sciensano

HEALTHCARE-ASSOCIATED INFECTIONS AND ANTIMICROBIAL RESISTANCE

SURVEILLANCE OF BLOODSTREAM INFECTIONS IN BELGIAN HOSPITALS

Report 2021
Data up to and including 2020

healthy all life long

.be

WHO WE ARE

SCIENSANO can count on more than 700 staff members who commit themselves, day after day, to achieving our motto: Healthy all life long. As our name suggests, science and health are central to our mission. Sciensano's strength and uniqueness lie within the holistic and multidisciplinary approach to health. More particularly we focus on the close and indissoluble interconnection between human and animal health and their environment (the "One health" concept). By combining different research perspectives within this framework, Sciensano contributes in a unique way to everybody's health.

For this, Sciensano builds on the more than 100 years of scientific expertise of the former Veterinary and Agrochemical Research Centre (CODA-CERVA) and the ex-Scientific Institute of Public Health (WIV-ISP).

Sciensano

Epidemiology and public health - Healthcare-associated infections and antimicrobial resistance

Surveillance of Bloodstream Infections in Belgian Hospitals

November 2021 • Brussels • Belgium
Internal reference number: D/2021/14.440/69

DUYSBURGH ELS

Els Duysburgh • T+32 2 647 57 44 • els.duysburgh@siensano.be

With the financial support of

service public fédéral SANTE PUBLIQUE, SECURITE DE LA CHAINE ALIMENTAIRE ET ENVIRONNEMENT

federale overheidsdienst VOLKSGEZONDHEID, VEILIGHEID VAN DE VOEDSELKETEN EN LEEFMILIEU

BRUSSELS HOOFDSTEDELIJK GEWEST

Vlaanderen is zorg

Wallonie

AViQ Agence pour une Vie de Qualité Familles Santé Handicap

Please cite as: Duysburgh E. Surveillance of Bloodstream infections in Belgian Hospitals: Report 2021. Brussels, Belgium: Sciensano; 2021.
Depot Number: D/2021/14.440/69
ISSN: 2505-9640

Acknowledgments

The author wish to thank all the participating hospitals for their continuous efforts to provide data, the members of the Working Group 'Bloodstream infections' for their help in improving the surveillance report and protocol, the Healthdata team, especially Marijke Pauwels, for their contribution in the development of the data collection and reporting tool. And last but not least, I wish to thank my colleagues Laure Morgat and Boudewijn Catry for the review of this report and their useful comments and input.

Main findings and recommendations

The 2020 bloodstream infection surveillance data shows the effect of COVID-19 on hospital-associated bloodstream infections:

- **An increase in hospital-associated bloodstream infections (HABSI) and central line-associated bloodstream infection (CLABSI) incidence in Belgian hospitals and**
- **An increase in the proportion of HABSI secondary to pulmonary infection and among critical ill patients**

Between 2013 and 2019, we did not observe a trend or statistic significant change in HABSI and CLABSI incidence per 10,000 patient days. **From 2019 to 2020,** we observed a statistical significant increase in the HABSI and CLABSI incidence and this at national and each of the regions level. **At Belgian level HABSI incidence increased by 20% and CLABSI incidence by 26%**.

In 2020, compared to previous years, we found proportionally more HABSI with as source a pulmonary infection and an endotracheal tube and more HABSI that occurred at the intensive care unit (ICU). These findings suggest that **compared with previous years** there were **proportionally more critically ill patients with a HABSI.**

In 2020, we did not observe a change in the trend of microorganism (MO) specific incidences of HABSI and in the antimicrobial resistance profile of selected causal MO. Also the 2020, findings on crude mortality for HABSI remained similar to previous years.

Recommendations

- Develop a robust and feasible crisis preparedness plan for the Belgian healthcare sector to guarantee the delivery of qualitative good care in all situations. Such a plan is needed on all levels, from the federal authority to the work floor level, and regular updates need to be foreseen.
- Continue the surveillance of bloodstream infections in Belgian hospitals to assess the HABSI and CLABSI incidence throughout and post COVID-19 crisis.
- Assess the impact of changing patient population due to the COVID-19 crisis on the increased HABSI and CLABSI incidence.

Belangrijkste bevindingen en aanbevelingen

De gegevens verzameld in 2020 via de surveillance van bloedstroom infecties tonen het effect van COVID-19 op de ziekenhuis-geassocieerde bloedstroominfecties:

- **Een stijging van de incidentie van ziekenhuis-geassocieerde bloedstroominfecties (HABSI) en centraal veneuze katheter-geassocieerde bloedstroominfecties (CLABSI) in Belgische ziekenhuizen en**
- **Een stijging van het aandeel HABSI met een longinfectie als oorsprong en van het aandeel HABSI bij patiënten in kritieke toestand**

Van 2013 tot 2019 observeerden we geen trend of statistisch significante verandering in de HABSI en CLABSI incidentie per 10.000 ligdagen. **Tussen 2019 en 2020** is er een statistisch significante toename van de HABSI en CLABSI incidentie en dit zowel op Belgisch niveau als op niveau van elk van de gewesten. **Op Belgisch niveau stijgt de HABSI incidentie met 20% en de CLABSI incidentie met 26%.**

In 2020 vonden we, in vergelijking met vorige jaren, proportioneel meer HABSI met een longinfectie als oorsprong en na endotracheale tube. Proportioneel waren er ook meer HABSI die op de intensieve zorgen afdeling ontstonden. Deze bevindingen suggereren dat er in **vergelijking met voorgaande jaren verhoudingsgewijs meer zwaar zieke patiënten met een HABSI** waren.

In 2020 vonden we noch een verandering in de trend van HABSI incidenties voor specifieke micro-organismen, noch in het antimicrobiële resistentieprofiel voor de betrokken micro-organismen. Ook de gegevens betreffende mortaliteit zijn vergelijkbaar met voorgaande jaren.

Aanbevelingen

- Ontwikkeling van een robuust en haalbaar crisisplan voor de Belgische gezondheidszorgsector, dit om in alle situaties kwalitatieve goede zorg te kunnen blijven garanderen. Een dergelijk plan is nodig op alle niveaus, van het federale niveau tot op de werkvloer, en moet regelmatig geactualiseerd worden.
- De surveillance van bloedstroominfecties in Belgische ziekenhuizen verderzetten om de HABSI en CLABSI incidentie tijdens en na de COVID-19-crisis op te volgen en te evalueren.
- De impact van de veranderende patiëntenpopulatie als gevolg van de COVID-19-crisis op de toegenomen HABSI en CLABSI incidentie onderzoeken.

Résultats principaux et recommandations

Les données recueillies en 2020 par le biais de la surveillance des septicémies montrent l'effet de la COVID-19 sur les septicémies associées à l'hôpital :

- **Une augmentation de l'incidence des septicémies associées à l'hôpital et des septicémies associées à un cathéter veineux central dans les hôpitaux belges et**
- **Une augmentation de la proportion de septicémies associées à l'hôpital provenant d'infections pulmonaires et une augmentation de la proportion de septicémies associées à l'hôpital chez les patients en état critique.**

De 2013 à 2019, nous n'avons observé aucune tendance particulière ni aucun changement statistiquement significatif dans l'incidence des septicémies associées à l'hôpital et celles associées à un cathéter veineux central pour 10 000 journées d'hospitalisation. Entre 2019 et 2020, nous observons une augmentation statistiquement significative de l'incidence des septicémies associées à l'hôpital ainsi qu'aux septicémies associées à un cathéter veineux central, tant au niveau de la Belgique dans son ensemble qu'au niveau des régions. **Au niveau de la Belgique, l'incidence des septicémies associées à l'hôpital a augmenté de 20 % et celle des septicémies associées à un cathéter veineux central de 26 %.**

En 2020, par rapport aux années précédentes, nous avons trouvé proportionnellement plus de septicémies associées à l'hôpital provenant d'une infection pulmonaire et après intubation endotrachéale. Il y a également eu proportionnellement plus de septicémies associées à l'hôpital qui sont apparues dans l'unité de soins intensifs. Ces résultats suggèrent qu'il y avait **proportionnellement plus de patients gravement malades avec une septicémie associée à l'hôpital par rapport aux années précédentes**.

En 2020, nous n'avons constaté aucun changement dans la tendance des incidences des septicémies associées à l'hôpital causées par des micro-organismes spécifiques, ni dans le profil de résistance aux antimicrobiens pour les micro-organismes impliqués. Les données sur la mortalité sont également similaires à celles des années précédentes.

Recommandations

- Développer un plan de crise robuste et réalisable pour le secteur des soins de santé en Belgique, afin de pouvoir continuer à garantir des soins de haute qualité dans toutes les situations. Un tel plan est nécessaire à tous les niveaux, du niveau fédéral au niveau hospitalier, et doit être régulièrement actualisé.
- Poursuivre la surveillance des septicémies dans les hôpitaux belges afin de suivre et d'évaluer l'incidence des septicémies associées à l'hôpital et celles associées à un cathéter veineux central pendant et après la crise COVID-19.
- Investiguer l'effet de l'évolution de la population de patients, consécutive à la crise COVID-19, sur l'augmentation de l'incidence des septicémies associées à l'hôpital et celles associées à un cathéter veineux central

Table of contents

Tables

Figures

Abbreviations

A. baumannii	*Acinetobacter baumannii*
BSI	Bloodstream infection
CDC	Centre for Disease Control and Prevention
CI	Confidence interval
CL	Central line
CLABSI	Central line-associated bloodstream infection
CRBSI	Central line-related bloodstream Infection
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECDC	European centre for disease prevention and control
E. coli	*Escherichia coli*
E. faecalis	*Enterococcus faecalis*
E. faecium	*Enterococcus faecium*
Gly	Glycopeptide
HABSI	Hospital-associated bloodstream infection
ICD-9-CM	International classification of diseases, 9th revision, clinical modification
ICD-10-CM	International classification of diseases, 10th revision, clinical modification
ICU	Intensive care unit
INAMI	Institut national d'assurance maladie-invalidité
IQR	interquartile range
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*
MZG/RHM	Minimale ziekenhuisgegevens/Résumé hospitalier minimum
NA	Not available
NSIH	National Surveillance of Infections in Hospitals (www.nsih.be), 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*
SD	Standard deviation
spp.	Species

Glossary

Acute care hospital
An acute care hospital is a hospital defined as an acute hospital by the National Institute for Health and Disability Insurance (NIHDI) (INAMI-RIZIV) in April 2017[1].

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: 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.

Long-term care facility
A long-term care facility is a hospital defined as a chronic hospital by NIHDI in April 2017[2].

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

[1] NIHDI - liste hôpitaux - april 2017: acute / chronic / psychiatric hospitals.
[2] NIHDI - liste hôpitaux - april 2017: acute / chronic / psychiatric hospitals.

Non-tertiary hospital
Non-tertiary hospitals include hospitals defined in the list of the Belgian ministry of health (Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg)[3] 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 chapter 1.3.1.2 at http://www.nsih.be/download/Protocol_Noemermodule%20en%20gemeenschappelijk%20gebruikte%20referentielijsten%20en%20variabelen%20(PDF)_2018.pdf (Dutch version) and http://www.nsih.be/download/Protocole_Module%20du%20dénominateur%20et%20listes%20de%20références%20et%20variables%20communes%20(PDF)_2018.pdf (French version).

