**
Citrobacter species	**0.5**	0.6	0.4	**0.6**	**0.9**	0.8	1.1	1.3	0.9	0.4	0.7	**0.6**
Enterobacter species	**4.5**	6.2	4.1	**5.4**	**6.4**	6.9	6.3	5.7	4.6	6.9	5.6	**5.3**
Escherichia coli	**3.7**	3.4	3.8	**5.9**	**12.0**	8.1	12.8	28.0	14.2	6.3	7.7	**7.1**
Klebsiella species	**6.1**	8.6	5.6	**7.5**	**9.5**	11.4	7.2	8.5	7.0	6.5	10.0	**7.6**
Proteus species	**0.9**	1.1	0.9	**1.1**	**1.7**	1.5	1.7	2.9	1.5	3.0	1.0	**1.2**
Serratia species	**1.8**	2.2	1.7	**2.3**	**2.6**	4.0	1.3	1.4	2.1	0.6	1.8	**2.2**
Other *Enterobacteriaceae*	**0.7**	0.8	0.7	**1.3**	**1.1**	1.1	1.4	0.7	1.2	1.7	0.7	**1.0**
Other Gram-negative bacilli (%)	**7.9**	13.0	6.8	**10.2**	**19.4**	26.2	11.3	14.9	14.9	16.4	16.6	**12.4**
Acinetobacter species	**2.2**	4.1	1.8	**2.5**	**4.6**	6.5	2.3	1.7	3.9	4.3	5.7	**3.1**
Pseudomonas aeruginosa	**4.7**	8.2	3.9	**5.9**	**12.7**	16.3	7.9	13.0	8.6	11.0	8.9	**7.7**
Stenotrophomonas maltophilia	**0.7**	0.5	0.7	**1.0**	**1.4**	2.1	0.9	0.2	1.9	0.9	1.0	**1.0**
Pseudomonadaceae family, other	**0.1**	<0.1	0.1	**0.4**	**0.3**	0.4	0.1	0.1	0.3	0.2	0.2	**0.3**
Haemophilus species	**0.1**	<0.1	0.1	**0.1**	**0.3**	0.7	0.0	0.0	0.0	0.0	0.2	**0.2**
Legionella species	**<0.1**	0.0	<0.1	**0.0**	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	**<0.1**
Other Gram-negative bacilli	**0.1**	0.2	0.1	**0.2**	**0.1**	0.2	0.1	0.0	0.2	0.0	0.4	**0.2**
Anaerobes (%)	**0.4**	0.1	0.5	**1.1**	**2.2**	0.3	7.5	0.1	4.3	1.7	1.1	**1.2**
Bacteroides species	**0.3**	0.1	0.4	**0.7**	**1.6**	0.1	5.9	0.0	2.7	1.5	0.9	**0.9**
Clostridium difficile	**0.0**	0.0	0.0	**<0.1**	**<0.1**	0.0	0.2	0.0	0.0	0.0	0.0	**<0.1**
Other anaerobes	**0.1**	0.0	0.1	**0.4**	**0.5**	0.2	1.4	0.1	1.5	0.2	0.2	**0.3**
Other bacteria (%)	**3.2**	0.8	3.8	**0.6**	**0.6**	1.0	0.2	0.1	1.0	0.4	0.2	**1.6**
Fungi or parasites (%)	**8.8**	8.7	8.8	**7.6**	**9.0**	7.1	12.9	11.7	10.3	4.5	7.3	**8.6**
Candida species	**8.4**	8.7	8.3	**7.3**	**8.7**	6.8	12.5	11.4	9.9	4.5	7.0	**8.2**
Aspergillus species	**<0.1**	0.0	<0.1	**0.0**	**0.1**	0.2	0.0	0.0	0.0	0.0	0.1	**<0.1**
Other fungi or parasites	**0.4**	0.0	0.4	**0.3**	**0.2**	0.2	0.4	0.3	0.3	0.0	0.1	**0.3**
Virus (%)	**<0.1**	0.0	<0.1	**0.1**	**0.1**	0.1	0.0	0.0	0.0	0.0	1.0	**0.1**
Negative codes* (%)	**2.5**	1.0	2.8	**5.4**	**3.5**	4.5	1.8	3.7	1.5	1.1	4.6	**3.6**
Microorganism not identified	**1.4**	0.1	1.6	**3.9**	**2.5**	3.4	1.2	3.1	0.3	0.9	2.5	**2.4**
Examination not done	**<0.1**	<0.1	0.0	**<0.1**	**<0.1**	<0.1	0.0	0.0	0.0	0.0	0.0	**<0.1**
Sterile examination	**0.1**	0.0	0.1	**0.1**	**0.4**	0.4	0.5	0.2	0.2	0.0	0.7	**0.2**
Not (yet) available or missing	**1.0**	0.8	1.1	**1.4**	**0.6**	0.7	0.1	0.3	1.0	0.2	1.4	**1.0**

*Data source: ECDC, HAI-Net ICU 2008–2012. BSI: bloodstream infection; CRI3: case definition code for catheter-related bloodstream infection with positive catheter tip culture; Distribution of microorganisms: percentage of total number of reported microorganisms, excluding negative codes; *Distribution of negative codes: percentage of all reported codes; Italy-GiViTI network: only 2011 and 2012 data were included because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011.*

Table A.1.6. Detailed distribution (%) of microorganisms isolated in ICU-acquired bloodstream infections by country/network, 2008–2012

	EU/EEA	Austria	Belgium	Czech Republic	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Malta	Portugal	Romania	Slovakia	Spain	UK-Scotland
Number of HAIs	26 058	1 265	708	175	100	5 760	8 565	1 493	334	264	220	123	1 029	151	70	5 284	517
HAIs with microorganism(s) (%)	96.0	98.8	99.6	100.0	98.0	99.7	95.4	98.6	79.3	83.3	97.7	99.2	97.8	89.4	100.0	93.1	87.8
Number of microorganisms	27 805	1 425	746	211	108	6 309	8 853	1 938	318	255	229	139	1 111	135	84	5 453	491
Gram-positive cocci	50.5	62.7	41.4	58.3	40.7	44.8	60.7	35.1	47.5	48.6	40.2	33.1	42.8	42.2	32.1	46.9	53.4
Staphylococcus aureus	10.9	5.8	6.8	6.2	4.6	12.7	14.5	10.5	4.4	7.1	6.6	10.8	13.2	26.7	3.6	5.0	15.5
Coagulase-negative staphylococci	23.8	28.0	17.3	39.3	17.6	18.1	28.1	14.4	28.0	29.4	15.3	3.6	18.5	9.6	13.1	28.9	16.1
Staphylococcus epidermidis	8.3	25.2	1.2	25.1	7.4	11.9	0.0	0.0	13.5	2.0	9.2	0.0	10.9	1.5	2.4	16.4	9.0
Staphylococcus haemolyticus	0.8	2.8	0.0	5.7	1.9	1.7	0.0	0.0	5.7	0.0	2.6	0.0	3.0	0.0	0.0	0.0	1.2
Other coagulase-negative staphylococci	2.8	0.0	16.1	8.5	8.3	4.5	<0.1	0.0	7.9	15.3	3.5	3.6	4.6	0.0	6.0	3.6	1.6
Coagulase-neg. staphylococci, not specified	11.9	0.0	0.0	0.0	0.0	0.0	28.1	14.4	0.9	12.2	0.0	0.0	0.0	8.1	4.8	8.9	4.3
Streptococcus species	1.3	2.1	1.9	0.0	0.0	2.6	0.4	0.8	0.6	2.7	0.9	2.2	1.0	0.0	1.2	1.3	4.1
Streptococcus pneumoniae	0.2	0.4	0.0	0.0	0.0	0.3	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.6
Streptococcus agalactiae (B)	0.1	0.1	0.3	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.7	0.0	0.0	0.0	0.1	0.2
Streptococcus pyogenes (A)	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	<0.1	0.0
Other haemol. Streptococcae (C, G)	0.1	0.1	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Streptococcus species, other	0.6	0.0	0.3	0.0	0.0	1.4	0.0	0.0	0.3	2.7	0.9	0.0	0.4	0.0	1.2	0.9	0.8
Streptococcus species, not specified	0.3	1.5	1.1	0.0	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.1	2.4
Enterococcus species	12.6	10.5	14.1	12.8	15.7	8.4	17.7	8.6	11.9	9.0	17.5	16.5	10.0	5.9	7.1	11.7	11.2
Enterococcus faecalis	4.0	3.2	8.0	10.0	7.4	5.6	0.0	5.4	7.5	4.7	10.9	10.8	4.7	0.7	0.0	6.9	3.5
Enterococcus faecium	2.5	6.0	1.9	2.8	6.5	2.5	0.0	3.0	4.1	3.1	6.1	4.3	4.7	0.0	1.2	4.4	5.5
Enterococcus species, other	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.8	0.4	1.4	0.6	0.0	0.0	0.0	0.0
Enterococcus species, not specified	6.0	1.3	4.2	0.0	1.9	0.2	17.7	0.1	0.0	0.4	0.0	0.0	0.0	5.2	6.0	0.4	2.2
Other Gram-positive cocci	1.8	16.3	1.3	0.0	2.8	3.0	0.0	0.9	2.5	0.4	0.0	0.0	0.2	0.0	7.1	0.0	6.5
Staphylococcus species, not specified	1.7	15.6	1.2	0.0	2.8	3.0	0.0	0.9	1.9	0.4	0.0	0.0	0.0	0.0	6.0	0.0	5.9
Other Gram-positive cocci	0.1	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.2	0.0	1.2	0.0	0.6
Gram-negative cocci	0.1	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Moraxella species, not specified	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-negative cocci	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Gram-positive bacilli	0.4	2.0	0.4	0.0	0.0	0.7	0.3	0.0	0.3	1.2	0.4	0.0	0.0	0.7	0.0	0.2	0.6
Corynebacterium species	0.3	1.5	0.0	0.0	0.0	0.2	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Bacillus species	0.1	0.1	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.2

