SURVEILLANCE OF BLOODSTREAM INFECTIONS IN BELGIAN HOSPITALS

Report 2023
Data up to and including 2022

M. VERCRUYCE • L. VAES • N. SHODU • K. MERTENS

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Surveillance of Bloodstream infections in Belgian Hospitals

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ABBREVIATIONS

A. baumannii	*Acinetobacter baumannii*
BSI	Bloodstream infection
C. albicans	*Candida albicans*
C. glabrata	*Candida glabrata*
CDC	Centre for Disease Control and Prevention
CI	Confidence interval
CL	Central line
CLABSI	Central line-associated bloodstream infection
COVID-19	Coronavirus disease 2019
CRBSI	Catheter-related bloodstream infection
ECDC	European centre for disease prevention and control
E. coli	*Escherichia coli*
E. cloacae	*Enterobacter cloacae*
E. faecalis	*Enterococcus faecalis*
E. faecium	*Enterococcus faecium*
Gly	Glycopeptide
HABSI	Hospital-associated bloodstream infection
IR	Non-susceptible
ICU	Intensive care unit
INAMI	Institut national d'assurance maladie-invalidité
IQR	interquartile range
IRR	incidence rate raio
K. aerogenes	*Klebsiella aerogenes*
K. oxytoca	*Klebsiella oxytoca*
K. pneumoniae	*Klebsiella pneumoniae*
LCBI	Laboratory-confirmed bloodstream infection
MBI	Mucosal barrier injury
MO	Microorganism
MRSA	Methicillin resistant *Staphylococcus aureus*
N/A	Not applicable
NSIH	National Surveillance of Infections in Hospitals, Belgium
NIHDI	National Institute for Health and Disability Insurance (INAMI-RIZIV)
pd	Patient-days
P. aeruginosa	*Pseudomonas aeruginosa*
P. mirabilis	*Proteus mirabilis*
R	Resistant
RIZIV	Rijksinstituut voor ziekte- en invaliditeitsverzekering
S. aureus	*Staphylococcus aureus*
S. epidermidis	*Staphylococcus epidermidis*
S. marcescens	*Serratia marcescens*
SD	Standard deviation
spp.	Species

GLOSSARY

Central line-associated bloodstream infection (CLABSI)
To be considered as CLABSI in the Belgian bloodstream infection surveillance, a CLABSI must first meet the surveillance definition for hospital-associated bloodstream infection (HABSI). Depending on surveillance information we then define three CLABSI classifications:

- ***Confirmed CLABSI = CRBSI (Catheter-related bloodstream infection):*** Laboratory-confirmed bloodstream infection (LCBI) with clinical suspicion that a central line (CL) is the cause of the LCBI and the association between the LCBI and the CL is microbiologically confirmed (same microorganism found in blood culture and on CL).
- ***Probable CLABSI:*** LCBI with clinical suspicion that a CL is the cause of the LCBI but no microbiological confirmation.
- ***Possible CLABSI:*** LCBI not secondary to an infection at another body site – origin recorded in the surveillance form as 'unknown' - but CL present within the two days prior to the LCBI.

Device-associated hospital-associated bloodstream infection (device-associated HABSI)
A device-associated HABSI is a HABSI in a patient with a (relevant) device that was used within the 48-hour period before onset of infection (even if it was used only intermittently). 'Relevant device' refers to intubation (endotracheal tube), a vascular catheter (central or peripheral) or an indwelling urinary catheter.

Hospital-associated bloodstream infection (HABSI)
A laboratory-confirmed bloodstream infection (LCBI) with date of bloodstream infection (BSI) diagnosis (that is sample date of first positive blood culture) two days or more after admission at the hospital (infection date – admission date ≥ 2 days).

Intensive care unit-associated bloodstream infection (ICU-associated BSI)
LCBI with date of BSI diagnosis (that is sample date of first positive blood culture) two days or more after admission at the intensive care unit (ICU).

Laboratory-confirmed bloodstream infection (LCBI)
A BSI where an eligible BSI organism is identified by the laboratory. As part of the surveillance programme only LCBI are registered. This implies that when mentioning BSI or HABSI in the frame of this surveillance programme this is always considered a LCBI.

Non hospital-associated bloodstream infection (Non-HABSI)
BSI diagnosed prior to the second day of hospitalisation.

Non-tertiary hospital
Non-tertiary hospitals include hospitals defined in the list of the Belgian ministry of health (Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg)[1] under 'type hospital' (soort ziekenhuis – type hôpital) as general hospital (Algemeen ziekenhuis - Hôpital general).

Patient-days
Patient-days (or hospitalisation days) are defined as the invoiced days of a patient admitted at the hospital as defined by the *résumé hospitalier minimal/minimale ziekenhuisgegevens* (RHM/MZG). This means that ambulatory patients, patients at day hospitalisation and at the emergency department (without staying overnight) are not included in the count of patient-days. See also https://www.sciensano.be/sites/default/files/protocol_noemermodule_en_gemeenschappelijk_gebruikte_referentielijsten_en_variabelen_may2019.pdf (Dutch version) and https://www.sciensano.be/nl/biblio/surveillances-nsih-module-du-denominateur-et-listes-de-references-et-variables-communes-protocol (French version).

Primary bloodstream infection
A primary BSI is a catheter-associated BSI (in this report central line, peripheral catheter and other catheter and related products) or a BSI with unknown source.

Secondary bloodstream infection
A secondary BSI is a BSI secondary to an infection at another body site.

Tertiary hospital
Tertiary hospitals include hospitals defined in the list of the Belgian ministry of health (Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg)[1] under 'type hospital' (soort ziekenhuis – type hôpital) as:

- University hospital (Universitair ziekenhuis - Hôpital universitaire) and;
- General hospital with university characteristics (Algemeen ziekenhuis met universitair karakter - Hôpital général à caractère universitaire).

[1] List of hospitals provided by the Belgian ministry of health (*Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg*); List dated December 2022: *Adressenlijst ziekenhuizen 12/2022 - Liste d'adresses des hôpitaux 02/2022*.

DESCRIPTIVE REPORT

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1. Introduction

Hospital-associated bloodstream infections (HABSI) cause considerable morbidity and mortality and have an important potential for prevention, especially for those HABSI associated with invasive devices (1–5). In Belgium, a national hospital-wide surveillance system for HABSI exists since 1992 (6).

The objective of the surveillance programme on HABSI in Belgian hospitals is to enhance the quality of care provided at the hospital by:

- monitoring HABSI trends, with a focus on BSI that can be prevented, at hospital and national level with the objective to enhance and evaluate preventive measures,
- monitoring causal microorganisms and their resistance profile.

The surveillance programme on HABSI in Belgian hospitals provides a standardized tool to (1) allow hospitals to follow-up their own HABSI and associated antimicrobial resistance trends at hospital and intensive care unit (ICU) level, and to (2) analyse data at national level.

Participation in the surveillance for a minimum of one quarter a year is legally required since 1 July 2014[2].The surveillance protocol has been reviewed and considerably updated and changed in 2013. This updated protocol aimed to focus on the usefulness of the surveillance as a tool for prevention of HABSI at hospital level.

This report describes trends in incidences of HABSI, causal microorganisms (MO), and their antimicrobial resistance profile until 2022 and provides a more detailed description of the 2022 BSI data. The descriptive report describes the results of a selection of main indicators for this surveillance. The statistical report includes exhaustive indicators, while the annexes show results on additional indicators including those stratified by region and hospital type..

[2] General hospitals with the exception of Sp hospitals palliative care are legally required to participate according to the Royal Decree: Koninklijk besluit van 25 april 2002 betreffende de vaststelling en de vereffening van het budget van financiële middelen van de ziekenhuizen, Art 56, Par 2, wijziging van 10 september 2020/ Arrêté royal du 25 avril 2002 relatif à la fixation et à la liquidation du budget des moyens financiers des hôpitaux, Art 56, Par 2, modification du 10 septembre 2020.

2. Methods

2.1. PARTICIPATION AND CASE DEFINITION

Participation criteria details and modalities for data collection can be found in the latest version of the protocol dated April 2019 (7,8). More information on the case definitions can also be found in the protocol.

Data on bloodstream infection (BSI) occurring before 1 July 2017 were collected and hospital based results displayed through the online tool NSIHweb2. Data on BSI occurring since 1 July 2017 are collected through the Healthdata platform (see: https://www.healthdata.be/dcd/#/collection/NSIH-SEP/version/27 and https://www.healthdata.be/dcd/#/collection/NSIH-Denominators/version/24) and hospital based results reported through Healthstat (see: https://www.healthstat.be/).

Hospitals are identified by their National Institute for Health and Disability Insurance (NIHDI)-number.

Only laboratory confirmed bloodstream infections (LCBI) are recorded. For the surveillance the criteria 'BSI occurring two days or more after admission at the hospital' is used as proxy-indicator for a BSI acquired in a hospital. BSI defined as such are called 'hospital-associated bloodstream infections'. Similarly, an ICU-associated BSI is defined as a BSI occurring two days or more after admission at ICU. Registration of HABSI is mandatory. BSI occurring <2d after admission (for example community acquired or acquired in another hospital or long-term care facility) can optionally be registered. Results of the latter type BSIs will not be discussed in detail in this report.

The suspected source of origin of the BSI is based on clinical identification. If this suspected source is a central line (CL), we identify, based on the surveillance information[3], three central line-associated bloodstream infections (CLABSI) classifications:

- *Confirmed CLABSI*: LCBI with clinical suspicion that a CL is the cause of the LCBI and the association between the LCBI and the CL is microbiologically confirmed (same MO found in blood culture and on CL). Confirmed CLABSI can also be called a catheter related bloodstream infection (CRBSI).
- *Probable CLABSI*: LCBI with clinical suspicion that a CL is the cause of the LCBI but no microbiological confirmation.
- *Possible CLABSI*: LCBI not secondary to an infection at another body site – source recorded in the surveillance form as 'unknown' – but CL present within the two days prior to the LCBI.

To be considered as CLABSI in the Belgian bloodstream infection surveillance, a CLABSI must first meet the surveillance definition for HABSI, being as described above; a LCBI occurring two days or more after admission at the hospital

A primary HABSI is a catheter-associated HABSI (in this report central line, peripheral catheter and other catheter and related products) or a HABSI with unknown source. A secondary HABSI is a HABSI secondary to an infection at another body site.

Based on the available surveillance data, we have included results on the incidence of HABSI associated to peripheral catheter. We make a distinction between HABSI with peripheral catheter as source for which the source is confirmed (same MO found in blood culture and on peripheral catheter) and for which the source is not confirmed. Note that the current BSI surveillance does not allow to calculate HABSI incidence with peripheral catheter as 'possible' source, unlike CLABSI. Data on the presence of a peripheral catheter present within the two days prior to the BSI when the source of the

[3] See BSI surveillance protocol chapter 4.5.2 (https://www.sciensano.be/nl/biblio/surveillance-bloedstroominfecties-belgische-ziekenhuizen-protocol-2019 (Dutch version), https://www.sciensano.be/fr/biblio/surveillance-des-septicemies-dans-les-hopitaux-belges-protocole-2019 (French version))

BSI is unknown is not collected. An underestimation of the incidence of HABSI with peripheral catheter in this report could be possible.

Two additional SNOMED codes were added in 2020 to identify the specialty of the ward where the BSI occurred, being: '*DS0001 - COVID-19 dedicated general ward*' and '*DS0002 - COVID-19 dedicated intensive care unit*'.

As the number of days a patient is hospitalised reflects best the risk of becoming infected with a HABSI (the longer a patient is in the hospital the higher his/her chance to get a HABSI), we mainly focus on reporting HABSI data per 10,000 patient-days although, several times the number of HABSI per 1,000 hospitalisations is also reported. This to put out findings in perspective.

In 2019, EUCAST (European Committee on Antimicrobial Susceptibility Testing) changed the definitions of susceptibility testing categories S, I and R to 'S' being 'Susceptible, standard dosing regimen', 'I' being 'Susceptible, increased exposure' and 'R' being 'Resistant' (see https://www.eucast.org/newsiandr/). This change in approach implied that 'I' should be categorised as susceptible. For this report, we continued to report %IR as indicator of resistance, but given the substantial number of laboratories that switched to new SIR definitions by 2022[4], we added an %R indicator for carbapenems to account for updated imipenem breakpoints in EUCAST v10.0 (9,10). Our data does not allow to make the distinction between R and I category prior to 2017. Calculation of non-susceptibility and resistance is based on the total number of strains.

2.2. DATA ANALYSIS

This report presents the analysis results, mainly descriptive, of surveillance data up to 2022 (database data labelled as 'Approved' in Healthdata on 12 July 2023). Data collected before the protocol review in 2013 are not always comparable and because of this, data from before 2013 are mostly not included in this report. They have been used only for trends in MO specific incidence data.

As defined in the Royal Decree[5], only data from general hospitals with the exception of Sp hospitals palliative care, are included.

Data of previous years given in the 2023 report may differ slightly from those in the 2022 report. This due to the fact that some hospitals still entered data after closing the data submission deadline. These data are included in the analyses done for the 2023 report.

Information on the methods used to compute incidences is given in Annex 1. In brief, the mean incidence was computed as the sum of numerators (HABSI or hospitalisations with at least one HABSI episode) divided by the sum of denominators (patient-days or hospitalisations). To calculate medians the reporting quarter was used as unit of analysis[6].

The cumulative incidence is calculated in this report both with the number of HABSI episodes as with the number of hospitalisations with at least one HABSI episode as numerator. In case of hospitalisation of the same patient during two surveillance years (for example hospitalisation during December 2021-January 2022) one hospitalisation is counted and this will be included in the surveillance data of the first

[4] A survey conducted in May 2023 by the unit 'Quality of laboratories' of Sciensano showed that 49 out of 101 laboratories that completed the survey had switched to the new EUCAST guidelines before July 2022, 42 switched between July 2022 and May 2023.

[5] Koninklijk besluit van 25 april 2002 betreffende de vaststelling en de vereffening van het budget van financiële middelen van de ziekenhuizen, Art 56, Par 2, wijziging van 10 september 2020/ Arrêté royal du 25 avril 2002 relatif à la fixation et à la liquidation du budget des moyens financiers des hôpitaux, Art 56, Par 2, modification du 10 septembre 2020.

[6] Median: incidences of the HABSI per hospital per quarter per total hospital-quarters. Mean and median include only data for which the denominator (number hospitalisations or patient-days) is available.

year of hospitalisation. Our data does not allow to make a distinction between number of HABSI episodes and number of hospitalisations with at least one HABSI episode before 2017.

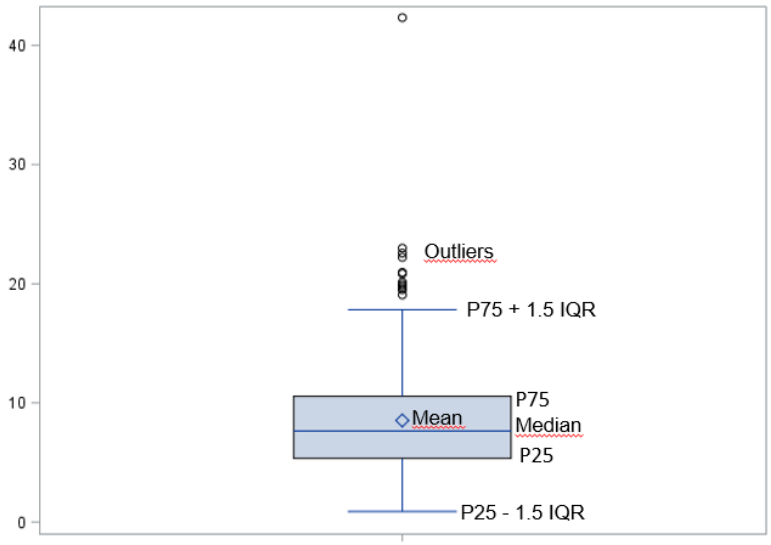
To calculate ICU-associated BSI incidence in the 2023 report a different method was used compared to the previous reports. In this report only denominator data and numerator data are taken into account if the data have a reported ICU speciality. Table 1 gives an overview of the SNOMED CT codes and their description used to define an ICU speciality. This method was applied to avoid including non-ICU related data in the calculation of ICU indicators. In the previous years the selection of data by ICU speciality was applied only to the numerator data. This can result in slightly different results compared to the results described in the previous reports related to ICU-associated BSI incidence.

Table 1 • SNOMED CT codes and description of ICU specialities

SNOMED CT code	Description
309904001	Intensive care unit (others or not specified or mixed)
309905000	Adult intensive care unit
309907008	Cardiac intensive care unit
309909006	Neurological intensive care unit
309910001	Paediatric intensive care unit
405269005	Neonatal intensive care unit
418433008	Surgical intensive care unit
441994008	Medical intensive care unit
DS0002	COVID-19 dedicated intensive care unit

Boxplots were used to assess distribution of hospital-specific HABSI incidences. A boxplot consist of a box with whiskers and may have some dots below or above these whiskers. The line in the box displays the median value, the box limits represent the P25 and P75 values, the whiskers mark the lower and upper adjusted values (respectively P25 - 1.5 IQR and P75 + 1.5 IQR) and the dots represent the outliers (outside values). To compile boxplots we used as unit of analysis at hospital level hospital-quarter (number of infections and pd per quarter for which the hospital participated in the surveillance) and at ICU-level ICU-quarter (number of infections and pd per quarter for which the ICU participated in the surveillance).

Figure 1 • Overview of a boxplot (IQR, interquartile range)



We fitted negative binomial longitudinal regression models (population-averaged) to assess changes in incidence of HABSI, CLABSI, antimicrobial non-susceptible isolates and trends in proportions of non-susceptible MO among all MO isolated. We assessed changes between the pre-pandemic period (2013-2019) and 2020-2022 and in case of relevant trends for the whole period 2013-2022.

Piecewise linear curves were added to these models to assess incidence changes in the period 2013-2019, 2019-2020 and 2020-2022. A model corrected for hospital type and region was used to detect significant differences of HABSI incidence between regions and hospital types.

Data was analysed in SAS enterprise guide 7.13 except for the statistical test for which STATA 16 (StataCorp LP, College Station, Texas, USA) was used.

3. Results

3.1. PARTICIPATION

In 2022, 97 (95%) out of 102 eligible hospitals[7] participated in the BSI-surveillance. The number of hospitals participating since 2014, the year participation in the surveillance became mandatory, has always been higher than 90% (Table S1) [8]. Fifty percent of the eligible hospitals participated the whole year. Participation throughout the year serves best the objective of surveillance.

Table S2 describes the participation by region: 12 of the total of 14 hospitals participated in Brussels, 43% of the Brussel's hospitals participated throughout the whole year, 50 of 51 hospitals participated in Flanders, 61% throughout the whole year, and 35 of 37 hospital in Wallonia of which 38% participating throughout the whole year (Table S2).

Altogether, data for 259 quarters were submitted from which 256 (98,8%) quarters had denominator data available. The denominator data consists of number of patient-days and number of hospitalisations and can be found in Table S4.

Registration of non-HABSI (BSI diagnosed prior to the second day of hospitalisation) is optional in the BSI surveillance. In 2022, 41 hospitals registered at least one non-HABSI episode. However 49% of these hospitals registered only 1 to 5 non-HABSI episodes. As data is not exhaustive, results on this type of BSI will not be described in detail.

3.2. INCIDENCE OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS

3.2.1. Hospital-wide

Calculation and analysis of incidences per patient-days and per hospitalisations include only the HABSI with matching denominator data. In 2022, 7,322 HABSI were registered in the surveillance of which 7,285 (99%) had matching denominator data. Ninety-five hospitals are included in the incidence calculations.

3.2.1.1. Hospital-associated bloodstream infections, 2013-2022

In 2022, the mean HABSI incidence per 10,000 patient-days (pd) was 9.2, see Table 2 below. The trend of HABSI incidence during 2013-2022 is visualized in Figure 2 below. The HABSI incidence was higher during the previous COVID-19 years than in 2022 (10.0 in 2021 and 10.4 in 2020). In the period 2020-2022 the HABSI incidence decreased significantly by 4% yearly (see also Table S4 for full details).

In the period 2013-2019 no significant changes in HABSI incidence can be observed. Comparing the pre-pandemic period (2013-2019) with the following years 2020-2022 a significant increase in HABSI per 10,000 pd can be observed with an incidence rate ratio of 1.19 (95% CI [1.12-1.26]), meaning an increase of HABSI incidence by 19% (see Table S12).

[7] The total number of hospitals that should participate is based on the Royal Decree (Koninklijk besluit van 25 april 2002 betreffende de vaststelling en de vereffening van het budget van financiële middelen van de ziekenhuizen, Art 56, Par 2, wijziging van 10 september 2020/ Arrêté royal du 25 avril 2002 relatif à la fixation et à la liquidation du budget des moyens financiers des hôpitaux, Art 56, Par 2, modification du 10 septembre 2020.)

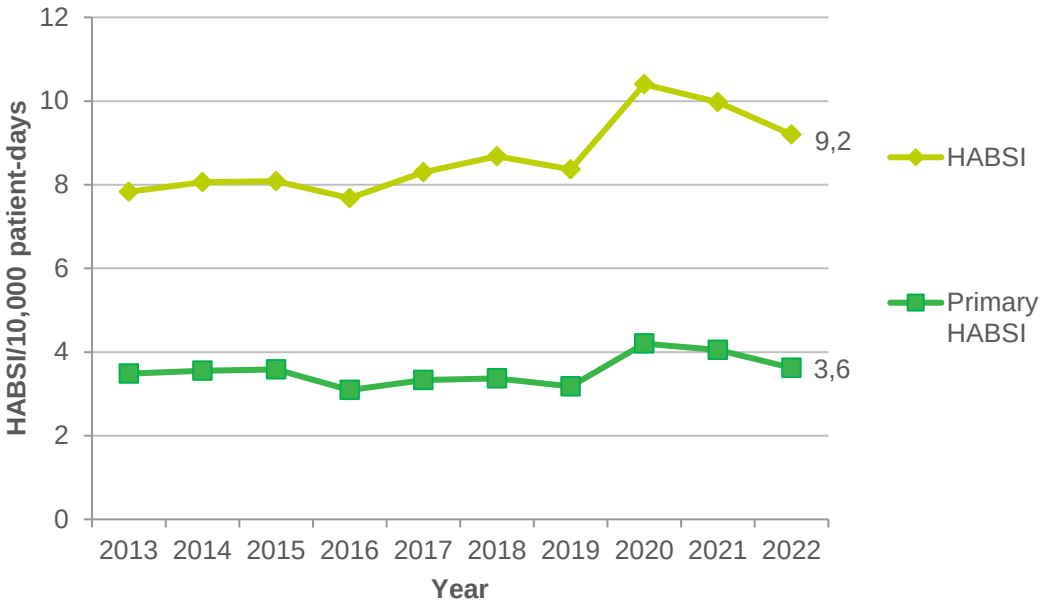
[8] Total number of hospitals differs between years because of merges of hospitals.

Table 2 • Overview of main HABSI incidence indicators

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Hospital-wide										
Mean Incidence density per 10,000 patient-days										
HABSI	7.8	8.1	8.1	7.7	8.3	8.7	8.4	10.4	10.0	9.2
Primary HABSI	3.5	3.6	3.6	3.1	3.3	3.4	3.2	4.2	4.1	3.6
CLABSI	2.11	2.14	2.17	1.76	1.86	2.06	2.03	2.62	2.58	2.36
CRBSI	0.87	0.89	0.94	0.73	0.69	0.80	0.81	0.93	0.95	0.93
ICU-only										
Mean Incidence density per 10,000 patient-days										
ICU-associated BSI	32.2	31.8	29.9	31.9	29.9	31.4	33.0	52.2	47.9	40.1
Primary HABSI (ICU-only)	15.6	15.2	14.4	13.9	13.0	14.4	14.2	23.4	21.9	18.5
CLABSI (ICU-only)	12.88	10.69	9.60	9.80	9.49	11.49	11.77	18.78	18.00	15.50
CRBSI (ICU-only)	4.70	4.30	3.67	3.53	3.23	3.81	3.94	6.59	5.37	5.18

ICU, intensive care unit; HABSI, hospital-associated bloodstream infections; CLABSI, central line-associated bloodstream infections; CRBSI, catheter related bloodstream infection = confirmed CLABSI; BSI, bloodstream infection

Figure 2 • Mean incidence density of hospital-associated bloodstream infections, hospital-wide, Belgium 2013-2022 (HABSI, hospital-associated bloodstream infections)



The incidence density of primary HABSI in 2022 (source is central line, peripheral catheter, other catheter and related products or unknown) was 3.6 per 10,000 pd, while the incidence of secondary HABSI (secondary to an infection at another body site) was 5.6 per 10,000 pd. Throughout the last 10 years, the incidence of primary HABSI has always been lower than secondary HABSI (see Table S5).