Primary bloodstream infection
A primary BSI is a catheter-associated BSI 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)[4] 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).

[3] List of hospitals provided by the Belgian ministry of health (*Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg*); List dated December 2020: *Adressenlijst ziekenhuizen 12/2020 - Liste d'adresses des hôpitaux 12/2020*.
[4] List of hospitals provided by the Belgian ministry of health (*Dienst Datamanagement - Directoraat-Generaal Gezondheidszorg*); List dated December 2020: *Adressenlijst ziekenhuizen 12/2020 - Liste d'adresses des hôpitaux 12/2020*.

Executive summary

1. BACKGROUND

Hospital-associated bloodstream infections (HABSI) are an important cause of morbidity and mortality. Many HABSI, especially those associated with an invasive device, are preventable. The surveillance programme on bloodstream infections (BSI) in Belgian hospitals exists since 1992. In 2013, there was a major surveillance protocol review. Since 2014, participation in the surveillance for a minimum of 3 months per year is mandatory for acute care hospitals and since 2017, data collection and reporting is through the Healthdata platform.

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 at hospital and national level with the objective to enhance and evaluate preventive measures,
- monitoring causal microorganisms and their resistance profile.

This report provides a summary of the Belgian surveillance data up to and including 2020. An additional objective of this report is to assess the impact of COVID-19 on HABSI and CLABSI.

2. RESULTS

In 2020, 97 out of 104 eligible hospitals participated in the BSI-surveillance. Forty-one percent of these hospitals participated throughout the whole year. Participation throughout the year serves best the objective of surveillance.

2.1. TRENDS OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS

2.1.1. HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS, 2013-2020

Between 2013 and 2019, no trend in the incidence of HABSI in Belgian hospitals – hospital-wide and at intensive care unit (ICU) level – was observed. However, comparing 2019 with 2020 we notice a statistically significant increase in HABSI per 10,000 patient-days (pd) (Table 1). At hospital level, HABSI incidences per 10,000 pd increased by 20% from 8.3 in 2019 to 10.3 in 2020. At ICU level, the incidence of ICU-associated BSI per 10,000 pd increased by 43% from 32.4 in 2019 to 50.0 in 2020. The impact of the COVID-19 on the incidence of HABSI is the most plausible hypothesis to explain this increase.

Table 1: Incidence of hospital-associated bloodstream infections, hospital-wide and at ICU-level, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Cumulative incidence per 1,000 admissions								
mean – hospital-wide*	5.6	5.8	5.6	5.2	5.5	5.8	5.5	6.9
mean – ICU-level**	14.3	14.1	13.6	14.8	13.9	15.5	16.4	27.6
Incidence density per 10,000 patient-days								
mean – hospital-wide*	7.8	8.1	8.1	7.7	8.3	8.7	8.3	10.3
mean – ICU-level**	32.2	31.8	29.9	31.9	29.5	31.1	32.4	50.0

ICU, intensive care unit
Notes:
* Total hospital-associated BSI/total admissions or patient-days at hospital-level
** Total ICU-associated BSI/total admissions or patient-days at ICU-level

2.1.2. CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS, 2013-2020

Central line-associated bloodstream infections (CLABSI) are classified as 'confirmed' (clinical suspicion that central line (CL) is the cause of the BSI, with microbiological confirmation), 'probable' (clinical suspicion, no microbiological confirmation), and 'possible' (BSI not secondary to an infection at another body site but CL present within the two days prior to the BSI).

CLABSI incidence (three classifications together) per 10,000 pd did not change substantially between 2013 and 2019, but similar to HABSI incidences, from 2019 to 2020 increased statistically significant by 26% from 2.0 CLABSI per 10,000 pd in 2019 to 2.6 in 2020 (Figure 1). In 2020, 36% were confirmed CLABSI, 33% probable CLABSI and 32% possible CLABSI.

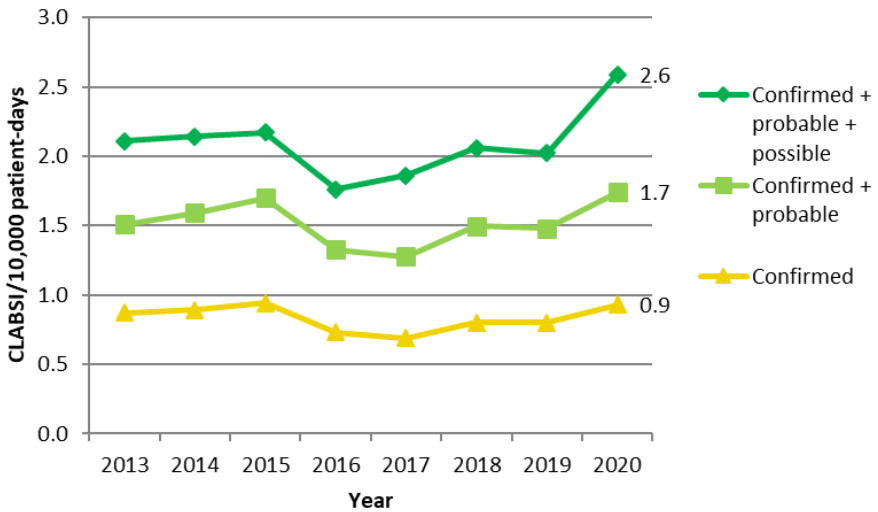


Figure 1: Mean incidence of central line-associated bloodstream infection hospital-wide, Belgium 2013-2020 (CLABSI, central line-associated bloodstream infections)

2.1.3. HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS PER MICROORGANISM, 2000-2020

Microorganism (MO) specific incidences of HABSI since 2000 for the most common MO are given in Figure 2. The incidence of HABSI with *S. aureus* did not change substantially over time. Since 2000, the incidence of HABSI with *E.coli* as causal MO doubled and with *K.*

pneumoniae almost tripled. Since 2013, we notice the same as the latter regarding the incidence of HABSI with *E. faecium*.

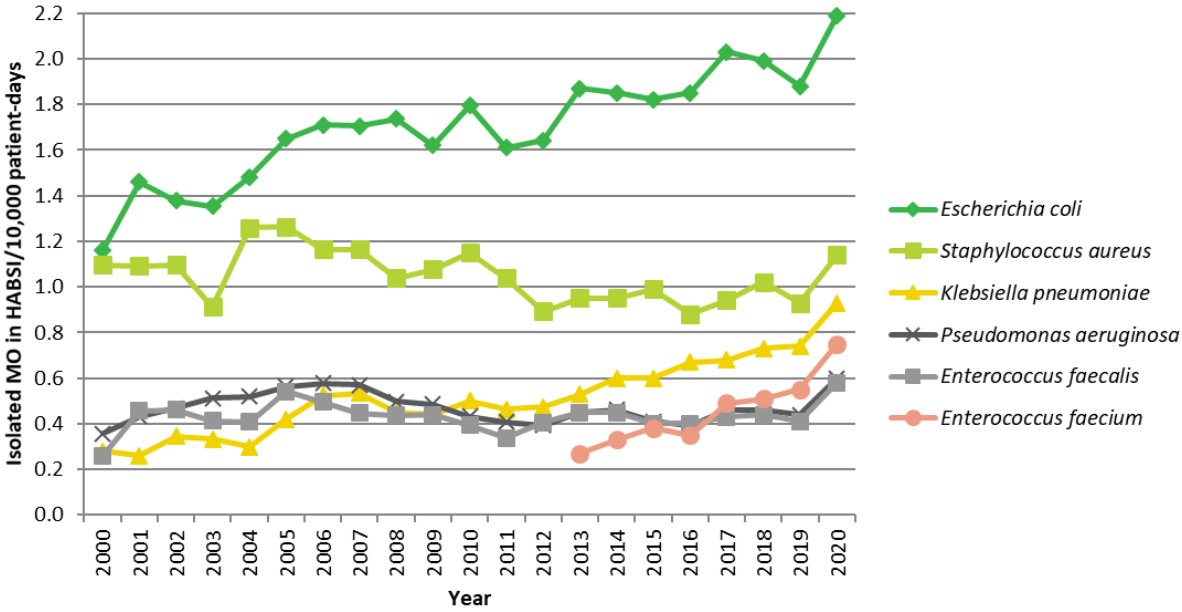


Figure 2: Mean incidence of hospital-associated bloodstream infections per microorganism, Belgium 2000-2020 (HABSI, hospital-associated bloodstream infections; MO, microorganism)

2.1.4. INCIDENCE OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS AT HOSPITAL LEVEL, 2020

In 2020, similar to previous years, there was a large variability in the reported incidence of HABSI between hospitals as shown in the boxplot[5] below where we notice several outliers (Figure 3).

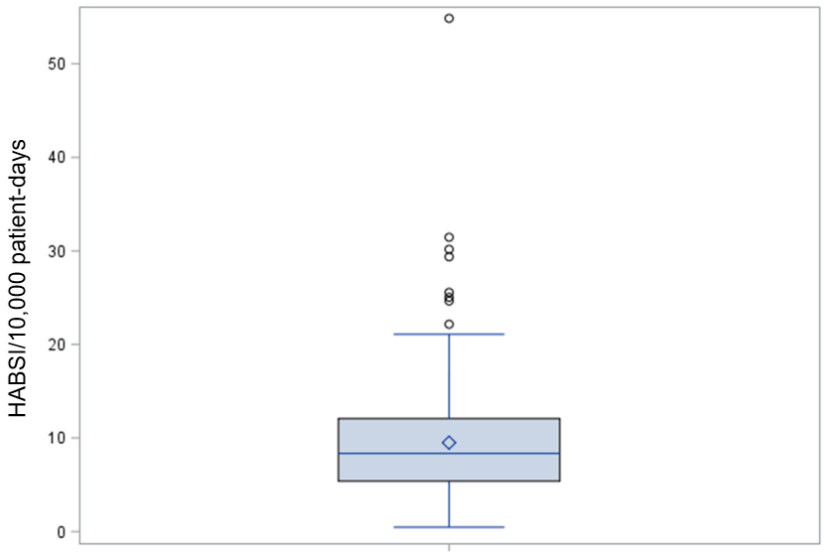


Figure 3: Hospital-associated bloodstream infections: incidence distribution across hospitals, Belgium, 2020 (HABSI, hospital-associated bloodstream infections)

[5] 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.

2.2. CHARACTERISTICS OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTION, 2020

In 2020, 97 hospitals registered together 7,138 HABSI. One HABSI out of four occurred two days or later after admission at ICU (definition of ICU-associated bloodstream infection).

Median number of days between admission in hospital and onset of HABSI was 13 days. Median age group of the patients was the 70-74 years of age group. Twenty two percent of patients with HABSI died. 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.

The most common source of HABSI, hospital-wide, was a CL (25%)[6], followed by urinary tract infection (19%) (Figure 4). At ICU the most common source was a CL (36%) followed by pulmonary infection (32%). For 45% 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). An invasive device was directly (CL and other catheters or invasive manipulation) or indirectly (urinary catheter, endotracheal tube) associated in 44% of the hospital-wide HABSI and in 69% of the ICU-associated BSI.