	EU/EEA	Austria	Belgium	Czech Republic	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Malta	Portugal	Romania	Slovakia	Spain	UK-Scotland
Lactobacillus species	<0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Listeria monocytogenes	<0.1	0.0	0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Other Gram-positive bacilli	0.1	0.3	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gram-positive bacilli, not specified	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.2
Gram-negative bacilli, *Enterobacteriaceae*	25.1	13.3	33.6	23.7	28.7	30.1	19.8	32.8	20.1	26.3	34.1	26.6	28.7	30.4	35.7	25.6	29.7
Citrobacter species	0.6	0.4	0.4	0.9	0.0	1.1	0.4	0.6	0.3	1.6	0.4	1.4	0.6	0.0	0.0	0.6	0.4
Citrobacter freundii	0.2	0.4	0.3	0.5	0.0	0.5	0.0	0.0	0.3	1.6	0.0	0.0	0.3	0.0	0.0	0.4	0.2
Citrobacter koseri (e.g. *diversus*)	0.1	0.1	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	0.0	0.2
Citrobacter species, other	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Citrobacter species, not specified	0.2	0.0	0.1	0.0	0.0	0.0	0.4	0.6	0.0	0.0	0.0	0.7	0.4	0.0	0.0	0.2	0.0
Enterobacter species	5.3	2.8	7.4	2.4	8.3	7.9	3.9	5.0	2.2	5.1	7.4	7.2	6.8	2.2	3.6	5.2	5.1
Enterobacter cloacae	2.5	2.2	4.4	2.4	6.5	5.3	0.0	0.0	1.6	0.8	6.1	6.5	4.4	1.5	2.4	3.6	2.4
Enterobacter aerogenes	1.0	0.4	2.7	0.0	0.9	2.3	0.0	0.0	0.3	3.1	0.9	0.7	2.3	0.0	1.2	1.4	0.4
Enterobacter agglomerans	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Enterobacter sakazakii	<0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enterobacter gergoviae	<0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Enterobacter species, other	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Enterobacter species, not specified	1.7	0.2	0.0	0.0	0.9	0.0	3.9	5.0	0.3	0.0	0.4	0.0	0.2	0.7	0.0	0.1	1.6
Escherichia coli	7.1	3.7	9.8	5.2	2.8	9.8	6.5	6.1	3.8	5.1	11.8	1.4	5.5	5.9	6.0	6.3	10.4
Klebsiella species	7.6	4.1	9.1	11.8	11.1	6.4	5.5	16.5	11.0	10.2	11.8	9.4	9.5	17.8	23.8	8.3	8.1
Klebsiella pneumoniae	3.7	2.7	6.6	11.4	9.3	4.9	0.0	0.0	11.0	5.1	7.4	9.4	8.2	12.6	21.4	6.6	3.5
Klebsiella oxytoca	0.9	1.3	2.5	0.5	1.9	1.4	0.0	0.0	0.0	3.9	4.4	0.0	1.3	0.0	0.0	1.6	1.2
Klebsiella species, other	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Klebsiella species, not specified	3.0	0.2	0.0	0.0	0.0	0.0	5.5	16.5	0.0	0.4	0.0	0.0	0.1	5.2	2.4	0.1	3.5
Proteus species	1.2	0.4	1.9	0.9	2.8	1.4	1.1	1.5	1.3	1.6	0.4	0.7	1.4	0.7	1.2	1.4	0.6
Proteus mirabilis	0.7	0.4	1.3	0.9	2.8	1.3	0.0	0.0	1.3	1.6	0.4	0.7	1.4	0.7	1.2	1.3	0.4
Proteus vulgaris	<0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Proteus species, other	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Proteus species, not specified	0.5	0.0	0.4	0.0	0.0	0.0	1.1	1.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2
Serratia species	2.2	1.3	3.9	2.4	2.8	1.8	1.9	3.1	1.3	2.7	0.9	2.9	3.6	2.2	0.0	2.5	3.7
Serratia marcescens	0.8	0.0	3.9	2.4	1.9	0.0	0.0	0.0	1.3	2.0	0.9	2.2	3.6	0.0	0.0	2.3	2.6
Serratia liquefaciens	<0.1	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.4	0.0	0.7	0.0	0.0	0.0	0.1	0.2

	EU/EEA	Austria	Belgium	Czech Republic	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Malta	Portugal	Romania	Slovakia	Spain	UK-Scotland
Serratia species, other	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Serratia species, not specified	1.3	1.3	0.0	0.0	0.0	1.8	1.9	3.1	0.0	0.0	0.0	0.0	0.0	2.2	0.0	<0.1	0.8
Other *Enterobacteriaceae*	1.0	0.5	1.2	0.0	0.9	1.6	0.6	0.0	0.3	0.0	1.3	3.6	1.2	1.5	1.2	1.2	1.4
Hafnia species	0.1	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.1	0.4
Morganella species	0.6	0.3	0.8	0.0	0.9	1.1	0.0	0.0	0.0	0.0	0.9	1.4	0.9	0.0	1.2	1.0	0.2
Providencia species	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	2.2	0.0	0.0	0.0	0.1	0.0
Salmonella enteritidis	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Salmonella species, other	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Salmonella species, not specified	0.2	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2
Other *Enterobacteriaceae*	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.4
Enterobacteriaceae, not specified	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Other Gram-negative bacilli	12.4	7.2	11.3	6.6	19.4	12.8	6.0	22.9	23.0	20.8	9.6	33.1	19.4	26.7	32.1	17.2	6.3
Acinetobacter species	3.1	0.6	0.9	1.9	6.5	1.2	1.0	10.3	12.6	11.4	0.0	0.7	5.7	16.3	7.1	5.6	0.8
Acinetobacter baumannii	1.9	0.4	0.7	0.5	6.5	1.2	0.0	0.0	11.6	11.0	0.0	0.7	5.5	1.5	1.2	5.4	0.0
Acinetobacter calcoaceticus	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	1.2	<0.1	0.0
Acinetobacter haemolyticus	<0.1	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acinetobacter lwoffii	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Acinetobacter species, other	<0.1	0.0	0.0	0.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Acinetobacter species, not specified	1.2	0.2	0.3	0.0	0.0	0.0	1.0	10.3	0.3	0.0	0.0	0.0	0.2	14.8	4.8	0.1	0.6
Pseudomonas aeruginosa	7.7	5.0	8.8	3.3	9.3	9.8	4.1	11.0	8.8	5.1	8.7	27.3	11.3	9.6	23.8	9.7	2.0
Pseudomonadaceae family, other	0.1	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.3	0.4	0.0	2.2	0.0	0.0	0.0	0.3	0.4
Pseudomonadaceae family, not specified	0.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.8
Stenotrophomonas maltophilia	1.0	0.6	0.9	1.4	3.7	0.9	0.8	0.9	0.6	2.0	0.9	2.2	1.9	0.7	1.2	1.3	1.0
Burkholderia cepacia	0.1	0.1	0.1	0.0	0.0	0.1	<0.1	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.0	0.1	0.2
Haemophilus species	0.2	0.0	0.0	0.0	0.0	0.3	0.1	0.7	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Haemophilus influenzae	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Haemophilus species, not specified	0.1	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Legionella species	<0.1	0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-negative bacilli	0.2	0.2	0.1	0.0	0.0	0.3	0.0	0.0	0.6	1.6	0.0	0.7	0.0	0.0	0.0	0.1	1.0
Achromobacter species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Aeromonas species	<0.1	0.0	0.1	0.0	0.0	<0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alcaligenes species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0

	EU/EEA	Austria	Belgium	Czech Republic	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Malta	Portugal	Romania	Slovakia	Spain	UK-Scotland
Campylobacter species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Flavobacterium species	<0.1	0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pasteurella species	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gram-negative bacilli, not specified	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
Other Gram-negative bacilli	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.4
Anaerobes	1.2	2.2	2.0	0.0	0.0	2.9	0.3	0.2	0.0	0.8	0.4	0.7	0.2	0.0	0.0	1.0	1.6
Bacteroides species	0.9	0.8	1.6	0.0	0.0	2.3	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.7	1.0
Bacteroides fragilis	0.5	0.5	1.5	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.6	0.4
Bacteroides species, other	0.2	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.4
Bacteroides species, not specified	0.1	0.3	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Clostridium difficile	<0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other anaerobes	0.3	1.4	0.4	0.0	0.0	0.6	0.0	0.2	0.0	0.8	0.4	0.7	0.0	0.0	0.0	0.3	0.6
Clostridium species, other	0.1	0.1	0.3	0.0	0.0	0.1	0.0	0.2	0.0	0.8	0.4	0.0	0.0	0.0	0.0	0.1	0.2
Propionibacterium species	0.1	0.9	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prevotella species	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Anaerobes, not specified	<0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Other anaerobes	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0
Other bacteria	1.6	0.4	0.0	0.0	0.0	0.1	4.3	2.6	0.3	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.0
Mycobacterium, atypical	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlamydia species	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mycoplasma species	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Actinomyces species	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Nocardia species	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Other bacteria	0.2	0.1	0.0	0.0	0.0	0.1	0.0	2.6	0.3	0.0	0.0	0.0	0.4	0.0	0.0	0.1	0.0
Other bacteria, not specified	1.4	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fungi	8.6	11.8	11.3	11.4	11.1	8.3	8.6	6.2	8.8	2.4	15.3	6.5	8.5	0.0	0.0	8.8	8.1
Candida species	8.2	11.6	10.6	11.4	11.1	8.1	7.9	6.2	8.8	2.0	14.4	6.5	8.0	0.0	0.0	8.7	7.7
Candida albicans	5.1	6.9	4.8	8.1	10.2	4.9	5.9	3.9	3.8	0.8	8.7	4.3	4.4	0.0	0.0	4.4	2.6
Candida glabrata	0.6	0.0	4.3	0.9	0.0	0.8	0.0	0.0	0.3	0.4	2.2	0.7	1.0	0.0	0.0	0.9	1.6
Candida krusei	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Candida parapsilosis	0.2	0.0	0.4	1.4	0.9	0.4	0.0	0.0	2.5	0.0	2.2	0.7	1.3	0.0	0.0	0.0	0.0
Candida tropicalis	0.2	0.0	0.1	0.5	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0