In the annexes 2 and 3 HABSI incidence by region and in tertiary and non-tertiary hospitals can be found (Table A2, Table A4), see also Figure 3 below for a visualization of these trends. As in previous year

the HABSI incidence is higher in tertiary[9] hospitals than in other hospitals, with the mean HABSI incidence density in tertiary hospitals in 2022 being 12.7 per 10,000 pd compared to 7.5 in non-tertiary hospitals.

Comparing the incidence between the regions we can observe that the HABSI incidence in Brussels (with a mean incidence density of 12.6 per 10,000 pd) is higher than in other regions (8.8 in Wallonia and 8.5 in Flanders), see Figure 4 below.

Figure 3 • Mean incidence of hospital-associated bloodstream infections, hospital-wide, by type of hospital, Belgium 2013-2022 (HABSI, hospital-associated bloodstream infections)

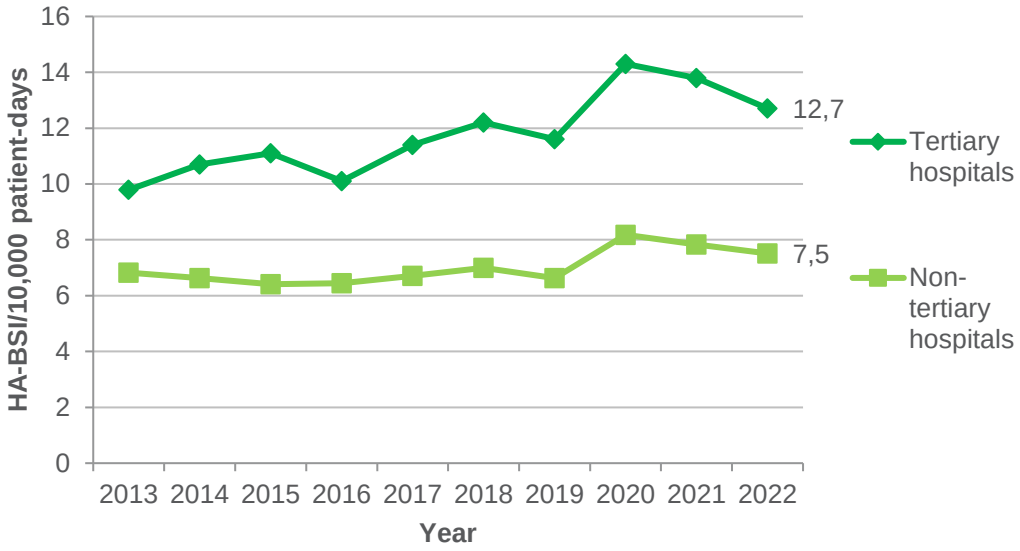
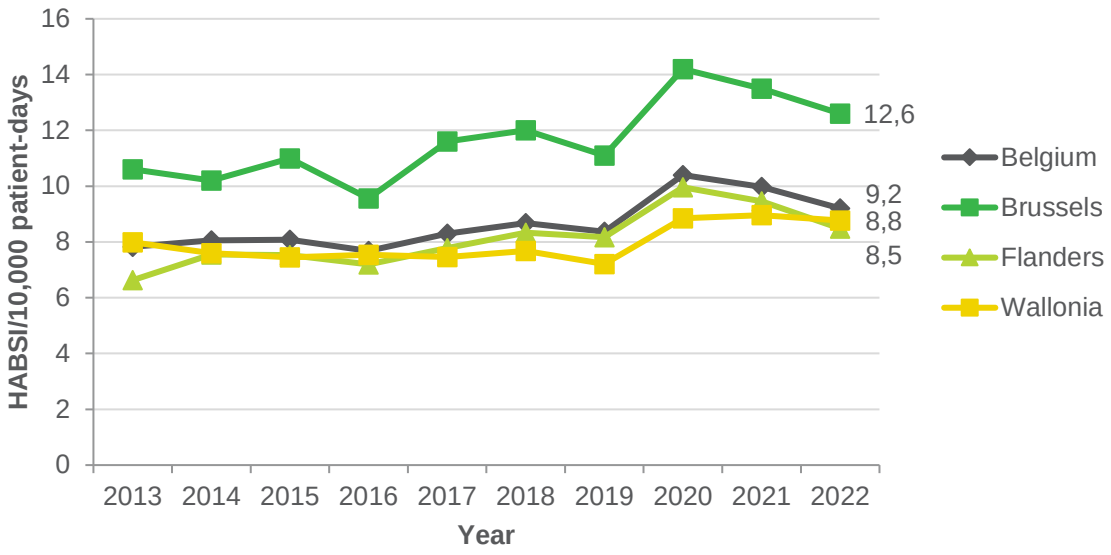


Figure 4 • Mean incidence of hospital-associated bloodstream infections, hospital-wide, by region, Belgium 2013-2022 (HABSI, hospital-associated bloodstream infections)



[9] 'Tertiary hospitals' include the hospitals defined as 'university hospital' and 'general hospital with university characteristics' in the 'Adressenlijst ziekenhuizen 12/2022 - Liste d'adresses des hôpitaux 12/2022' published by FOD volksgezondheid – SPF santé publique.

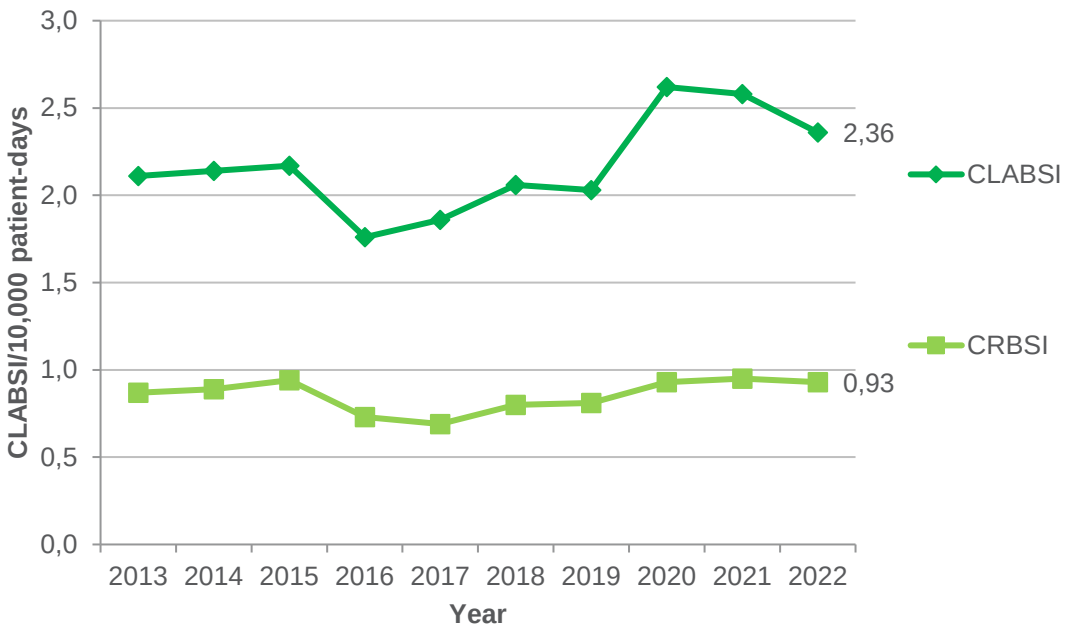
A negative binomial regression model corrected for hospital type and region was used to detect differences of HABSI incidence between regions and hospital types. In this model we could only observe significant differences between hospital type, the HABSI incidence in tertiary hospitals being 76% higher than in non-tertiary hospitals both in the pre-pandemic period as in 2020-2022. This implies that the higher number of tertiary hospitals in Brussels[10] as compared to Flanders and Wallonia explains the regional difference between regions.

3.2.1.2. Central line-associated bloodstream infections, 2013-2022

In 2022, the mean central line-associated bloodstream infection (CLABSI) incidence per 10,000 patient-days was 2.36 for total CLABSI (confirmed, probable and possible together) and 0.93 for confirmed CLABSI, see also Table 2 above and Table S11 for full details.

The trend of CLABSI incidence during 2013-2022 can be found in Figure 5 below. Similarly to HABSI, we observed that the CLABSI incidence was higher in the previous two years than in 2022 (2.58 in 2021 and 2.62 in 2020), however this decreasing trend is not statistically significant. Similar to HABSI incidences, CLABSI incidence increased significantly by 20% comparing the pre-pandemic period (2013-2019) with the following years 2020-2022.

Figure 5 • Mean incidence of central line-associated bloodstream infections), hospital-wide, Belgium 2013-2022 (CLABSI, central line-associated bloodstream infections; CRBSI, catheter related bloodstream infection=Confirmed CLABSI)



In 2022, 39% of HABSI episodes were confirmed CLABSI, 35% probable CLABSI and 26% possible CLABSI. These proportions did not change substantially since 2013 (see Table A8).

The incidence of confirmed CLABSI (CRBSI) shifted upwards in 2020 (Table 2 and Figure 5 above), but this increase was less substantial as compared to total CLABSI. Also, no meaningful trend in confirmed CLABSI incidence could be observed during 2020-2022.

[10] Proportion (absolute numbers and %) of tertiary hospitals participating by region in 2022;
- Brussels: 6/12 (50%)
- Flanders: 7/49 (14%)
- Wallonia: 10/34 (29%)

CLABSI incidence by region can be found in Annex 4 (Table A5). Similar to HABSI incidence, CLABSI incidence is higher in Brussels with an incidence of 2.94 per 10,000 pd compared to Flanders (2.34) and Wallonia (2.06).

Annex 5 describes the CLABSI incidence in tertiary and non-tertiary hospitals. Since 2013, the mean CLABSI incidence (three classifications together) per 10,000 pd remained more than two times as high in tertiary hospitals compared with other hospitals (see Table A7).

Table S7 describes the incidence of HABSI with peripheral catheter as source. The mean incidence of HABSI with peripheral catheter (both confirmed and non-confirmed source) was 0.23 per 10,000 patient-days in 2022, which is more than 10 times lower than the CLABSI incidence of 2.36. An underestimation of the HABSI incidence with peripheral catheter as source could be possible.

3.2.2. Intensive care

Calculation and analysis of incidences per patient-days and per hospitalisations include only the ICU-associated BSI with matching ICU-denominator data (similar to the HABSI incidence calculation). In 2022, 1,593 ICU-associated BSI were registered in the surveillance of which 1,372 (86%) had matching ICU-denominator data. In total we had ICU-associated BSI data with matching ICU-denominator data for 463 quarters. In case a hospital has multiple ICU units, these quarters are calculated separately for each unit because ICU data is analysed on ICU unit level.[11]

To calculate ICU-associated BSI incidences at national level, ICU-denominators of hospitals that participated in the surveillance but had no ICU-associated BSI registered for that quarter are also considered. We found that in 2022, 83 (18%) of the 463 ICU quarters that participated in the surveillance and for which denominator data were available had no ICU-associated BSI registered, meaning no ICU-associated BSI occurred in that ICU during the reporting quarter.

3.2.2.1. Intensive care unit-associated bloodstream infections, 2013-2022

In 2022, the ICU-associated BSI incidence was 40.1 per 10,000 patient-days (see Table 2 above). The trend of ICU-associated BSI incidence during 2013-2022 can be found in Figure 6 below. The ICU-associated BSI incidence in 2022 shows a clear decrease compared to 2021 (47.9) and 2020 (52.2). In the period 2020-2022, the ICU-associated BSI incidence decreased significantly by 7% yearly (Table S12) during period 2020-2022. The incidence of ICU-associated BSI in Belgium at national level did not change significantly between 2013 and 2019 but increased by 44% comparing 2020-2022 with the pre-pandemic period.

The incidence density of primary ICU-associated BSI in 2022 (source is central line, peripheral catheter, other catheter and related products or unknown) was 18.5 per 10,000 pd, while the incidence of secondary HABSI (secondary to an infection at another body site) was 21.6 per 10,000 pd (Table S9).

As previous years, regional data for 2022 shows the highest ICU-associated BSI incidence in Brussels and the lowest in Flanders, see Figure 7 below and annex 7 Table A9).

[11] For example: If a hospital has 2 ICU units and has participated for 2 quarters to the BSI surveillance; the number of ICU quarters will be 4.

Figure 6 • Mean incidence density of intensive care unit-associated bloodstream infections, hospital-wide, Belgium 2013-2022 (ICU-BSI, intensive care unit-associated bloodstream infections)

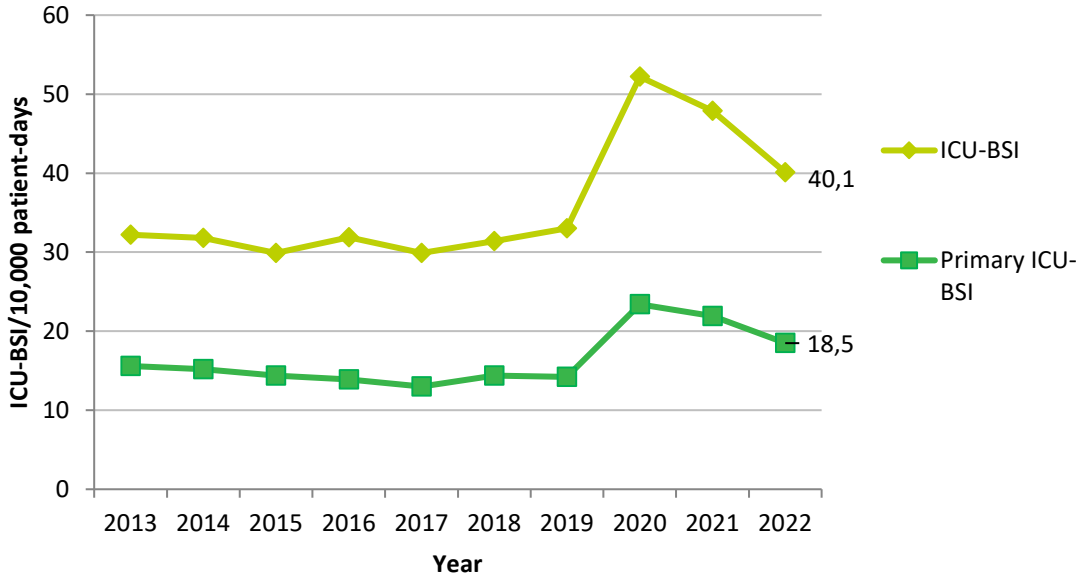
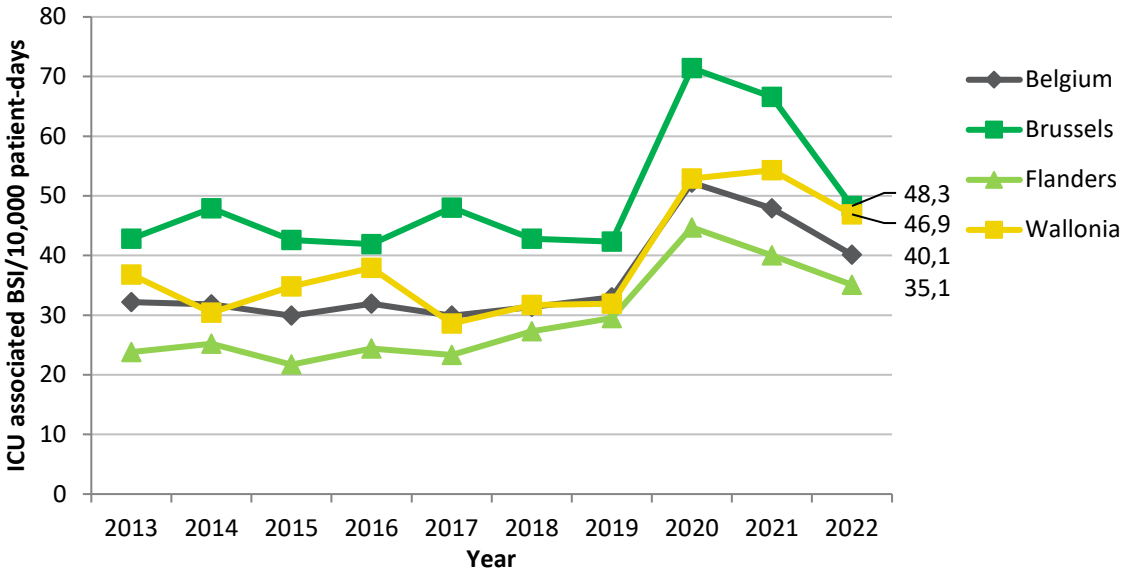


Figure 7 • Mean incidence of intensive care unit-associated bloodstream infections, by region, Belgium 2013-2022 (BSI, bloodstream infections; ICU, intensive care unit)



3.2.2.2. Intensive care unit-associated central line-associated bloodstream infections, 2013-2022

In 2022, the mean CLABSI incidence at ICU per 10,000 patient-days for the three classifications together was 15.50, which is more than 6 times higher than the hospital-wide incidence of 2.36 CLABSI per 10,000 patient-days (see Table 2 above). In 2022, 35% of ICU-associated CLABSI episodes were confirmed CLABSI (see Table A11).

The trend of CLABSI incidence at ICU during 2013-2022 can be found in Figure 8 below. In 2020 and 2021 the CLABSI incidence at ICU was higher than in 2022 (18.78 and 18.00 per 10,000 pd respectively), however this decreasing trend in 2020-2022 is not no statistically significant (Table S11).

Between 2013 and 2019, the total CLABSI incidence at ICU per 10,000 pd shows no meaningful trend. Comparing 2020-2022 with the pre-pandemic period, we can observe an increase of 57%.

Incidence of confirmed CLABSI (CRBSI) at ICU also increased more than 50% to 6.59 episodes per 10,000 pd in 2020 (Table 2 above and Figure 8 below). As with total CLABSI, incidence of CRBSI has decreased since 2020 to 5.18 episodes per 10,000 pd, which remains above pre-COVID19 levels.

Figure 8 • Mean incidence of central line-associated bloodstream infections in intensive care units, Belgium 2013-2022 (CLABSI, central line-associated bloodstream infections; CRBSI, catheter related bloodstream infection=confirmed CLABSI)

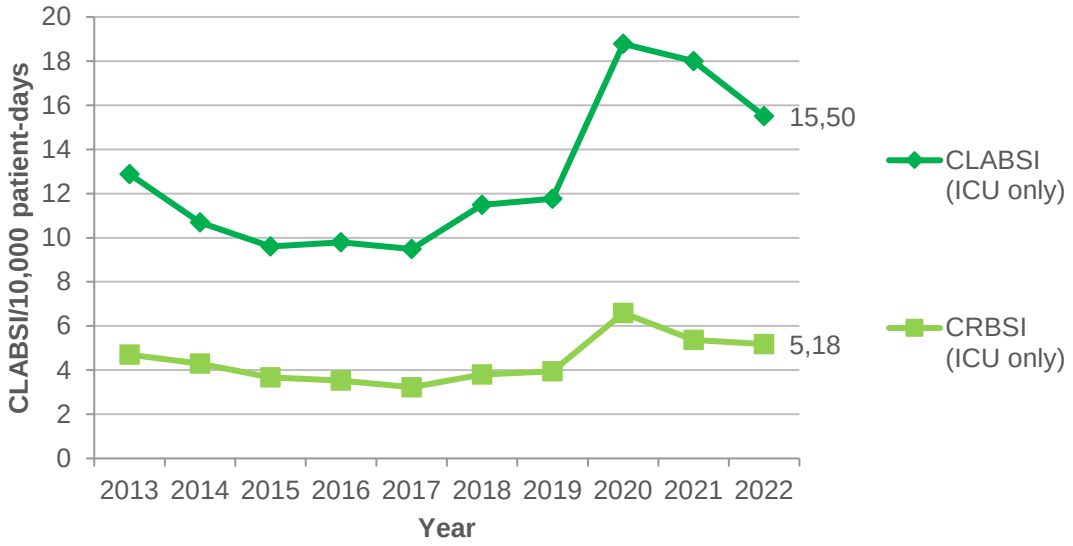


Table S11 describes the incidence of ICU-BSI with peripheral catheter as source. The mean incidence of ICU-BSI with peripheral catheter (both confirmed and non-confirmed source) was 0.38 per 10,000 patient-days in 2022, which is more than 40 times lower than the CLABSI incidence of 15.50. An underestimation of the HABSI incidence with peripheral catheter as source could be possible.

3.3. Characteristics of hospital-associated bloodstream infection, 2022

3.3.1. Hospital-wide

In 2022, 97 hospitals registered together 8,901 BSI of which 7,322 were reported as HABSI.

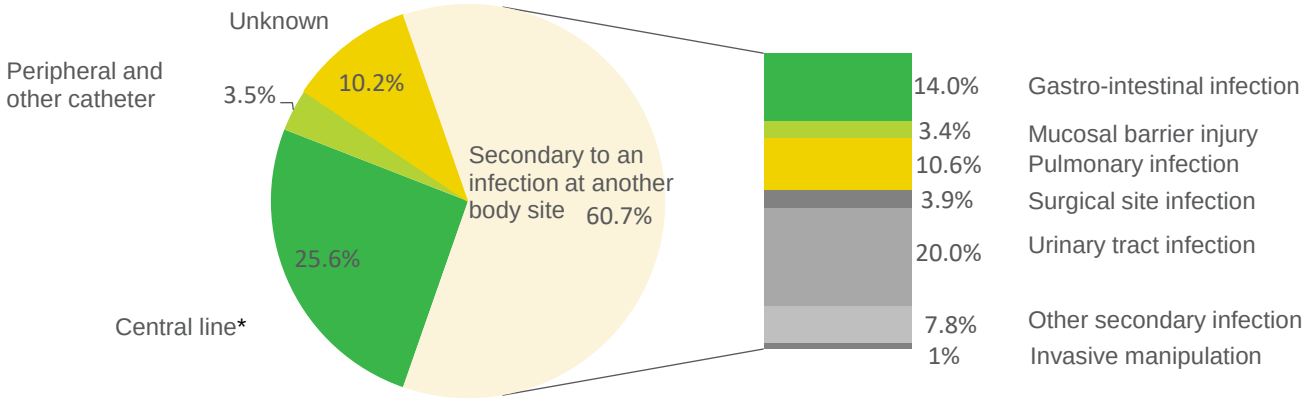
Of all HABSI 25.9% were diagnosed at a medical department and 23.7% were diagnosed at ICU ('diagnosed in ICU' is different than 'ICU-associated') (see Table S13).

The most common source of HABSI, hospital-wide, was a central line (25.6%)[12], followed by urinary tract infection (20%), see Figure 9 below. The source per specialty can be found in annex 10 (Table A12). CL was the main single suspected source of HABSI diagnosed at ICU, oncology and paediatric

[12] Including 'confirmed', 'probable' and 'possible' CLABSI

department. At geriatrics, the medical department and surgery department, urinary tract infection was the main suspected source. Sixty-six percent of all CLABSI was ***not*** diagnosed in ICU.

Figure 9 • Sources of hospital-associated bloodstream infections, Belgium 2022 (*Includes 'confirmed', 'probable' and 'possible' central line-associated bloodstream infection)



For 46% of the HABSI (hospital-wide) the infection source was confirmed (same MO isolated from blood cultures and the site considered to be the source of infection). The proportion of confirmation varies by source (Table S14).

An invasive device was directly (CL and other catheters) or indirectly (urinary catheter, endotracheal tube) associated in 43% of the hospital-wide HABSI, among which 55% (1,727/3,165) were confirmed (see Table S16). Of all HABSI, 25.6% were associated with a central line. Among all HABSI with a urinary tract infection as source 49% (n=710) were catheter-associated. Of these 710 cases, 614 cases (86%) were confirmed (same MO found in blood culture(s) and on device). Regarding HABSI with a pulmonary infection as suspected origin, 42% of these BSI were endotracheal tube -associated of which 89% were confirmed (see Table S15). In 2020 and 2021, the proportion endotracheal tube associated HABSI with a pulmonary infection as suspected origin was 53% and 55% respectively. Before the COVID-19 pandemic this proportion was around 30% (for example 34% in 2019 and 33% in 2018).