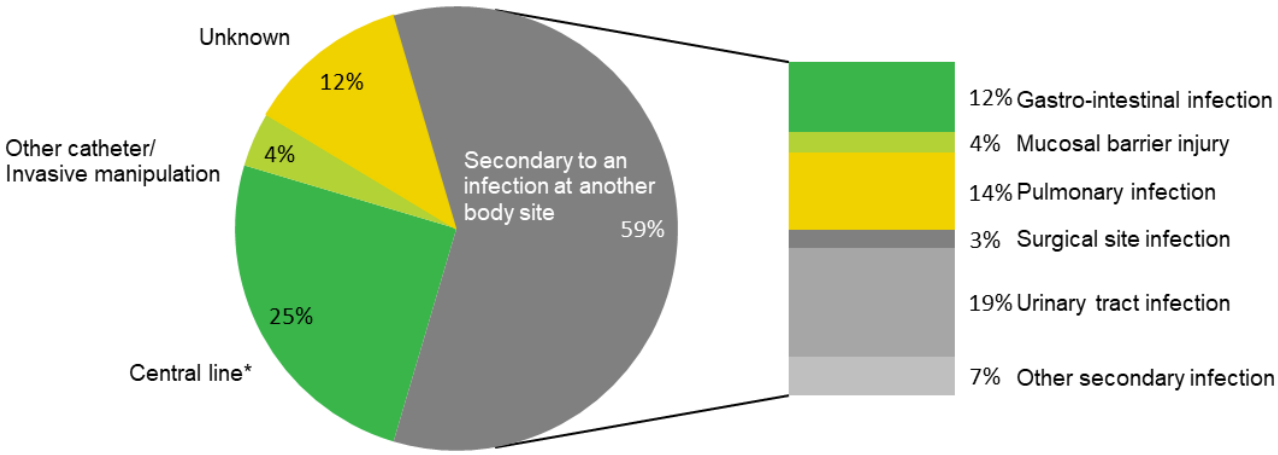


Figure 4: Source of hospital-associated bloodstream infections, Belgium 2020 (* Includes 'confirmed', 'probable' and 'possible' central line associated bloodstream infection)

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

2.3. IDENTIFIED CAUSAL MICROORGANISMS AND THEIR ANTIMICROBIAL RESISTANCE PROFILE

The most common MO isolated from HABSI in 2020 were *E. coli* (19%), *S. aureus* (10%), and *S. epidermidis* (10%). Less than half of the hospitals reported a case of HABSI caused by a methicillin resistant *S. aureus* (MRSA) (Table 2).

Phenotypic antimicrobial resistance for selected markers is shown in Table 2. Between 2013 and 2020, the decrease in the proportion of MRSA (from 20.9% to 8.9%) was statistically significant. Other changes (if any) in proportion of resistant MO were not statistically significant.

Table 2: Resistance in microorganisms isolated from hospital-associated bloodstream infections, Belgium 2020

		Microorganisms 2020			% hospitals with >= one resistant case* (N=97)
	Antibiotics	N	n	%	
Staphylococcus aureus	Meti	788	70	8.9	39
	Gly	788	0	0.0	0
Enterococcus faecalis	Gly	402	5	1.2	5
Enterococcus faecium	Gly	512	15	2.9	13
Escherichia coli	C3G	1,512	227	15.0	66
	CAR	1,512	10	0.7	9
Klebsiella pneumoniae	C3G	649	189	29.1	54
	CAR	649	31	4.8	18
Enterobacter cloacae	C3G	257	115	44.7	41
	CAR	257	7	2.7	5
Proteus mirabilis	C3G	137	1	0.7	1
	CAR	137	0	0.0	0
Klebsiella oxytoca	C3G	159	30	18.9	18
	CAR	159	2	1.3	2
Klebsiella aerogenes	C3G	99	41	41.4	24
	CAR	99	2	2.0	2
Pseudomonas aeruginosa	CAR	441	63	14.3	31
Acinetobacter baumannii	CAR	27	0	0.0	0

C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem); Gly, glycopeptides (vancomycin, teicoplanin); Meti, methicillin; n, number resistant MO; N, total number MO; %, percent resistant MO
* hospitals participated 1, 2, 3 or 4 quarters

3. DETAILED RECOMMENDATIONS

Recommendations for policy makers

- Continue to support and enable infection prevention and control teams at hospitals in their responsibilities and tasks to decrease HABSI. More focus on infection prevention and control in pre-service training (medical and nursing schools) would be useful.
- As part of broader quality of care improvement initiatives, enhance the creation of a general culture of good quality of care practice at hospital level. This includes the creation of a supportive, safe, secure and not judging hospital environment in which internal quality audits conducted by the hospital infection prevention and control teams can be implemented.
- Support the organisation of BSI surveillance data validation. This validation can be conducted by Sciensano.
- Continue to support a national organised surveillance of HABSI to assess changes in HABSI incidence at national and hospital level. Especially in the frame of the COVID-19 crisis it is very important to continue this surveillance, this to assess the impact of the COVID-19 crisis on the occurrence of HABSI and to be able to formulate, if needed, measures, guidelines and actions to strengthen quality of care and infection prevention and control management in times of a health crisis (lessons learned).
- The present COVID-19 crisis stresses the importance to enhance a sound infection prevention and control policy at national and hospital level.

Recommendations for hospitals

- Assess if there is still room for decrease of HABSI and, if needed, implement actions and activities to establish HABSI decrease. The organisation of internal HABSI audits conducted by the local infection prevention and control team is suggested.
- Continue recording and reporting HABSI data in the national BSI surveillance to be able to evaluate the HABSI situation at hospital level over time and evaluate the impact of locally implemented activities to decrease HABSI incidences and of locally occurred events on this HABSI incidence. Especially in the frame of the COVID-19 crisis it is very important to continue this reporting and recording, this to assess the impact of the COVID-19 crisis on the occurrence of HABSI and to be able to formulate, if needed, measures, guidelines and actions to strengthen quality of care and infection prevention and control management in times of a health crisis (lessons learned).

Recommendations for the scientists in charge of the surveillance (Sciensano)

- Validation of surveillance data. Comparing data from the surveillance with data received through the MZG/RHM could be a first step in this validation.
- Assess why there was between 2013 and 2019, no decline in HABSI incidence in Belgian hospitals at national level. This can be done by assessing if same hospitals have consistently better or worse HABSI incidences and if so, assess through an additional study why this is the case. Or, by comparing hospitals with a low HABSI incidence with similar hospitals with a high incidence and assess reasons for this difference.
- Assess if the in the BSI surveillance asked antibiotic resistance data should be updated and streamlined with international recommendations.
- Streamline between the other Sciensano surveillances the collection of antibiotic resistance data to avoid same data are asked several times.

- Continue implementing the surveillance of BSI in Belgian hospitals which includes a yearly update of protocol and data collection tool.
- Further improve the Healthdata data collection and reporting tool (Healthstat).
- Assess if data recording and reporting cannot be further simplified and streamlined in the future. It would be useful to assess if data collected through other channels (e.g. MZG/RHM) could serve to timely answer the objectives of the surveillance of BSI in Belgian hospitals.

Nederlandstalige samenvatting

1. ACHTERGROND

Ziekenhuis-geassocieerde bloedstroominfecties zijn een belangrijke oorzaak van morbiditeit en mortaliteit. Vele van deze bloedstroominfecties zijn te voorkomen, vooral deze geassocieerd met invasieve hulpmiddelen ('*invasive devices*'). De surveillance van bloedstroominfecties in het ziekenhuis bestaat in België sinds 1992. In 2013 vond een belangrijke aanpassing van het protocol plaats. Sinds 2014 is deelname aan de surveillance gedurende minimaal 1 kwartaal per jaar wettelijk verplicht voor acute ziekenhuizen en sinds 2017 gebeurt de gegevensverzameling en rapportage via het Healthdata platform.

De doelstelling van de bloedstroominfectie surveillance in Belgische ziekenhuizen is de kwaliteit van de zorg in Belgische ziekenhuizen te versterken door:

- het opvolgen van de trends van bloedstroominfecties, zowel op ziekenhuis als nationaal niveau, met als doel preventieve maatregelen te evalueren en te sturen,
- het opvolgen van de oorzakelijke micro-organismen en hun resistentieprofiel.

Dit rapport is een samenvatting van de Belgische surveillancegegevens tot en met 2020. Een bijkomende doelstelling is het beoordelen van de impact van COVID-19 op HABSI en CLABSI.

2. RESULTATEN

In 2020 namen 97 van de 104 ziekenhuizen die in aanmerking komen deel aan de bloedstroominfectie surveillance. Eenenveertig percent van de ziekenhuizen registreerden gegevens voor het hele jaar. Deelname gedurende het hele jaar beantwoordt best aan de doelstelling van surveillance.

2.1. ZIEKENHUIS-GEASSOCIEERDE BLOEDSTROOMINFECTIE TRENDS

2.1.1. ZIEKENHUIS-GEASSOCIEERDE BLOEDSTROOMINFECTIES, 2013-2020

Tussen 2013 en 2019 bleef de incidentie van ziekenhuis-geassocieerde bloedstroominfectie voor het hele ziekenhuis en voor de intensieve zorgen afdeling ongeveer hetzelfde (Tabel 1). Echter, tussen 2019 en 2020 is er een statistisch significante stijging van ziekenhuis-geassocieerde bloedstroominfectie per 10.000 ligdagen (Tabel 1). De gemiddelde ziekenhuis-geassocieerde bloedstroominfectie incidentie per 10.000 ligdagen steeg voor het hele ziekenhuis met 20% van 8,3 in 2019 tot 10,3 in 2020. Voor de bloedstroominfecties die 2 dagen of later na opname op intensieve zorgen optraden steeg de incidentie per 10.000 ligdagen met 43% van 32,4 in 2019 tot 50,0 in 2020. De impact van het COVID-19 op de HABSI incidentie is de meest plausibele hypothese om deze stijging te verklaren.