	EU/EEA	Austria	Belgium	Czech Republic	Estonia	France	Germany	Italy-GiViTI	Italy-SPIN-UTI	Lithuania	Luxembourg	Malta	Portugal	Romania	Slovakia	Spain	UK-Scotland
Candida species, other	0.9	0.0	0.5	0.5	0.0	1.5	0.0	2.1	0.9	0.0	1.3	0.0	0.0	0.0	0.0	2.0	0.4
Candida species, not specified	1.1	4.7	0.4	0.0	0.0	0.0	2.0	0.2	0.9	0.8	0.0	0.7	1.2	0.0	0.0	0.5	3.1
Aspergillus species	<0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0
Aspergillus fumigatus	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	<0.1	0.0
Aspergillus niger	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1	0.0
Aspergillus species, not specified	<0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other fungi or parasites	0.3	0.1	0.7	0.0	0.0	0.2	0.6	0.0	0.0	0.4	0.9	0.0	0.4	0.0	0.0	0.1	0.4
Other yeasts	0.1	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.4
Fungi other	0.2	0.0	0.4	0.0	0.0	0.0	0.6	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Filaments other	<0.1	0.1	0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.9	0.0	0.1	0.0	0.0	0.0	0.0
Other fungi or parasites	<0.1	0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Virus	0.1	0.4	0.0	0.0	0.0	<0.1	<0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Cytomegalovirus (CMV)	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Herpes simplex virus	<0.1	0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Influenza virus, not specified	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Virus, not specified	<0.1	0.1	0.0	0.0	0.0	0.0	<0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Negative codes	3.6	1.0	0.4	0.0	1.8	0.3	4.3	1.1	17.8	14.7	2.1	0.7	2.0	10.6	0.0	6.3	11.4
Micro-organism not identified	2.4	0.0	0.3	0.0	0.9	0.2	3.6	0.0	0.3	1.0	0.9	0.7	0.0	3.3	0.0	5.4	3.4
Examination not done	<0.1	0.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sterile examination	0.2	1.0	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.7	0.0
Not (yet) available/missing	1.0	0.0	0.1	0.0	0.9	0.0	0.7	1.1	17.6	12.0	1.3	0.0	2.0	7.3	0.0	0.2	7.9

*Data source: ECDC, HAI-Net ICU 2008–2012. Distribution of microorganisms: percentage of total number of reported microorganisms, excluding negative codes; *Distribution of negative codes: percentage of all reported codes; Italy-GiViTI network: only 2011-2012 data because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011.*

Table A.1.7. Detailed distribution of microorganisms (%) isolated in ICU-acquired urinary tract infections by country/network, 2008–2012

	EU/EEA	Austria	Belgium	Estonia	France	Germany	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain
Number of HAIs	15 508	1 987	233	71	5 877	2 412	168	236	221	345	123	131	3 704
HAIs with microorganisms (%)	96.4	99.9	94.4	94.4	99.6	92.0	75.6	95.3	98.6	95.9	93.5	95.4	93.5
Number of microorganisms	16 870	2 338	231	70	6 489	2 654	162	277	271	366	115	156	3 741
Gram-positive cocci	20.5	27.7	18.6	24.3	17.4	26.0	21.0	18.1	29.2	15.3	18.3	13.5	17.9
Staphylococcus aureus	1.1	1.0	0.9	1.4	1.4	1.2	3.7	0.4	1.8	0.8	7.0	0.0	0.5
Coagulase-negative staphylococci	1.9	3.4	1.7	1.4	1.8	1.4	2.5	1.1	1.1	0.5	0.0	0.0	2.0
Staphylococcus epidermidis	1.0	2.5	0.9	0.0	0.9	0.0	1.9	0.4	0.7	0.3	0.0	0.0	1.3
Staphylococcus haemolyticus	0.3	0.9	0.4	0.0	0.5	0.0	0.6	0.0	0.4	0.3	0.0	0.0	0.0
Other coagulase-negative staphylococci	0.2	0.0	0.4	0.0	0.4	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.2
Coagulase-neg. staphylococci, not specified	0.3	0.0	0.0	1.4	0.0	1.4	0.0	0.4	0.0	0.0	0.0	0.0	0.5
Streptococcus species	0.5	0.5	0.9	0.0	0.8	0.1	0.0	0.0	0.4	0.0	0.9	1.9	0.5
Streptococcus agalactiae (B)	0.2	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.2
Streptococcus pyogenes (A)	<0.1	0.0	0.0	0.0	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	<0.1
Other haemol. Streptococcae (C, G)	0.1	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Streptococcus species, other	0.2	0.0	0.9	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2
Streptococcus species, not specified	<0.1	0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.9	1.3	<0.1
Enterococcus species	16.2	19.3	15.2	21.4	12.9	23.2	14.8	16.6	25.8	13.9	10.4	11.5	15.0
Enterococcus faecalis	7.5	10.0	7.8	10.0	7.8	0.0	11.7	9.0	18.5	10.7	0.0	0.6	10.0
Enterococcus faecium	3.0	6.8	0.4	8.6	2.6	0.0	3.1	4.7	7.0	3.3	0.0	0.0	3.4
Enterococcus species, other	0.3	0.0	0.9	0.0	0.7	0.0	0.0	1.8	0.4	0.0	0.0	0.0	0.0
Enterococcus species, not specified	5.3	2.5	6.1	2.9	1.8	23.2	0.0	1.1	0.0	0.0	10.4	10.9	1.6
Other gram-positive cocci	0.7	3.6	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Staphylococcus species, not specified	0.6	3.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-positive cocci	0.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gram-negative cocci	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gram-positive bacilli	0.2	0.5	0.0	0.0	0.2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.1
Corynebacterium species	0.1	0.4	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.1
Lactobacillus species	<0.1	0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-positive bacilli	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gram-negative bacilli, Enterobacteriaceae	45.3	27.6	55.4	45.7	52.6	48.6	39.5	38.3	46.9	44.3	34.8	41.0	42.0
Citrobacter species	1.4	0.7	0.9	0.0	2.0	1.4	0.6	0.0	1.5	0.8	0.0	0.6	0.9

	EU/EEA	Austria	Belgium	Estonia	France	Germany	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain
Citrobacter freundii	0.5	0.3	0.9	0.0	0.9	0.0	0.6	0.0	0.4	0.8	0.0	0.6	0.3
Citrobacter koseri (e.g. *diversus)*	0.4	0.3	0.0	0.0	1.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
Citrobacter species, other	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<0.1
Citrobacter species, not specified	0.3	0.1	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Enterobacter species	4.4	3.0	6.1	4.3	5.5	5.0	3.7	2.9	5.9	5.2	0.0	2.6	3.1
Enterobacter cloacae	2.4	2.4	2.2	4.3	3.5	0.0	1.9	0.4	4.4	3.6	0.0	0.6	2.1
Enterobacter aerogenes	0.9	0.5	3.9	0.0	1.4	0.0	1.2	0.7	1.5	1.4	0.0	0.6	0.8
Enterobacter agglomerans	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Enterobacter species, other	0.2	0.0	0.0	0.0	0.5	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0
Enterobacter species, not specified	0.9	0.1	0.0	0.0	0.0	5.0	0.6	0.7	0.0	0.3	0.0	1.3	0.1
Escherichia coli	26.3	15.1	28.6	18.6	32.4	27.4	17.9	17.0	26.9	21.6	9.6	9.6	24.5
Klebsiella species	7.4	5.0	10.8	21.4	6.7	8.0	11.1	8.7	8.1	8.7	25.2	23.7	7.4
Klebsiella pneumoniae	4.8	3.8	6.5	18.6	5.1	0.0	10.5	7.6	7.0	8.5	19.1	16.0	6.1
Klebsiella oxytoca	1.1	1.1	4.3	2.9	1.5	0.0	0.6	0.7	1.1	0.0	0.9	0.6	1.0
Klebsiella species, other	<0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Klebsiella species, not specified	1.4	0.1	0.0	0.0	0.0	8.0	0.0	0.4	0.0	0.3	5.2	7.1	0.2
Proteus species	3.8	2.6	6.9	1.4	3.6	4.8	1.9	7.9	2.6	5.5	0.0	4.5	3.7
Proteus mirabilis	2.7	2.2	5.2	1.4	3.2	0.0	1.9	6.1	2.6	5.5	0.0	4.5	3.4
Proteus vulgaris	0.1	0.0	1.3	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.2
Proteus species, other	0.2	0.0	0.0	0.0	0.4	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.1
Proteus species, not specified	0.8	0.3	0.4	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Serratia species	0.7	0.4	0.4	0.0	0.6	1.1	0.0	1.1	0.7	0.0	0.0	0.0	1.0
Serratia marcescens	0.2	0.0	0.4	0.0	0.0	0.0	0.0	1.1	0.4	0.0	0.0	0.0	0.9
Serratia liquefaciens	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Serratia species, other	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Serratia species, not specified	0.5	0.4	0.0	0.0	0.6	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Other *Enterobacteriaceae*	1.4	0.8	1.7	0.0	1.8	0.8	4.3	0.7	1.1	2.5	0.0	0.0	1.4
Hafnia species	0.1	<0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Morganella species	1.0	0.6	1.7	0.0	1.4	0.0	1.9	0.4	1.1	1.9	0.0	0.0	1.1
Providencia species	0.1	0.1	0.0	0.0	0.1	0.0	2.5	0.4	0.0	0.3	0.0	0.0	0.1
Salmonella species, other	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salmonella species, not specified	0.1	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0

	EU/EEA	Austria	Belgium	Estonia	France	Germany	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain
Other *Enterobacteriaceae*	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enterobacteriaceae, not specified	0.1	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-negative bacilli	15.8	15.4	14.3	10.0	15.3	14.5	24.1	19.9	15.1	18.9	47.0	28.8	15.5
Acinetobacter species	1.3	0.5	0.0	1.4	0.5	0.3	8.0	9.7	0.0	3.0	15.7	5.1	2.4
Acinetobacter baumannii	1.0	0.4	0.0	1.4	0.4	0.0	8.0	8.7	0.0	3.0	0.0	1.3	2.3
Acinetobacter species, other	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acinetobacter species, not specified	0.2	0.1	0.0	0.0	0.0	0.3	0.0	1.1	0.0	0.0	15.7	3.8	0.1
Pseudomonas aeruginosa	13.9	14.3	13.0	8.6	14.1	14.1	14.2	9.4	15.1	15.6	30.4	23.1	12.6
Pseudomonadaceae family, other	0.1	0.0	0.0	0.0	0.2	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.1
Pseudomonadaceae family, not specified	<0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.6	0.0
Stenotrophomonas maltophilia	0.3	0.3	0.9	0.0	0.4	0.1	0.6	0.4	0.0	0.3	0.0	0.0	0.4
Burkholderia cepacia	<0.1	<0.1	0.0	0.0	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Haemophilus species	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Haemophilus influenzae	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Haemophilus species, not specified	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Legionella species	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Gram-negative bacilli	<0.1	0.0	0.4	0.0	0.1	0.0	0.6	0.0	0.0	0.0	0.0	0.0	<0.1
Achromobacter species	<0.1	0.0	0.4	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alcaligenes species	<0.1	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	<0.1
Other Gram-negative bacilli	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anaerobes	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bacteroides species	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bacteroides fragilis	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bacteroides species, other	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other anaerobes	<0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Propionibacterium species	<0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prevotella species	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other bacteria	0.2	0.1	0.0	0.0	<0.1	0.9	0.0	0.7	0.0	0.5	0.0	0.0	0.0
Chlamydia species	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other bacteria	<0.1	0.1	0.0	0.0	<0.1	0.0	0.0	0.4	0.0	0.5	0.0	0.0	0.0
Other bacteria, not specified	0.1	0.0	0.0	0.0	0.0	0.9	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Fungi	18.0	28.7	11.7	20.0	14.2	10.1	15.4	22.7	8.9	21.0	0.0	16.7	24.5