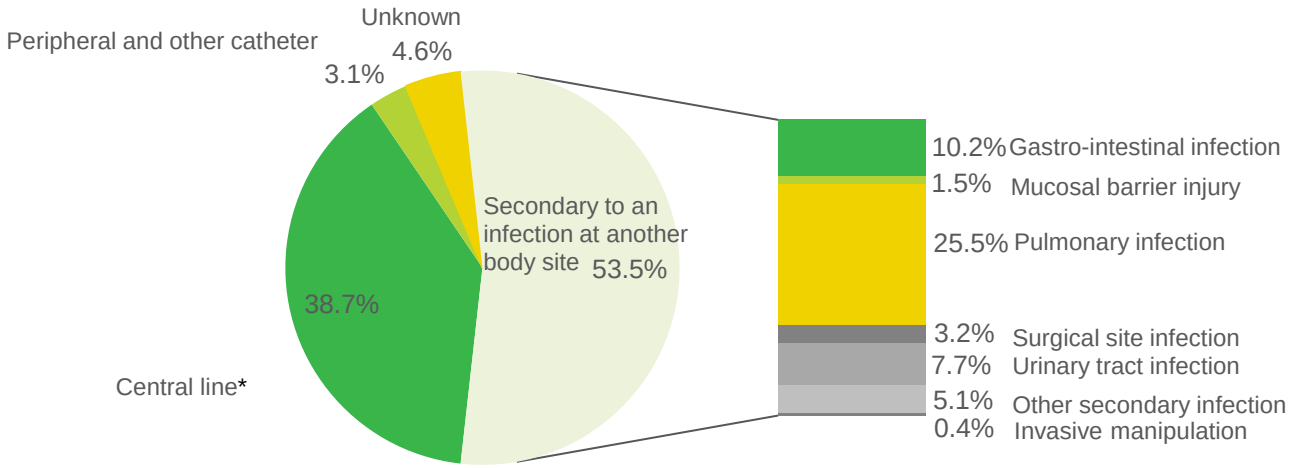
Median number of days between admission in hospital and onset of HABSI was 13 days (IQR 6-24). Forty percent of the HABSI patients were female (Table S19) and sixty five percent were 65 years or older (Table S18). Twenty percent of patients with HABSI died (Table S20). However, there was a substantial amount of missing data for status at end-of-follow-up (26% missing data) and our data do not allow determining a causal link between death and infection.

3.3.2. Intensive care unit

Of all HABSI 22% (1,593) occurred two days or later after admission at ICU (definition of ICU-associated BSI). Before 2020 the proportion of ICU-associated BSI was around 20%. This proportion increased in 2020 (first COVID-19 year) to 27% and to 28% in 2021.

At ICU the most common source was a CL (38.7%) followed by pulmonary infection (25.5%), see Figure 10 below. For 52% of the ICU-associated BSI the infection source was confirmed (see Table S21).

Figure 10 • Sources of intensive care unit-associated bloodstream infections, Belgium 2022 (*Includes 'confirmed', 'probable' and 'possible' central line-associated bloodstream infections)



An invasive device was directly (CL and other catheters) or indirectly (urinary catheter, endotracheal tube) associated in 66% of the ICU-associated BSI (see Table S23).

Median number of days between admission in hospital and onset of ICU-associated BSI was 11 days (IQR 5-21). Twenty-nine percent of patients with ICU-associated BSI died. However, status at end-of-follow-up was missing for 25% of the patients. Our data do not allow determining a causal link between death and infection (see Table S24).

3.4. Identified causal microorganisms and their antimicrobial resistance profile, 2013-2022

3.4.1. Hospital-wide

In 2022, 8,034 microorganisms (MO) were identified as etiological agent for 7,322 HABSI, 2,070 MO for 1,872 CLABSI and 802 MO for 736 CRBSI. Table S25 gives the data for the MO that caused at least 50 in the surveillance registered HABSI episodes in 2022 (for data on MO with less than 50 episodes see Annex 11, Table A13). The majority of the HABSI were caused by one MO; 10% of the infection episodes involved more than one MO.

The most commonly MO isolated from HABSI in 2022 were *E. coli* (20%), *S. aureus* (10%) and *S. epidermidis* (10%), followed by *K pneumoniae* (7%), *E faecium* (6%), *E faecalis* (5%) and *P aeruginosa* (5%). S. *epidermidis* was by far the most common MO isolated from CLABSI (27%) and CRBSI (35%), followed by *S. aureus*, *E. faecium*, *E. coli* and *C. albicans*.

The most frequently found MO by source are given in Annex 12, Table A14 and were:

- *E. coli* in BSI secondary to urinary tract (46%), gastro-intestinal (28%) and MBI (25%) infection, and BSI with as source invasive manipulation (28%),
- *S. epidermidis* in CLABSI (27%), and
- *S. aureus* in BSI secondary to pulmonary (14%) and surgical site (17%) infections and BSI with as source peripheral catheter (32%) and other catheter (31%).

Trends of microorganism (MO) -specific incidences of HABSI since 2000 for the most common MO are given in Figure 11 below. This graph shows long-term increasing trends of *E. coli*, *K. pneumoniae*, and

E. faecium[13], with incidences having peaked in 2020 for all included except *S. aureus*. The incidence of HABSI with *S. aureus* showed a decreasing trend since 2004, but shifted upwards in 2020.

Trends of MO-specific incidences of CLABSI and CRBSI since 2013 for the most common MO are given in Figure 12 and Figure 13 respectively (see below). Total CLABSI incidences due to *S epidermidis* and *E faecium* show increasing trends up to 2020, and declining trends since then, while the CLABSI trend of *S aureus* is decreasing. Confirmed CLABSI shows an increasing trend since 2017 for episodes due to *S epidermidis*. Similar to total CLABSI, confirmed CLABSI shows a decreasing trend for episodes due to *S aureus*.

Figure 11 • Mean incidence of hospital-associated bloodstream infections per microorganism, Belgium 2000-2022 (HABSI, hospital-associated bloodstream infection; MO, microorganism)

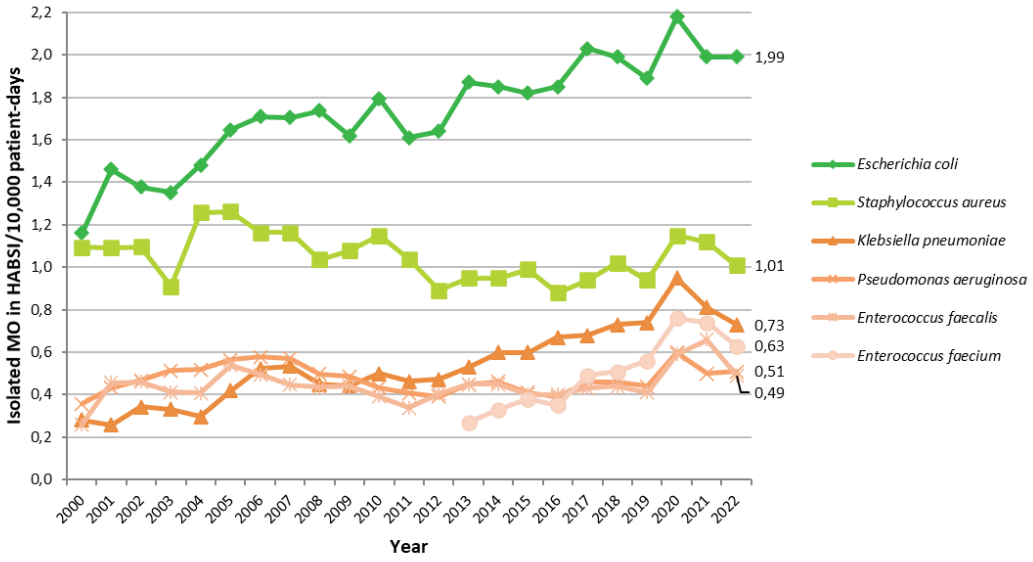
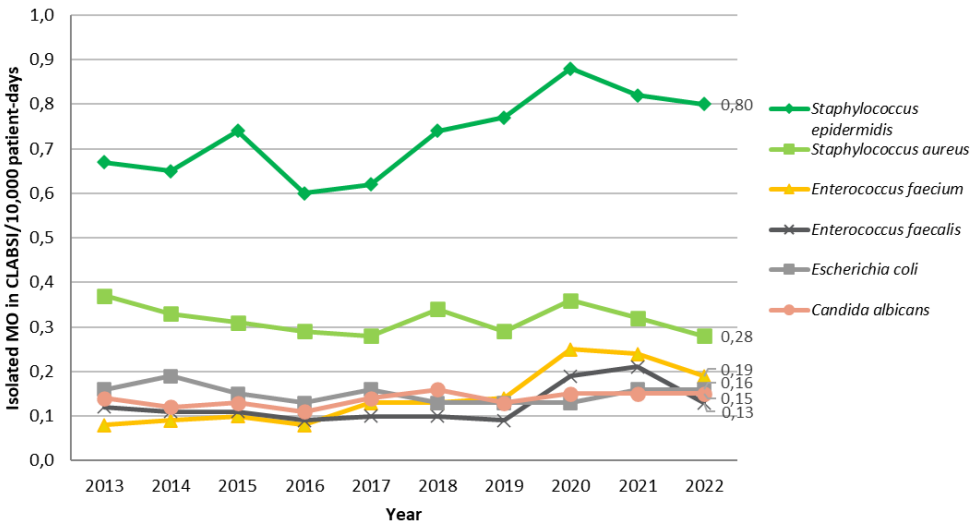
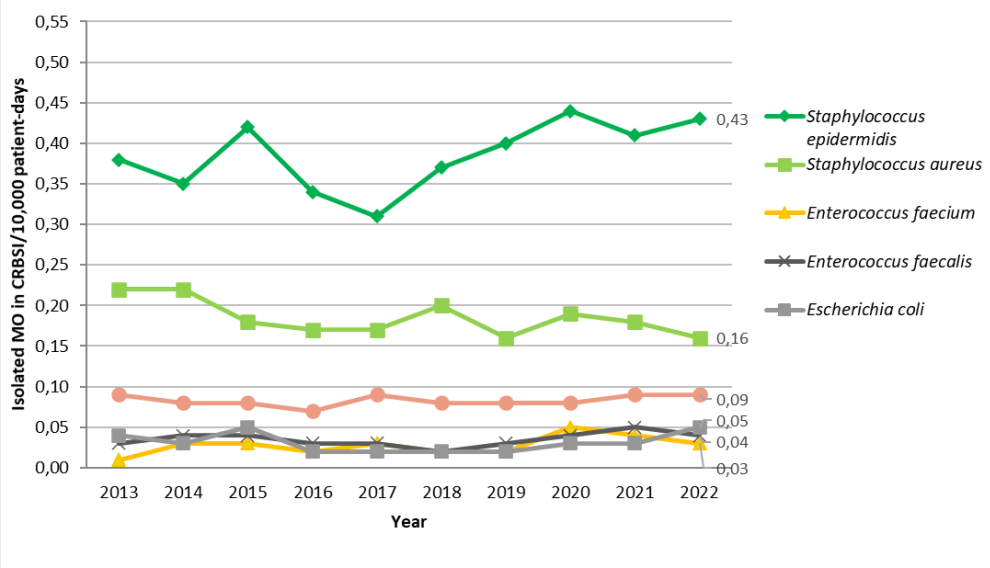


Figure 12 • Mean incidence of central line-associated bloodstream infections per microorganism, Belgium 2013-2022 (CLABSI, central line-associated bloodstream infection; MO, microorganism)



[13] For *E. faecium* only data since 2013 available

Figure 13 • Mean incidence of confirmed central line-associated bloodstream infections per microorganism, Belgium 2013-2022 (CRBSI, catheter related bloodstream infection = confirmed central line-associated bloodstream infection; MO, microorganism)



In line with ECDC recommendations, for a set of selected MO and selected antibiotics (markers), results on antimicrobial resistance were collected through the NSIH-SEP surveillance (11,12). Table 3 below summarizes main results for *S. aureus, E. coli, K. pneumoniae, E. cloacae, P. aeruginosa*, *E. faecium* and *A. baumanii* during period 2013-2022, please refer to Table S26 - Table S31 for detailed results behind these resistance percentages, as well as the mean incidences of HABSI with a non-susceptible MO per 10,000 patient-days.

In 2022, The percentage of S*. aureus* non-susceptible to methicillin was 2022 6.1%. This percentage also decreased yearly by 12% in the period 2013-2022 (yearly resistance rate ratio of 0.88, 95% CI [0.86-0.90]), see Figure 14 below as well as Table S26. The incidence of HABSI with a *S. aureus* non-susceptible to methicillin was 0.06 per 10,000 patient-days in 2022. Also here, this incidence decreased in the period 2013-2022 yearly with 10% (yearly incidence rate ratio of 0.90, 95% CI [0.87-0.92]).

Figure 15 below shows trends in resistance (%R) and non-susceptibility (%IR) rates of *P. aeruginosa* to carbapenems (meropenem or imipenem). In 2022, the percentage of *P. aeruginosa* resistant to carbapenems (%R) was 14.2%, which is lower as compared to 2021 but higher as compared to %R levels below 10% observed in 2018 and 2019. Non-susceptibility (%IR) against carbapenems has increased substantially since 2021, but since the introduction of 2020 EUCAST guidelines which left only the *I category* to report susceptibility to Imipenem (9,10), %IR has become an unreliable indicator to assess resistance of *P. aeruginosa* against carbapenems.

Table 3 • Antimicrobial non-susceptibility and resistance of hospital-associated bloodstream infection episodes, Belgium, 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Staphylococcus aureus										
Methicillin										
%IR	20.9	17.7	15.4	16.2	13.6	10.5	10.5	8.5	9.3	6.1
Glycopeptides (vancomycin, teicoplanin)										
%IR	0.0	0.5	0.7	0.7	0.8	0.4	0.4	0.0	0.2	0.2
Escherichia coli										
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)										
%IR	14.0	16.7	17.3	15.1	15.7	15.8	16.4	14.6	13.0	14.3
Carbapenems (imipenem, meropenem)										
%IR	0.3	0.7	0.9	0.5	1.3	0.6	0.4	0.6	0.5	1.3
%R	N/A	N/A	N/A	N/A	1.3	0.5	0.3	0.4	0.4	0.8
Klebsiella pneumoniae										
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)										
%IR	25.8	31.2	35.2	34.2	28.6	35.1	34.0	27.9	28.7	29.8
Carbapenems (imipenem, meropenem)										
%IR	2.4	3.7	5.8	6.5	6.0	3.9	4.2	4.6	3.4	4.7
%R	N/A	N/A	N/A	N/A	5.0	3.0	2.8	3.2	2.6	3.6
Enterobacter cloacae										
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)										
%IR	43.9	38.6	37.3	36.8	37.3	38.2	46.4	42.6	38.6	38.3
Carbapenems (imipenem, meropenem)										
%IR	1.3	1.6	3.2	3.1	2.8	3.3	1.8	2.6	2.5	1.2
%R	N/A	N/A	N/A	N/A	1.9	2.0	1.1	2.2	1.4	0.6
Pseudomonas aeruginosa										
Carbapenems (imipenem, meropenem)										
%IR	17.2	16.7	14.7	15.9	15.2	14.2	14.1	14.8	23.7	26.9
%R	N/A	N/A	N/A	N/A	13.8	9.9	8.9	11.5	17.3	14.2
Enterococcus faecium										
Glycopeptides (vancomycin, teicoplanin)										
%IR	3.6	3.9	4.8	4.5	5.3	3.6	2.9	2.6	2.4	3.4
Acinetobacter baumanii										
Carbapenems (imipenem, meropenem)										
%IR	13.2	12.0	5.4	3.8	8.8	7.3	2.4	0.0	7.4	7.4
%R	N/A	N/A	N/A	N/A	8.8	5.5	2.4	0.0	7.4	3.7

%IR: non-susceptibility percentage
%R: resistance percentage

Figure 14 • Percentage non-susceptibility (%IR) of S. aureus to methicillin and glycopeptides

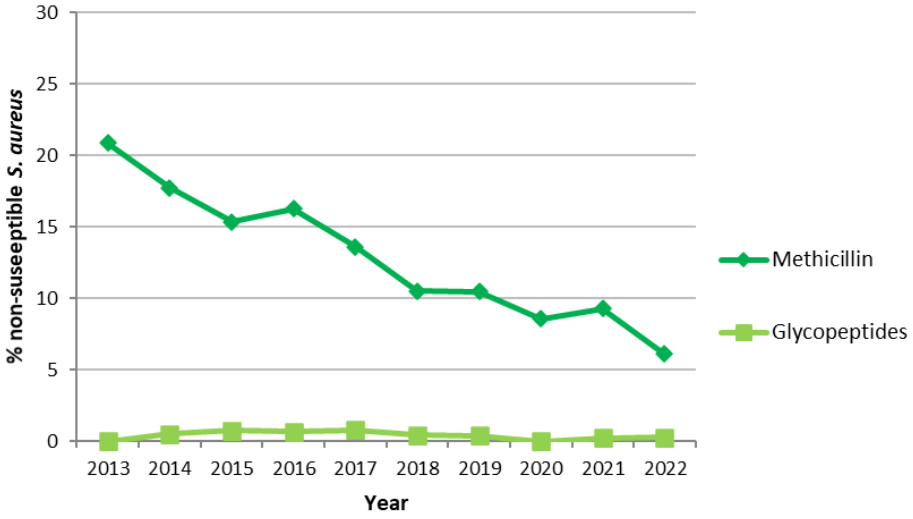
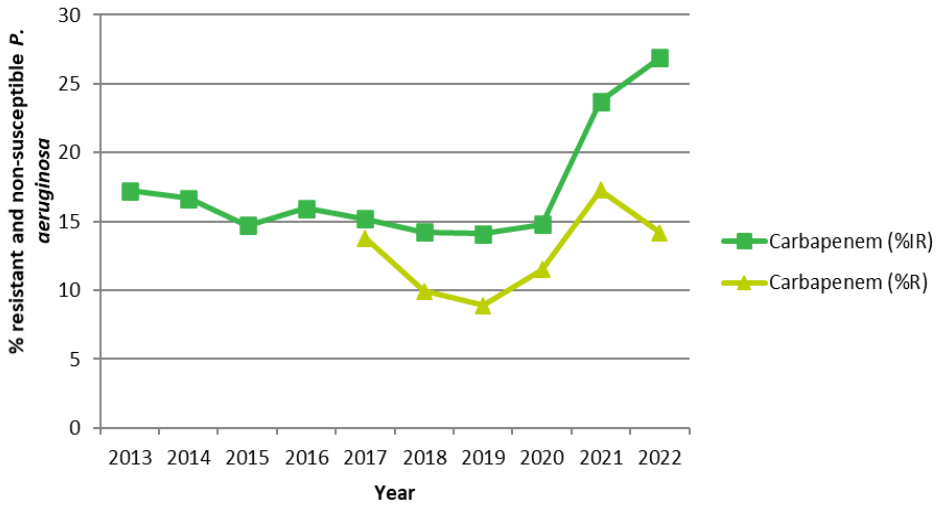


Figure 15 • Percentage resistance and non-susceptibility of *P. aeruginosa* to carbapenems



3.4.2. Intensive care unit

A total of 1,738 MO were identified as etiological agent for 1,593 ICU-associated BSI, 666 MO for 617 ICU associated CLABSI and 233 MO for 213 ICU-associated CRBSI (Table S33).

Generally, interpretation of MO-specific ICU-BSI indicators is difficult due to low numbers. *S. epidermidis, E. coli, S. aureus, E. faecium, E faecalis, K pneumoniae, and P aeruginosa* were the most frequently identified MO from ICU-BSI cases in 2022. S. *epidermidis,* similar to the hospital-wide findings, was by far the most frequently identified MO for both ICU-associated CLABSI (22%) and CRBSI (26%), followed by *E faecium, E faecalis, S aureus, K pneumoniae,* and *C albicans*.

For a set of selected MO and selected antibiotics (markers) (11,12), number and percentage of non-susceptible MO among the MO isolated from the ICU-associated BSI are given in Table S34. In 2022, *E. coli* non-susceptibility to C3G (22%), *K. pneumoniae* resistance to carbapenems (7%) and *P. aeruginosa* resistance to carbapenems (20%) was higher in ICU-associated BSI as compared to hospital-wide HABSI.

4. Main findings and recommendations

These 2022 results of the National Surveillance of Bloodstream Infections (NSIH-SEP) show a hospital-associated bloodstream infection (HABSI) cumulative incidence of 5.4 patients with HABSI per 1,000 hospitalisations, and a HABSI incidence density of 9.2 episodes per 10,000 patient-days (pd). Incidence of Central line-associated bloodstream infection (CLABSI) in 2022 was 2.4 episodes per 10,000 pd. Generally, hospital-wide incidences of HABSI show decreasing trends since 2020, however their 2022 results remain higher as compared to pre-COVID19 levels (2019 and before).

ICU-associated BSI cumulative incidence in 2022 was 18.6 patients with ICU-BSI per 1,000 ICU hospitalisations, and ICU-BSI incidence density in 2022 was 40 episodes per 10,000 ICU pd. ICU-associated CLABSI incidence density in 2022 was 15.5 episodes per 10,000 ICU pd. Generally, incidences of ICU-BSI are multiple times higher as compared to hospital-wide HABSI. As with hospital-wide HABSI, ICU-BSI incidences also show decreasing trends since 2020, but their 2022 incidence also remains higher as compared to 2019 and before.

Forty–three percent of hospital-wide HABSI cases and even 66% of ICU-BSI cases were linked to an invasive device whether directly (central and other catheters) or indirectly (urinary catheter, endotracheal tube). Of these, exposure to central vascular catheter remains the most frequently reported origin of HABSI cases both hospital-wide (26% of HABSI) as well as ICU-only (39% of ICU-BSI). This report also presents for the first time results on the incidence of HABSI cases associated to the use of peripheral line, their 2022 incidence density being 0.23 episodes per 10,000 pd (hospital-wide) and 0,38 episodes per 10,000 ICU pd (ICU-specific). Incidence of these peripheral line-associated HABSI is much lower as compared to CLABSI incidence, however this type of HABSI is possibly underreported in the current version of the NSIH-SEP surveillance protocol.

In 2022, the most commonly micro-organisms (MO) isolated from hospital-wide HABSI cases were *E. coli, S. aureus, and S. epidermidis*, this last MO also being the most commonly isolated from hospital-wide CLABSI cases. Long-term increasing trends can be observed for hospital-wide HABSI incidences due to *E. coli, K. pneumoniae*, and *E. faecium*. The trend of hospital-wide CLABSI due to *S epidermidis* is also increasing since 2016, while it is decreasing for CLABSI due to *S aureus*. We also observe a long-term decreasing trend in the prevalence of methicillin-resistant *S aureus* (MRSA).

While the NSIH-SEP register was the first national Healthcare-associated infection surveillance to migrate to the Healthdata environment in 2017, its actual tools for data collection and centralized data processing and results reporting are now in need of revision. Tools for data collection need to be harmonized with other registers on BSI/AMR such as surveillance of antimicrobial resistance and of ICU-acquired infections, and also need to be adapted towards automated collection of hospital data where possible. Healthdata tools for centralized data processing and reporting of national NSIH-SEP results should also be automated where possible. Next to this, recent and ongoing technical problems of data collection and analysis environments of the Healthdata platform have resulted in unnecessary delays in the reporting of these results; Sciensano and its Healthdata service are therefore recommended to prioritize on the resolution of these issues, and also to elaborate alternative procedures for data collection and reporting such that deadlines for annual publication of national surveillance results remain unaffected.

Another reason for delayed publication of these national results is the late submission of surveillance data for a substantial number of hospitals. A discussion on the (suspension of) the mandatory status of the NSIH-SEP surveillance might be needed, as the delays now observed in collecting and validating surveillance results from many hospitals might as such be avoided.

These results show that central catheter is the most frequently documented HABSI origin in 2022, and that CLABSI incidence in 2022 remains at an increased level as compared to pre-COVID19 years.

We therefore recommend a strong focus on the prevention of this type of HABSI, in the first place by freeing resources for the development of national recommendations on catheter use, and for the follow-up of their compliance on a national level. The NSIH-SEP surveillance should also be adapted such that it allows a more detailed look into catheter infections, for example by adding indicators on catheter use in hospitals in Belgium, and also by additionally documenting exposure to peripheral line exposure for each HABSI episode.