Tabel 1: Ziekenhuis-geassocieerde bloedstroominfectie incidentie, ziekenhuis-breed en op de intensieve zorgen afdeling, België 2013-2020

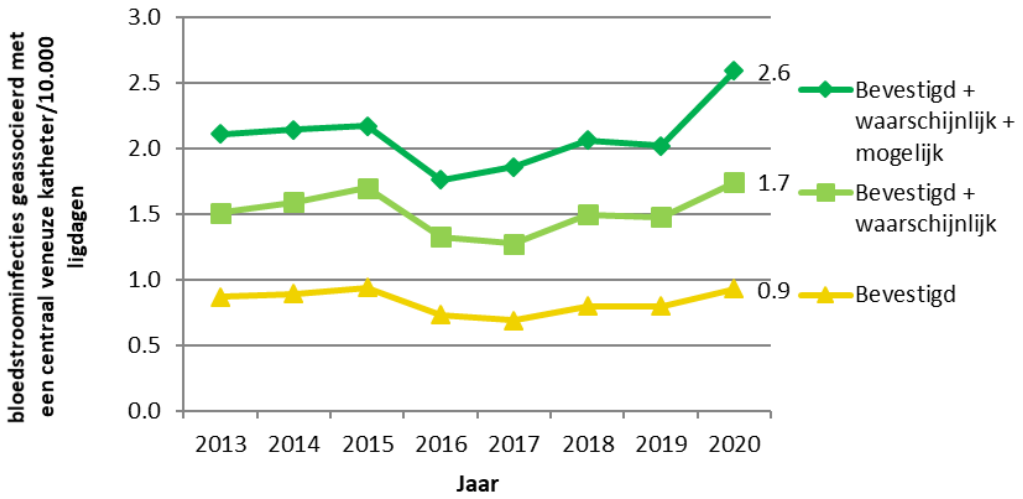
Jaar	2013	2014	2015	2016	2017	2018	2019	2020
Cumulatieve incidentie per 1.000 opnames								
gemiddelde – ziekenhuis-breed*	5,6	5,8	5,6	5,2	5,5	5,8	5,6	6.9
gemiddelde – op intensieve zorgen afdeling**	14,3	14,1	13,6	14,8	13,9	15,5	16,4	27,6
Incidentie dichtheid per 10.000 ligdagen								
gemiddelde – ziekenhuis-breed *	7,8	8,1	8,1	7,7	8,3	8,7	8,3	10,3
gemiddelde – op intensieve zorgen afdeling **	32,2	31,8	29,9	31,9	29,5	31,1	32,4	50,0

* Totaal aantal ziekenhuis-geassocieerde bloedstroominfecties/totaal aantal opnames of ligdagen op ziekenhuis niveau
** Totaal aantal intensieve zorgen afdeling-geassocieerde bloedstroominfecties/totaal aantal opnames of ligdagen op de intensieve zorgen afdeling

2.1.2. BLOEDSTROOMINFECTIES GEASSOCIEERD MET EEN CENTRAAL VENEUZE KATHETER, 2013-2020

Bloedstroominfecties geassocieerd met een centraal veneuze katheter worden ingedeeld als 'bevestigd' (klinisch vermoeden dat de centraal veneuze katheter de oorzaak is van de bloedstroominfectie en microbiologische bevestiging), 'waarschijnlijk' (klinisch vermoeden maar geen microbiologische bevestiging) en 'mogelijk' (bloedstroominfectie niet secundair aan een infectie op een andere lichaamsplaats maar centraal veneuze katheter aanwezig gedurende de twee dagen voorafgaand aan de bloedstroominfectie).

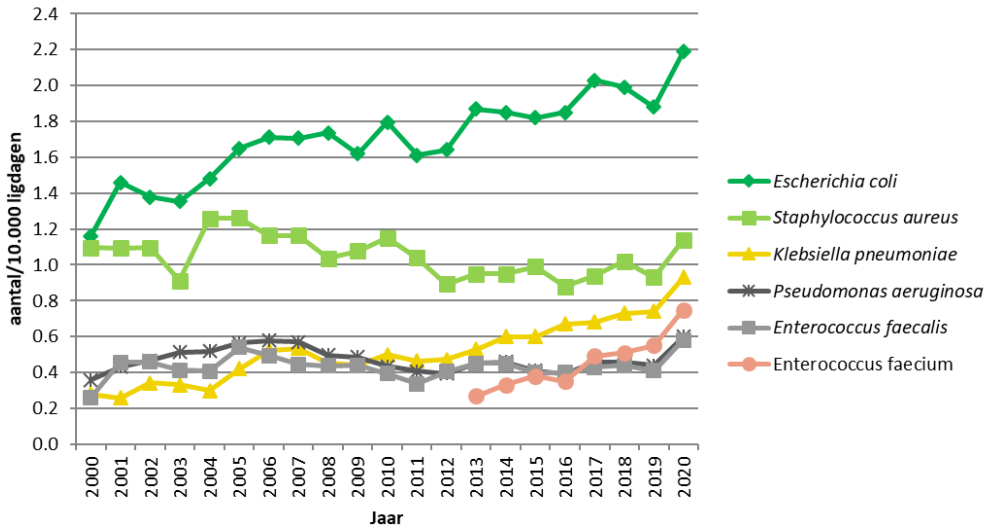
De incidentie van bloedstroominfecties geassocieerd met een centraal veneuze katheter (drie classificaties samen) per 10.000 ligdagen bleef tussen 2013 en 2019 ongeveer hetzelfde. Echter, zoals ook bij de incidentie van ziekenhuis-geassocieerde bloedstroominfectie, steeg deze incidentie tussen 2019 en 2020 statistisch significant met 26% van 2,0 bloedstroominfecties geassocieerd met een centraal veneuze katheter per 10.000 ligdagen in 2019 tot 2,6 in 2020 (Figuur 1). In 2020 was van alle bloedstroominfecties geassocieerd met een centraal veneuze katheter 36% 'bevestigd', 33% 'waarschijnlijk' en 32% 'mogelijk'.



Figuur 1: Gemiddelde incidentie van bloedstroominfecties geassocieerd met een centraal veneuze katheter, ziekenhuis-breed, België 2013-2020

2.1.3. ZIEKENHUIS-GEASSOCIEERDE BLOEDSTROOMINFECTIES PER MICRO-ORGANISME, 2000-2020

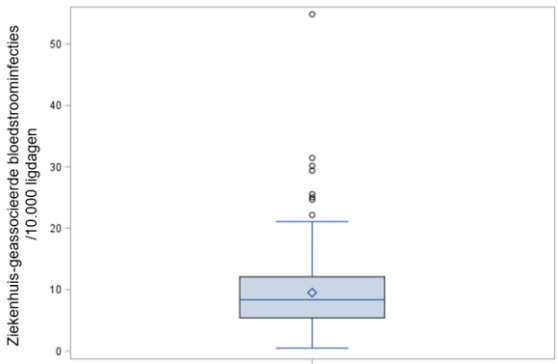
Figuur 2 geeft voor de meest voorkomende micro-organismen de micro-organismen-specifieke ziekenhuis-geassocieerde bloedstroominfectie incidentie vanaf 2000. De incidentie van bloedstroominfecties veroorzaakt door *S. aureus* bleef ongeveer gelijk. De incidentie van ziekenhuis-geassocieerde bloedstroominfecties met *E. coli* is sinds 2000 verdubbeld en met *K. pneumoniae* bijna verdrievoudigd. Hetzelfde als dit laatste zien we sinds 2013 voor de incidentie van ziekenhuis-geassocieerde bloedstroominfecties met *E. faecium.*



Figuur 2: Gemiddelde incidentie van ziekenhuis-geassocieerde bloedstroominfecties per micro-organisme, België 2000-2020

2.1.4. ZIEKENHUIS-GEASSOCIEERDE BLOEDSTROOMINFECTIE INCIDENTIE OP ZIEKENHUIS NIVEAU, 2020

Zoals de vorige jaren, was er ook in 2020 een grote variabiliteit tussen de ziekenhuizen in ziekenhuis-geassocieerde bloedstroominfectie incidentie. Dit is duidelijk in de boxplot[7] (Figuur 3) waar we verschillende uitschieters waarnemen.



Figuur 3: Ziekenhuis-geassocieerde bloedstroominfectie incidentie: incidentie verdeling per ziekenhuis, België 2020

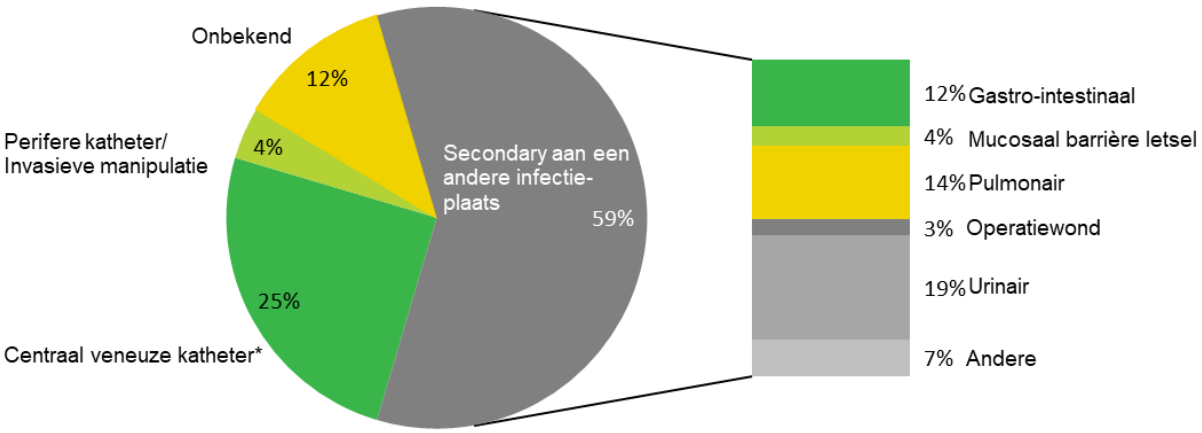
[7] De boxplot toont de ziekenhuis-geassocieerde bloedstroominfectie incidentie mediaan (blauwe lijn in de rechthoek) per 10.000 ligdagen per ziekenhuis per kwartaal dat het ziekenhuis deelnam aan de surveillance. De bovenste en onderste lijn van de rechthoek geven respectievelijk het 3de en 1ste kwartiel weer. De verticale lijnen strekken zich uit van de onder- en bovengrens van de rechthoek tot maximaal 1,5 keer de breedte van de rechthoek (de 1,5 interkwartielafstand) en de punten onder en boven deze lijnen geven de uitschieters weer. De diamantvorm geeft de gemiddelde incidentiedichtheid per 10.000 ligdagen.

2.2. KENMERKEN ZIEKENHUIS-GEASSOCIEERDE BLOEDSTROOMINFECTIES, 2020

In 2020 registreerden 97 ziekenhuizen 7,138 ziekenhuis-geassocieerde bloedstroominfecties. Eén op vier ziekenhuis-geassocieerde bloedstroominfecties ontstond 2 of meer dagen na opname op intensieve zorgen (definitie van intensieve zorgen-geassocieerde bloedstroominfectie).

In de helft van de ziekenhuis-geassocieerde bloedstroominfecties werd de diagnose 13 dagen of meer na ziekenhuisopname gesteld. De helft van de patiënten behoorde tot de leeftijdsgroep 70-74 jarige of ouder en 22% van de patiënten overleed. Er was echter een aanzienlijke hoeveelheid ontbrekende follow-up gegevens (26% ontbrekende gegevens) en onze gegevens laten evenmin toe om een oorzakelijk verband tussen overlijden en bloedstroominfectie te bepalen.