	EU/EEA	Austria	Belgium	Estonia	France	Germany	Italy-SPIN-UTI	Lithuania	Luxembourg	Portugal	Romania	Slovakia	Spain
Candida species	17.5	28.7	8.2	20.0	13.6	9.0	15.4	22.7	8.9	21.0	0.0	16.7	24.4
Candida albicans	11.1	17.0	8.2	15.7	9.8	6.7	6.2	15.2	5.2	13.7	0.0	8.3	13.6
Candida glabrata	1.3	0.0	0.0	2.9	0.8	0.0	4.9	1.4	1.5	0.5	0.0	1.3	3.7
Candida krusei	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Candida parapsilosis	0.2	0.0	0.0	0.0	0.2	0.0	0.6	0.0	0.0	3.6	0.0	1.3	0.0
Candida tropicalis	0.6	0.0	0.0	0.0	0.4	0.0	0.6	0.0	1.1	0.5	0.0	0.6	1.7
Candida species, other	1.4	0.0	0.0	0.0	2.2	0.0	1.2	5.4	0.4	0.0	0.0	0.0	1.9
Candida species, not specified	2.8	11.7	0.0	1.4	0.0	2.3	1.9	0.7	0.7	2.7	0.0	5.1	2.9
Aspergillus species	<0.1	0.0	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other fungi or parasites	0.5	0.0	3.5	0.0	0.5	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Other yeasts	0.2	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fungi other	0.2	0.0	3.5	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Negative codes	3.2	<0.1	5.3	5.4	0.3	6.8	20.2	3.8	1.1	3.7	6.5	3.7	6.1
Micro-organism not identified	2.1	0.0	0.0	5.4	0.2	4.2	0.0	0.7	0.4	0.0	3.3	0.0	5.3
Examination not done	0.1	0.0	0.0	0.0	0.1	0.0	0.5	1.7	0.0	0.0	0.0	0.0	0.0
Sterile examination	0.2	<0.1	0.0	0.0	<0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
Not (yet) available/missing	0.9	0.0	5.3	0.0	0.0	2.6	19.7	1.4	0.7	3.7	3.3	3.7	0.1

*Data source: ECDC, HAI-Net ICU 2008–2012. Distribution of microorganisms: percentage of total number of reported microorganisms, excluding negative codes; *Distribution of negative codes: percentage of all reported codes; Italy-GiViTI network: only 2010 data available for urinary tract infections, which were excluded because* Candida *species,* Enterobacter *species,* Stenotrophomonas maltophilia *and* Serratia *species were not specified in this network before 2011. Croatia excluded because of too small numbers.*

Table A.1.8. Detailed antimicrobial resistance data, by microorganism, 2008–2012

Microorganism(s) and antimicrobial category	N tested 2008–2012	N NS	% NS	Countries - networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality (unadjusted)	
						S	NS
Gram-positive cocci							
Staphylococcus aureus							
Aminoglycosides	1 308	128	9.8	BE, ES, IT-S, MT, PT, SK, SE	n.s.	35.1	30.5
Ansamycins (rifampin/rifampicin)	620	24	3.9	ES, IT-S	n.s.	34.5	26.1
Anti-staphylococcal beta-lactamse	6 938	2 392	34.5	AT, BE, EE, ES, FR, IT-G, IT-S, LT, MT, PT, RO, SK, SE, UK-SC	↓ <0.001	25.9	36.7
Fluoroquinolones	1 030	346	33.6	BE, ES, IT-S, MT, PT, SK	n.s.	31.4	41.7
Folate pathway inhibitors	1 133	31	2.7	BE, ES, IT-S, MT, PT, SE	↓ <0.05	33.3	44.8
Fucidanes	213	15	7.0	BE, IT-S, MT, SE	n.s.		
Glycopeptides	5 903	105	1.8	AT, BE, EE, ES, FR, IT-G, IT-S, LT, MT, PT	↑ <0.05	30.5	32.4
Glycylcyclines	155	3	1.9	ES	n.s.	36.2	33.3
Lincosamides	296	69	23.3	BE, IT-S, MT, SE	↓ <0.05	32.9	46.9
Macrolides	292	79	27.1	BE, IT-S, MT, SE	↓ <0.01	33.3	41.8
Oxazolidinones	873	12	1.4	BE, ES, IT-S, PT, SE	n.s.	34.6	18.2
Phosphonic acid	48	7	14.6	IT-S, MT	↓ <0.05	34.6	50
Streptogramins	14	0	0.0	IT-S	n.s.	42.9	-
Tetracyclines	214	13	6.1	BE, IT-S, MT	n.s.	36.6	22.2
Coagulase-negative staphylococci							
Aminoglycosides	1 565	973	62.2	BE, ES, IT-S, PT, SK	n.s.	29.3	36.1
Ansamycins (rifampin/rifampicin)	1 033	281	27.2	ES, IT-S	n.s.	33.0	37.7
Anti-staphylococcal beta-lactams	2 263	1 936	85.6	BE, EE, ES, IT-G, IT-S, PT, RO, SK	↓ <0.01	23.0	32.5
Fluoroquinolones	1 245	1 006	80.8	BE, ES, IT-S, PT, SK	n.s.	21.6	36.6
Folate pathway inhibitors	1 509	850	56.3	BE, ES, IT-S, PT	n.s.	28.2	36.7
Fucidanes	191	79	41.4	BE, IT-S	n.s.	25	35.3
Glycopeptides	1 958	122	6.2	BE, EE, ES, IT-S, PT, SK	↑ <0.01	32.7	33.1
Glycylcyclines	295	13	4.4	ES	n.s.	35.9	30.8
Lincosamides	261	183	70.1	BE, IT-S, SK	n.s.	32.1	32.8
Macrolides	268	224	83.6	BE, IT-S, SK	n.s.	19.2	35.2
Oxazolidinones	1 165	138	11.8	BE, ES, IT-S, PT	n.s.	32.4	32.3
Phosphonic acid	47	24	51.1	IT-S	↑ <0.001	38.9	40
Streptogramins	42	6	14.3	IT-S	n.s.	38.2	40
Tetracyclines	223	27	12.1	BE, IT-S	n.s.	35.3	25
Enterococcus species							
Aminoglycosides	235	115	48.9	BE, IT-S, MT, PT, SK	n.s.	34.5	46.1
Carbapenems	75	38	50.7	IT-S, PT	n.s.	22.6	39.4
Fluoroquinolones	911	553	60.7	BE, ES, IT-S, MT, PT, SK	n.s.	22.4	40.3
Glycopeptides	3 961	134	3.4	AT, BE, EE, ES, FR, IT-G, IT-S, MT, PT, SK	n.s.	31.4	40.7
Glycylcyclines	196	4	2.0	ES	-	39.3	25.0
Oxazolidinones	802	26	3.2	BE, ES, IT-S, PT	n.s.	37.4	42.3
Penicillins	3 903	1 355	34.7	AT, BE, EE, ES, FR, IT-G, IT-S, MT, PT, RO, SK	n.s.	26.0	40.7
Streptogramins	44	26	59.1	IT-S, MT	n.s.	46.2	18.2
Tetracyclines	93	62	66.7	BE, IT-S, MT, SK	n.s.	69.6	30.4
Enterococcus faecalis							
Aminoglycosides	133	56	42.1	BE, IT-S, MT, PT	n.s.	26.8	57.9
Carbapenems	43	11	25.6	IT-S, PT	n.s.	21.4	30.0

Microorganism(s) and antimicrobial category	N tested 2008–2012	N NS	% NS	Countries - networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality (unadjusted)	
						S	NS
Fluoroquinolones	561	270	48.1	BE, ES, IT-S, MT, PT	n.s.	21.1	35.6
Glycopeptides	2 528	45	1.8	AT, BE, EE, ES, FR, IT-G, IT-S, MT, PT	n.s.	27.9	52.4
Glycylcyclines	102	1	1.0	ES	-	31.3	-
Oxazolidinones	449	11	2.4	BE, ES, IT-S, PT	n.s.	32.6	27.3
Penicillins	2 533	324	12.8	AT, BE, EE, ES, FR, IT-G, IT-S, MT, PT, RO	n.s.	25.9	41.2
Streptogramins[a]	25	22	88.0	IT-S, MT	n.s.	-	-
Tetracyclines	50	35	70.0	BE, IT-S, MT, SK	n.s.	81.8	30.4
Enterococcus faecium							
Aminoglycosides	51	25	49.0	IT-S, PT	n.s.	53.9	36.8
Carbapenems[a]	24	23	95.8	IT-S, PT	-	-	-
Fluoroquinolones	272	238	87.5	IT-S, ES, PT	n.s.	40.6	48.1
Glycopeptides	1 271	66	5.2	AT, BE, EE, ES, FR, IT-G, IT-S, PT	n.s.	38.6	33.3
Glycylcyclines	75	3	4.0	ES	-	53.6	-
Oxazolidinones	297	12	4.0	ES, IT-S, PT	n.s.	46.4	66.7
Penicillins	1 222	968	79.2	AT, BE, EE, ES, FR, IT-G, IT-S, MT, PT, RO, SK	n.s.	27.0	40.7
Streptogramins	16	3	18.8	IT-S	-	-	-
Tetracyclines	18	5	27.8	BE, IT-S, MT, SK	n.s.	-	-
Enterobacteriaceae							
Enterobacteriaceae, all							
Aminoglycosides	6 106	991	16.2	BE, EE, ES, IT-S, MT, PT, SK, SE	↑ <0.001	28.1	40
Antipseudomonal penicillins + inhibitor	3 988	1 004	25.2	BE, EE, ES, IT-S, MT, PT, SK, SE	n.s.	30	36.3
Carbapenems	9 535	301	3.2	BE, EE, ES, FR, IT-G, IT-S, LT, MT, PT, RO, SK, SE	↑ <0.001	30	40.8
Cephalosporins,1st- and 2nd-generation	2 105	1 217	57.8	BE, EE, IT-S, MT, PT, SK, SE	n.s.	25.8	33.5
Cephalosporins, 3rd- and 4th-generation	19 946	6 207	31.1	AT, BE, EE, ES, FR, IT-G, IT-S, LT, LU, MT, PT, RO, SK, SE	↑ <0.001	26.3	34.4
Fluoroquinolones	6 238	1 750	28.1	BE, ES, IT-S, MT, PT, SK, SE	↑ <0.01	27.8	36.8
Folate pathway inhibitors	1 770	506	28.6	BE, IT-S, MT, PT, SK, SE	n.s.	28.1	31.2
Penicillins	9 573	7 281	76.1	AT, BE, FR, IT-S, MT, PT, SK, SE	↑ <0.05	23.7	28.9
Penicillins + lactamase inhibitor	6 362	3 506	55.1	BE, EE, ES, IT-S, MT, PT, RO, SK	n.s.	27.3	30.8
Phosphonic acids	53	14	26.4	IT-S	n.s.	13.5	14.3
Polymyxins	271	50	18.5	BE, IT-S, PT, RO, SK	n.s.	37.8	25.6
Escherichia coli							
Aminoglycosides	2 007	308	15.3	BE, ES, IT-S, PT, SK	↑ <0.05	27.2	39.5
Antipseudomonal penicillins + inhibitor	1 263	241	19.1	BE, ES, IT-S	n.s.	27.1	36
Carbapenems	3 274	42	1.3	BE, EE, ES, FR, IT-S, LT, PT, SK	n.s.	28.7	42.9
Cephalosporins,1st- and 2nd-generation	555	184	33.2	BE, IT-S, PT, SK	n.s.	27.9	36
Cephalosporins, 3rd- and 4th-generation	7 371	1 574	21.4	AT, BE, EE, ES, FR, IT-G, IT-S, MT, PT, RO, SK	↑ <0.001	25.2	33.4
Fluoroquinolones	2 096	818	39.0	BE, ES, IT-S, PT, SK	↑ <0.01	25.2	34.7
Folate pathway inhibitors	479	184	38.4	BE, IT-S, PT, SK	n.s.	28.1	33.3
Penicillins	3 667	2 282	62.2	AT, BE, FR, IT-S, PT, SK	n.s.	22.6	27.3
Penicillins + beta-lactamase inhibitor	2 166	844	39.0	BE, EE, ES, IT-S, PT, SK	↑ <0.05	25.5	32.7