STATISTICAL REPORT

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1. Participation

Table S1 • Participation in the surveillance of bloodstream infections in Belgian hospitals, Belgium 2013-2022

N participating quarters	N hospitals participating (% of hospitals on total number of hospitals that should participate, until 2017 N=109 – 2018 N=107 – 2019-2021 N=104 – 2022 N=102)*									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
At least 1 quarter	**91 (83)**	**100 (92)**	**106 (97)**	**106 (97)**	**105 (96)**	**104 (97)**	**98 (94)**	**97 (93)**	**100 (96)**	**97 (95)**
1 quarter	35 (32)	34 (31)	34 (31)	31 (28)	29 (27)	27 (25)	31 (30)	39 (37)	39 (37)	38 (37)
2 quarters	11 (10)	11 (10)	7 (6)	6 (6)	12 (11)	9 (8)	10 (10)	8 (8)	10 (10)	7 (7)
3 quarters	5 (5)	3 (3)	1 (1)	2 (2)	4 (4)	6 (6)	5 (5)	7 (7)	5 (5)	1 (1)
4 quarters (whole year)	40 (36)	52 (48)	64 (59)	67 (61)	60 (55)	62 (58)	52 (50)	43 (41)	46 (44)	51 (50)

N, number

Note:

* Hospitals are identified by their RIZIV/INAMI number - total number of hospitals differs between years because of merges of hospitals.

Table S2 • Participation in the surveillance of bloodstream infections in Belgian hospitals by region, 2022

N participating quarters	N hospitals participating (% of hospitals on total number of hospitals that should participate: Brussels N=14, Flanders N=51, Wallonia N=37)*		
	Brussels	Flanders	Wallonia
At least 1 quarter	**12 (86)**	**50 (98)**	**35 (95)**
1 quarter	5 (36)	15 (29)	18 (49)
2 quarters	1 (7)	3 (6)	3 (8)
3 quarters	0 (0)	1 (2)	0 (0)
4 quarters (whole year)	6 (43)	31 (61)	14 (38)

N, number

Note:

* Hospitals as identified by their RIZIV/INAMI number

Table S3 • Participation in the surveillance of bloodstream infections in Belgian Hospitals by quarter and region, 2022

Quarter	N hospitals participating (% of hospitals on total number of hospitals that should participate: Brussels N=14, Flanders N=51, Wallonia N=37, Belgium N=102)*			
	Brussels	Flanders	Wallonia	Belgium
Q1	10 (71)	36 (71)	24 (65)	70 (69)
Q2	7 (50)	33 (65)	20 (54)	60 (59)
Q3	8 (57)	40 (78)	17 (46)	65 (64)
Q4	6 (43)	39 (76)	19 (51)	64 (63)

N, number, Q, quarter

Note:

* Hospitals as identified by their RIZIV/INAMI number

2. Incidence of hospital-associated bloodstream infections

2.1. HOSPITAL-WIDE

2.1.1. Hospital-associated bloodstream infections, 2013-2022

Table S4 • Incidence of hospital-associated bloodstream infections (hospital-wide), Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N hospitals included in calculation of incidence*	86	96	102	103	93	100	98	97	99	95
N HABSI	5,584	6,926	7,875	7,791	6,755	7,905	7,239	7,262	7,589	7,285
N hospitalisations with at least one HABSI episode	5,584	6,926	7,875	7,791	6,479	7,284	6,691	6,683	6,923	6,732
N hospitalisations	994,440	1,198,137	1,410,607	1,497,167	1,225,950	1,368,592	1,308,541	1,066,608	1,204,862	1,257,060
N patient-days	7,129,817	8,588,698	9,750,587	10,141,410	8,139,011	9,108,203	8,644,480	6,996,582	7,614,056	7,914,885
*Cumulative incidence per 1,000 hospitalisations (calculations include all HABSI episodes**)*										
mean***	5.6	5.8	5.6	5.2	5.5	5.8	5.5	6.8	6.3	5.8
median****	5.2	4.8	4.8	4.7	4.7	4.6	4.5	5.5	5.2	4.9
Cumulative incidence per 1,000 hospitalisations (calculations based on number hospitalisations with at least one HABSI episode)										
mean	N/A	N/A	N/A	N/A	5.3	5.3	5.1	6.3	5.8	5.4
median****	N/A	N/A	N/A	N/A	4.7	4.3	4.4	5.3	4.9	4.7
Incidence density per 10,000 patient-days										
mean***	7.8	8.1	8.1	7.7	8.3	8.7	8.4	10.4	10.0	9.2
median****	6.9	6.9	6.8	6.8	7.0	7.2	7.1	8.6	8.1	7.6

HABSI, hospital-associated BSI; N, number; N/A, Not Applicable

Notes:

* Hospitals included when denominator of the participating quarter was available[14]

** Multiple HABSI episodes of the same patient during 1 hospitalisation (same hospital admission date) are counted separately.

***Total hospital-associated BSI/total denominator

**** Unit of analysis used to calculate median is quarter

[14] In 2022, for 99% of the reported HABSI matching denominator data was available.

Table S5 • Incidence of hospital-associated bloodstream infections (hospital-wide), by type, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Primary HABSI										
N*	2,481	3,051	3,486	3,129	2,709	3,065	2,748	2,936	3,087	2,868
mean incidence per 10,000 pd	3.5	3.6	3.6	3.1	3.3	3.4	3.2	4.2	4.1	3.6
Secondary HABSI										
N*	3,103	3,875	4,389	4,662	4,046	4,840	4,491	4,326	4,502	4,417
mean incidence per 10,000 pd	4.4	4.5	4.5	4.6	5.0	5.3	5.2	6.2	5.9	5.6
Total HABSI										
N*	5,584	6,926	7,875	7,791	6,755	7,905	7,239	7,262	7,589	7,285
mean incidence per 10,000 pd	7.8	8.1	8.1	7.7	8.3	8.7	8.4	10.4	10.0	9.2

HABSI, hospital-associated BSI; N, number; pd, patient-days
Note:
*Includes only those episodes for which a denominator is available

2.1.2. Central-line associated bloodstream infections, 2013-2022

Table S6 • Mean incidence of central line-associated bloodstream infections, hospital-wide, according to classification, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Confirmed CLABSI										
N*	619	768	918	739	565	732	697	654	720	735
mean incidence per 10,000 pd	0.87	0.89	0.94	0.73	0.69	0.80	0.81	0.93	0.95	0.93
Probable CLABSI										
N*	459	601	742	610	475	636	582	561	594	647
mean incidence per 10,000 pd	0.64	0.70	0.76	0.60	0.58	0.70	0.67	0.80	0.78	0.82
Possible CLABSI										
N*	424	465	459	439	477	505	474	619	648	488
mean incidence per 10,000 pd	0.59	0.54	0.47	0.43	0.59	0.55	0.55	0.88	0.85	0.62
Total CLABSI										
N*	1,502	1,834	2,119	1,788	1,517	1,873	1,753	1,834	1,962	1,870
mean incidence per 10,000 pd	2.11	2.14	2.17	1.76	1.86	2.06	2.03	2.62	2.58	2.36

CLABSI, central line-associated bloodstream infection; N, number; pd, patient-days
Note:
* Includes only those episodes for which a denominator is available

Figure S1 • Mean incidence of central line-associated bloodstream infections (confirmed, probable, and possible), hospital-wide, Belgium 2013-2022 (CLABSI, central line-associated bloodstream infections). Confirmed CLABSI = CRBSI (catheter related bloodstream infection).

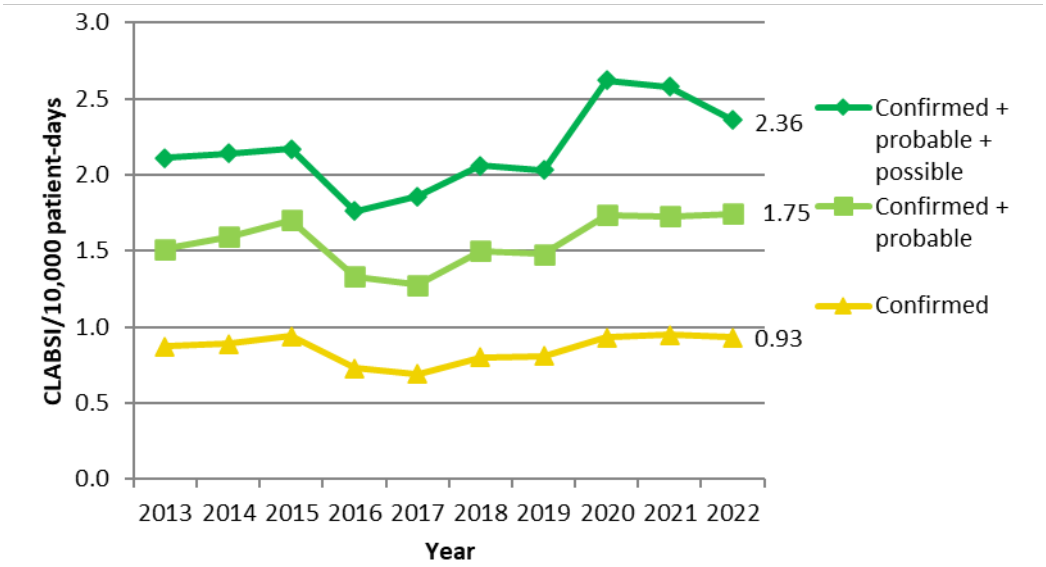


Table S7 • Mean incidence of hospital-associated bloodstream infections with peripheral catheter as source, hospital-wide, according to classification, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
HABSI with peripheral catheter as confirmed source										
N*	35	31	122	101	32	40	35	40	59	47
mean incidence per 10,000 pd	0.05	0.04	0.13	0.10	0.04	0.04	0.04	0.06	0.08	0.06
HABSI with peripheral catheter as non-confirmed source										
N*	72	80	96	84	84	114	115	91	101	138
mean incidence per 10,000 pd	0.10	0.09	0.10	0.08	0.10	0.13	0.13	0.13	0.13	0.17
Total HABSI with peripheral catheter as source										
N*	107	111	218	185	116	154	150	131	160	185
mean incidence per 10,000 pd	0.15	0.13	0.22	0.18	0.14	0.17	0.17	0.19	0.21	0.23

N, Number; pd, patient-days, HABSI, hospital-associated bloodstream infection

Note:

* Includes only those episodes for which a denominator is available

2.1.3. Distribution of hospital-specific HABSI incidences, 2022

Figure S2 • Hospital-associated bloodstream infections: incidence distribution across hospitals, Belgium 2022 (HABSI, hospital-associated bloodstream infection)[15]

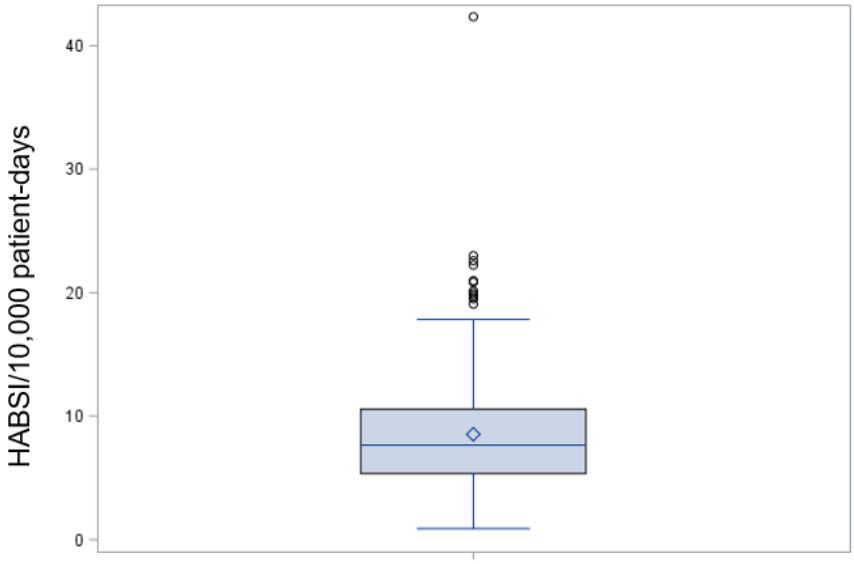
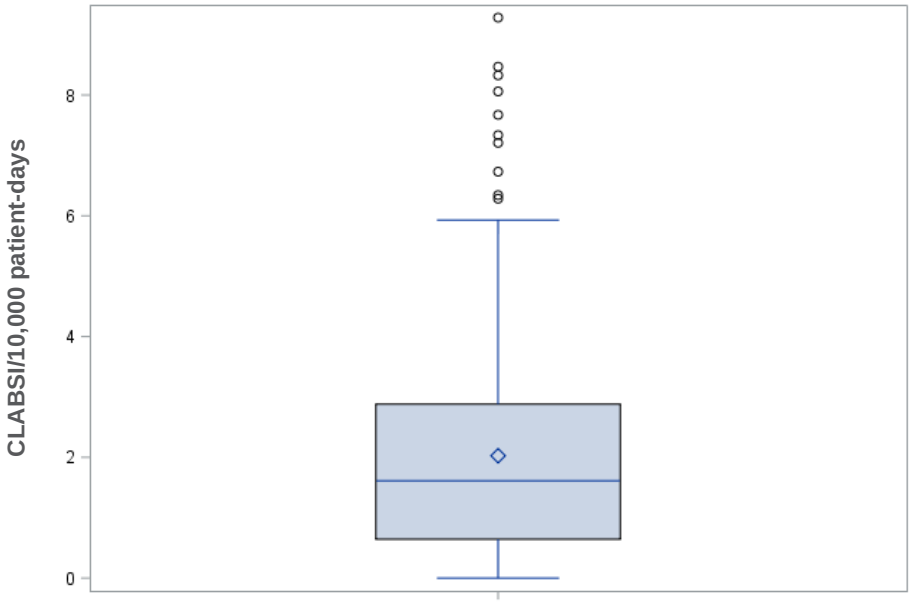
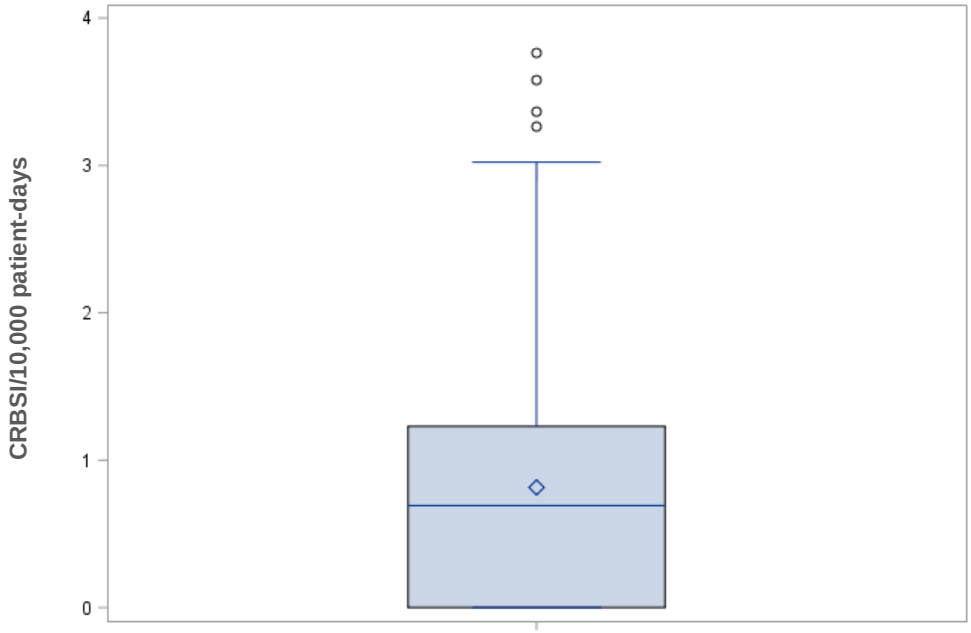


Figure S3 • Central line-associated bloodstream infections: incidence distribution across hospitals, Belgium 2022 (CLABSI, central line-associated bloodstream infection)



[15] The boxplot displays the median incidence (blue line in the box) of the HABSI per 10,000 patient-days per hospital per participating quarter. The box limits represent the P25 and P75 values, the whiskers mark the lower and upper adjusted values (respectively P25 - 1.5 IQR and P75 + 1.5 IQR) and the dots represent the outliers (outside values). The diamond shape indicates the mean incidence density.

Figure S4 • Catheter related bloodstream infections: incidence distribution across hospitals, Belgium 2022 (CRBSI, catheter related bloodstream infection)



2.2. INTENSIVE CARE UNIT

2.2.1. Intensive care unit-associated bloodstream infections, 2013-2022

Table S8 • Incidence of intensive care unit-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N hospitals included in calculation of incidence*	55	62	67	67	76	92	93	93	97	90
N ICU wards included in calculation of incidence	92	101	107	109	143	174	170	186	178	169
N ICU-associated BSI	692	776	792	850	788	1,263	1,246	1,766	1,794	1,372
N hospitalisations with at least one ICU-associated BSI episode	692	776	792	850	751	1,180	1,160	1,601	1,618	1,255
N ICU hospitalisations	48,543	55,066	58,160	57,357	56,550	81,373	75,311	61,945	65,868	67,409
N ICU patient-days	215,050	244,137	264,664	266,411	263,568	401,980	377,984	338,617	374,390	341,992
*Cumulative incidence per 1,000 hospitalisations calculations include all ICU-associated BSI episodes**)*										
mean***	14.3	14.1	13.6	14.8	13.9	15.5	16.5	28.5	27.2	20.4
median****	13.6	11.5	10.8	12.2	11.6	12.3	15.6	24.4	24.4	17.5
Cumulative incidence per 1,000 hospitalisations (calculations based on number of hospitalisations with at least one ICU-associated BSI episode)										
mean	N/A	N/A	N/A	N/A	13.3	14.5	15.4	25.9	24.6	18.6
median****	N/A	N/A	N/A	N/A	18.5	17.5	18.6	31.3	28.3	20.4
Incidence density per 10,000 patient-days										
mean***	32.2	31.8	29.9	31.9	29.9	31.4	33.0	52.2	47.9	40.1
median****	24.3	23.5	23.1	25.1	25.1	25.8	28.1	41.2	39.4	32.9

BSI, bloodstream infection; ICU, intensive care unit; N, number; N/A, Not Applicable
Notes:
* Hospitals included when ICU-denominator of the participating quarter was available
** Multiple ICU-associated BSI episodes of the same patient during 1 ICU hospitalisation (same ICU admission date) are counted separately.
*** Total ICU-associated BSI/total denominator
**** Unit of analysis used to calculate median is quarter

Table S9 • Incidence of intensive care unit-associated bloodstream infections by type, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Primary ICU-BSI										
N*	335	372	381	370	343	578	538	792	821	633
mean incidence per 10,000 pd	15.6	15.2	14.4	13.9	13.0	14.4	14.2	23.4	21.9	18.5
Secondary ICU-BSI										
N*	357	404	411	480	445	685	708	974	973	739
mean incidence per 10,000 pd	16.6	16.5	15.5	18.0	16.9	17.0	18.7	28.8	26.0	21.6
Total ICU-BSI										
N*	692	776	792	850	788	1,263	1,246	1,766	1,794	1,372
mean incidence per 10,000 pd	32.2	31.8	29.9	31.9	29.9	31.4	33.0	52.2	47.9	40.1

ICU-BSI, Intensive care unit-associated BSI; N, number; pd, patient-days
Note:
*Includes only those episodes for which a denominator is available

2.2.2. Intensive care unit-associated central line-associated bloodstream infections, 2013-2022

Table S10 • Mean incidence of central line-associated bloodstream infections in intensive care units according to classification, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Confirmed CLABSI										
N*	101	105	97	94	85	153	149	223	201	177
mean incidence per 10,000 pd	4.70	4.30	3.67	3.53	3.23	3.81	3.94	6.59	5.37	5.18
Probable CLABSI										
N*	65	60	67	69	79	152	137	164	178	171
mean incidence per 10,000 pd	3.02	2.46	2.53	2.59	3.00	3.78	3.62	4.84	4.75	5.00
Possible CLABSI										
N*	111	96	90	98	86	157	159	249	295	182
mean incidence per 10,000 pd	5.16	3.93	3.40	3.68	3.26	3.91	4.21	7.35	7.88	5.32
Total CLABSI										
N*	277	261	254	261	250	462	445	636	674	530
mean incidence per 10,000 pd	12.88	10.69	9.60	9.80	9.49	11.49	11.77	18.78	18.00	15.50

CLABSI, central line-associated bloodstream infection; N, number; pd, patient-days
Note:
* Includes only those episodes for which a denominator is available

Figure S5 • Mean incidence of central line-associated bloodstream infections (confirmed, probable, and possible) in intensive care units, Belgium 2013-2022 (CLABSI, central line-associated bloodstream infections)

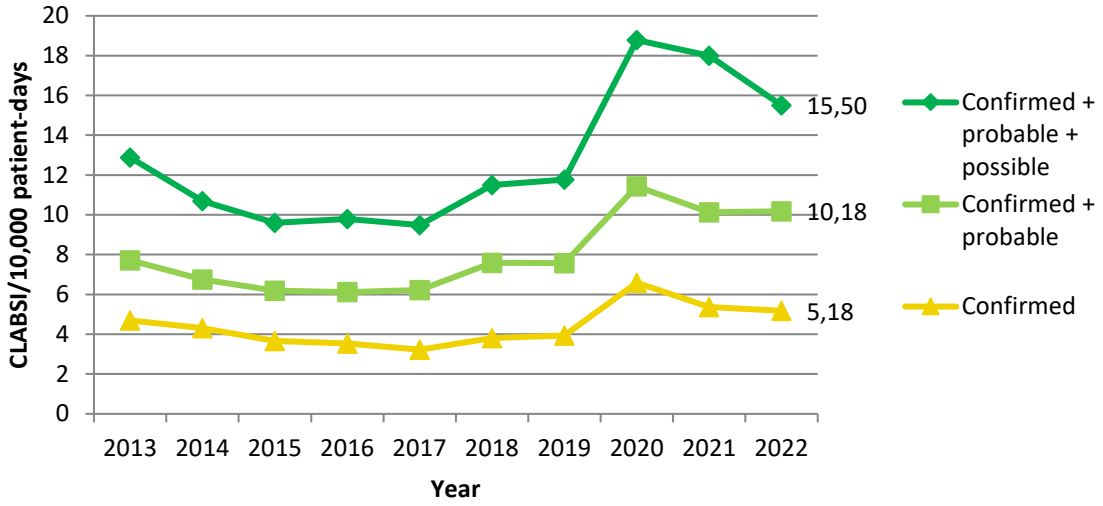


Table S11 • Mean incidence of hospital-associated bloodstream infections with peripheral catheter as source in intensive care units according to classification, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ICU-BSI with peripheral catheter as confirmed source										
N*	2	1	3	1	1	3	4	11	8	2
mean incidence per 10,000 pd	0.09	0.04	0.11	0.04	0.04	0.07	0.11	0.32	0.21	0.06
ICU-BSI with peripheral catheter as non-confirmed source										
N*	2	4	2	6	1	8	6	12	5	11
mean incidence per 10,000 pd	0.09	0.16	0.08	0.23	0.04	0.20	0.16	0.35	0.13	0.32
Total ICU-BSI with peripheral catheter as source										
N*	4	5	5	7	2	11	10	23	13	13
mean incidence per 10,000 pd	0.19	0.20	0.19	0.26	0.08	0.27	0.26	0.68	0.35	0.38

N, Number; pd, patient-days, ICU-BSI, intensive care unit-associated bloodstream infection

Note:

* Includes only those episodes for which a denominator is available

2.2.3. Distribution of intensive care unit-specific ICU associated BSI incidences, 2022

Figure S6 • Intensive care unit-associated bloodstream infections: incidence distribution across intensive care units, Belgium 2022 (BSI, bloodstream infection; ICU, intensive care unit)[16]