De meest voorkomende vermoedelijke oorsprong van ziekenhuis-geassocieerde bloedstroominfecties, ziekenhuis-breed, was een centraal veneuze katheter (25%)[8], gevolgd door een urineweginfectie (19%) (Figuur 4). Op intensieve zorgen was de meest voorkomende vermoedelijke oorsprong een centraal veneuze katheter (36%) gevolgd door longinfectie (32%). De oorsprong van ziekenhuis-geassocieerde bloedstroominfecties (ziekenhuis-breed) werd in 45% van de gevallen bevestigd (zelfde micro-organisme geïsoleerd in bloedkwe(e)k(en) en vermoedelijke infectiebron). Een invasief hulpmiddel was rechtstreeks (centraal veneuze of andere katheter of invasieve manipulatie) of onrechtstreeks (urineweg sonde of endotracheale tube) geassocieerd met de infectie in 44% van de ziekenhuis-brede ziekenhuis-geassocieerde bloedstroominfecties en in 69% van de intensieve zorgen-geassocieerde bloedstroominfecties.



Figuur 4: Vermoedelijke oorsprong van ziekenhuis-geassocieerde bloedstroominfecties, België 2020 (* Omvat 'bevestigde', 'waarschijnlijke' en 'mogelijke' bloedstroominfecties geassocieerd met een centraal veneuze katheter)

[8] Omvat 'bevestigde', 'waarschijnlijke' en 'mogelijke' bloedstroominfecties geassocieerd met een centraal veneuze katheter

2.3. GEIDENTIFICEERDE OORZAKELIJKE MICRO-ORGANISMEN EN HUN RESISTENTIE PROFIEL

E. coli (19%), *S. aureus* (10%) en *S. epidermidis* (10%) waren in 2019 de meest voorkomende micro-organismen in ziekenhuis-geassocieerde bloedstroominfecties. Minder dan de helft van de ziekenhuizen rapporteerde een ziekenhuis-geassocieerde bloedstroominfectie veroorzaakt door een methicilline resistente *S. aureus* (Tabel 2).

Tabel 2 geeft antimicrobiële resistentie voor geselecteerde markers. Van 2013 tot 2020 was de daling in de proportie van methicilline-resistentie *S. aureus* (van 20,9% naar 8,9%) statistisch significant. Andere veranderingen (indien aanwezig) waren niet statistisch significant.

Tabel 2: Resistentie in micro-organismen geïsoleerd uit ziekenhuis-geassocieerde bloedstroominfecties, België 2020

		Micro-organismen 2020			% ziekenhuizen met minstens 1 resistent geval*
	Antibiotica	N	n	%	(N=97)
Staphylococcus aureus	Meti	788	70	8,9	39
	Gly	788	0	0,0	0
Enterococcus faecalis	Gly	402	5	1,2	5
Enterococcus faecium	Gly	512	15	2,9	13
Escherichia coli	C3G	1.512	227	15,0	66
	CAR	1.512	10	0,7	9
Klebsiella pneumoniae	C3G	649	189	29,1	54
	CAR	649	31	4,8	18
Enterobacter cloacae	C3G	257	115	44,7	41
	CAR	257	7	2,7	5
Proteus mirabilis	C3G	137	1	0,7	1
	CAR	137	0	0,0	0
Klebsiella oxytoca	C3G	159	30	18,9	18
	CAR	159	2	1,3	2
Klebsiella aerogenes	C3G	99	41	41,4	24
	CAR	99	2	2,0	2
Pseudomonas aeruginosa	CAR	441	63	14,3	31
Acinetobacter baumannii	CAR	27	0	0,0	0

C3G, derde generatie cefalosporines (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem); Gly, glycopeptides (vancomycine, teicoplanine); Meti, methicilline; N, aantal; %, percent resistente micro-organismen
* Ziekenhuizen namen deel gedurende 1, 2, 3 of 4 kwartalen.

3. AANBEVELINGEN

Aanbevelingen voor beleidsmakers

- Blijf infectie controle teams in ziekenhuizen ondersteunen en de mogelijkheid bieden om hun taken en verantwoordelijkheden uit te oefenen dit met als doel het aantal ziekenhuis-geassocieerde bloedstroominfecties te doen dalen. Meer aandacht voor infectiepreventie en -controle training in de medische opleidingen (geneeskunde- en verpleegkunde-opleidingen) zou nuttig zijn.
- Ondersteun in zorginstellingen, als deel van een algemeen beleid om de kwaliteit van ziekenhuiszorg te verbeteren, het creëren van een algemene cultuur voor kwaliteitsvolle zorg. Dit omvat het creëren van een ondersteunende, veilige en niet-beschuldigende ziekenhuisomgeving waarin interne zorgkwaliteit-audits kunnen plaatsvinden.
- Ondersteun het opzetten en uitvoeren van een validatie van de bloedstroominfectie-surveillance gegevens. Deze validatie kan door Sciensano uitgevoerd worden.
- Doorgaan met de ondersteuning van een nationale ziekenhuis-geassocieerde bloedstroominfectie surveillance om veranderingen in ziekenhuis-geassocieerde bloedstroominfectie incidentie op nationaal en ziekenhuis-niveau op te volgen. Vooral in het kader van de COVID-19-crisis is het van groot belang om deze surveillance verder te zetten, dit om de impact van de COVID-19-crisis op het ontstaan van ziekenhuis-geassocieerde bloedstroominfecties te evalueren en om, indien nodig, maatregelen, richtlijnen en acties te formuleren om de kwaliteit van de zorg en het infectiepreventie en -controlebeleid en management in tijden van een gezondheidscrisis bij te sturen en te optimaliseren.
- De huidige COVID-19-crisis benadrukt het belang van het versterken en ondersteunen van een goed werkend infectiepreventie en -controlebeleid en management op nationaal en ziekenhuisniveau.

Aanbevelingen voor ziekenhuizen

- Onderzoek of een vermindering van het aantal ziekenhuis-geassocieerde bloedstroominfectie nog mogelijk is en, indien nodig, implementeer maatregelen en activiteiten om het aantal ziekenhuis-geassocieerde bloedstroominfectie te doen dalen. Hiervoor wordt de organisatie van interne audits uitgevoerd door lokale infectiepreventie en controle teams voorgesteld.
- Ga door met het registreren en rapporteren van ziekenhuis-geassocieerde bloedstroominfectie gegevens in de nationale bloedstroominfectie surveillance dit om de ziekenhuis-geassocieerde bloedstroominfectie situatie in de tijd en de impact van lokaal geïmplementeerde activiteiten en van lokaal optredende gebeurtenissen op de ziekenhuis-geassocieerde bloedstroominfectie incidentie te kunnen evalueren. Vooral in het kader van de COVID-19-crisis is het zeer belangrijk om deze rapportage en registratie verder te zetten, dit om de impact van de COVID-19-crisis op het ontstaan van ziekenhuis-geassocieerde bloedstroominfecties te evalueren en om, indien nodig, maatregelen, richtlijnen en acties te formuleren om de kwaliteit van de zorg en het infectiepreventie en -controlebeleid en management in tijden van een gezondheidscrisis bij te sturen en te optimaliseren.

Aanbevelingen voor de wetenschappers verantwoordelijk voor de surveillance (Sciensano)

- Validatie van de surveillance gegevens. Het vergelijken van surveillance gegevens met de gegevens van de ‘minimale ziekenhuisgegevens’ gegevensverzameling zou een eerste stap kunnen zijn in deze validatie.
- Onderzoek waarom tussen 2013 en 2019 de ziekenhuis-geassocieerde bloedstroominfectie incidentie in Belgische ziekenhuizen op nationaal niveau niet is gedaald. Dit kan worden gedaan door te onderzoeken of dezelfde ziekenhuizen consistent een betere of slechtere bloedstroominfectie incidentie hadden en indien dit het geval is, met een bijkomende studie nagaan waarom dit zo is. Of, door ziekenhuizen met een lage ziekenhuis-geassocieerde bloedstroominfectie incidentie te vergelijken met vergelijkbare ziekenhuizen met een hogere incidentie en de oorzaak van dit verschil in incidentie te onderzoeken.
- Nagaan of de antibiotica-resistentiegegevens die momenteel in de bloedstroominfecties surveillance verzameld worden moeten worden aangepast om ze in overeenstemming te brengen met de internationale aanbevelingen.
- De verzameling van antibioticaresistentie gegevens tussen de Sciensano surveillances stroomlijnen om te voorkomen dat dezelfde gegevens verschillende keren worden gevraagd.
- Verder gaan met de bloedstroominfectie surveillance in Belgische ziekenhuizen. Dit omvat een jaarlijkse update van het protocol en de gegevensverzamelingstool.
- Verdere verbetering van het Healthdata gegevensverzamelingstool en rapportageplatform (Healthstat).
- Onderzoek of in de toekomst de gegevensregistratie en rapportage niet verder kan worden vereenvoudigd en gestroomlijnd. In deze context zou het nuttig zijn te onderzoeken of gegevens verzameld via andere kanalen (bijvoorbeeld de ‘minimale ziekenhuisgegevens’) gebruikt zouden kunnen worden om de doelstellingen van de bloedstroominfectie surveillance in Belgische ziekenhuizen tijding te beantwoorden.

Résumé en français

1. CONTEXTE

Les septicémies associées à l'hôpital sont une source importante de morbidité et de mortalité. Nombre d'entre elles sont évitables, en particulier celles qui sont associées à des dispositifs invasifs (« *invasive devices* »). En Belgique, ces infections font l'objet d'une surveillance depuis 1992. Le protocole a été revu en 2013, pour mettre l'accent sur l'utilité de la récolte de données en vue d'orienter et d'évaluer les mesures de prévention. Depuis 2014, la participation à la surveillance est une obligation légale pour les hôpitaux aigus à raison d'au moins un trimestre par an et depuis 2017, la collecte et la visualisation des données sont via la plateforme Healthdata

L'objectif de la surveillance des septicémies dans les hôpitaux belges est d'améliorer la qualité des soins dans les hôpitaux belges par:

- le suivi des tendances des septicémies, tant au niveau local qu'au niveau national, dans le but de guider et d'évaluer les efforts de prévention,
- le suivi des microorganismes impliqués et de leur profil de résistance.

Le présent rapport résume les données de surveillance belges jusqu'en 2020 inclus. Un objectif supplémentaire de ce rapport est d'évaluer l'impact de COVID-19 sur les septicémies associées à l'hôpital et les septicémies associées au cathéter veineux central.

2. RÉSULTATS

En 2020, 97 des 104 hôpitaux éligibles ont participé à la surveillance des septicémies. Parmi eux, 41% ont enregistré des données sur l'ensemble de l'année. L'enregistrement en continu sert mieux l'objectif de la surveillance.

2.1. TENDANCES DES SEPTICÉMIES ASSOCIÉES À L'HÔPITAL

2.1.1. SEPTICÉMIES ASSOCIÉES À L'HÔPITAL, 2013-2020

Entre 2013 et 2019, l'incidence des septicémies associées à l'hôpital est resté stable tant au niveau de tout l'hôpital, qu'au niveau des unités de soins intensifs. Cependant, entre 2019 et 2020, nous remarquons une augmentation statistiquement significative des septicémies associées à l'hôpital sur 10 000 journées d'hospitalisation (Tableau 1).

Au niveau de tout l'hôpital, l'incidence moyenne des septicémies associées à l'hôpital par 10 000 journées d'hospitalisation a augmenté avec 20%, de 8,3 en 2019 à 10,3 en 2020. Au niveau des unités de soins intensifs, l'incidence des septicémies survenant deux jours ou plus après l'admission dans une unité de soins intensifs par 10 000 journées d'hospitalisation a augmenté avec 43%, de 32,4 en 2019 à 50,0 en 2020. L'impact du COVID-19 sur l'incidence des septicémies associées à l'hôpital est l'hypothèse la plus plausible pour expliquer cette augmentation.