Microorganism(s) and antimicrobial category	N tested 2008–2012	N NS	% NS	Countries - networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality (unadjusted)	
						S	NS
Phosphonic acids	24	1	4.2	IT-S	-	-	-
Polymyxins	68	9	13.2	BE, IT-S, SK	-	-	-
Klebsiella species							
Aminoglycosides	1 716	446	26.0	BE, ES, IT-S, MT, PT, SK, SE	n.s.	30	38.7
Antipseudomonal penicillins + inhibitor	1 104	416	37.7	BE, ES, IT-S, MT, SK	↑ <0.05	33.6	35.8
Carbapenems	2 392	112	4.7	BE, EE, ES, FR, IT-S, LT, MT, PT, SK	↑ <0.001	32.4	43.8
Cephalosporins,1st- and 2nd-generation	651	337	51.8	BE, IT-S, MT, PT, SK, SE	n.s.	25.6	32
Cephalosporins, 3rd- and 4th-generation	5 069	2 021	39.9	AT, BE, EE, ES, FR, IT-G, IT-S, LT, MT, PT, RO, SK, SE	↑ <0.001	28.1	37.7
Fluoroquinolones	1 721	625	36.3	BE, ES, IT-S, MT, PT, SK, SE	n.s.	30	37.8
Folate pathway inhibitors	526	187	35.6	BE, IT-S, MT, PT, SK, SE	n.s.	28.6	29.0
Penicillins[a]	2 159	1 939	89.8	AT, BE, FR, IT-S, MT, PT, SK, SE	n.s.	30.7	30.5
Penicillins + beta-lactamase inhibitor	1 743	819	47.0	BE, EE, ES, IT-S, MT, PT, RO, SK	↑ <0.05	29	32.9
Phosphonic acids	15	6	40.0	IT-S	-	-	-
Polymyxins	142	11	7.7	IT-S, SK	↑ <0.01	38.6	27.3
Klebsiella pneumoniae							
Aminoglycosides	1 332	404	30.3	BE, ES, IT-S, MT, PT, SK	n.s.	30.7	39.6
Antipseudomonal penicillins + inhibitor	850	330	38.8	BE, ES, IT-S, MT, SK	↑ <0.01	33.3	37.7
Carbapenems	1 859	94	5.1	BE, EE, ES, FR, IT-S, LT, MT, PT, SK	↑ <0.01	33.3	50
Cephalosporins,1st- and 2nd-generation	477	253	53.0	BE, IT-S, MT, PT, SK	n.s.	24.8	32.5
Cephalosporins, 3rd- and 4th-generation	3 130	1 306	41.7	AT, BE, EE, ES, FR, IT-S, MT, PT, RO, SK	↑ <0.001	29.7	37.8
Fluoroquinolones	1 336	541	40.5	BE, ES, IT-S, MT, PT, SK	n.s.	30.3	39.4
Folate pathway inhibitors	388	149	38.4	BE, IT-S, MT, PT, SK	n.s.	27.7	30.0
Penicillins[a]	1 547	1 387	89.7	AT, BE, FR, IT-S, MT, PT, SK	n.s.	30.9	31.8
Penicillins + beta-lactamase inhibitor	1 353	661	48.9	BE, EE, ES, IT-S, MT, PT, RO, SK	↑ <0.01	29	35.4
Phosphonic acids	15	6	40.0	IT-S	-	-	-
Polymyxins	129	11	8.5	IT-S, SK	↑ <0.01	38.1	27.3
Klebsiella oxytoca							
Aminoglycosides	337	18	5.3	BE, ES, PT	n.s.	28.6	27.8
Antipseudomonal penicillins + inhibitor	234	76	32.5	BE, ES	n.s.	33.9	23.1
Carbapenems	479	14	2.9	BE, EE, ES, FR, PT	n.s.	28.1	-
Cephalosporins,1st- and 2nd-generation	154	68	44.2	BE, PT	n.s.	26.9	29
Cephalosporins, 3rd- and 4th-generation	904	220	24.3	AT, BE, EE, ES, FR, PT	↑ <0.001	27.8	25.5
Fluoroquinolones	338	58	17.2	BE, ES, PT	n.s.	29.2	22.2
Folate pathway inhibitors	113	21	18.6	BE, PT	n.s.	29.4	27.3
Penicillins[a]	547	494	90.3	AT, BE, FR, PT	n.s.	26.1	28.1
Penicillins + beta-lactamase inhibitor	346	133	38.4	BE, ES, PT	n.s.	29.2	20.6
Enterobacter species							
Aminoglycosides	1 157	89	7.7	BE, ES, IT-S, MT, PT	n.s.	26.8	44.3

Microorganism(s) and antimicrobial category	N tested 2008–2012	N NS	% NS	Countries - networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality (unadjusted)	
						S	NS
Antipseudomonal penicillins + inhibitor	810	276	34.1	BE, ES, IT-S, MT	n.s.	27.6	40.2
Carbapenems	1 927	82	4.3	BE, EE, ES, FR, IT-S, PT	n.s.	31.2	33.8
Cephalosporins,1st- and 2nd-generation[a]	433	390	90.1	BE, IT-S, PT	-	-	-
Cephalosporins, 3rd- and 4th-generation	3 687	1 850	50.2	AT, BE, EE, ES, FR, IT-G, IT-S, LT, MT, PT	n.s.	24.5	32.6
Fluoroquinolones	1 163	165	14.2	BE, ES, IT-S, MT, PT	n.s.	27.3	39.8
Folate pathway inhibitors	382	61	16.0	BE, IT-S, MT, PT	n.s.	27.5	28.6
Penicillins[a]	1 878	1 707	90.9	AT, BE, FR, IT-S, PT	-	-	-
Penicillins + beta-lactamase inhibitor[a]	1 216	1 118	91.9	BE, EE, ES, IT-S, MT, PT	-	-	-
Polymyxins	31	4	12.9	IT-S	n.s.	-	-
Enterobacter cloacae							
Aminoglycosides	745	62	8.3	BE, ES, IT-S, PT	n.s.	26.9	45.8
Antipseudomonal penicillins + inhibitor	533	170	31.9	BE, ES, IT-S	n.s.	28.7	44.9
Carbapenems	1 249	45	3.6	BE, EE, ES, FR, IT-S, PT	n.s.	32.4	33.3
Cephalosporins,1st- and 2nd-generation[a]	272	245	90.1	BE, IT-S, PT	-	-	-
Cephalosporins, 3rd- and 4th-generation	2 266	1 226	54.1	AT, BE, EE, ES, FR, IT-S, PT	↑ <0.01	24.5	34.2
Fluoroquinolones	745	90	12.1	BE, ES, IT-S, PT	n.s.	27.1	44.1
Folate pathway inhibitors	230	35	15.2	BE, IT-S, PT	n.s.	25.6	-
Penicillins[a]	1 210	1 123	92.8	AT, BE, FR, IT-S, PT	-	-	-
Penicillins + beta-lactamase inhibitor[a]	769	724	94.1	BE, EE, ES, IT-S, PT	-	-	-
Polymyxins	24	3	12.5	IT-S, SK	n.s.	-	-
Enterobacter aerogenes							
Aminoglycosides	370	21	5.7	BE, ES, PT	n.s.	26.7	26.7
Antipseudomonal penicillins + inhibitor	251	100	39.8	BE, ES, IT-S	n.s.	26.9	32.8
Carbapenems	608	32	5.3	BE, ES, FR, PT	n.s.	29.2	31
Cephalosporins,1st- and 2nd-generation[a]	153	137	89.5	BE, PT	-	-	-
Cephalosporins, 3rd- and 4th-generation	1 091	547	50.1	AT, BE, ES, FR, PT	n.s.	25.1	29.3
Fluoroquinolones	371	64	17.3	BE, ES	↓ <0.05	28.9	23.5
Folate pathway inhibitors	143	23	16.1	BE, PT	↓ <0.05	28.6	28.6
Penicillins[a]	596	536	89.9	AT, BE, FR, PT	-	-	-
Penicillins + beta-lactamase inhibitor[a]	396	359	90.7	BE, ES, PT	-	-	-
Serratia species							
Aminoglycosides	513	60	11.7	BE, ES, IT-S, PT	↑ <0.01	28.9	40.7
Antipseudomonal penicillins + inhibitor	365	49	13.4	BE, ES	n.s.	35.7	25
Carbapenems	729	23	3.2	BE, ES, FR, IT-S, PT	↑ <0.01	32.3	34.8
Cephalosporins,1st- and 2nd-generation[a]	180	173	96.1	BE, PT	-	-	-
Cephalosporins, 3rd- and 4th-generation	1 358	319	23.5	AT, BE, ES, FR, IT-G, IT-S, PT	↑ <0.001	29.0	30.9
Fluoroquinolones	525	30	5.7	BE, ES, IT-S, PT	n.s.	30	42.9
Folate pathway inhibitors	152	6	3.9	BE, PT	n.s.	21.7	-
Penicillins[a]	574	507	88.3	AT, BE, FR, IT-S	-	-	-
Penicillins + beta-lactamase inhibitor[a]	491	459	93.5	BE, ES, PT	-	-	-
Proteus species							