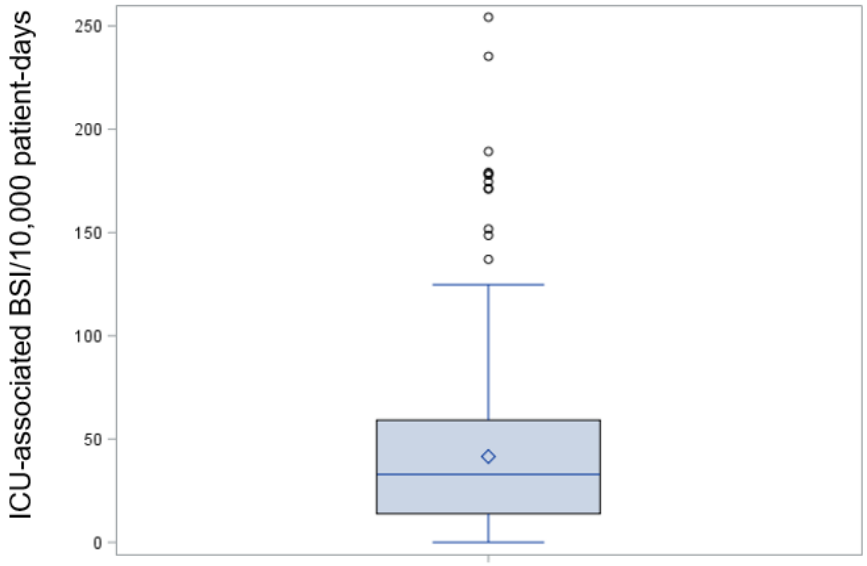
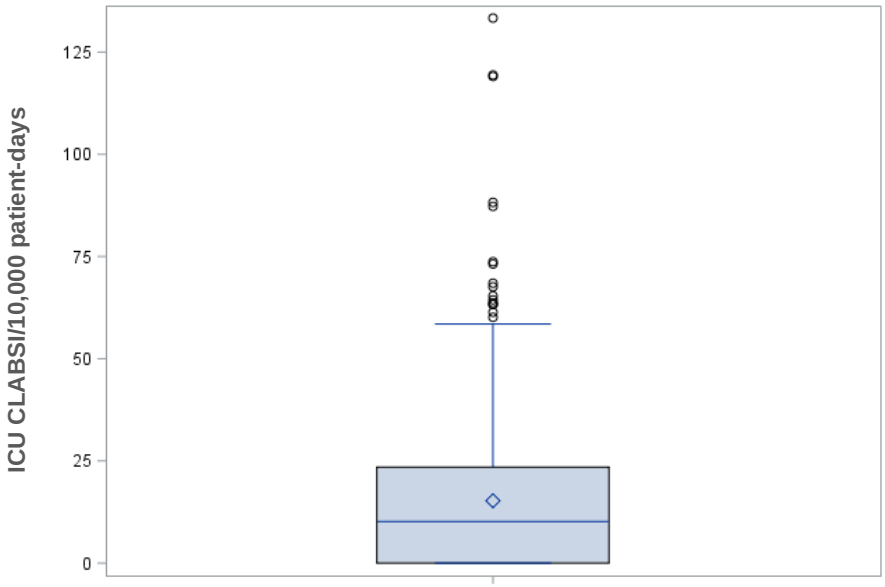
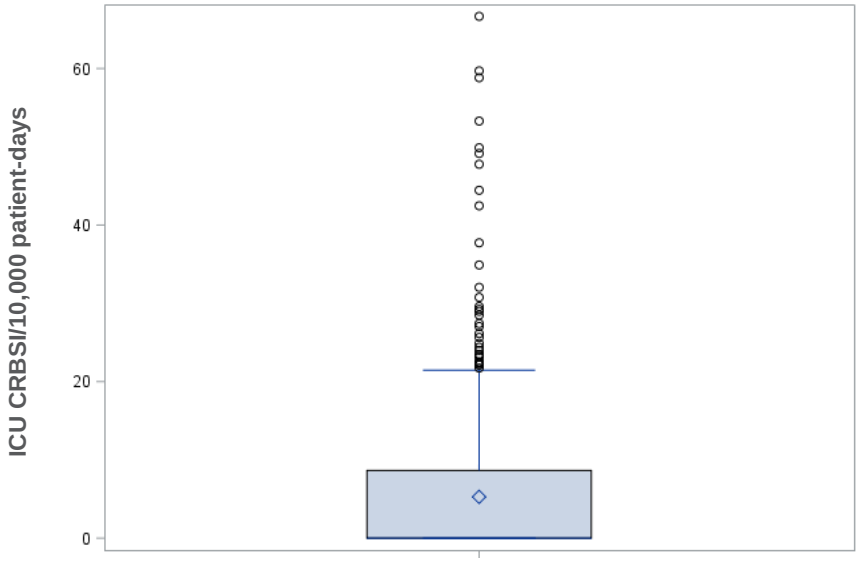


Figure S7 • Intensive care unit central line-associated bloodstream infections: incidence distribution across intensive care units, Belgium 2022 (CLABSI, central line-associated bloodstream infection; ICU, intensive care unit)



[16] The boxplot displays the median incidence (blue line in the box) of the HABSI per 10,000 patient-days per hospital per participating quarter. The box limits represent the P25 and P75 values, the whiskers mark the lower and upper adjusted values (respectively P25 - 1.5 IQR and P75 + 1.5 IQR) and the dots represent the outliers (outside values). The diamond shape indicates the mean incidence density.

Figure S8 • Intensive care unit catheter related bloodstream infections: incidence distribution across intensive care units, Belgium 2022 (CRBSI, catheter related bloodstream infection; ICU, intensive care unit)



2.3. TRENDS OF BLOODSTREAM INFECTION INCIDENCE 2013-2022

Table S12 • Trends of bloodstream infection incidence densities, Belgium 2013-2022

	HABSI	CLABSI (hospital-wide)	ICU-associated BSI	CLABSI (ICU-only)
Comparison 2013-2019 with 2020-2022				
IRR [95% CI]	**1.19 [1.12-1.26]**	**1.20 [1.08-1.32]**	**1.44 [1.30-1.59]**	**1.57 [1.37-1.80]**
Yearly IRR of the period 2020-2022				
IRR [95% CI]	**0.96 [0.93-0.99]**	0.97 [0.89-1.05]	**0.93 [0.87-0.99]**	0.94 [0.84-1.04]

IRR, incidence rate ratio; CI, confidence interval; HABSI, hospital-associated bloodstream infection; CLABSI, central line-associated bloodstream infection; ICU, Intensive care unit

3. Characteristics of hospital-associated bloodstream infection, 2022

3.1. HOSPITAL-WIDE

3.1.1. Department where the hospital-associated bloodstream infection was diagnosed

Table S13 • Department of hospital-associated bloodstream infection diagnosis, Belgium 2022

Department	N	%
Medical department	1,896	25.9
Gastro-enterology	*543*	*7.4*
Cardiology	*238*	*3.3*
Pneumology	*171*	*2.3*
COVID-19 general department	*6*	*0.1*
Other	*938*	*12.8*
ICU*	1,737	23.7
COVID-19 ICU	*9*	*0.1*
Adult ICU	*644*	*8.8*
Paediatric ICU	*43*	*0.6*
Neonatal ICU	*140*	*1.9*
Cardiac ICU	*67*	*0.9*
Neurological ICU	*3*	*0.0*
Surgical ICU	*56*	*0.8*
Medical ICU	*59*	*0.8*
ICU (other/not specified/mixed)	*716*	*9.8*
Surgery	904	12.3
Geriatrics	1,046	14.3
Hemato-oncology	978	13.4
Paediatrics	75	1.0
Obstetrics/gynaecology	35	0.5
Other**	651	8.9
Total	**7,322**	**100**

ICU, intensive care unit; N, number
Note:
* 'Diagnosed in ICU' is different than 'ICU-associated'
** Department is a required field and unknown cannot be selected

3.1.2. Source of hospital-associated bloodstream infections

Table S14 • Confirmed and non-confirmed sources of hospital-associated bloodstream infections, Belgium 2022

	Hospital-associated bloodstream infections					
	Confirmed		Non-confirmed		Total	
Source	N	%	N	%	N	%
CLABSI*	736	22	1,136	29	1,872	25.6
Urinary tract infection	1,260	38	203	5	1,463	20.0
with catheter	*614*		*96*		*710*	
Gastro-intestinal infection	263	8	764	19	1,027	14.0
Pulmonary infection	508	15	266	7	774	10.6
with endotracheal tube/cannula	*293*		*35*		*328*	
Surgical site infection	175	5	108	3	283	3.9
Peripheral catheter	47	1	139	4	186	2.5
Other Catheter and related products	37	1	32	1	69	0.9
Mucosal barrier injury	31	1	218	5	249	3.4
Invasive manipulation	24	1	57	1	81	1.1
Other secondary infection**	274	8	294	7	568	7.8
Unknown	0	0	750	19	750	10.2
Total	**3,355**	**100**	**3,967**	**100**	**7,322**	**100**

CLABSI, central line-associated bloodstream infection; N, number
Notes:
***** Includes 'probable' and 'possible' CLABSI
** Skin/soft tissue and other

Table S15 • Hospital-associated bloodstream infections origins and associations with invasive devices, Belgium 2022

	HABSI	
HABSI	N	%
CLABSI*	**1,872**	**100**
Confirmed (CRBSI)	736	39
Urinary tract infection	**1,463**	**100**
Urinary catheter present	710	49
Presence urinary catheter unknown	58	4
Urinary catheter present and catheter as origin of HABSI is confirmed	614	42
Pulmonary infection	**774**	**100**
Endotracheal tube present	328	42
Presence endotracheal tube unknown	33	4
Endotracheal tube is present and tube as origin of HABSI is confirmed	293	38
Peripheral catheter associated BSI	**186**	**100**
Confirmed	47	25
Other catheter and related products associated BSI	**69**	**100**
Confirmed	37	54

BSI, bloodstream infection; CLABSI, central line-associated bloodstream infection; CRBSI, central line-related bloodstream infection; HABSI, hospital-associated bloodstream infection; N, number
Note:
* Includes 'confirmed', 'probable' and 'possible' CLABSI

Table S16 • Hospital-associated bloodstream infections associated with invasive devices, Belgium 2022

Invasive device	Confirmed N	Confirmed % total HABSI	Non-confirmed N	Non-confirmed % total HABSI	Total HABSI N	Total HABSI % total HABSI
Central line (CLABSI*)	736	22	1,136	29	1,872	26
Urinary tract infection with catheter	614	18	96	2	710	10
Pulmonary infection with ET/cannula	293	9	35	1	328	4
Peripheral catheter	47	1	139	4	186	3
Other catheter	37	1	32	1	69	1
Total invasive device associated HABSI	**1,727**	**51**	**1,438**	**36**	**3,165**	**43**
Total HABSI	**3,355**	**100**	**3,967**	**100**	**7,322**	**100**

CLABSI, central line-associated bloodstream infection; ET, endotracheal tube; HABSI, hospital-associated bloodstream infection; N, number

Note:

* Includes 'probable' and 'possible' CLABSI

3.1.3. Classification of hospital-associated bloodstream infections according to case definition

Table S17 • Bloodstream infections per case definition, Belgium 2022

Case definition	HABSI N (%)
At least one BC positive for a recognised pathogen	6,163 (84)
At least two different BC positive for the same pathogen belonging to the normal microbiota of the skin and clinical symptoms	1,114 (15)
Only one positive BC for a coagulase negative *Staphylococcus* sp. (this applies only to neonatal cases)	45 (1)
Total BSI	**7,322 (100)**

BSI, bloodstream infection; BC, blood culture; HABSI, hospital-associated bloodstream infection; N, number

3.1.4. Patients' characteristics and end-of-follow-up status

Table S18 • Age of patients* diagnosed with hospital-associated bloodstream infections, Belgium 2022

	Patients with HABSI	
Age group	N	%
<1 month	110	1.6
1 month - 4 years	118	1.7
5-9	11	0.2
10-14	22	0.3
15-19	31	0.5
20-24	44	0.7
25-29	65	1.0
30-34	104	1.5
35-39	103	1.5
40-44	151	2.2
45-49	204	3.0
50-54	301	4.4
55-59	460	6.8
60-64	610	9.0
65-69	823	12.2
70-74	913	13.5
75-79	912	13.5
80-84	763	11.3
85-89	637	9.4
90-94	317	4.7
95+	66	1.0
Missing	2	0.0
Total	**6,767**	**100**

HABSI, hospital-associated bloodstream infection; N, Number of patients with HABSI

Note:

* Patients with multiple hospitalisations (different hospital admission dates or different hospitals) are counted separately

Table S19 • Sex of patients* diagnosed with hospital-associated bloodstream infections, Belgium 2022

	Patients with HABSI	
Sex	N	%
Female	2,683	40
Male	4,078	60
Unknown	6	0
Total	**6,767**	**100**

HABSI, hospital-associated bloodstream infection; N, Number of patients with HABSI

Note:

* Patients with multiple hospitalisations (different hospital admission dates or different hospitals) are counted separately

Table S20 • End-of-follow-up status* of patients with diagnosed hospital-associated bloodstream infections, Belgium 2022**

	Patients with HABSI	
End-of-follow-up status	N	%
Died***	1,339	20
Still admitted	549	8
Discharged	3,049	45
Unknown	1,746	26
Conflicting status****	84	1

HABSI, hospital-associated bloodstream infection; N, Number of patients with HABSI

Notes:

* End-of-follow-up is hospital discharge or death. If the patient is still admitted 30 days after the end of the surveillance quarter follow-up is also ended.

** Patients with multiple hospitalisations (different hospital admission dates or different hospitals) are counted separately

*** Causality between death and HABSI cannot be implied

****Discharge status was registered differently for HABSI episodes of the same hospitalisation of the same patient

3.2. INTENSIVE CARE UNIT

3.2.1. Source of intensive care unit-associated bloodstream infections

Table S21 • Confirmed and non-confirmed sources of ICU-associated bloodstream infections, Belgium 2022

Source	ICU-associated bloodstream infections					
	Confirmed		Non-confirmed		Total	
	N	%	N	%	N	%
CLABSI*	213	26	404	53	617	38.7
Urinary tract infection	114	14	8	1	122	7.7
with catheter	*89*		*4*		*93*	
Gastro-intestinal infection	57	7	105	14	162	10.2
Pulmonary infection	342	41	65	9	407	25.5
with endotracheal tube/cannula	*262*		*28*		*290*	
Surgical site infection	30	4	21	3	51	3.2
Peripheral catheter	4	0	13	2	17	1.1
Other Catheter and related products	16	2	17	2	33	2.1
Mucosal barrier injury	2	0	22	3	24	1.5
Invasive manipulation	4	0	2	0	6	0.4
Other secondary infection**	49	6	32	4	81	5.1
Unknown	0	0	73	10	73	4.6
Total	**831**	**100**	**762**	**100**	**1,593**	**100**

CLABSI, central-line associated bloodstream infection; ICU, intensive care unit; N, Number
* Includes 'probable' and 'possible' CLABSI
** Skin/soft tissue and other

Table S22 • Intensive care unit-associated bloodstream infections origins and associations with invasive devices, Belgium 2022

ICU-associated BSI	ICU-associated BSI	
	N	%
CLABSI*	**617**	**100**
Confirmed (CRBSI)	213	35
Urinary tract infection	**122**	**100**
Urinary catheter present	93	76
Presence urinary catheter unknown	7	6
Urinary catheter is present and catheter as origin of HABSI is confirmed	89	73
Pulmonary infection	**407**	**100**
Endotracheal tube present	290	71
Presence endotracheal tube unknown	11	3
Endotracheal tube is present and tube as origin of HABSI is confirmed	262	64
Peripheral catheter associated BSI	**17**	**100**
Confirmed	4	24
Other catheter associated BSI	**33**	**100**
Confirmed	16	48

BSI, bloodstream infection; CLABSI, central line-associated bloodstream infection; CRBSI, central line-related bloodstream infection; ICU, intensive care unit; N, number
Note:
* Includes 'confirmed', 'probable' and 'possible' CLABSI

Table S23 • Intensive care unit-associated bloodstream infections associated with invasive devices, Belgium 2022

Invasive device	Confirmed		Non-confirmed		Total ICU-BSI	
	N	% total ICU-BSI	N	% total ICU-BSI	N	% total ICU-BSI
Central line (CLABSI*)	213	26	404	53	617	39
Urinary tract infection with catheter	89	11	4	1	93	6
Pulmonary infection with ET/cannula	262	32	28	4	290	18
Peripheral catheter	4	0	13	2	17	1
Other catheter	16	2	17	2	33	2
Total invasive device associated ICU associated BSI	**584**	**70**	**466**	**61**	**1,050**	**66**
Total ICU-BSI	**831**	**100**	**762**	**100**	**1,593**	**100**

CLABSI, central line-associated bloodstream infection; ET, endotracheal tube; BSI, bloodstream infection; ICU, intensive care unit; N, number
Note:
* Includes 'probable' and 'possible' CLABSI

3.2.2. Patients' characteristics and end-of-follow-up status

Table S24 • End-of-follow-up* status of patients with diagnosed ICU-associated bloodstream infections, Belgium 2022**

End-of-follow-up status	N	%
Died***	428	29
Still admitted	178	12
Discharged	469	32
Unknown	370	25
Conflicting status****	13	1

N, number
Note:
*End-of-follow-up is hospital discharge or death. If the patient is still admitted 30 days after the end of the surveillance quarter follow-up is also ended.
** Patients with multiple ICU hospitalisations (different ICU admission dates or different hospitals) are counted separately
*** Causality between death and ICU-associated BSI cannot be implied
****Discharge status was registered differently for ICU-associated BSI episodes of the same ICU hospitalisation of the same patient

4. Identified causal microorganisms and their antimicrobial resistance profile, 2013-2022

4.1. HOSPITAL-WIDE

4.1.1. Identified microorganisms, 2022

Table S25 • Microorganisms* isolated from bloodstream infections in hospitals, Belgium 2022

	HABSI		CLABSI		CRBSI***	
Microorganisms	**N**	**%**	**N**	**%**	**N**	**%**
Enterobacterales**	**3,376**	**42**	**398**	**19**	**128**	**16**
Escherichia coli	1,584	20	108	5	27	3
Klebsiella pneumoniae	580	7	79	4	28	3
Enterobacter cloacae	329	4	69	3	23	3
Klebsiella oxytoca	177	2	39	2	16	2
Serratia marcescens	139	2	29	1	12	1
Proteus mirabilis	144	2	11	1	3	0
Klebsiella aerogenes	73	1	6	0	1	0
Morganella morganii	58	1	6	0	4	0
Genus Klebsiella (others or not specified)	66	1	15	1	4	0
Citrobacter freundii	53	1	11	1	4	0
Other/not identified**	173	2	25	1	6	1
Gram-positive cocci	**3,210**	**40**	**1,272**	**61**	**503**	**63**
Staphylococcus aureus	801	10	175	8	84	10
Staphylococcus epidermidis	765	10	560	27	278	35
Enterococcus faecium	501	6	138	7	23	3
Enterococcus faecalis	392	5	93	4	25	3
Staphylococcus hominis	124	2	87	4	39	5
Staphylococcus haemolyticus	96	1	68	3	30	4
Staphylococcus spp., *coagulase negative (others or not specified)*	67	1	45	2	9	1
Staphylococcus capitis	53	1	34	2	8	1
Other/not identified**	411	5	72	3	7	1
Non-fermenting Gram-negative bacilli	**623**	**8**	**138**	**7**	**47**	**6**
Pseudomonas aeruginosa	402	5	77	4	30	4
Genus *Acinetobacter* (others or not specified)	65	1	22	1	7	1
Other/not identified**	156	2	39	2	10	1
Fungi	**523**	**7**	**218**	**11**	**115**	**14**
Candida albicans	250	3	112	5	57	7
Candida glabrata	127	2	42	2	17	2
Other/not identified**	146	2	64	3	41	5
Anaerobic bacilli	**220**	**3**	**20**	**1**	**0**	**0**
Bacteroides fragilis	85	1	6	0	0	0
Other/not identified**	135	2	14	1	0	0
Gram-positive bacilli	**45**	**1**	**12**	**1**	**6**	**1**
Gram-negative cocci	**14**	**0**	**6**	**0**	**1**	**0**
Other and not identified	**23**	**0**	**6**	**0**	**2**	**0**
Total	**8,034**	**100**	**2,070**	**100**	**802**	**100**

BSI, bloodstream infection; HABSI, hospital-associated bloodstream infection; CLABSI, central line-associated bloodstream infection; CRBSI, catheter related bloodstream infection; N, number

Notes:

*Includes all registered microorganisms (maximum of 3 microorganisms per HABSI episode)

** Other includes microorganisms causing among the HABSI reported in the 2022 surveillance <50 episodes of HABSI/year

*** CRBSI= catheter related bloodstream infection = Confirmed CLABSI

**** Adeolu M, Alnajar S, Naushad S, Gupta RS. 2016. Genome-based phylogeny and taxonomy of the 'Enterobacteriales': proposal for Enterobacterales ord. nov. divided into the families Enterobacteriaceae, Erwiniaceae fam. nov., Pectobacteriaceae fam. nov., Yersiniaceae fam. nov., Hafniaceae fam. nov., Morganellaceae fam. nov., and Budviciaceae fam. nov. Int J Syst Evol Microbiol 66:5575–5599.

4.1.2. Trends in antimicrobial resistance for selected microorganisms and selected antibiotics, 2013-2022

1. Staphylococcus aureus

Table S26 • Antimicrobial resistance in *S. aureus* strains isolated from hospital-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N strains	681	813	964	893	890	971	813	819	873	801
N hospitals**	87	96	103	103	102	101	98	98	101	97
Methicillin										
nIR	142	144	148	145	121	102	85	70	81	49
nU	4	11	18	7	68	18	7	10	8	4
%IR	*20.9*	*17.7*	*15.4*	*16.2*	*13.6*	*10.5*	*10.5*	*8.5*	*9.3*	*6.1*
Mean incidence per 10,000 pd (IR)*	0.20	0.17	0.15	0.14	0.14	0.11	0.10	0.10	0.11	0.06
Glycopeptides (vancomycin, teicoplanin)										
nIR	0	4	7	6	7	4	3	0	2	2
nU	25	52	61	52	143	98	112	100	89	79
%IR	*0.0*	*0.5*	*0.7*	*0.7*	*0.8*	*0.4*	*0.4*	*0.0*	*0.2*	*0.2*
Mean incidence per 10,000 pd (IR)*	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00

N, total number; nIR, number non-susceptible (R or I) MO; nR, number Resistant MO; nU, number unknown or missing resistance; pd, patient-days; R, resistant; I, intermediate

Notes:

* Total HABSI/total patient-days x 10,000 for all hospitals participating at least one quarter

** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

2. Escherichia coli

Table S27 • Antimicrobial resistance in *E. coli* strains isolated from hospital-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N strains	1,339	1,593	1,776	1,873	1,926	1,893	1,637	1,558	1,556	1,584
N hospitals**	87	96	103	103	102	101	98	98	101	97
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)										
nIR	188	266	308	282	303	300	269	228	203	226
nU	14	44	63	73	127	114	41	21	29	24
%IR	*14.0*	*16.7*	*17.3*	*15.1*	*15.7*	*15.8*	*16.4*	*14.6*	*13.0*	*14.3*
Mean incidence per 10,000 pd (IR)*	0.26	0.31	0.32	0.28	0.32	0.32	0.31	0.32	0.26	0.28
Carbapenems (imipenem, meropenem)										
nIR	4	11	16	9	26	12	6	10	8	20
nU	30	55	66	68	147	91	54	53	43	62
%IR	*0.3*	*0.7*	*0.9*	*0.5*	*1.3*	*0.6*	*0.4*	*0.6*	*0.5*	*1.3*
Mean incidence per 10,000 pd (IR)*	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.03
nR	N/A	N/A	N/A	N/A	24	10	5	6	6	12
%R	*N/A*	*N/A*	*N/A*	*N/A*	*1.3*	*0.5*	*0.3*	*0.4*	*0.4*	*0.8*
Mean incidence per 10,000 pd (R)*	N/A	N/A	N/A	N/A	0.01	0.01	0.01	0.01	0.01	0.02

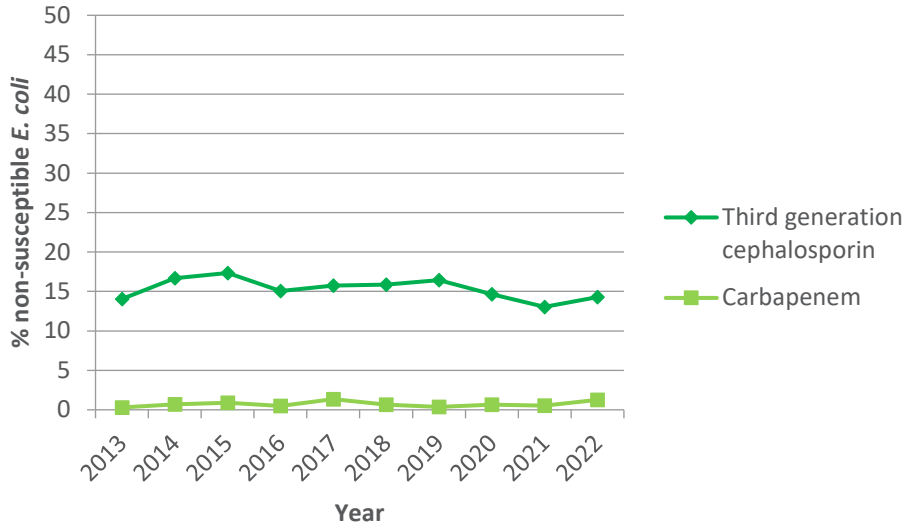
N, total number; nIR, number non-susceptible (R or I) MO; nR, number Resistant MO; nU, number unknown or missing resistance; pd, patient-days;