Tableau 1 : Incidence des septicémies associées à l'hôpital, au niveau de tout l'hôpital et de l'unité de soins intensifs, Belgique 2013-2020

Année	2013	2014	2015	2016	2017	2018	2019	2020
Incidence cumulative pour 1000 admissions								
moyenne – au niveau de tout l'hôpital*	5,6	5,8	5,6	5,2	5,5	5,8	5,6	6.9
moyenne – unité de soins intensifs**	14,3	14,1	13,6	14,8	13,9	15,5	16,4	27,6
Incidence pour 10 000 journées d'hospitalisation								
moyenne – au niveau de tout l'hôpital*	7,8	8,1	8,1	7,7	8,3	8,7	8,3	10,3
moyenne – unité de soins intensifs**	32,2	31,8	29,9	31,9	29,5	31,1	32,4	50,0

* nombre total de septicémies associées à l'hôpital / nombre total d'admissions ou de journées d'hospitalisation au niveau de tout l'hôpital
** nombre total de septicémies associées aux unités de soins intensifs / nombre total d'admissions ou de journées d'hospitalisation aux soins intensifs

2.1.2. SEPTICÉMIES ASSOCIÉES AU CATHÉTER VEINEUX CENTRAL, 2013-2020

Les septicémies associées au cathéter veineux central sont classifiées comme : « confirmées » (suspicion clinique que le cathéter veineux central est à l'origine de l'infection et confirmation microbiologique), « probables » (suspicion clinique, mais pas de confirmation microbiologique) et « possibles » (septicémies non secondaires à une infection d'un autre site mais présence d'un cathéter veineux central dans les deux jours précédant l'infection).

L'incidence des septicémies associées au cathéter veineux central (trois classifications ensemble) par 10 000 journées d'hospitalisation n'a pas changé de manière significative entre 2013 et 2019, mais, comme pour les septicémies associées à l'hôpital, entre 2019 et 2020, elle a augmenté de manière statistiquement significative avec 26%, de 2,0 septicémies associées au cathéter veineux central par 10 000 journées d'hospitalisation en 2019 à 2,6 en 2020 (Figure 1). En 2020, parmi ces septicémies, 36% étaient « confirmées », 33% « probables » et 32% « possibles ».

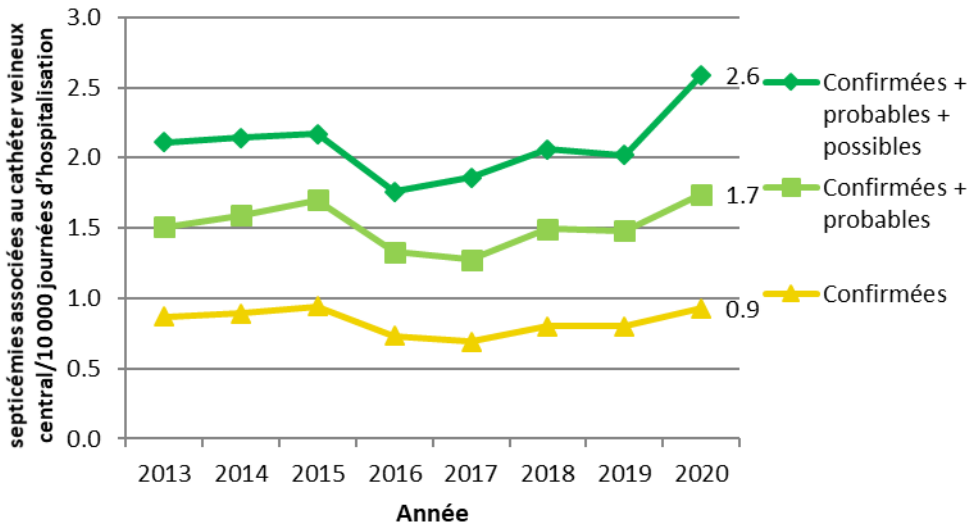


Figure 1 : Incidence moyenne des septicémies associées au cathéter veineux central au niveau de tout l'hôpital, Belgique, 2013-2020

2.1.3. SEPTICÉMIES ASSOCIÉES À L'HÔPITAL, PAR MICRO-ORGANISME, 2000-2020

Les incidences des septicémies associées à l'hôpital par micro-organisme sont présentées dans la Figure 2, depuis l'année 2000 et pour les micro-organismes les plus communs. L'incidence des septicémies à *S. aureus* est restée plus ou moins stable. Pour *E. coli* l'incidence des septicémies associées à l'hôpital a doublé depuis 2000 et pour *K. pneumoniae* a elle a presque triplé. Elle a fait de même que cette dernière pour E. *faecium* depuis 2013.

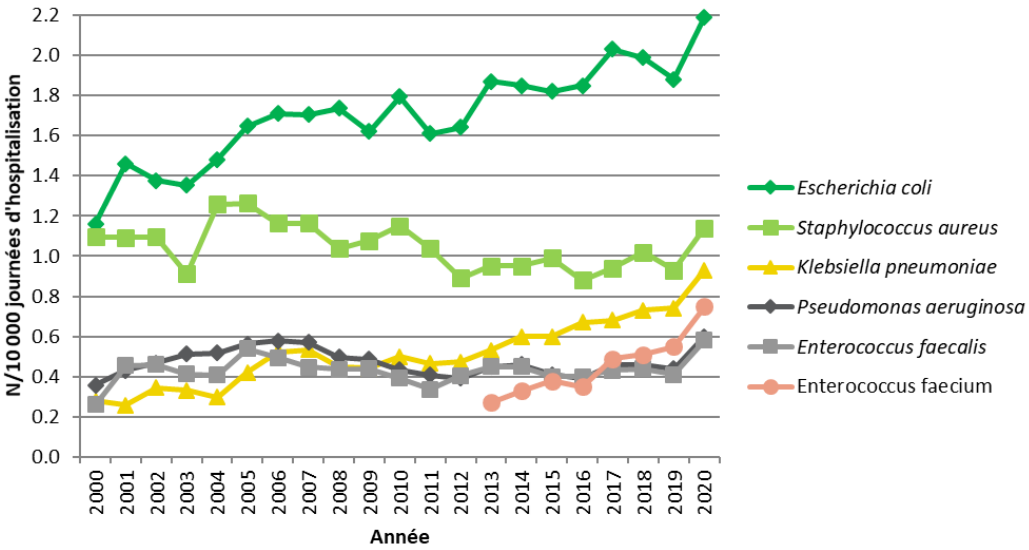


Figure 2 : Incidence moyenne des septicémies associées à l'hôpital par micro-organisme, Belgique, 2000-2020

2.1.4. INCIDENCE DES SEPTICÉMIES ASSOCIÉES À L'HÔPITAL AU NIVEAU DE L'HÔPITAL, 2020

Comme les années précédentes, on observe en 2020 une grande variabilité de l'incidence des septicémies associées à l'hôpital d'un hôpital à un autre. Cet aspect est clairement visible dans la boîte à moustaches[9] (Figure 3), qui fait apparaître plusieurs valeurs extrêmes.

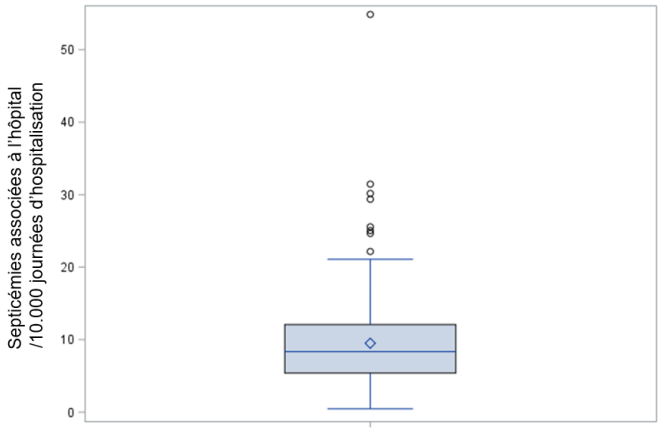


Figure 3 : Incidence des septicémies associées à l'hôpital, par hôpital, Belgique, 2020

[9] La boîte à moustaches montre l'incidence médiane des septicémies associées à l'hôpital (ligne bleue dans la boîte) par 10 000 journées d'hospitalisation par hôpital par trimestre de participation. La ligne du haut et la ligne du bas de la boîte représentent respectivement le 3e et le 1er quartile. Les lignes verticales indiquent ces mêmes valeurs, ajustées d'1.5 X l'écart interquartile (Q3 + 1.5 écart interquartile et Q1 - 1.5 écart interquartile respectivement) et les points indiquent les valeurs extrêmes. Le losange représente l'incidence moyenne par 10 000 journées d'hospitalisation.

2.2. CARACTÉRISTIQUES DES SEPTICÉMIES ASSOCIÉES À L'HÔPITAL, 2020

En 2020, les 97 hôpitaux participants ont enregistré 7 138 septicémies associées à l'hôpital. Une septicémie associée à l'hôpital sur quatre est apparue deux jours ou plus après une admission aux soins intensifs (définition des septicémies associées aux soins intensifs).

La moitié des épisodes sont survenus 13 jours ou plus après l'admission à l'hôpital. La moitié des patients avaient au moins 70-74 ans et 22% des patients sont décédés. Cependant, une proportion importante des données relatives au « status en fin de suivi » était manquante (26%) et nos données ne permettent pas d'établir un lien causal entre le décès et la septicémie.

Les origines les plus fréquentes, au niveau de tout l'hôpital, étaient le cathéter veineux central (25%)[10], suivi par les infections urinaires (19%) (Figure 4). Aux soins intensifs, les origines les plus fréquentes étaient le cathéter veineux central (36%), suivi par les pneumonies (32%). L'origine des septicémies associées à l'hôpital (au niveau de tout l'hôpital) était confirmée dans 45% des cas (même micro-organisme isolé dans les hémocultures qu'au niveau du site supposé être la source de l'infection). Un dispositif invasif était en cause directement (cathéter veineux central, autre cathéter ou manipulation invasive) ou indirectement (sonde urinaire ou tube endotrachéal) dans 44% des septicémies associées à l'hôpital au niveau de tout l'hôpital et dans 69% des septicémies associées aux soins intensifs.