Microorganism(s) and antimicrobial category	N tested 2008–2012	N NS	% NS	Countries - networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality (unadjusted)	
						S	NS
Aminoglycosides	458	74	16.2	BE, ES, IT-S, PT, SK	n.s.	27.2	46
Antipseudomonal penicillins + inhibitor	293	13	4.4	BE, ES, IT-S	n.s.	32.9	50
Carbapenems	654	29	4.4	BE, ES, FR, IT-S, PT	n.s.	28	60
Cephalosporins,1st- and 2nd-generation[b]	163	48	29.4	BE, PT, SK	n.s.	25.3	51.9
Cephalosporins, 3rd- and 4th-generation	1 364	135	9.9	AT, BE, ES, FR, IT-G, IT-S, PT	↑ <0.001	26.8	34.3
Fluoroquinolones	478	91	19.0	BE, ES, IT-S, PT, SK	↑ <0.05	27.5	43.3
Folate pathway inhibitors	136	54	39.7	BE, IT-S, PT, SK	↑ <0.05	26.3	34.9
Penicillins[b]	673	294	43.7	AT, BE, FR, IT-S, PT, SK	n.s.	26	26.1
Penicillins + beta-lactamase inhibitor[b]	474	77	16.2	BE, ES, IT-S, PT, RO	n.s.	28.7	43.8
Polymyxins[a]	17	14	82.4	-	-	-	-
Citrobacter species							
Aminoglycosides	188	13	6.9	BE, ES, PT	n.s.	28.3	33.3
Antipseudomonal penicillins + inhibitor	121	17	14.0	BE, ES	n.s.	23.2	20
Carbapenems	380	6	1.6	BE, ES, FR, IT-S, PT	↑ <0.05	23.1	-
Cephalosporins,1st- and 2nd-generation[b]	69	37	53.6	BE, PT	↓ <0.05	16.7	40.9
Cephalosporins, 3rd- and 4th-generation	728	220	30.2	AT, BE, ES, FR, PT	n.s.	25.4	35.6
Fluoroquinolones	191	13	6.8	BE, ES, PT	n.s.	30.2	33.3
Folate pathway inhibitors	50	9	18.0	BE, PT	n.s.	-	-
Penicillins[b]	378	332	87.8	AT, BE, FR	n.s.	25	31.1
Penicillins + beta-lactamase inhibitor	201	116	57.7	BE, ES, PT	n.s.	28.2	30.6
Morganella species							
Carbapenems	190	7	3.7	BE, FR	n.s.	24.2	-
Cephalosporins, 3rd- and 4th-generation	382	100	26.2	BE, FR, PT	↑ <0.001	30.3	26.0
Non-fermentative gram-negative bacteria							
Pseudomonas species							
Aminoglycosides	3 504	801	22.9	BE, ES, IT-G, IT-S, MT, PT, SK	n.s.	37.4	35.3
Antipseudomonal cephalosporins	9 053	2 265	25.0	AT, BE, EE, ES, FR, IT-S, MT, PT, SK	n.s.	33.9	44.9
Antipseudomonal penicillins	4 550	1 895	41.6	AT, BE, EE, FR, IT-S, MT, PT, RO, SK	n.s.	30.6	41
Antipseudomonal penicillins + inhibitor	2 669	623	23.3	BE, EE, ES, IT-S, MT, SK	↑ <0.01	37.6	48
Carbapenems	6 140	2 049	33.4	BE, EE, ES, FR, IT-G, IT-S, MT, PT, RO, SK	n.s.	32.7	41.9
Fluoroquinolones	3 266	1 151	35.2	BE, ES, IT-S, MT, PT, SK	n.s.	35.3	47.3
Phosphonic acids	14	10	71.4	IT-S	-	-	-
Polymyxins	1 817	43	2.4	BE, ES, IT-S, MT, PT, RO, SK	n.s.	40.9	33.3
Acinetobacter species							
Aminoglycosides	1 345	888	66.0	BE, ES, IT-S, PT, SK	n.s.	34.8	46.5
Antipseudomonal penicillins + inhibitor	119	84	70.6	BE, IT-S, SK	n.s.	33.3	50.7
Carbapenems	2 330	1 859	79.8	BE, EE, ES, FR, IT-G, IT-S, LT, PT, RO, SK	↑ <0.05	30.7	43.6
Cephalosporins, 3rd-and 4th-generation	950	695	73.2	AT, BE, FR, IT-S, LT, PT, SK	n.s.	30.7	40.7
Fluoroquinolones	393	333	84.7	BE, IT-S, PT, SK	↑ <0.05	22.2	46

Microorganism(s) and antimicrobial category	N tested 2008–2012	N NS	% NS	Countries - networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality (unadjusted)	
						S	NS
Folate pathway inhibitors	263	197	74.9	BE, IT-S, PT, SK	↑ <0.01	37.8	38.9
Polymyxins	1 148	42	3.7	EE, ES, IT-S, PT, RO, SK	n.s.	43.5	40
Stenotrophomonas maltophilia							
Aminoglycosides	369	254	68.8	BE, ES, PT	↑ <0.01	46.2	50
Antipseudomonal cephalosporins	709	397	56.0	BE, ES, FR, IT-S, PT	n.s.	42	51.8
Antipseudomonal penicillins + inhibitor	413	299	72.4	BE, FR	n.s.	52	44.3
Fluoroquinolones	485	186	38.4	BE, ES, IT-S, PT	n.s.	49.2	51.7
Folate pathway inhibitors	575	42	7.3	BE, ES, IT-S, PT	n.s.	48.1	54.3
Polymyxins	159	61	38.4	ES	n.s.	60.2	42.1
Tetracyclines	69	20	29.0	ES	n.s.	51.1	50
Fungi							
Candida species							
Amphotericin B	750	14	1.9	BE, ES, IT-S	n.s.	45.8	61.5
Echinocandins	461	3	0.7	ES	n.s.	46.1	-
Fluconazole	816	106	13.0	BE, ES, IT-S, SK	n.s.	46	40.7
Itraconazole	438	64	14.6	BE, ES, SK	n.s.	45	47.4
Candida albicans							
Amphotericin B	398	1	0.3	BE, ES, IT-S	n.s.	46.6	-
Echinocandins	235	0	0.0	ES	n.s.	49.1	-
Fluconazole	440	18	4.1	BE, ES, IT-S, SK	n.s.	45.2	50
Itraconazole	238	15	6.3	ES	n.s.	45.2	61.5
Candida glabrata							
Amphotericin B	115	6	5.2	ES	n.s.	42.3	-
Echinocandins	75	0	0.0	ES	n.s.	40.3	-
Fluconazole	124	53	42.7	ES	n.s.	45.6	44.4
Itraconazole	64	27	42.2	ES	n.s.	32.4	41.7
Other non-albicans *Candida* species							
Amphotericin B	196	6	3.1	IT-S, ES	n.s.	45.7	-
Echinocandins	129	2	1.6	ES	n.s.	44	-
Fluconazole	207	30	14.5	IT-S, ES	n.s.	47.7	28
Itraconazole	110	19	17.3	ES	n.s.	44.9	47.1

Data source: ECDC, HAI-Net ICU 2008–2012. N=number of isolates. NS=non-susceptible; S=susceptible. P-value for 2008–2012 trend: Poisson regression assessing increasing (↑) or decreasing (↓) trend in the cohort of ICUs with regular participation. % ICU mortality: observed (non-adjusted) mortality in the ICU in patients with HAI (pneumonia, bloodstream infection or urinary tract infection), by susceptibility of the isolated microorganism(s). Countries-networks: AT: Austria, BE: Belgium, EE: Estonia, ES: Spain, FR: France, IT-G: Italy-GiViTI netwrork, IT-S: Italy-SPIN-UTI network, LT: Lithuania, LU: Luxembourg, MT: Malta, PT: Portugal, RO: Romania, SE: Sweden, SK: Slovakia, UK-SC: United Kingdom-Scotland. Results not shown if less than 10 observations. [a] Species should be considered intrinsically resistant to this antimicrobial category. [b] intrinsic resistance of some species belonging to the genus [40].

Table A.1.9. Combined antimicrobial resistance in ICU-acquired infections: percentages, 2008–2012 trends and association with mortality in the ICU, 2008–2012 (optional resistance data)