Notes:

* Total HABSI/total patient-days x 10,000 for all hospitals participating at least one quarter

** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

Figure S9 • Percentage non-susceptibility (%IR) of *E.coli* to third generation cephalosporins and carbapenems



3. Klebsiella pneumoniae

Table S28 • Antimicrobial resistance in *K. pneumoniae* strains isolated from hospital-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N strains	380	513	585	682	667	737	644	680	621	580
N hospitals**	87	96	103	103	102	101	98	98	101	97
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)										
nIR	98	160	206	233	191	259	219	190	178	173
nU	1	24	21	26	58	60	23	54	18	7
%IR	*25.8*	*31.2*	*35.2*	*34.2*	*28.6*	*35.1*	*34.0*	*27.9*	*28.7*	*29.8*
Mean incidence per 10,000 pd (IR)*	0.14	0.19	0.21	0.23	0.19	0.26	0.25	0.26	0.23	0.22
Carbapenems (imipenem, meropenem)										
nIR	9	19	34	44	40	29	27	31	21	27
nU	1	29	26	20	62	57	23	67	22	18
%IR	*2.4*	*3.7*	*5.8*	*6.5*	*6.0*	*3.9*	*4.2*	*4.6*	*3.4*	*4.7*
Mean incidence per 10,000 pd (IR)*	0.01	0.02	0.03	0.04	0.04	0.03	0.03	0.04	0.03	0.03
nR	N/A	N/A	N/A	N/A	33	22	18	22	16	21
%R	*N/A*	*N/A*	*N/A*	*N/A*	*5.0*	*3.0*	*2.8*	*3.2*	*2.6*	*3.6*
Mean incidence per 10,000 pd (R)*	N/A	N/A	N/A	N/A	0.04	0.02	0.02	0.03	0.02	0.03

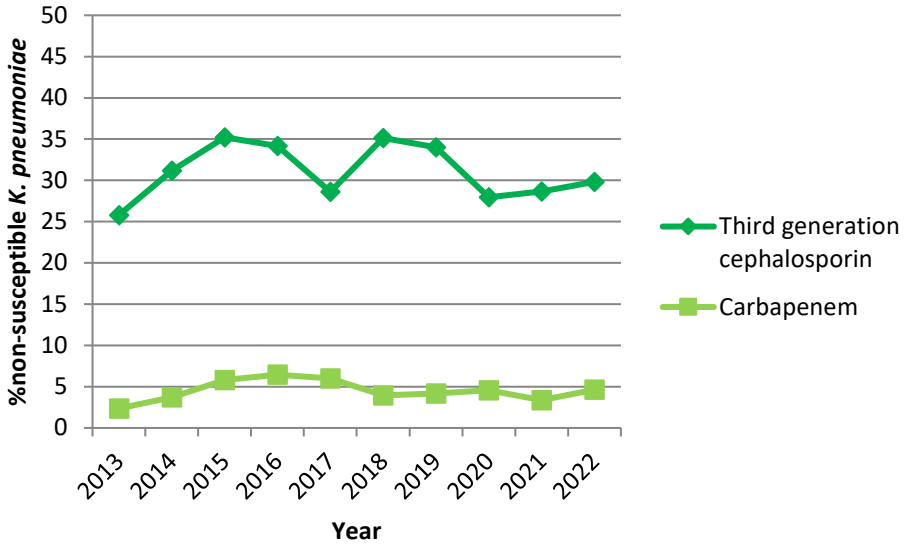
N, total number; nIR, number non-susceptible (R or I) MO; nR number resistant MO; nU, number unknown or missing resistance; pd, patient-days; R, resistant; I, intermediate; N/A, Not Applicable

Notes:

* Total HABSI/total patient-days x 10,000 for all hospitals participating at least one quarter

** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

Figure S10 • Percentage non-susceptibility (%IR) of *K. pneumoniae* to third generation cephalosporins and carbapenems



4. Enterobacter cloacae

Table S29 • Antimicrobial resistance in *E. cloacae* strains isolated from hospital-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N strains	223	249	311	323	316	306	280	270	277	329
N hospitals**	87	96	103	103	102	101	98	98	101	97
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)										
nIR	98	96	116	119	118	117	130	115	107	126
nU	1	12	16	13	38	27	22	21	33	22
%IR	*43.9*	*38.6*	*37.3*	*36.8*	*37.3*	*38.2*	*46.4*	*42.6*	*38.6*	*38.3*
Mean incidence per 10,000 pd (IR)*	0.14	0.11	0.12	0.12	0.12	0.12	0.15	0.15	0.14	0.16
Carbapenems (imipenem, meropenem)										
nIR	3	4	10	10	9	10	5	7	7	4
nU	2	2	12	7	22	12	10	8	12	15
%IR	*1.3*	*1.6*	*3.2*	*3.1*	*2.8*	*3.3*	*1.8*	*2.6*	*2.5*	*1.2*
Mean incidence per 10,000 pd (IR)*	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
nR	N/A	N/A	N/A	N/A	6	6	3	6	4	2
%R	*N/A*	*N/A*	*N/A*	*N/A*	*1.9*	*2.0*	*1.1*	*2.2*	*1.4*	*0.6*
Mean incidence per 10,000 pd (R)*	N/A	N/A	N/A	N/A	0.01	0.01	0.00	0.01	0.01	0.00

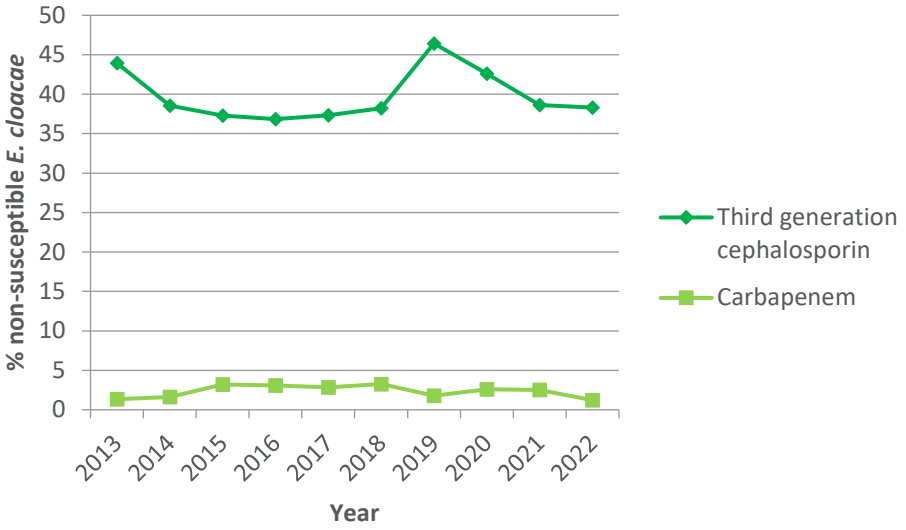
N, total number; nIR, number non-susceptible (R or I) MO; nR number resistant MO; nU, number unknown or missing resistance; pd, patient-days; R, resistant; I, intermediate; N/A, Not Applicable

Notes:

* Total HABSI/total patient-days x 10,000 for all hospitals participating at least one quarter

** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

Figure S11 • Percentage non-susceptibility (%IR) of *E. cloacae* to third generation cephalosporins and carbapenems



5. *Pseudomonas aeruginosa*

Table S30 • Antimicrobial resistance in *P. aeruginosa* strains isolated from hospital-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N strains	319	396	401	395	421	443	383	426	388	402
N hospitals**	87	96	103	103	102	101	98	98	101	97
Carbapenems (imipenem, meropenem)										
nIR	55	66	59	63	64	63	54	63	92	108
nU	5	9	14	4	28	17	9	14	8	9
%IR	*17.2*	*16.7*	*14.7*	*15.9*	*15.2*	*14.2*	*14.1*	*14.8*	*23.7*	*26.9*
Mean incidence per 10,000 pd (IR)*	0.08	0.08	0.06	0.06	0.06	0.07	0.06	0.09	0.12	0.14
nR	N/A	N/A	N/A	N/A	58	44	34	49	67	57
%R	*N/A*	*N/A*	*N/A*	*N/A*	*13.8*	*9.9*	*8.9*	*11.5*	*17.3*	*14.2*
Mean incidence per 10,000 pd (R)*	N/A	N/A	N/A	N/A	0.06	0.05	0.04	0.07	0.09	0.07

N, total number; nIR, number non-susceptible (R or I) MO; nR number resistant MO; nU, number unknown or missing resistance; pd, patient-days; R, resistant; I, intermediate; N/A, Not Applicable

Notes:

* Total HABSI/total patient-days x 10,000 for all hospitals participating at least one quarter

** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

6. *Enterococcus faecium*

Table S31 • Antimicrobial resistance in *E. faecium* strains isolated from hospital-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N strains	197	285	377	357	454	496	480	538	580	501
N hospitals**	87	96	103	103	102	101	98	98	101	97
Glycopeptides (vancomycin, teicoplanin)										
nIR	7	11	18	16	24	18	14	14	14	17
nU	2	3	16	2	25	11	0	2	5	9
%IR	*3.6*	*3.9*	*4.8*	*4.5*	*5.3*	*3.6*	*2.9*	*2.6*	*2.4*	*3.4*
Mean incidence per 10,000 pd (IR)*	0.01	0.01	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02

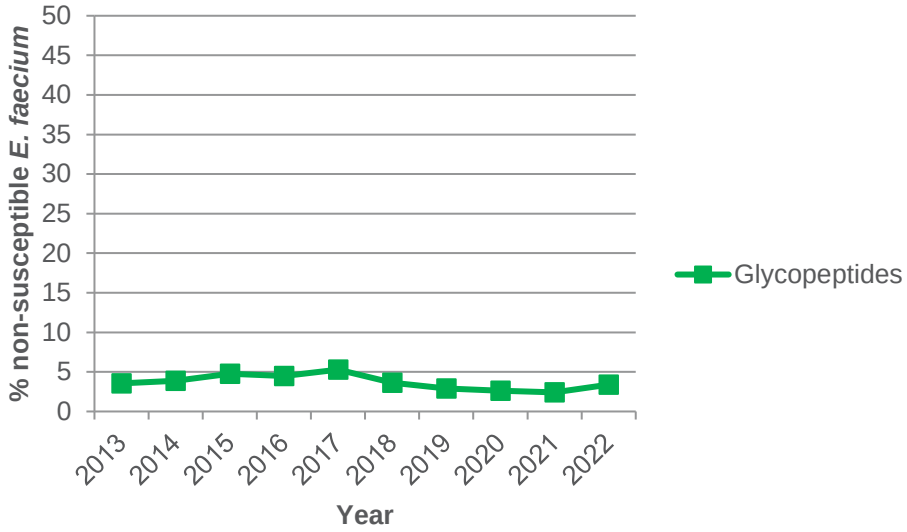
N, total number; nIR, number non-susceptible (R or I) MO; nU, number unknown or missing resistance; pd, patient-days; R, resistant; I, intermediate

Notes:

* Total HABSI/total patient-days x 10,000 for all hospitals participating at least one quarter

** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

Figure S12 • Percentage non-susceptibility (%IR) of *E. faecium* to glycopeptides



7. A. baumanii

Table S32 • Antimicrobial resistance in *A. baumanii* strains isolated from hospital-associated bloodstream infections, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N strains	38	50	56	53	57	55	41	28	27	27
N hospitals**	87	96	103	103	102	101	98	98	101	97
Carbapenems (imipenem, meropenem)										
nIR	5	6	3	2	5	4	1	0	2	2
nU	3	2	1	2	4	2	3	2	5	1
%IR	*13.2*	*12.0*	*5.4*	*3.8*	*8.8*	*7.3*	*2.4*	*0.0*	*7.4*	*7.4*
Mean incidence per 10,000 pd (IR)*	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
nR	N/A	N/A	N/A	N/A	5	3	1	0	2	1
%R	*N/A*	*N/A*	*N/A*	*N/A*	*8.8*	*5.5*	*2.4*	*0.0*	*7.4*	*3.7*
Mean incidence per 10,000 pd (R)*	N/A	N/A	N/A	N/A	0.00	0.00	0.00	0.00	0.00	0.00

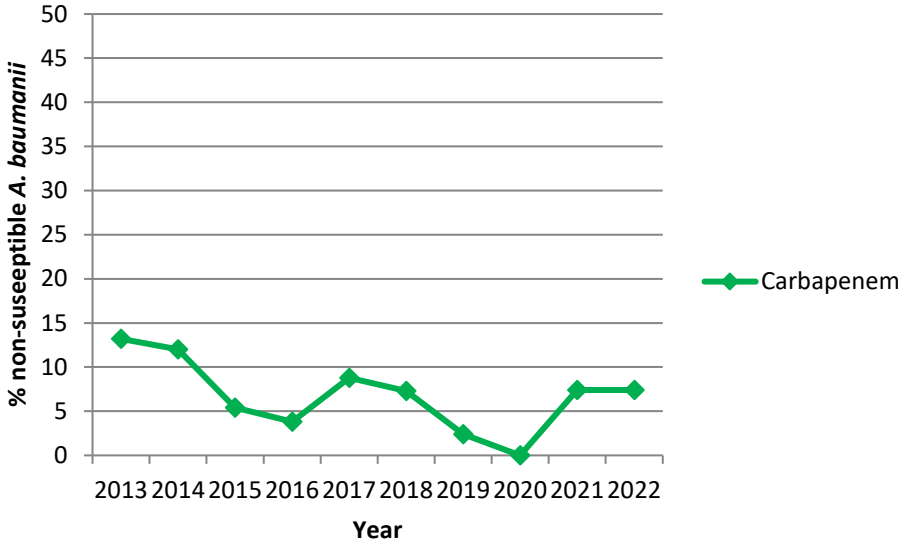
N, total number; nIR, number non-susceptible (R or I) MO; nR number resistant MO; nU, number unknown or missing resistance; pd, patient-days; R, resistant; I, intermediate; N/A, Not Applicable

Notes:

* Total HABSI/total patient-days x 10,000 for all hospitals participating at least one quarter

** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

Figure S13 • Percentage non-susceptibility (%IR) of *A. baumanii* to carbapenems



4.2. INTENSIVE CARE UNIT

4.2.1. Identified microorganisms, 2022

Table S33 • Microorganisms* isolated from intensive care unit-associated bloodstream infections, Belgium 2022

Microorganisms	ICU-associated BSI		CLABSI (ICU only)		CRBSI*** (ICU only)	
	n	%	n	%	n	%
Enterobacterales	627	36	149	22	60	26
Escherichia coli	175	10	29	4	8	3
Klebsiella pneumoniae	121	7	31	5	12	5
Enterobacter cloacae	93	5	27	4	12	5
Serratia marescens	68	4	19	3	8	3
Klebsiella oxytoca	38	2	16	2	10	4
Klebsiella aerogenes	29	2	2	0	0	0
Other/not identified**	103	6	25	4	10	4
Gram-positive cocci	743	43	405	61	129	55
Staphylococcus epidermidis	182	10	146	22	60	26
Staphylococcus aureus	152	9	48	7	20	9
Enterococcus faecium	144	8	61	9	6	3
Enterococcus faecalis	115	7	55	8	14	6
Staphylococcus capitis	26	1	22	3	5	2
Staphylococcus spp., *coagulase negative (others or not specified)*	25	1	21	3	5	2
Other/not identified**	99	6	52	8	19	8
Non-fermenting Gram-negative bacilli	149	9	35	5	17	7
Pseudomonas aeruginosa	105	6	21	3	13	6
Other/not identified**	44	3	14	2	4	2
Fungi	156	9	68	10	27	12
Candida albicans	72	4	36	5	13	6
Candida glabrata	34	2	15	2	3	1
Other/not identified**	50	3	17	3	11	5
Anaerobic bacilli	52	3	6	1	0	0
Gram-positive bacilli	5	0	1	0	0	0
Gram-negative cocci	2	0	1	0	0	0
Other and not identified	4	0	1	0	**0**	0
Total	**1,738**	**100**	**666**	**100**	**233**	**100**

BSI, bloodstream infection; n, number; CLABSI, central line-associated bloodstream infection; CRBSI, catheter related bloodstream infection;
Note:
*Includes all registered microorganisms (maximum of 3 microorganisms per ICU-associated BSI episode)
** Other includes microorganisms causing <25 episodes of ICU-associated BSI/year
*** CRBSI= catheter related bloodstream infection = Confirmed CLABSI

4.2.2. Antimicrobial resistance data for selected microorganisms and selected antibiotics, 2022

Table S34 • Resistance in microorganisms isolated from ICU-associated bloodstream infections, Belgium 2022

		Microorganisms		
	Antibiotics*	N	n	%
S. aureus	Meti	152	10	7
	Gly	152	1	1
E. faecium	Gly	144	7	5
E. coli	C3G	175	39	22
	CAR IR	175	1	1
	CAR R	175	0	0
K. pneumoniae	C3G	121	39	32
	CAR IR	121	10	8
	CAR R	121	8	7
E. cloacae	C3G	93	33	35
	CAR IR	93	1	1
	CAR R	93	1	1
P. aeruginosa	CAR IR	105	31	30
	CAR R	105	21	20
A. baumannii	CAR IR	7	1	14
	CAR R	7	0	0

BSI, bloodstream infection; C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem, doripenem); Gly, glycopeptides (vancomycin, teicoplanin); ICU, intensive care unit; Meti, Methicillin; N, total number MO; n, number non-susceptible (IR) or number resistant (R) MO; %, percent non-susceptible (IR) or percent resistant (R) MO

Notes:

*IR is used as indicator of non-susceptibility unless otherwise mentioned

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ANNEXES

1. Calculation of incidences

Table A1 • Calculation of mean incidences, surveillance of bloodstream infections in Belgian hospitals

Incidences	NUMERATOR	DENOMINATOR
Hospital-wide		
Mean cumulative incidence (calculations include all HABSI episodes) HABSI/1,000 hospitalisations	∑ N BSI ≥2 days in hospital	∑ Total hospitalisations
Mean cumulative incidence (calculations based on number hospitalisations with at least one HABSI episode) Hospitalisations with at least one HABSI episode/1,000 hospitalisations	∑ N hospitalisations with at least one BSI ≥2 days in hospital	
Mean incidence density HABSI/10,000 patient-days	∑ N BSI ≥2 days in hospital	∑ Total patient-days
ICU		
Mean cumulative incidence (calculations include all ICU-BSI episodes) ICU-associated BSI/1,000 ICU hospitalisations	∑ N BSI ≥2 days in ICU	∑ Total hospitalisations ICU
Mean cumulative incidence (calculations based on number hospitalisations with at least one ICU-BSI episode) Hospitalisations with at least one ICU-associated BSI episode /1,000 hospitalisations ICU	∑ N hospitalisations with at least one BSI ≥2 days in ICU	
Mean incidence density ICU-associated BSI/10,000 patient-days ICU	∑ N BSI ≥2 days in ICU	∑ Total patient-days ICU

HABSI, hospital-associated bloodstream infection; ICU, intensive care unit; ICU-BSI; Intensive care unit-associated bloodstream infection; N, number; ∑, sum

The mean incidence numerator at ICU includes the number of ICU-associated BSI (≥2 days in ICU) and the denominator includes the TOTAL number of hospitalisations or patient-days at ICU (including patients staying < 2 days in ICU). This means that the denominator includes patients who are not at risk for acquiring an ICU-associated BSI.

For the incidence calculation only those hospitals and ICU units with available and matching denominator data for the reporting quarter and year were included in the analysis. We noticed that this denominator data was often missing for the ICU units.

2.Incidence of hospital-associated bloodstream infections by region

Table A2 • Incidence of hospital-associated bloodstream infections by region, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Brussels										
N hospitals included in calculation of incidence*	11	11	12	12	10	12	12	12	12	12
N HABSI	1,586	1,686	1,741	1,635	1,485	1,591	1,541	1,672	1,644	1,586
N hospitalisations with at least one HABSI episode	1,586	1,686	1,741	1,635	1,369	1,411	1,353	1,453	1,416	1,414
N hospitalisations	203,195	228,601	223,382	234,776	181,957	191,544	206,119	169,421	199,065	204,796
N patient-days	1,496,470	1,658,084	1,581,864	1,710,341	1,280,491	1,330,695	1,389,177	1,180,052	1,220,528	1,260,264
Cumulative incidence per 1,000 hospitalisations *(calculations include all HABSI episodes**)*										
mean***	7.8	7.4	7.8	7.0	8.2	8.3	7.5	9.9	8.3	7.7
median****	8.1	6.8	8.1	7.2	7.6	8.1	5.5	9.3	7.9	7.7
Cumulative incidence per 1,000 hospitalisations *(calculations based on number of hospitalisations with at least one HABSI episode)*										
mean	N/A	N/A	N/A	N/A	7.5	7.4	6.6	8.6	7.1	6.9
median****	N/A	N/A	N/A	N/A	6.7	7.6	4.6	8.2	7.1	7.4
Incidence density per 10,000 patient-days										
mean***	10.6	10.2	11.0	9.6	11.6	12.0	11.1	14.2	13.5	12.6
median****	9.4	9.3	11.3	9.2	8.8	11.2	7.8	10.8	10.2	10.1
Flanders										
N hospitals included in calculation of incidence*	44	51	53	53	49	51	50	51	51	49
N HABSI	2,450	3,634	4,273	4,242	3,676	4,349	3,973	3,985	4,140	3,965
N hospitalisations with at least one HABSI episode	2,450	3,634	4,273	4,242	3,568	4,028	3,713	3,718	3,821	3,681
N hospitalisations	533,801	690,492	838,447	905,065	742,862	791,247	771,049	646,028	714,172	774,577
N patient-days	3,696,705	4,816,198	5,671,565	5,893,613	4,722,593	5,218,264	4,863,601	4,002,313	4,378,113	4,676,672
Cumulative incidence per 1,000 hospitalisations *(calculations include all HABSI episodes**)*										
mean***	4.6	5.3	5.1	4.7	5.0	5.5	5.2	6.2	5.8	5.1
median****	4.3	4.2	4.3	4.3	4.5	4.5	4.5	5.3	4.8	4.4
Cumulative incidence per 1,000 hospitalisations *(calculations based on number of hospitalisations with at least one HABSI episode)*										
mean	N/A	N/A	N/A	N/A	4.8	5.1	4.8	5.8	5.4	4.8
median****	N/A	N/A	N/A	N/A	4.4	4.3	4.3	5.1	4.6	4.2
Incidence density per 10,000 patient-days										
mean***	6.6	7.6	7.5	7.2	7.8	8.3	8.2	10.0	9.5	8.5
median****	6.2	6.5	6.4	6.5	6.8	7.2	7.2	8.3	8.1	7.3
Wallonia										
N hospitals included in calculation of incidence*	31	34	37	38	34	37	36	34	36	34
N HABSI	1,548	1,606	1,861	1,914	1,594	1,965	1,725	1,605	1,805	1,734
N hospitalisations with at least one HABSI episode	1,548	1,606	1,861	1,914	1,542	1,845	1,625	1,512	1,686	1,637

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N hospitalisations	257,444	279,044	348,778	357,326	301,131	385,801	331,373	251,159	291,625	277,687
N patient-days	1,936,642	2,114,416	2,4971,58	2,537,456	2,135,927	2,559,244	2,391,702	1,814,217	2,015,415	1,977,949
Cumulative incidence per 1,000 hospitalisations *(calculations include all HABSI episodes**)*										
mean***	6.0	5.8	5.3	5.4	5.3	5.1	5.2	6.4	6.2	6.2
median****	5.8	5.1	5.4	5.2	4.5	4.6	4.6	5.4	5.3	5.2
Cumulative incidence per 1,000 hospitalisations *(calculations based on number of hospitalisations with at least one HABSI episode)*										
mean	N/A	N/A	N/A	N/A	5.1	4.8	4.9	6.0	5.8	5.9
median****	N/A	N/A	N/A	N/A	4.4	4.4	4.4	5.1	4.9	5.2
Incidence density per 10,000 patient-days										
mean***	8.0	7.6	7.5	7.5	7.5	7.7	7.2	8.9	9.0	8.8
median****	8.0	7.0	7.0	6.7	6.7	6.9	6.3	7.2	7.8	7.7

HABSI, hospital-associated BSI; N, number; N/A, Not Applicable

Notes:

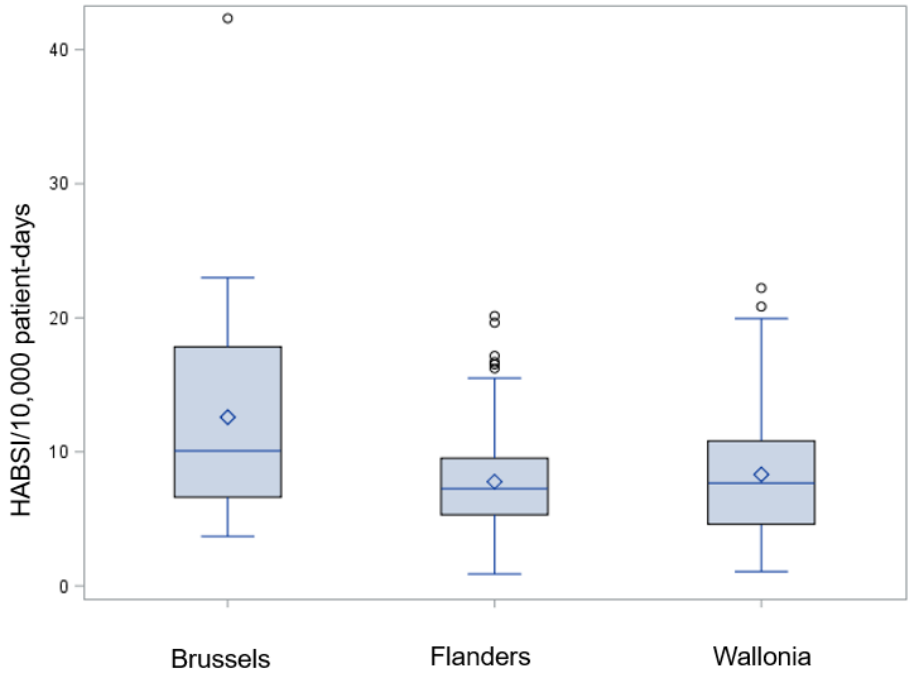
* Hospitals included when denominator of the participating quarter was available

** Multiple HABSI episodes of the same patient during 1 hospitalisation (same hospital admission date) are counted separately.