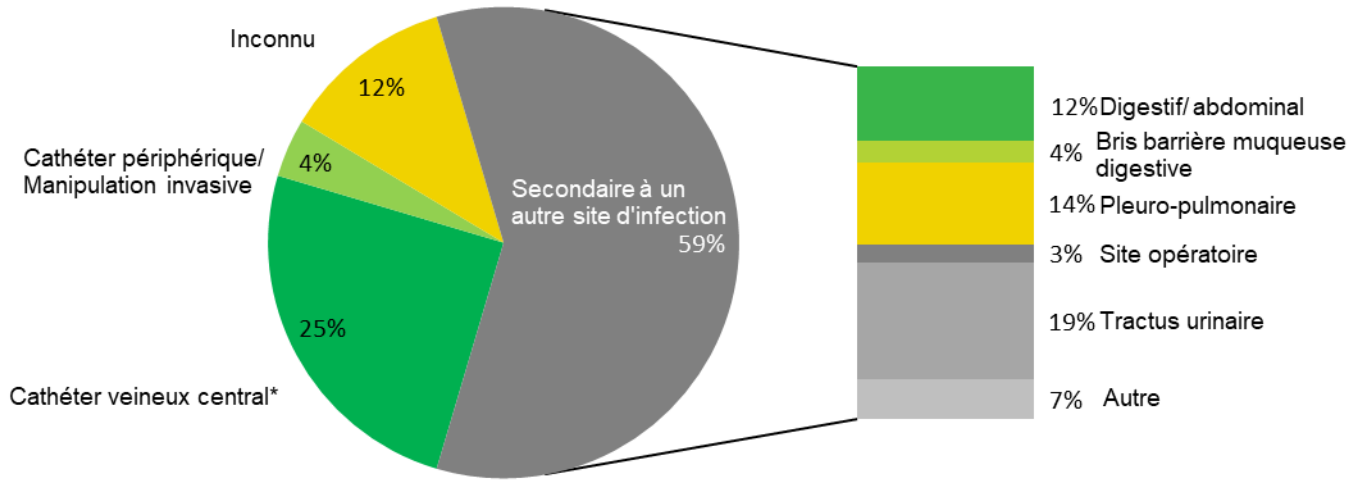


Figure 4 : Origine présumée des septicémies associées à l'hôpital, Belgique, 2020 (*Inclut origine « confirmées », « probables » et « possibles » pour les septicémies associées au cathéter veineux central)

[10] Ce chiffre inclut les septicémies liées à un cathéter veineux central « confirmées », « probables » et « possibles ».

2.3. MICRO-ORGANISMES CAUSAUX IDENTIFIÉS ET LEURS PROFILE DE RÉSISTANCE ANTIMICROBIENNE

Les micro-organismes les plus fréquemment isolés dans les septicémies associées à l'hôpital en 2020 étaient *E. coli* (19%), *S. aureus* (10%) et *S. epidermidis* (10%). Moins de la moitié des hôpitaux a rapporté un cas de septicémie associée à l'hôpital due à un *S. aureus* résistant à la méthicilline (MRSA) (Tableau 2).

Les profils de résistance phénotypique pour les micro-organismes objets de la surveillance sont présentés dans le Tableau 2. Entre 2013 et 2020, la diminution de la proportion de *S. aureus* résistante à la méthicilline (de 20,9% à 8,9%) étaient statistiquement significative. Les autres changements (s'il y en avait) n'étaient pas statistiquement significatifs.

Tableau 2 : Résistance aux antibiotiques pour les micro-organismes isolés dans les septicémies associées à l'hôpital, Belgique, 2020

		Micro-organismes 2020			% d'hôpitaux présentant au moins 1 cas de résistance* (N=97)
	Antibiotiques	N	n	%	
Staphylococcus aureus	Meti	788	70	8,9	39
	Gly	788	0	0,0	0
Enterococcus faecalis	Gly	402	5	1,2	5
Enterococcus faecium	Gly	512	15	2,9	13
Escherichia coli	C3G	1.512	227	15,0	66
	CAR	1.512	10	0,7	9
Klebsiella pneumoniae	C3G	649	189	29,1	54
	CAR	649	31	4,8	18
Enterobacter cloacae	C3G	257	115	44,7	41
	CAR	257	7	2,7	5
Proteus mirabilis	C3G	137	1	0,7	1
	CAR	137	0	0,0	0
Klebsiella oxytoca	C3G	159	30	18,9	18
	CAR	159	2	1,3	2
Klebsiella aerogenes	C3G	99	41	41,4	24
	CAR	99	2	2,0	2
Pseudomonas aeruginosa	CAR	441	63	14,3	31
Acinetobacter baumannii	CAR	27	0	0,0	0

C3G : céphalosporines de 3e génération (céfotaxime, ceftriaxone, ceftazidime) ; CAR : carbapénèmes (imipénème, méropénème) ; Gly : glycopeptides (vancomycine, teicoplanine) ; Meti : méthicilline ; N : nombre ; % : pourcentage de micro-organismes résistants.
* Les hôpitaux ont pris part à la surveillance pendant 1, 2, 3 ou 4 trimestres.

3. RECOMMANDATIONS

Recommandations à l'intention des décideurs politiques

- Renforcer le soutien fourni aux équipes d'hygiène hospitalière et faciliter l'exercice de leurs missions et responsabilités en termes de lutte contre les septicémies associées à l'hôpital. Dans ce contexte, il serait utile de porter une attention accrue à la prévention et au contrôle des infections dans les formations médicales (médecine et soins infirmiers).
- Dans le cadre d'une politique générale d'amélioration de la qualité des soins, renforcer la création d'une culture de bonnes pratiques de qualité des soins au niveau de l'hôpital. Cela implique la mise en place d'un environnement positif, sécurisant, fiable et non-jugeant qui permette l'organisation d'audits internes de qualité des soins par l'équipe d'hygiène hospitalière.
- Soutenir la mise en œuvre d'une validation des données de surveillance des septicémies. Sciensano peut se charger de la réalisation de cet étude.
- Continuer à soutenir la surveillance nationale des septicémies associées à l'hôpital afin de suivre les modifications d'incidence aux niveaux national et hospitalier. En particulier dans le cadre de la crise COVID-19, il est très important de poursuivre cette surveillance, ceci afin d'évaluer l'impact de la crise COVID-19 sur l'apparition des septicémies associées à l'hôpital et de pouvoir formuler, si nécessaire, des mesures, des directives et des actions pour renforcer la qualité des soins et la gestion de la prévention et du contrôle des infections en temps de crise sanitaire.
- La crise COVID-19 actuelle souligne l'importance de renforcer une politique solide de prévention et de contrôle des infections au niveau national et hospitalier.

Recommandations à l'intention des hôpitaux

- Évaluer s'il y a encore une place pour une diminution du nombre de septicémies associées à l'hôpital et, au besoin, implémenter les mesures et activités pour ce faire. L'organisation d'audits internes, menés par l'équipe locale d'hygiène hospitalière, est suggérée à cet effet.
- Poursuivre l'enregistrement et la communication des données sur les septicémies associées à l'hôpital dans le cadre de la surveillance nationale, afin de permettre l'évaluation de la situation dans le temps et de l'effet des activités mises en place localement afin de réduire leur incidence et de l'effet des événements survenus localement sur cette incidence. En particulier dans le cadre de la crise COVID-19, il est très important de poursuivre cette surveillance, afin d'évaluer l'impact de la crise COVID-19 sur l'apparition des septicémies associées à l'hôpital et de pouvoir formuler, si nécessaire, des mesures, des directives et des actions pour renforcer la qualité des soins et la gestion de la prévention et du contrôle des infections en période de crise sanitaire.

Recommandations à l'intention des scientifiques responsables de la surveillance (Sciensano)

- Procéder à une validation des données de surveillance. Un premier pas serait de comparer, au niveau de l'hôpital et du service, les données de surveillance avec celles du résumé hospitalier minimum.
- Investiguer les raisons pour lesquelles entre 2013 et 2019, l'incidence des septicémies associées à l'hôpital dans les hôpitaux belges n'a pas diminué au niveau national. Cela peut être fait en évaluant si ce sont systématiquement les mêmes hôpitaux qui

présentent les meilleures ou les pires incidences et, dans ce cas, en investiguer les raisons par une étude supplémentaire. Ou, en comparant les hôpitaux à faible incidence avec des hôpitaux similaires à incidence élevée et évaluer les raisons de cette différence.

- Évaluer si les données sur la résistance antibiotique actuellement demandées dans le cadre de la surveillance des septicémies devraient être mises à jour pour être harmonisées avec les recommandations internationales.
- Rationaliser entre les autres surveillances Sciensano le recueil des données de résistance aux antibiotiques pour éviter que les mêmes données soient demandées plusieurs fois.
- Poursuivre la surveillance des septicémies dans les hôpitaux belges. Cette mission implique la mise à jour annuelle du protocole et de l'outil de collecte des données.
- Continuer à améliorer l'outil de collecte de données et la plateforme de *reporting* Healthdata (Healthstat).
- Examiner si l'enregistrement et le *reporting* des données ne peuvent pas être simplifiés et rationalisés à l'avenir. Dans ce contexte, il serait utile d'étudier si des données recueillies par d'autres canaux (par exemple, le résumé hospitalier minimum) pourraient être utilisées pour satisfaire en temps opportun aux objectifs de la surveillance des septicémies dans les hôpitaux belges.

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 for acute care hospitals (Royal decree 08-01-2015) is legally required since 1 July 2014 (6). 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. Apart from this, a yearly review of the protocol takes place which includes minor updates and changes.

Data on bloodstream infection (BSI) occurring before 1 July 2017 were collected and hospital based results displayed though the online tool NSIHweb2. Data on BSI occurring since 1 July 2017 are collected through the Healthdata platform (see: https://healthdata.sciensano.be/en/home, https://www.healthdata.be/dcd/#/collection/NSIH-SEP/version/7 and https://www.healthdata.be/dcd/#/collection/NSIH-Denominators/version/19) and hospital based results reported through Healthstat (see: https://www.healthstat.be/).

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 admissions is also reported. This to put out findings in perspective.

This report describes trends in incidences of HABSI, causal microorganisms (MO), and their antimicrobial resistance profile until 2020 and provides a more detailed description of the 2020 BSI data.

2020 was the year the COVID-19 pandemic hit the world. In Belgium, the first imported case was detected on February 3rd, and local transmission was identified early March 2020. An additional objective of this report is to assess the impact of COVID-19 on HABSI and CLABSI. A dedicated chapter on this issue (Chapter 5) is added.

2 Methods

2.1 PARTICIPATION AND DEFINITIONS

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

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

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[11], three central line-associated bloodstream infections (CLABSI) classifications:
Confirmed CLABSI: LCBI with clinical suspicion that a CL the cause of the LCBI is and the association between the LCBI and the CL is microbiologically confirmed (same MO found in blood culture and on CL).
Probable CLABSI: LCBI with clinical suspicion that a CL the cause of the LCBI is 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 able assessing in depth the impact of COVID-19 on HABSI and CLABSI we added in 2020 two additional SNOMED codes 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*'.

2.2 DATA ANALYSIS

This report presents the analysis results, mainly descriptive, of surveillance data up to 2020 (database data labelled as 'Approved' in Healthdata on 9 September 2021). 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. For data on HABSI before 2013, see previous reports (6).

In line with the statement of the Royal Decree, we only included data from acute care hospitals.

[11] See BSI surveillance protocol chapter 4.5.2 (http://www.nsih.be/download/BSI%20surv%20protocol_NL_April2019.pdf (Dutch version), http://www.nsih.be/download/BSI%20surv%20protocol_FR_April2019.pdf (French version))

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 divided by the sum of denominators. To calculate medians the reporting quarter was used as unit of analysis[12].