	N (a)	% (b)	Countries-networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality	p-value for trend mortality*
Gram-positive cocci						
Staphylococcus aureus: aminoglycosides, anti-staphylococcal beta-lactams, fluoroquinolones, folate pathway inhibitors, glycopeptides (c)						
N tested for 5 antimicrobial categories	733		BE, ES, IT-S, MT, PT	n.s.		n.s.
N and % non-susceptible to:						
0	460	62.8			32.8	
1	55	7.5			26.2	
2	159	21.7			43.2	
3-5	59	8.1			36.4	
Coagulase-negative staphylococci: aminoglycosides, anti-staphylococcal beta-lactams, fluoroquinolones, folate pathway inhibitors, glycopeptides						
N tested for 5 antimicrobial categories	987		BE, ES, IT-S, PT	n.s.		<0.001
N and % non-susceptible to:						
0	85	8.6			18.8	
1	59	6.0			25.5	
2	45	14.7			30.6	
3	255	25.8			32.5	
4	394	39.9			38.6	
5	49	5.0			41.7	
Enterococcus species: aminopenicillins, fluoroquinolones, glycopeptides, oxazolidinones						
N tested for 4 antimicrobial categories	546		ES, IT-S	n.s.		<0.001
N and % non-susceptible to:						
0	179	32.8			23.8	
1	169	31.0			38.9	
2	183	33.5			48.0	
3-4	15	2.7			40.0	
Enterobacteriaceae						
Enterobacteriaceae (1): aminoglycosides, carbapenems, extended spectrum cephalosporins, fluoroquinolones, penicillins + beta-lactamase inhibitors						
N tested for 5 antimicrobial categories	3 666		BE, ES, IT-S, MT, PT, SK	↑, <0.001		<0.001
N and % non-susceptible to:						
0	1 088	29.7			27.5	
1	1 006	27.4			29.2	
2	710	19.4			31.7	
3	445	12.1			36.6	
4	348	9.5			41.6	
5	69	1.9			53.1	
Escherichia coli: aminoglycosides, carbapenems, extended spectrum cephalosporins, fluoroquinolones, penicillins + beta-lactamase inhibitors						
N tested for 5 antimicrobial categories	1 179		BE, ES, IT-S, PT	↑, <0.01		<0.001
N and % non-susceptible to:						
0	434	36.8			21.8	
1	274	23.2			30.1	
2	200	17.0			25.4	
3	179	15.2			39.9	
4-5	92	7.8			47.8	
Klebsiella species: aminoglycosides, extended spectrum cephalosporins, carbapenems, fluoroquinolones, penicillins + beta-lactamase inhibitors						
N tested for 5 antimicrobial categories	1 031		BE, ES, IT-S, MT, PT	↑, p<0.001		<0.01
N and % non-susceptible to:						
0	421	40.8			33.2	
1	106	10.3			26.0	
2	107	10.4			33.3	
3	150	14.5			36.1	
4	196	19.0			36.5	
5	51	4.9			53.2	

	N (a)	% (b)	Countries-networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality	p-value for trend mortality*
Klebsiella pneumoniae: aminoglycosides, extended spectrum cephalosporins, carbapenems, fluoroquinolones, penicillins + beta-lactamase inhibitors						
N tested for 5 antimicrobial categories	819		BE, ES, IT-S, MT, PT	↑, p<0.001		<0.01
N and % non-susceptible to:						
0	318	38.8			31.4	
1	75	9.2			27.5	
2	77	9.4			36.8	
3	122	14.9			38.3	
4	178	21.7			36.8	
5	49	6.0			53.3	
Enterobacter species: aminoglycosides, carbapenems, extended spectrum cephalosporins, fluoroquinolones						
N tested for 4 antimicrobial categories	785		BE, ES, IT-S, PT	n.s.		n.s.
N and % non-susceptible to:						
0	352	44.8			28.3	
1	289	36.8			35.1	
2	86	11.0			26.6	
3-4	58	7.4			50.0	
Enterobacter cloacae: aminoglycosides, carbapenems, extended spectrum cephalosporins, fluoroquinolones						
Combined resistance* (4 categories)	506		BE, ES, IT-S, PT	↑, p<0.05		p=0.08
0 (susceptible to all)l	239	47.2			30.6	
1	186	36.8			35.6	
2	44	8.7			38.9	
3-4	37	7.3			54.1	
Serratia species: aminoglycosides, carbapenems, extended spectrum cephalosporins, fluoroquinolones						
N tested for 4 antimicrobial categories	385		BE, ES, IT-S, PT	↑, p<0.01		n.s.
N and % non-susceptible to:						
0	255	66.2			31.9	
1	88	22.9			32.9	
2	27	7.0			32.0	
3-4	15	3.9			40.0	
Proteus species: aminoglycosides, carbapenems, extended spectrum cephalosporins, fluoroquinolones						
N tested for 4 antimicrobial categories	255		BE, ES, IT-S, PT	n.s.		<0.01
N and % non-susceptible to:						
0	166	65.1			26.8	
1	53	20.8			30.0	
2	21	8.2			60.0	
3-4	15	5.9			53.3	
Citrobacter species: aminoglycosides, carbapenems, extended spectrum cephalosporins, fluoroquinolones						
N tested for 4 antimicrobial categories	121		BE, ES, IT-S, PT	n.s.		n.s.
N and % non-susceptible to:						
0	75	62.0			27.9	
1	35	28.9			21.4	
2-4	11	9.1			40.0	
Non-fermenting gram-negative bacilli						
Pseudomonas species: aminoglycosides, anti-pseudomonal cephalosporins, carbapenems, fluoroquinolones						
N tested for 4 antimicrobial categories	2 635		BE, ES, IT-S, MT, PT, SK	n.s.		<0.001
N and % non-susceptible to:						
0	1 063	40.3			34.6	
1	537	20.4			39.8	
2	402	15.3			44.2	
3	341	12.9			49.8	
4	292	11.1			49.3	
Acinetobacter species: aminoglycosides, carbapenems, polymyxins						
N tested for 3 antimicrobial categories	1 002		ES, IT-S, PT, SK	n.s.		<0.01

	N (a)	% (b)	Countries-networks reporting >= 10 isolates	Trend 2008–2012, p-value	% ICU mortality	p-value for trend mortality*
N and % non-susceptible to:						
0	82	8.2			32.9	
1	241	24.1			35.0	
2	657	65.6			48.0	
3	22	2.2			40.9	
Stenotrophomonas maltophylia: anti-pseudomonal cephalosporins, folate pathway inhibitors, fluoroquinolones						
N tested for 3 antimicrobial categories	399		ES, IT-S, PT, SK	n.s.		p=0.06
N and % non-susceptible to:						
0	118	29.6			40.8	
1	144	36.1			53.6	
2	125	31.3			52.4	
3	12	3.0			54.5	

Data source: ECDC, HAI-Net ICU 2008–2012. N (a)=number of isolates. % (b)= percentage of total number of isolates for which antimicrobial susceptibility results for all selected antimicrobial categories were available (c) Microorganism(s) and antimicrobial categories for which susceptibility results were combined. The selection of antimicrobial categories depended on the number of available observations (see Table A.1.8) on P-value for 2008–2012 trend: Poisson regression assessing increasing (↑) or decreasing (↓) occurrence of combined antimicrobial non-susceptibility in the cohort of ICUs with regular participation. % ICU mortality: observed (non-adjusted) mortality in the ICU in patients with HAI, by increasing levels of antimicrobial non-susceptibility of the isolated microorganism(s). P-value for trend ICU mortality: logistic regression assessing the trend of increasing (or decreasing) mortality across categories of increasing antimicrobial non-susceptibility ("biological gradient"), adjusting for HAI type (pneumonia, bloodstream infection, urinary tract infection), age, gender, length of stay in the ICU before onset of infection and country-network. Countries-networks: BE: Belgium, ES: Spain, IT-S: Italy-SPIN-UTI network, MT: Malta, PT: Portugal, SK: Slovakia. (1) Enterobacteriaceae: Escherichia coli, Klebsiella species, Enterobacter species, Serratia species, Proteus species, Citrobacter species and Morganella species.

Annex 2. Attributable mortality analyses

Table A.2.1. Overview of results of matched cohort analyses using propensity score matching for the assessment of attributable mortality and excess length of stay in patients with ICU-acquired infections, HAI-Net ICU 2008–2012

ICU-acquired infection type	Total (1)	N of cases (% of total)	N of matched cases (% of cases)	Mortality (%)						Length of stay (days, median)						
				Before matching		Matched		Attributable mortality (95% CI)	p-value (2)	Before matching		Matched		Attributable length of stay (95% CI)	IQR	p-value (3)
				non-case	case	non-case	case			non-case	case	non-case	case			
Pneumonia (PN)	347 034	21 389 (6.2)	20 693 (96.7)	14.2	33.0	29.3	32.8	3.5 (2.6-4.3)	<0.001	5	26	11	26	14 (14-14)	[6-27]	<0.001
PN without secondary BSI	345 881	20 236 (5.9)	19 597 (96.8)	14.2	32.4	28.9	32.1	3.3 (2.3-4.2)	<0.001	5	26	11	26	14 (14-14)	[6-27]	<0.001
Bloodstream infection (BSI), all	345 680	12 650 (3.7)	12 295 (97.2)	14.6	34.8	29.6	34.6	5.0 (3.9-6.2)	<0.001	5	27	14	27	14 (13-14)	[6-28]	<0.001
Primary BSI, all	340 469	7 439 (2.2)	7 298 (98.1)	14.6	32.1	29.9	32.0	2.1 (0.7-3.6)	<0.01	5	27	14	27	13 (13-13)	[6-25]	<0.001
Catheter-related BSI	336 767	3 737 (1.1)	3 668 (98.2)	14.6	29.0	29.9	29.0	-0.9 (-3.0-1.2)	NS	5	28	16	28	12 (12-13)	[5-25]	<0.001
BSI of unknown origin	336 732	3 702 (1.1)	3 642 (98.4)	14.6	35.3	30.5	35.2	4.7 (2.5-6.8)	<0.001	5	26	13	26	14 (13-14)	[6-26]	<0.001
Central line-associated BSI	339 995	6 965 (2.0)	6 831 (98.1)	14.6	32.7	30.4	32.7	2.3 (0.7-3.8)	<0.01	5	27	15	27	13 (12-13)	[5-25]	<0.001
Secondary BSI, all	338 241	5 211 (1.5)	5 063 (97.2)	14.6	38.6	30.0	38.6	8.7 (6.8-10.5)	<0.001	5	27	13	27	15 (14-16)	[6-30]	<0.001
BSI secondary to:																
Pulmonary infection	335 085	2 055 (0.6)	2 019 (98.2)	14.6	41.1	31.1	41.1	10.0 (7.1-13.0)	<0.001	5	28	14	28	15 (15-16)	[7-30]	<0.001
Digestive tract infection	334 449	1 419 (0.4)	1 404 (98.9)	14.6	42.5	30.3	42.6	12.3 (8.8-15.9)	<0.001	5	26	13	26	14 (13-15)	[6-29]	<0.001
Urinary tract infection	377 719	647 (0.2)	643 (99.4)	14.7	30.3	27.5	30.2	2.6 (-2.2-7.5)	NS	5	25	12	24	13 (12-15)	[5-24]	<0.001
Surgical site infection	377 458	386 (0.1)	379 (98.2)	14.7	37.0	22.2	36.7	14.5 (8.1-21.0)	<0.001	5	29	11	29	18 (16-20)	[8-29]	<0.001
Skin/soft tissue infection	377 389	317 (0.1)	313 (98.7)	14.7	33.4	25.6	33.5	8.0 (0.6-15.4)	<0.05	5	29	13	29	14 (12-17)	[6-32]	<0.001
Other/unknown infection	377 675	603 (0.2)	592 (98.2)	14.7	31.7	28.9	31.6	2.7 (-2.4-7.8)	NS	5	26	12	26	15 (13-16)	[6-30]	<0.001
Urinary tract infection	299 168	10 288 (3.4)	10 098 (98.2)	15.2	23.8	22.9	23.7	0.8 (-0.3-2.0)	NS	6	26	13	26	13 (13-13)	[5-28]	<0.001

Data source: ECDC, HAI-Net ICU 2008–2012. Total (1): Number of patients after exclusion of patients with missing risk factors. For less frequent secondary BSI subtypes, one missing risk factor out of four (SAPS II score, impaired immunity, trauma and antimicrobial treatment on admission) was allowed to increase sample size. N of cases (% of total): number and percentage of patients with at least one ICU-acquired infection of the given type. N of matched cases: number of cases for which 1:1 propensity score matching with a non-case was successful. 95% CI: 95% confidence interval. P-value (2): McNemar chi square p-value. IQR: interquartile range. P-value (3): Primary BSI: sum of BSIs for which the origin was reported to be catheter-related and BSIs for which the origin was unknown, Central line-associated BSI (CLABSI): primary BSI with central vascular catheter use within 48 hours or two days before BSI onset.