*** Total hospital-associated BSI/total denominator

**** Unit of analysis used to calculate median is quarter

Figure A1 • Hospital-associated bloodstream infections: incidence distribution across hospitals, by region, Belgium 2022 (HABSI, hospital-associated bloodstream infection)



3.Incidence of hospital-associated bloodstream infections in tertiary and non-tertiary hospitals

Table A3 • Incidence of hospital-associated bloodstream infections in tertiary and non-tertiary hospitals, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Non-tertiary hospital										
N hospitals included in calculation of incidence*	67	74	78	79	73	77	75	74	76	72
N HABSI	3,207	3,663	4,035	4,307	3,609	4,317	3,704	3,670	3,834	4,011
N hospitalisations with at least one HABSI episode	3,207	3,663	4,035	4,307	3,503	4,049	3,487	3,444	3,572	3,794
N hospitalisations	654,386	785,004	925,016	977,194	801,736	937,693	860,180	690,467	771,234	856,617
N patient-days	4,701,929	5,525,438	6,297,689	6,682,599	5,374,701	6,171,762	5,587,359	4,485,790	4,896,093	5,343,445
mean incidence 1,000 hospitalisations (*calculations include all HABSI episodes)* **	4.9	4.7	4.4	4.4	4.5	4.6	4.3	5.3	5.0	4.7
mean incidence 1,000 hospitalisations (*calculations based on number of hospitalisations with at least one HABSI episode)*	N/A	N/A	N/A	N/A	4.4	4.3	4.1	5.0	4.6	4.4
mean incidence 10,000 patient-days***	6.8	6.6	6.4	6.5	6.7	7.0	6.6	8.2	7.8	7.5
Tertiary hospital										
N hospitals included in calculation of incidence*	19	22	24	24	20	23	23	23	23	23
N HABSI	2,377	3,263	3,840	3,484	3,146	3,588	3,535	3,592	3,755	3,274
N hospitalisations with at least one HABSI episode	2,377	3,263	3,840	3,484	2,976	3,235	3,204	3,239	3,351	2,938
N hospitalisations	340,054	413,133	485,591	519,973	424,214	430,899	448,361	376,141	433,628	400,443
N patient-days	2,427,888	3,063,260	3,452,898	3,458,811	2,764,310	2,936,441	3,057,121	2,510,792	2,717,963	2,571,440
mean incidence 1,000 hospitalisations (*calculations include all HABSI episodes)* **	7.0	7.9	7.9	6.7	7.4	8.3	7.9	9.6	8.7	8.2
mean incidence 1,000 hospitalisations (*calculations based on number of hospitalisations with at least one HABSI episode)*	N/A	N/A	N/A	N/A	7.0	7.5	7.2	8.6	7.7	7.3
mean incidence 10,000 patient-days***	9.8	10.7	11.1	10.1	11.4	12.2	11.6	14.3	13.8	12.7

HABSI, hospital-associated BSI; N, number; N/A, Not Applicable

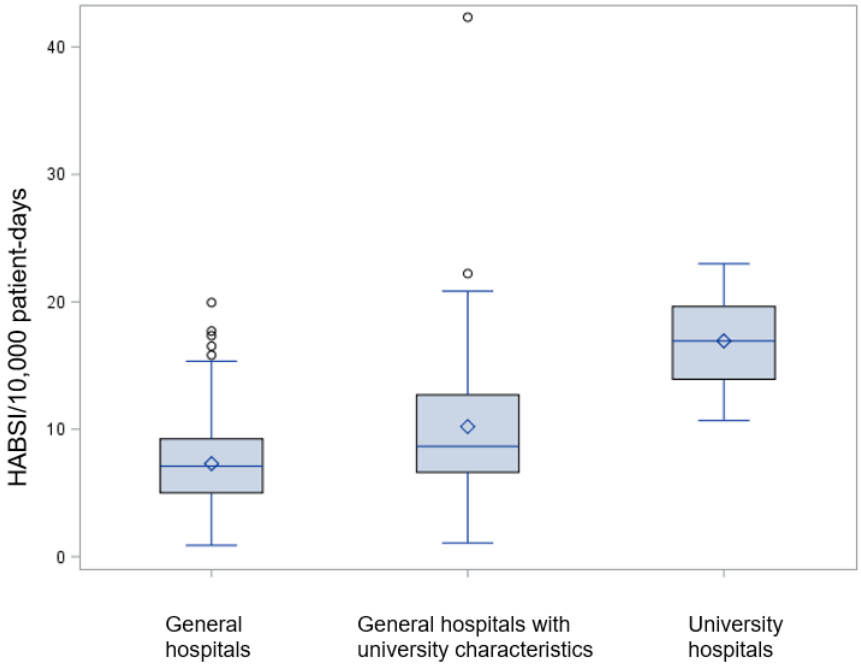
Notes:

* Hospitals included when denominator of the participating quarter was available

** Total HABSI/total denominator. Multiple HABSI episodes of the same patient during 1 hospitalisation (same hospital admission date) are counted separately.

*** Total HABSI/total denominator

Figure A2 • Hospital-associated bloodstream infections: incidence distribution across hospitals, and by hospital type[17], Belgium 2022 (HABSI, hospital-associated bloodstream infection)



[17] Based on the classification given in the list of hospitals provided by the Belgian ministry of health (Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg); List dated December 2022: Adressenlijst ziekenhuizen 02/2022 - Liste d'adresses des hôpitaux 12/2022.

Table A4 • Incidence of hospital-associated bloodstream infections in tertiary and non-tertiary hospitals by region, Belgium 2018-2022[18]

	Brussels					Flanders					Wallonia				
Year	**2018**	**2019**	**2020**	**2021**	**2022**	**2018**	**2019**	**2020**	**2021**	**2022**	**2018**	**2019**	**2020**	**2021**	**2022**
Non-tertiary hospital															
N hospitals included in calculation of incidence*	6	6	6	6	6	44	43	43	43	42	27	26	25	27	24
N HABSI	312	285	353	305	300	2,893	2,491	2,431	2,434	2,533	1,112	928	886	1,095	1,178
N hospitalisations with at least one HABSI episode	295	268	318	274	293	2,711	2,347	2,294	2,270	2,391	1,043	872	832	1,028	1,110
N hospitalisations	72,188	80,941	66,035	69,132	69,882	608,544	572,466	466,661	510,330	603,636	256,961	206,773	157,771	191,772	183,099
N patient-days	489,396	518,446	438,527	429,096	421,136	3,975,276	3,570,864	2,910,405	3,109,006	3,578,139	1,707,090	1,498,049	1,136,858	1,357,991	1,344,170
mean incidence 1,000 hospitalisations (*calculations include all HABSI episodes)***	4.3	3.5	5.4	4.4	4.3	4.8	4.4	5.2	4.8	4.2	4.3	4.5	5.6	5.7	6.4
mean incidence 1,000 hospitalisations (*calculations based on number of hospitalisations with at least one HABSI episode)*	4.1	3.3	4.8	4.0	4.2	4.5	4.1	4.9	4.5	4.0	4.1	4.2	5.3	5.4	6.1
mean incidence 10,000 patient-days***	6.4	5.5	8.1	7.1	7.1	7.3	7.0	8.4	7.8	7.1	6.5	6.2	7.8	8.1	8.8
Tertiary hospital															
N hospitals included in calculation of incidence*	6	6	6	6	6	7	7	8	8	7	10	10	9	9	10
N HABSI	1,279	1,256	1,319	1,339	1,286	1,456	1,482	1,554	1,706	1,432	853	797	719	710	556
N hospitalisations with at least one HABSI episode	1,116	1,085	1,135	1,142	1,121	1,317	1,366	1,424	1,551	1,290	802	753	680	658	527
N hospitalisations	119,356	125,178	103,386	129,933	134,914	182,703	198,583	179,367	203,842	170,941	128,840	124,600	93,388	99,853	94,588
N patient-days	841,299	870,731	741,525	791,432	839,128	1,242,988	1,292,737	1,091,908	1,269,107	1,098,533	852,154	893,653	677,359	657,424	633,779
mean incidence 1,000 hospitalisations *(calculations include all HABSI episodes)***	10.7	10.0	12.8	10.3	9.5	8.0	7.5	8.7	8.4	8.4	6.6	6.4	7.7	7.1	5.9
mean incidence 1,000 hospitalisations *(calculations based on number of hospitalisations with at least one HABSI episode)*	9.4	8.7	11.0	8.8	8.3	7.2	6.9	7.9	7.6	7.6	6.2	6.0	7.3	6.6	5.6

[18] Because of readability of the table, data from only five last years are given. See 2020 report for 2013-2016 data: https://www.sciensano.be/en/biblio/surveillance-bloodstream-infections-belgian-hospitals-report-2020. See 2022 report for 2017 data: https://www.sciensano.be/nl/biblio/surveillance-bloodstream-infections-belgian-hospitals-report-2022

	Brussels					Flanders					Wallonia				
Year	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
mean incidence 10,000 patient-days***	15.2	14.4	17.8	16.9	15.3	11.7	11.5	14.2	13.4	13.0	10.0	8.9	10.6	10.8	8.8

HABSI, hospital-associated BSI; N, number

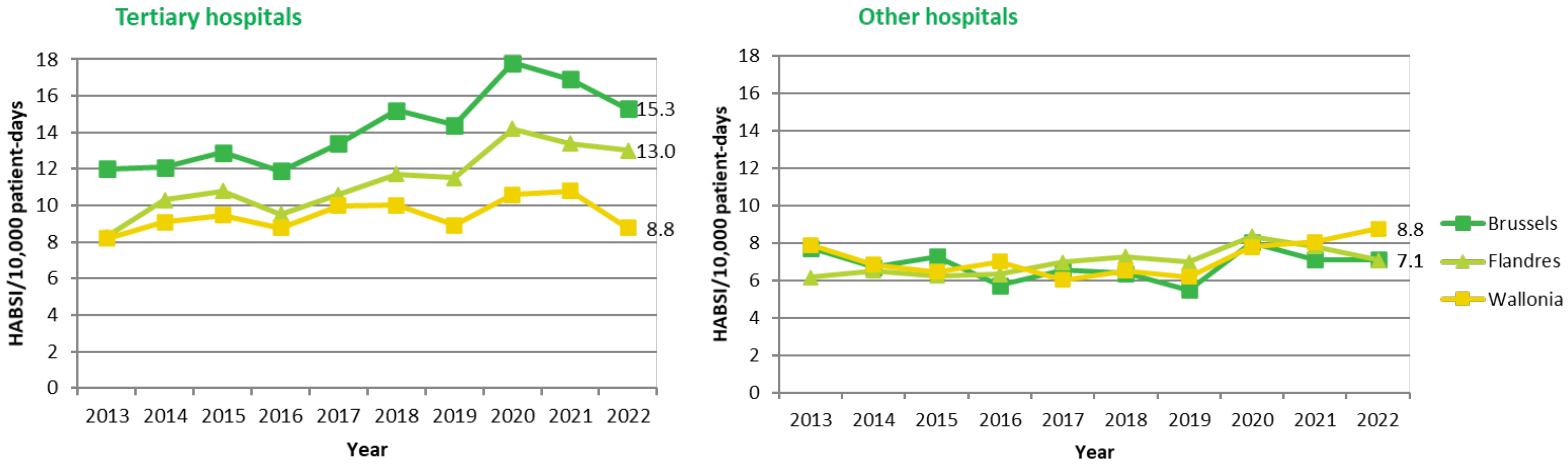
Notes:

* Hospitals included when denominator of the participating quarter was available

** Total HABSI/total denominator. Multiple HABSI episodes of the same patient during 1 hospitalisation (same hospital admission date) are counted separately.

*** Total HABSI/total denominator

Figure A3 • Mean incidence of hospital-associated bloodstream infections in tertiary and non-tertiary hospitals by region, Belgium 2013-2022 (HABSI, hospital-associated bloodstream infection)



4. Incidence of central line-associated bloodstream infections by region

Table A5 • Incidence of central line-associated bloodstream infections by region, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Brussels										
N hospitals included in calculation of incidence*	11	11	12	12	10	12	12	12	12	12
N CLABSI	473	409	416	341	348	341	347	416	406	370
Incidence density per 10,000 patient-days										
mean**	3.16	2.47	2.63	1.99	2.72	2.56	2.50	3.53	3.33	2.94
Flanders										
N hospitals included in calculation of incidence*	44	51	53	53	49	51	50	51	51	49
N CLABSI	648	992	1256	1,048	852	1,138	1,039	1,059	1,129	1,093
Incidence density per 10,000 patient-days										
mean**	1.75	2.06	2.21	1.78	1.80	2.18	2.14	2.65	2.58	2.34
Wallonia										
N hospitals included in calculation of incidence*	31	34	37	38	34	37	36	34	36	34
N CLABSI	381	433	447	399	317	394	367	359	427	407
Incidence density per 10,000 patient-days										
mean**	1.97	2.05	1.79	1.57	1.48	1.54	1.53	1.98	2.12	2.06

CLABSI, central line-associated bloodstream infection; N, number

Notes:

* Hospitals included when denominator of the participating quarter was available

** Total central line-associated BSI/total denominator

Figure A4 • Mean incidence of central line-associated bloodstream infections, hospital-wide, by region, Belgium 2013-2022 (CLABSI, central line-associated bloodstream infections)

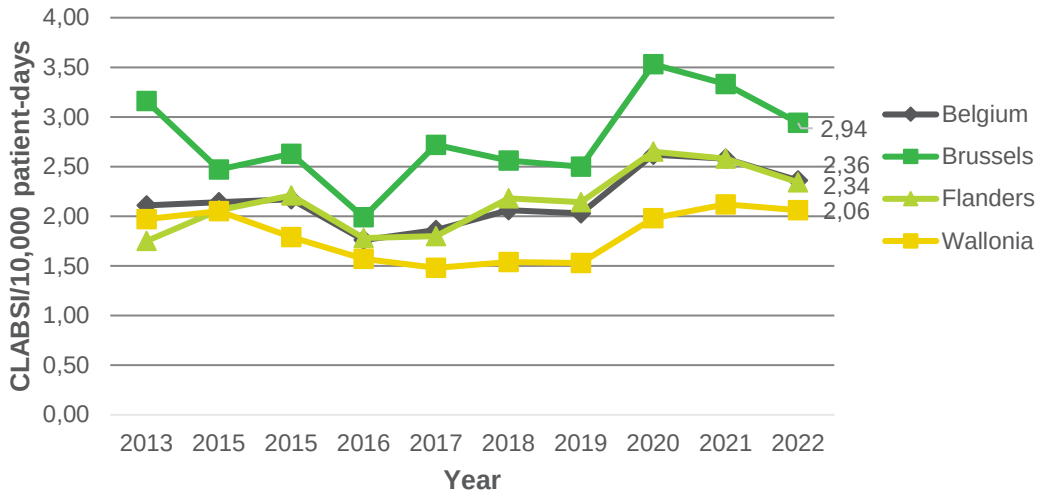
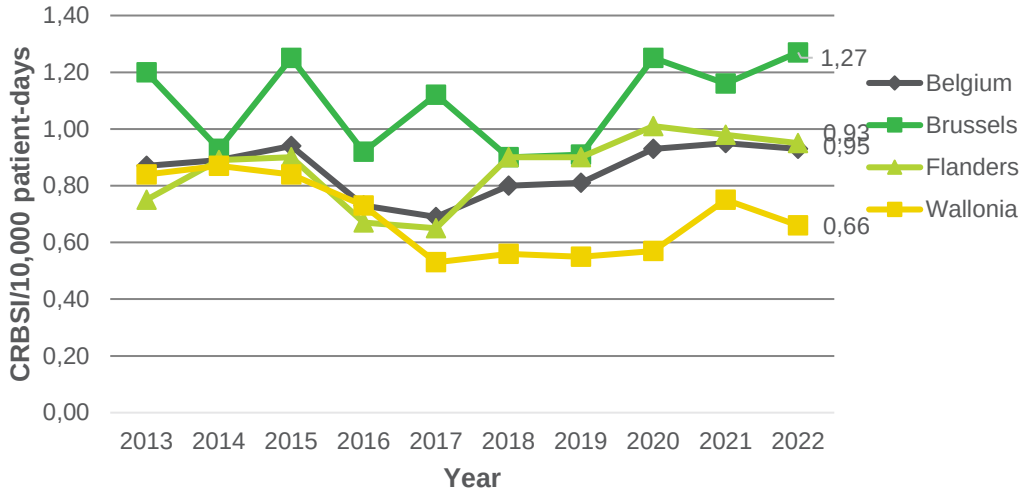


Table A6 • Incidence of catheter related bloodstream infections by region, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Brussels										
N CRBSI	179	155	197	157	144	120	126	148	141	160
Incidence density per 10,000 patient-days										
mean*	1.20	0.93	1.25	0.92	1.12	0.90	0.91	1.25	1.16	1.27
Flanders										
N CRBSI	277	430	511	396	308	469	440	403	427	444
Incidence density per 10,000 patient-days										
mean*	0.75	0.89	0.90	0.67	0.65	0.90	0.90	1.01	0.98	0.95
Wallonia										
N CRBSI	163	183	210	186	113	143	131	103	152	131
Incidence density per 10,000 patient-days										
mean*	0.84	0.87	0.84	0.73	0.53	0.56	0.55	0.57	0.75	0.66

CRBSI, catheter related bloodstream infection = confirmed CLABSI; N, number
Note:
* Total catheter related BSI/total denominator

Figure A5 • Mean incidence of confirmed central line-associated bloodstream infections, hospital-wide, by region, Belgium 2013-2022 (CRBSI, catheter related bloodstream infection = confirmed CLABSI)



5.Incidence of central line-associated bloodstream infections in tertiary and non-tertiary hospitals

Table A7 • Incidence of central line-associated bloodstream infections* in tertiary and non-tertiary hospitals, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Non-tertiary hospital										
N hospitals included in calculation of incidence**	67	74	78	79	73	77	75	74	76	72
N CLABSI	714	806	919	793	700	886	801	827	895	921
mean incidence 10,000 patient-days***	1.52	1.46	1.46	1.19	1.30	1.44	1.43	1.84	1.83	1.72
Tertiary hospital										
N hospitals included in calculation of incidence**	19	22	24	24	20	23	23	23	23	23
N CLABSI	788	1,028	1,200	995	817	987	952	1,007	1,067	949
mean incidence 10,000 patient-days***	3.25	3.36	3.48	2.88	2.96	3.36	3.11	4.01	3.93	3.69

CLABSI, central line associated bloodstream infection; N, number

Notes:

* Includes 'confirmed', 'probable' and 'possible' CLABSI

** Hospitals included when denominator of the participating quarter was available

*** Total CLABSI/total denominator

6. Hospital-wide central line-associated bloodstream infections by classification

Table A8 • Central line-associated bloodstream infections, hospital-wide, according to classification (proportions)*, Belgium 2013-2022

Year	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022	
CLABSI	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Confirmed	623	41	768	42	920	43	739	41	666	37	774	39	699	40	665	36	729	37	736	39
Probable	459	30	601	33	742	35	610	34	613	34	652	33	582	33	570	31	600	30	648	35
Possible	425	28	465	25	463	22	439	25	537	30	557	28	476	27	626	34	659	33	488	26
Total	**1,507**	**100**	**1,834**	**100**	**2,125**	**100**	**1,788**	**100**	**1,816**	**100**	**1,983**	**100**	**1,757**	**100**	**1,861**	**100**	**1,988**	**100**	**1,872**	**100**

CLABSI, central line associated bloodstream infection; N, number

Note:

* Includes all CLABSI episodes (also those without denominator)

7. Incidence of intensive care-associated bloodstream infections by region

Table A9 • Incidence of ICU-associated bloodstream infections by region, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Brussels										
N hospitals included in calculation of incidence*	6	6	7	8	8	12	12	12	12	12
N ICU wards included in calculation of incidence*	20	20	22	24	28	38	36	36	33	34
N ICU-associated BSI	252	280	264	260	264	325	351	502	472	326
N patient-days	58,862	58,484	61,961	62,072	54,996	75,875	82,955	70,309	70,854	67,440
Incidence density per 10,000 patient-days										
mean**	42.8	47.9	42.6	41.9	48.0	42.8	42.3	71.4	66.6	48.3
Flanders										
N hospitals included in calculation of incidence*	33	37	39	37	43	48	48	50	51	47
N ICU wards included in calculation of incidence*	49	55	56	54	69	82	79	95	93	82
N ICU-associated BSI	248	331	293	333	322	595	577	847	910	719
N patient-days	104,061	131,381	135,103	136,517	137,996	217,972	195,356	189,474	227,658	204,797
Incidence density per 10,000 patient-days										
mean**	23.8	25.2	21.7	24.4	23.3	27.3	29.5	44.7	40.0	35.1
Wallonia										
N hospitals included in calculation of incidence*	16	19	21	22	25	32	33	31	34	31
N ICU wards included in calculation of incidence*	23	26	29	31	46	54	55	55	52	53
N ICU-associated BSI	192	165	235	257	202	343	318	417	412	327
N patient-days	52,127	54,272	67,600	67,822	70,576	108,133	99,673	78,834	75,878	69,755
Incidence density per 10,000 patient-days										
mean**	36.8	30.4	34.8	37.9	28.6	31.7	31.9	52.9	54.3	46.9

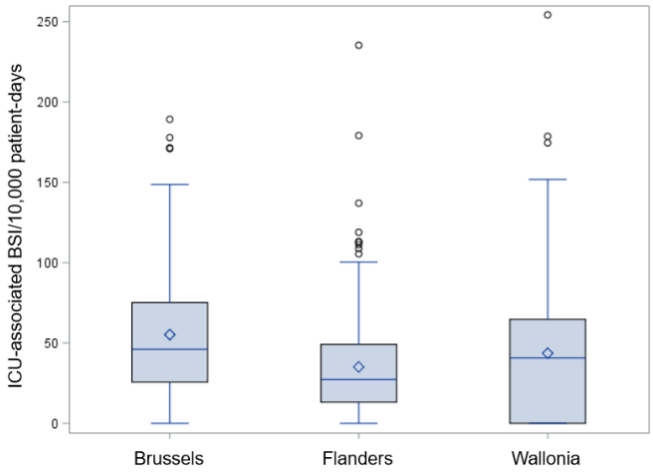
ICU, Intensive care unit; BSI, bloodstream infection; N, number