Table A.2.2. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with ICU-acquired pneumonia, excluding pneumonia with secondary bloodstream infection

	Pneumonia without BSI*	
	no	yes
Number of patients	19 597	19 597
Median age	65	65
Gender (% male)	70.6	70.9
Median propensity score	181	181
Median intubation days before onset*	8	8
Median length of stay (days) before onset*	11	9
Median SAPS II score	46	46
Trauma patient (%)	15.1	15.9
Impaired immunity (%)	13.2	12.4
Admission type:		
Medical (%)	64.6	65.2
Scheduled surgical (%)	10.5	10.3
Urgent surgery (%)	24.3	24.0
ICU mortality (%)	**28.9**	**32.1**
Median length of stay (days)	**11**	**26**
Median length of stay in survivors (days)	12	26

**Excluding pneumonia with bloodstream infection secondary to a pulmonary site infection and with onset from three days before until 5 days after the onset of the pneumonia episode*

Table A.2.3. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with primary ICU-acquired bloodstream infection, catheter-related BSI and BSI of unkown origin combined

	Primary BSI	
	no	yes
Number of patients	7 298	7 298
Median age	66	64
Gender (% male)	66.6	68.3
Median propensity score	165	165
Median CVC days before onset*	13	12
Median intubation days before onset*	11	11
Median length of stay (days) before onset*	14	14
Median SAPS II score	45	45
Trauma patient (%)	13.2	13.3
Impaired immunity (%)	13.6	14.0
Admission type:		
Medical (%)	67.2	67.0
Scheduled surgical (%)	10.3	10.4
Urgent surgery (%)	21.4	22.0
ICU mortality (%)	**29.9**	**32.0**
Median length of stay (days)	**14**	**27**
Median length of stay in survivors (days)	14	27

Table A.2.4. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with catheter-related bloodstream infection

	Catheter-related BSI	
	no	yes
Number of patients	3 668	3 668
Median age	66	64
Gender (% male)	66.1	67.5
Median propensity score	187	187
Median CVC days before onset*	15	15
Median intubation days before onset*	12	13
Median length of stay (days) before onset*	16	17
Median SAPS II score	45	45
Trauma patient (%)	13	13.2
Impaired immunity (%)	11.1	12.1
Admission type:		
Medical (%)	65.3	65.6
Scheduled surgical (%)	9.9	10.1
Urgent surgery (%)	23.6	23.7
ICU mortality (%)	**29.9**	**29.0**
Median length of stay (days)	**16**	**28**
Median length of stay in survivors (days)	16	28

Table A.2.5. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with bloodstream infection of unknown origin

	BSI of unknown origin	
	no	yes
Number of patients	3 642	3 642
Median age	65	64
Gender (% male)	66.9	69.0
Median propensity score	149	149
Median CVC days before onset*	11	11
Median intubation days before onset*	10	10
Median length of stay (days) before onset*	13	12
Median SAPS II score	45	45
Trauma patient (%)	13.6	13.4
Impaired immunity (%)	15.5	16
Admission type:		
Medical (%)	70	68.8
Scheduled surgical (%)	10.4	10.7
Urgent surgery (%)	18.7	19.9
ICU mortality (%)	**30.5**	**35.2**
Median length of stay (days)	**13**	**26**
Median length of stay in survivors (days)	13	27

Table A.2.6. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with central line-associated bloodstream infection (CLABSI)

	CLABSI	
	no	yes
Number of patients	6 831	6 831
Median age	66	64
Gender (% male)	66.9	68.1
Median propensity score	235	235
Median CVC days before onset*	13	13
Median intubation days before onset*	11	11
Median length of stay (days) before onset*	15	14
Median SAPS II score	45	45
Trauma patient (%)	12.8	13.1
Impaired immunity (%)	13.6	13.9
Admission type:		
Medical (%)	66.4	66.7
Scheduled surgical (%)	10.6	10.3
Urgent surgery (%)	21.8	22.4
ICU mortality (%)	**30.4**	**32.7**
Median length of stay (days)	**15**	**27**
Median length of stay in survivors (days)	15	27

Table A.2.7. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with secondary bloodstream infection, all sites

	Secondary BSI	
	no	yes
Number of patients	5 063	5 063
Median age	66	66
Gender (% male)	68.1	68.6
Median propensity score	153	153
Median CVC days before onset*	11	10
Median intubation days before onset*	10	10
Median length of stay (days) before onset*	13	11
Median SAPS II score	46	46
Trauma patient (%)	12.2	12.7
Impaired immunity (%)	14.2	13.9
Admission type:		
Medical (%)	59.3	58.8
Scheduled surgical (%)	11.6	12.2
Urgent surgery (%)	28.5	28.5
ICU mortality (%)	**30.0**	**38.6**
Median length of stay (days)	**13**	**27**
Median length of stay in survivors (days)	13	28

Table A.2.8. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with bloodstream infection secondary to pulmonary infection

	BSI secondary to pulmonary infection	
	no	yes
Number of patients	2 019	2 019
Median age	66	65
Gender (% male)	71.4	72.7
Median propensity score	219	219
Median CVC days before onset*	12	11
Median intubation days before onset*	10	10
Median length of stay (days) before onset*	14	12
Median SAPS II score	47	47
Trauma patient (%)	16.6	15.9
Impaired immunity (%)	13	14.1
Admission type:		
Medical (%)	69.8	69.6
Scheduled surgical (%)	9.4	9.1
Urgent surgery (%)	20.0	20.9
ICU mortality (%)	**31.1**	**41.1**
Median length of stay (days)	**14**	**28**
Median length of stay in survivors (days)	14	30

Table A.2.9. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with bloodstream infection secondary to digestive tract infection

	BSI secondary to digestive tract infection	
	no	yes
Number of patients	1 404	1 404
Median age	68	67
Gender (% male)	66.9	66.4
Median propensity score	162	162
Median CVC days before onset*	11	10
Median intubation days before onset*	9	9
Median length of stay (days) before onset*	13	10.5
Median SAPS II score	47	48
Trauma patient (%)	7	7.2
Impaired immunity (%)	16.4	15.4
Admission type:		
Medical (%)	51.7	50.1
Scheduled surgical (%)	11.7	12.7
Urgent surgery (%)	36.0	36.8
ICU mortality (%)	**30.3**	**42.6**
Median length of stay (days)	**13**	**26**
Median length of stay in survivors (days)	12	27

Table A.2.10. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with bloodstream infection secondary to urinary tract infection

	BSI secondary to urinary tract infection	
	no	yes
Number of patients	643	643
Median age	66	66
Gender (% male)	60.9	60.6
Median propensity score	101	101
Median CVC days before onset*	10	11
Median intubation days before onset*	9	9
Median length of stay (days) before onset*	12	12
Median SAPS II score	43	44
Trauma patient (%)	11	12
Impaired immunity (%)	12.9	14.4
Admission type:		
Medical (%)	66.9	68.4
Scheduled surgical (%)	13.8	11.7
Urgent surgery (%)	18.4	19.4
ICU mortality (%)	**27.5**	**30.2**
Median length of stay (days)	**12**	**24**
Median length of stay in survivors (days)	12	24

Table A.2.11. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with bloodstream infection secondary to surgical site infection

	BSI secondary to surgical site infection	
	no	yes
Number of patients	379	379
Median age	68	66
Gender (% male)	68.9	69.9
Median propensity score	198	196
Median CVC days before onset*	10	10
Median intubation days before onset*	9	9
Median length of stay (days) before onset*	11	10
Median SAPS II score	46	43
Trauma patient (%)	10.4	11
Impaired immunity (%)	10.4	10.4
Admission type:		
Medical (%)	21.1	19.5
Scheduled surgical (%)	21.9	24.3
Urgent surgery (%)	57.0	55.7
ICU mortality (%)	**22.2**	**36.7**
Median length of stay (days)	**11**	**29**
Median length of stay in survivors (days)	11	29.5

Table A.2.12. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with bloodstream infection secondary to skin and soft tissue infection

	BSI secondary to skin and soft tissue infection	
	no	yes
Number of patients	313	313
Median age	67	62
Gender (% male)	65.5	69.6
Median propensity score	128	128
Median CVC days before onset*	11	10
Median intubation days before onset*	10	10
Median length of stay (days) before onset*	13	11
Median SAPS II score	44.5	45
Trauma patient (%)	20	21.3
Impaired immunity (%)	15.9	12.6
Admission type:		
Medical (%)	54.3	53.4
Scheduled surgical (%)	13.1	13.7
Urgent surgery (%)	31.0	32.6
ICU mortality (%)	**25.6**	**33.5**
Median length of stay (days)	**13**	**29**
Median length of stay in survivors (days)	13	31

Table A.2.13. Matched (1:1) cohort analysis for the assessment of attributable mortality and excess length of stay in patients with bloodstream infection secondary to other or unknown infection site

	BSI secondary to other or unkown infection	
	no	yes
Number of patients	592	592
Median age	67	65
Gender (% male)	64	66.7
Median propensity score	137	137
Median CVC days before onset*	11	10
Median intubation days before onset*	9	9
Median length of stay (days) before onset*	12	11
Median SAPS II score	43	45
Trauma patient (%)	16.1	18.1
Impaired immunity (%)	6.4	8.3
Admission type:		
Medical (%)	58.6	56.3
Scheduled surgical (%)	11.0	12.7
Urgent surgery (%)	29.2	30.6
ICU mortality (%)	**28.9**	**31.6**
Median length of stay (days)	**12**	**26**
Median length of stay in survivors (days)	13	25

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