Notes:

* Hospitals/wards included when denominator of the participating quarter was available

** Total ICU-associated BSI/total denominator

Figure A6 • Intensive care unit-associated bloodstream infections: incidence distribution across intensive care units, by region, Belgium 2022 (BSI, bloodstream infection; ICU, intensive care unit)



8. Incidence of intensive care-associated bloodstream infections in tertiary and non-tertiary hospitals

Table A10 • Incidence of ICU-associated bloodstream infections in tertiary and non-tertiary hospitals, Belgium 2013-2022

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Non-tertiary hospital										
N hospitals included in calculation of incidence*	43	50	54	52	58	69	70	71	75	68
N ICU wards included in calculation of incidence*	54	63	67	64	82	95	91	100	99	94
N ICU-associated BSI	333	396	400	426	342	529	500	709	799	630
N patient-days	109,451	126,435	141429	140,565	142,332	208,133	175,309	164,407	185,552	169,833
mean incidence 10,000 patient-days**	30.4	31.3	28.3	30.3	24.0	25.4	28.5	43.1	43.1	37.1
Tertiary hospital										
N hospitals included in calculation of incidence*	12	12	13	15	18	23	23	22	22	22
N ICU wards included in calculation of incidence*	38	38	40	45	61	79	79	86	79	75
N ICU-associated BSI	359	380	392	424	446	734	746	1057	995	742
N patient-days	105,599	117,702	123,235	125,846	121,236	193,847	202,675	174,210	188,838	172,159
mean incidence 10,000 patient-days**	34.0	32.3	31.8	33.7	36.8	37.9	36.8	60.7	52.7	43.1

ICU, Intensive care unit; BSI, bloodstream infection; N, number

Notes:

* Hospitals/wards included when denominator of the participating quarter was available

** Total ICU-associated BSI/total denominator

Figure A7 • Mean incidence of intensive care unit-associated bloodstream infections, hospital-wide, by type of hospital, Belgium 2013-2022 (ICU-BSI, intensive care unit-associated bloodstream infections)

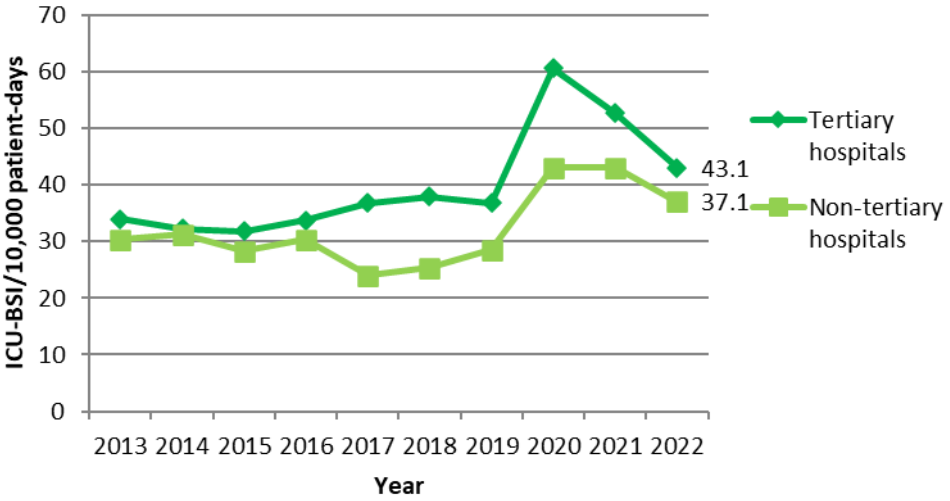
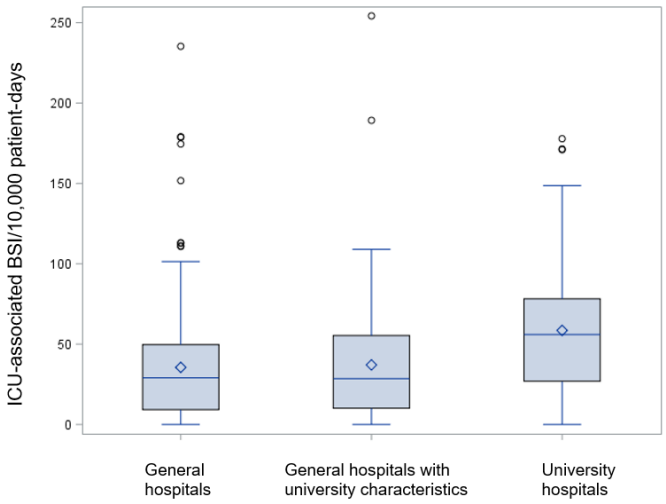


Figure A8 • Intensive care unit-associated bloodstream infections: incidence distribution across intensive care units, by hospital type[19], Belgium 2022 (BSI, bloodstream infection; ICU, intensive care unit)



[19] Based on the classification given in the list of hospitals provided by the Belgian ministry of health (Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg); List dated December 2022: Adressenlijst ziekenhuizen 12/2022 - Liste d'adresses des hôpitaux 12/2022.

9. Intensive care unit-associated central line-associated bloodstream infections by classification

Table A11 • Intensive care unit-associated central line-associated bloodstream infections according to case definition (proportions)*, Belgium 2013-2022

Year	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022	
CLABSI	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Confirmed	177	37	202	40	222	39	185	35	173	34	218	35	204	36	256	34	253	31	213	35
Probable	128	27	133	26	189	33	173	33	159	31	188	30	168	30	203	27	207	26	197	32
Possible	170	36	170	34	158	28	173	33	174	34	217	35	192	34	290	39	350	43	207	34
Total	**475**	**100**	**505**	**100**	**569**	**100**	**531**	**100**	**506**	**100**	**623**	**100**	**564**	**100**	**749**	**100**	**810**	**100**	**617**	**100**

CLABSI, central line-associated bloodstream infection; ICU, intensive care unit; N, number

Note:

* Includes all CLABSI episodes (also those without denominator)

10. Hospital-associated bloodstream infections by source and speciality

Table A12 • Hospital-associated bloodstream infections by source and speciality, Belgium 2022

Speciality	Geriatrics		Intensive care unit****		Medical department*		Obstetrics/ gynaecology		Oncology		Paediatrics		Surgery		Other		Total	
source	n	%	n	%	n	%	n	%	n	%	n	%	n	%	N	%	n	%
CL**	152	15	636	37	394	21	1	3	363	37	30	40	204	23	92	14	1,872	26
Urinary tract infection	394	38	140	8	404	21	6	17	104	11	7	9	205	23	203	31	1,463	20
Gastro-intestinal infection	93	9	199	11	348	18	3	9	111	11	9	12	173	19	91	14	1,027	14
Pulmonary infection	71	7	428	25	151	8	1	3	41	4	4	5	35	4	43	7	774	11
Surgical site infection	23	2	65	4	27	1	4	11	10	1	0	0	111	12	43	7	283	4
Peripheral catheter	26	2	19	1	86	5	3	9	21	2	1	1	21	2	9	1	186	3
Other catheter	4	0	35	2	20	1	0	0	4	0	2	3	3	0	1	0	69	1
MBI	2	0	28	2	15	1	1	3	181	19	10	13	10	1	2	0	249	3
Invasive manipulation	9	1	6	0	30	2	0	0	8	1	0	0	8	1	20	3	81	1
Other secondary infections***	108	10	87	5	168	9	12	34	62	6	5	7	53	6	73	11	568	8
Unknown	164	16	94	5	253	13	4	11	73	7	7	9	81	9	74	11	750	10
Total	**1,046**	**100**	**1,737**	**100**	**1,896**	**100**	**35**	**100**	**978**	**100**	**75**	**100**	**904**	**100**	**651**	**100**	**7,322**	**100**

CL, central line; MBI, mucosal barrier injury

Notes:

* Medical department includes; cardiology, gastro-enterology, nephrology, neurology, pneumology, urology, COVID-19 general department and other internal medicine

** Includes confirmed, probable and possible CLABSI

*** Skin/soft tissue and other infections

**** Intensive care unit includes COVID-19 intensive care unit

11. Exhaustive list of microorganisms isolated from bloodstream infections, Belgian acute care hospitals

Table A13 • Microorganisms isolated as etiological agents for bloodstream infections, exhaustive list, Belgium 2022

	HABSI		CLABSI		CRBSI	
Microorganism	N	%	N	%	N	%
Escherichia coli	1,584	20	108	5	27	3
Staphylococcus aureus	801	10	175	8	84	10
Staphylococcus epidermidis	765	10	560	27	278	35
Klebsiella pneumoniae	580	7	79	4	28	3
Enterococcus faecium	501	6	138	7	23	3
Pseudomonas aeruginosa	402	5	77	4	30	4
Enterococcus faecalis	392	5	93	4	25	3
Enterobacter cloacae	329	4	69	3	23	3
Candida albicans	250	3	112	5	57	7
Klebsiella oxytoca	177	2	39	2	16	2
Proteus mirabilis	144	2	11	1	3	0
Serratia marcescens	139	2	29	1	12	1
Candida glabrata	127	2	42	2	17	2
Staphylococcus hominis	124	2	87	4	39	5
Staphylococcus haemolyticus	96	1	68	3	30	4
Bacteroides fragilis	85	1	6	0	0	0
Enterobacter aerogenes	73	1	6	0	1	0
Staphylococcus spp., *coagulase negative (*others or not specified*)*	67	1	45	2	9	1
*Genus Klebsiella (*others or not specified)	66	1	15	1	4	0
*Genus Acinetobacter (*others or not specified)	65	1	22	1	7	1
Morganella morganii	58	1	6	0	4	0
Citrobacter freundii	53	1	11	1	4	0
Staphylococcus capitis	53	1	34	2	8	1
Candida parapsilosis	49	1	25	1	19	2
Streptococcus pneumoniae	48	1	1	0	0	0
Streptococcus mitis group	46	1	14	1	0	0
Stenotrophomonas maltophilia	44	1	15	1	4	0
Candida tropicalis	40	0	18	1	9	1
Citrobacter koseri	36	0	7	0	1	0
*Genus Candida (*others or not specified*)*	36	0	13	1	10	1
*Genus Streptococcus (*others or not specified*)*	36	0	11	1	2	0
Streptococcus agalactiae	35	0	1	0	0	0
*Genus Bacteroides (*others or not specified*)*	31	0	2	0	0	0
*Genus Enterobacter (*others or not specified*)*	28	0	3	0	0	0
Acinetobacter baumannii	27	0	5	0	2	0
Streptococcus, viridans group	24	0	4	0	0	0
Streptococcus anginosus	23	0	2	0	0	0
Streptococcus gallolyticus	21	0	2	0	0	0
Genus Pseudomonas	20	0	6	0	1	0
*Genus Enterococcus (*others or not specified*)*	19	0	2	0	1	0

Microorganism	HABSI N	HABSI %	CLABSI N	CLABSI %	CRBSI N	CRBSI %
Streptococcus dysgalactiae	19	0	1	0	0	0
Bacteroides thetaiotaomicron	16	0	2	0	0	0
*Genus Staphylococcus (*not specified*)*	16	0	8	0	1	0
Clostridium perfringens	15	0	0	0	0	0
*Gram-positive coccus (*others or not specified*)*	15	0	5	0	0	0
Raoultella ornithinolytica	15	0	2	0	0	0
*Gram-negative bacillus (*not specified*)*	13	0	2	0	0	0
Streptococcus salivarius group	13	0	0	0	0	0
Candida krusei	12	0	4	0	1	0
Streptococcus pyogenes	12	0	1	0	1	0
*Anaerobic bacteria (*others or not specified*)*	11	0	1	0	0	0
Genus Achromobacter	11	0	4	0	2	0
*Genus Clostridium (*others or not specified*)*	11	0	4	0	0	0
Genus Lactobacillus	11	0	3	0	2	0
Genus Prevotella	11	0	1	0	0	0
Haemophilus influenzae	11	0	1	0	0	0
Hafnia alvei	11	0	2	0	1	0
Genus Corynebacterium	10	0	4	0	3	0
Proteus vulgaris	10	0	3	0	2	0
Enterococcus gallinarum	9	0	1	0	0	0
Genus Morganella	9	0	1	0	0	0
*Genus Serratia (*others or not specified*)*	9	0	1	0	0	0
Acinetobacter Iwoffi	8	0	1	0	0	0
Pantoea agglomerans	8	0	0	0	0	0
Providencia rettgeri	8	0	1	0	1	0
Streptococcus constellatus	8	0	3	0	0	0
Streptococcus oralis	8	0	2	0	0	0
Citrobacter braakii	7	0	1	0	0	0
Enterococcus avium	7	0	2	0	1	0
Genus Fusobacterium	7	0	0	0	0	0
Streptococcus bovis group	7	0	1	0	0	0
Streptococcus sanguis group	7	0	2	0	1	0
Aerococcus urinae	6	0	0	0	0	0
Gemella morbillorum	6	0	2	0	0	0
Genus Actinomyces	6	0	2	0	0	0
Genus Bacillus	6	0	3	0	0	0
*Gram-positive bacillus (*others or not specified*)*	6	0	1	0	0	0
Parvimonas micra	6	0	3	0	0	0
Bacteroides vulgatus	5	0	1	0	0	0
Clostridium ramosum	5	0	1	0	0	0
Fusobacterium nucleatum	5	0	0	0	0	0
Genus Providencia	5	0	1	0	0	0
Serratia liquefaciens	5	0	0	0	0	0
Yeast	5	0	2	0	1	0
Enterobacter asburiae	4	0	0	0	0	0
Enterococcus casseliflavus	4	0	1	0	0	0
Genus Aeromonas	4	0	0	0	0	0

Microorganism	HABSI N	HABSI %	CLABSI N	CLABSI %	CRBSI N	CRBSI %
*Genus Moraxella (*others or not specified*)*	4	0	3	0	1	0
*Genus Proteus (*others or not specified*)*	4	0	0	0	0	0
*Genus Salmonella (*others or not specified*)*	4	0	1	0	0	0
Listeria monocytogenes	4	0	0	0	0	0
Parabacteroides distasonis	4	0	1	0	0	0
Staphylococcus warneri	4	0	2	0	0	0
Campylobacter jejuni	3	0	1	0	0	0
Clostridium clostridiiforme	3	0	0	0	0	0
*Family Pseudomonadaceae (*others or not specified*)*	3	0	2	0	1	0
*Fungus (*others or not specified*)*	3	0	1	0	0	0
Genus Anaerococcus	3	0	0	0	0	0
Genus Paenibacillus	3	0	0	0	0	0
Staphylococcus pettenkoferi	3	0	1	0	0	0
Aerococcus sanguinicola	2	0	0	0	0	0
Bacteroides faecis	2	0	1	0	0	0
Bacteroides fragilis group	2	0	0	0	0	0
Eggerthella lenta	2	0	0	0	0	0
*Family Enterobacteriaceae (*others or not specified*)*	2	0	0	0	0	0
Finegoldia magna	2	0	1	0	0	0
Genus Actinotignum	2	0	0	0	0	0
Genus Campylobacter	2	0	1	0	0	0
Genus Eubacterium	2	0	0	0	0	0
Genus Yersinia	2	0	1	0	1	0
*Gram-negative coccus (*others or not specified*)*	2	0	2	0	0	0
Haemophilus parainfluenzae	2	0	1	0	0	0
Mycobacterium, non-tuberculosis	2	0	0	0	0	0
Prevotella bivia	2	0	0	0	0	0
Staphylococcus schleiferi	2	0	0	0	0	0
Abiotrophia adjacens	1	0	1	0	1	0
Acinetobacter calcoaceticus	1	0	0	0	0	0
Acinetobacter haemolyticus	1	0	0	0	0	0
Anaerobic Gram-positive coccus	1	0	0	0	0	0
Aspergillus fumigatus	1	0	1	0	1	0
Bacteroides caccae	1	0	0	0	0	0
Burkholderia cepacia	1	0	0	0	0	0
Clostridioides difficile	1	0	0	0	0	0
Fusobacterium necrophorum	1	0	1	0	0	0
Genus Agrobacterium	1	0	0	0	0	0
Genus Alcaligenes	1	0	0	0	0	0
*Genus Citrobacter (*others or not specified*)*	1	0	0	0	0	0
Genus Flavobacterium	1	0	0	0	0	0
Genus Gardnerella	1	0	0	0	0	0
Genus Hafnia	1	0	0	0	0	0
Genus Mycoplasma	1	0	0	0	0	0
Genus Nocardia	1	0	0	0	0	0
Genus Propionibacterium	1	0	0	0	0	0
Genus Veillonella	1	0	0	0	0	0

Microorganism	HABSI N	HABSI %	CLABSI N	CLABSI %	CRBSI N	CRBSI %
Moraxella catarrhalis	1	0	0	0	0	0
Mycobacterium tuberculosis complex	1	0	0	0	0	0
*Non-Enterobacteriaceae (*others or not specified)	1	0	0	0	0	0
Pasteurella multocida	1	0	0	0	0	0
Peptoniphilus harei	1	0	0	0	0	0
Prevotella oris	1	0	0	0	0	0
Ruminococcus gnavus	1	0	0	0	0	0
Salmonella Enteritidis	1	0	0	0	0	0
Salmonella Typhimurium	1	0	0	0	0	0
Streptococcus, group G	1	0	0	0	0	0
Veillonella parvula	1	0	0	0	0	0
*Bacterium (*others or not specified*)*	0	0	0	0	0	0
Genus Dialister	0	0	0	0	0	0
Propionibacterium acnes	0	0	0	0	0	0
Salmonella Typhi (not specified*)*	0	0	0	0	0	0
Streptococcus, group C	0	0	0	0	0	0
Unidentified	12	0	4	0	2	0
TOTAL	**8,034**	**100**	**2,070**	**100**	**802**	**100**

CLABSI, central line-associated bloodstream infection; HABSI, hospital-associated bloodstream infection; CRBSI, catheter related bloodstream infection= confirmed CLABSI; N, number

12. Microorganisms by suspected source of the bloodstream infection

Table A14 • Microorganisms isolated from hospital-associated bloodstream infection by source, Belgian acute care hospitals, 2022

	CL		Urinary tract infection		Gastro-intestinal infection		Pulmonary infection		Surgical site infection		Peripheral catheter		Other catheter		Invasive manipulation		MBI		Other*		Unknown		Total	
Family MO	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Enterobacterales	398	19	1,136	73	657	56	406	48	129	40	25	13	9	12	51	58	119	42	164	27	282	35	3,376	42
E. coli	108	5	712	46	330	28	95	11	51	16	2	1	1	1	25	28	72	25	67	11	121	15	1,584	20
K. pneumoniae	79	4	174	11	93	8	99	12	15	5	3	2	3	4	10	11	22	8	25	4	57	7	580	7
E. cloacae	69	3	46	3	78	7	51	6	15	5	9	5	0	0	8	9	10	3	18	3	25	3	329	4
K. oxytoca	39	2	28	2	44	4	26	3	5	2	1	1	1	1	4	5	2	1	8	1	19	2	177	2
P. mirabilis	11	1	79	5	10	1	9	1	6	2	1	1	2	3	1	1	1	0	15	2	9	1	144	2
S.marcescens	29	1	16	1	13	1	53	6	10	3	2	1	0	0	1	1	1	0	6	1	8	1	139	2
K. aerogenes	6	0	8	1	17	1	22	3	3	1	3	2	0	0	1	1	1	0	6	1	6	1	73	1
Other/not identified	57	3	73	5	72	6	51	6	24	8	4	2	2	3	1	1	10	3	19	3	37	5	350	4
Gram-positive cocci	1,272	61	239	15	279	24	246	29	130	41	156	78	55	74	23	26	117	41	342	56	351	43	3,210	40
S. aureus	175	8	50	3	15	1	119	14	55	17	64	32	23	31	4	5	7	2	179	29	110	14	801	10
S. epidermidis	560	27	14	1	4	0	5	1	21	7	48	24	10	14	3	3	8	3	27	4	65	8	765	10
E. faecium	138	7	58	4	142	12	29	3	23	7	5	3	2	3	7	8	27	9	30	5	40	5	501	6
E. faecalis	93	4	94	6	72	6	20	2	11	3	2	1	4	5	1	1	11	4	28	5	56	7	392	5
Other/not identified	306	15	23	1	46	4	73	9	20	6	37	19	16	22	8	9	64	22	78	13	80	10	751	9
Non-fermenting Gram-negative bacilli	138	7	113	7	66	6	129	15	21	7	9	5	3	4	6	7	27	9	43	7	68	8	623	8
P. aeruginosa	77	4	105	7	32	3	90	11	15	5	1	1	2	3	5	6	17	6	28	5	30	4	402	5
Other/not identified	61	3	8	1	34	3	39	5	6	2	8	4	1	1	1	1	10	3	15	2	38	5	221	3
Fungi	218	11	64	4	67	6	45	5	19	6	8	4	7	9	3	3	8	3	30	5	54	7	523	7
C. albicans	112	5	32	2	28	2	18	2	9	3	4	2	4	5	1	1	0	0	19	3	23	3	250	3
C. glabrata	42	2	18	1	21	2	12	1	4	1	0	0	2	3	2	2	1	0	7	1	18	2	127	2
Other/not identified	64	3	14	1	18	2	15	2	6	2	4	2	1	1	0	0	7	2	4	1	13	2	146	2
Anaerobic bacilli	20	1	2	0	92	8	10	1	20	6	2	1	0	0	3	3	12	4	25	4	34	4	220	3

Family MO	MO	CL		Urinary tract infection		Gastro-intestinal infection		Pulmonary infection		Surgical site infection		Peripheral catheter		Other catheter		Invasive manipulation		MBI		Other*		Unknown		Total	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Gram-positive bacilli		12	1	5	0	5	0	3	0	1	0	0	0	0	0	2	2	3	1	6	1	8	1	45	1
Gram-negative cocci		6	0	1	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	14	0
Other and not identified		6	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	8	1	23	0
Total		**2,070**	**100**	**1,561**	**100**	**1,172**	**100**	**841**	**100**	**320**	**100**	**200**	**100**	**74**	**100**	**88**	**100**	**286**	**100**	**615**	**100**	**807**	**100**	**8,034**	**100**

CL, central line; MBI, mucosal barrier injury; MO, microorganism; n, number
Note: * Skin/soft tissue and other

13. Antimicrobial resistance by region, 2022

Table A15 • Resistance in microorganisms isolated from hospital-associated bloodstream infections by region, Belgium 2022

		Brussels			Flanders			Wallonia		
Microorganisms	Antibiotics*	N	n	%	N	n	%	N	n	%
S. aureus	Meti	149	8	5.4	420	26	6.2	232	15	6.5
	Gly	149	0	0.0	420	1	0.2	232	1	0.4
E. faecium	Gly	99	3	3.0	269	5	1.9	133	9	6.8
E. coli	C3G	342	60	17.5	828	119	14.4	414	47	11.4
	CAR IR	342	5	1.5	828	11	1.3	414	4	1.0
	CAR R	342	4	1.2	828	5	0.6	414	3	0.7
K. pneumoniae	C3G	145	50	34.5	274	73	26.6	161	50	31.1
	CAR IR	145	5	3.4	274	13	4.7	161	9	5.6
	CAR R	145	4	2.8	274	11	4.0	161	6	3.7
E. cloacae	C3G	103	41	39.8	167	63	37.7	59	22	37.3
	CAR IR	103	1	1.0	167	3	1.8	59	0	0.0
	CAR R	103	0	0.0	167	2	1.2	59	0	0.0
P. aeruginosa	CAR IR	105	25	23.8	195	51	26.2	102	32	31.4
	CAR R	105	22	21.0	195	23	11.8	102	12	11.8
A. baumannii	CAR IR	5	0	0.0	16	1	6.3	6	1	16.7
	CAR R	5	0	0.0	16	0	0.0	6	1	16.7

C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem, doripenem); Gly, glycopeptides (vancomycin, teicoplanin); Meti, Methicillin; MO, microorganism; N, total number MO; n, number non-susceptible MO (IR) or number of resistant (R) MO; %, percent non-susceptible (IR) MO or percent resistant (R) MO

Notes:

*IR is used as indicator of non-susceptibility unless otherwise mentioned

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