To compare the HABSI incidences of the three Belgian regions we applied direct standardisation. For this we used the hospital population (number patient-days) distribution between tertiary and non-tertiary hospitals in Brussels as standard (reference) population.

We planned to assess separately HABSI incidences in COVID-19 dedicated wards and compare these with the ones found in non-COVID-19 dedicated wards. However, only two hospitals reported denominator data (number of patient-days and/or admissions) for COVID-19 dedicated wards (SNOMED DS0001 or DS0002). Because of this it was not possible to assess incidence separately.

A Pearson chi-square test was used to check differences in antimicrobial resistance between regions.

Boxplots and funnel plots were used to assess variability of data. 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). In a Funnel plot an estimate of a parameter is plotted against a measure of its precision, here number of HABSI per 10,000 patient-days (pd) against size of the hospital (number of pd). Funnel plots give a visual identification of outliers – curved lines (above or below 2SD (95%) and 3 SD (99.7%)). To compile boxplots and funnel plots 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).

We fitted a negative binomial regression model with hospital as random effect and 2013 or the previous year as reference year to explore and assess statistically significant ($p<0.05$) changes in incidence of HABSI, CLABSI and antimicrobial resistant isolates. To assess whether trends observed in proportions of resistant MO among all MO isolated were statistically significant ($p<0.05$), we used chi-square for trends.

Regarding resistance; ‘intermediary’ resistance was categorized in the analysis as ‘resistant’.

Data was analysed in SAS enterprise guide 7.1 except for the funnel plot that was designed using the tool developed by Public Health England[13] and for the statistical test for which STATA 14.1. (StataCorp LP, College Station, Texas, USA) was used.

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

[13] https://fingertips.phe.org.uk/profile/guidance - Analytical tools - Funnel plot for rates (updated July 2018)

3 Results surveillance of bloodstream infection in hospitals, 2013-2020

Participation

In 2020, 97 (93%) out of 104 eligible hospitals[14] participated in the BSI-surveillance. Forty-one percent of the eligible hospitals participated the whole year (Table 3)[15]. Divided by region this resulted in: 12 of the total of 14 hospitals participated in Brussels, 50% of the Brussel's hospitals participated throughout the whole year, 50 of 52 hospitals participated in Flanders, 46% throughout the whole year, and 35 of 38 hospital in Wallonia of which 32% participating throughout the whole year (Annex 2, Table 26).

Altogether, data for 248 quarters were submitted from which 238 (96%) quarters had denominator data available.

The number of hospitals participating since 2014, the year participation in the surveillance became mandatory, has always been higher than 90% (Table 3).

Table 3: Participation in the surveillance of bloodstream infections in Belgian hospitals, Belgium 2013-2020

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

N, number

Note:

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

[14] The total number of hospitals that should participate is based on the list of hospitals provided by the Belgian ministry of health (data management unit); List dated December 2020 (*Adressenlijst ziekenhuizen 12/2020 - Liste d'adresses des hôpitaux 12/2020*). Hospitals are identified by their RIZIV/INAMI number.

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

3.1 TREND OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS

3.1.1 HOSPITAL-WIDE

3.1.1.1 HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS, 2013-2020

Between 2013 and 2019, no trend in the incidence of HABSI in Belgian hospitals was observed. However, comparing 2019 with 2020 we notice a statistically significant increase in HABSI per 10,000 patient-days (pd) and per 1,000 admissions (Table 4 and Figure 5). HABSI incidences per 10,000 pd increased from 8.3 in 2019 to 10.3 in 2020, incidence rate ratio 1.20 with 95% CI [1.14-1.27], meaning an increase of HABSI incidence by 20%. For HABSI incidence per 1,000 admissions we observed an increase from 5.5 in 2019 to 6.9 in 2020 (incidence rate ratio 1.21 with 95% CI [1.14-1.28]).

The impact of the COVID-19 epidemic on the incidence of HABSI is the most plausible hypothesis to explain this increase. This will be further discussed in chapter 5 of this report.

Table 4: Incidence of hospital-associated bloodstream infections (hospital-wide), Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N hospitals included in calculation of incidence*	86	96	102	103	93	100	98	94
N HABSI	5,584	6,926	7,875	7,791	6,755	7,909	7,239	6,822
Cumulative incidence per 1,000 admissions								
mean**	5.6	5.8	5.6	5.2	5.5	5.8	5.5	6.9
median***	5.2	4.8	4.8	4.7	4.7	4.6	4.5	5.5
Incidence density per 10,000 patient-days								
mean**	7.8	8.1	8.1	7.7	8.3	8.7	8.3	10.3
median***	6.9	6.9	6.8	6.8	7.0	7.2	7.0	8.4

HABSI, hospital-associated BSI; N, number
Notes:
* Hospitals included when denominator of the participating quarter was available[16]
** Total hospital-associated BSI/total denominator
*** Unit of analysis used to calculate median is quarter

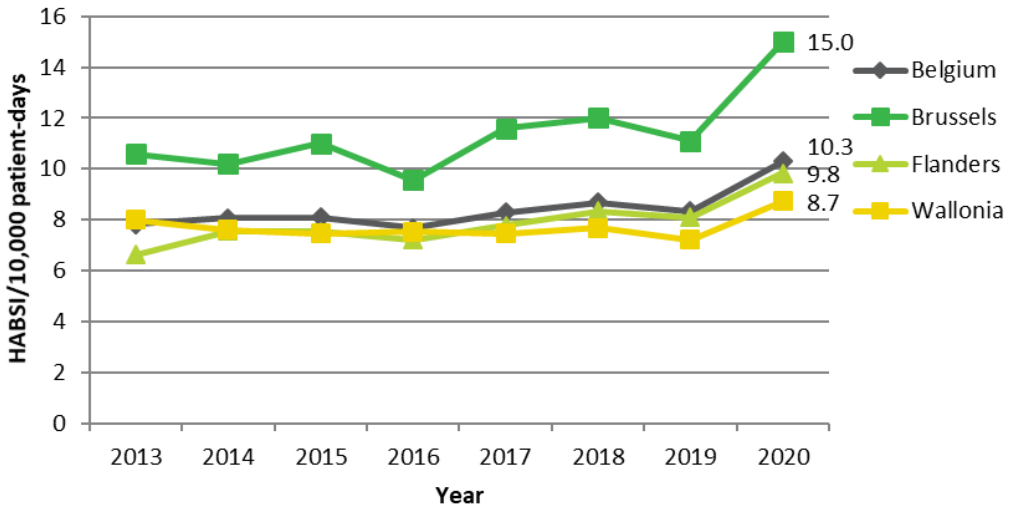


Figure 5: Mean incidence of hospital-associated bloodstream infections, hospital-wide, by region, Belgium 2013-2020 (HABSI, hospital-associated bloodstream infections)

[16] In 2020, for 96% of the reported HABSI matching denominator data were available.

Figure 5 and Annex 3, Table 27, show HABSI incidences by region. Between 2013 and 2019, also by region no clear trends in HABSI incidence are observed. However, in 2020, similar to the finding for whole Belgium, we find compared to 2019 for each of the three regions a statistically significant increase of HABSI incidences per 10,000 pd. In Brussels HABSI incidence per 10,000 pd increased from 11.1 in 2019 to 15.0 in 2020 (incidence rate ratio 1.28 with 95% CI [1.09-1.51]), for Flanders this was from 8.1 in 2019 to 9.8 in 2020 (incidence rate ratio 1.18 with 95% CI [1.09-1.26]) and for Wallonia from 7.3 in 2019 to 8.7 in 2020 (incidence rate ratio 1.22 with 95% CI [1.11-1.33]).

Compared to the two other regions, HABSI incidences are higher in Brussels. Since Brussels has more tertiary hospitals[17,18], observed differences in incidence of HABSI could be the result of confounding by type of hospital (tertiary versus other types) as we found that HABSI incidence in tertiary hospitals was persistently higher than in other hospitals (Annex 4, Table 28 and 29, Figure 28). We therefore applied on the 2020 data direct standardization to control for potential confounding. As standard population we used the 2020 hospital population of Brussels (patient-days per type of hospital), to which we applied rates observed in all three regions to obtain standardized rate ratios. After standardization, the 2020 HABSI incidence rate in Brussels remained higher than those of Flanders and Wallonia. Standardized rate ratios for the latter regions were 0.80 and 0.62 respectively when compared to Brussels. This means that with the same distribution of the population between tertiary and other hospitals we would find in Flanders 20% less HABSI than in Brussel and in Wallonia 38% less HABSI.

Apart from our observation that HABSI incidence in tertiary hospitals is persistently higher than in other hospitals the HABSI incidence in tertiary and in other hospitals per 10,000 pd remains fairly stable between 2013 and 2019 but statistically significant increased from 2019 to 2020 (Annex 4, Table 28). In tertiary hospitals HABSI incidence per 10,000 pd increased from 11.6 in 2019 to 14.8 in 2020 (incidence rate ratio 1.26 with 95% CI [1.12-1.32]) and in other non-tertiary hospitals from 6.6 in 2019 to 8.1 in 2020 (incidence rate ratio 1.20 with 95% CI [1.12-1.28]).

In 2020, the median number of HABSI episodes in Belgian hospitals was 19 (IQR 10-38) episodes per quarter.

3.1.1.2 CENTRAL-LINE ASSOCIATED BLOODSTREAM INFECTIONS, 2013-2020

To be considered as CLABSI in the Belgian bloodstream infection surveillance, a CLABSI must first meet the surveillance definition for HABSI, being; a LCBI occurring two days or more after admission at the hospital. Depending on surveillance information we then define three CLABSI classifications: (1) confirmed CLABSI, (2) probable CLABSI and, (3) possible CLABSI.

In 2020, 36% were confirmed CLABSI, 33% probable CLABSI and 32% possible CLABSI. These proportions did not change substantially since 2013 (Annex 5, Table 30) and incidences varied

[17] 'Tertiary hospitals' include the hospitals defined as 'university hospital' and 'general hospital with university characteristics' in the '*Adressenlijst ziekenhuizen 12/2020 - Liste d'adresses des hôpitaux 12/2020*' published by FOD volksgezondheid – SPF santé publique.

[18] Proportion (absolute numbers and %) of tertiary hospitals participating by region in 2020;
- Brussels: 5/11 (45%)
- Flanders: 7/49 (14%)
- Wallonia: 9/34 (26%)

accordingly (Table 5). CLABSI incidence (three classifications together) per 10,000 pd did not change substantially between 2013 and 2019, but similar to all previous reported incidences, from 2019 to 2020 increased statistically significant from 2.0 CLABSI per 10,000 pd in 2019 to 2.6 in 2020 (incidence rate ratio 1.26 with 95% CI [1.15-1.37]) (Figure 6).

Since 2013, the mean CLABSI incidence (three classifications together) per 10,000 pd remained more than twice as high in tertiary hospitals compared with other hospitals (Annex 6, Table 31).

Table 5: Mean incidence of central line-associated bloodstream infections, hospital-wide, according to classification, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Confirmed CLABSI								
N*	619	768	918	739	565	732	697	616
mean incidence per 10,000 pd	0.9	0.9	0.9	0.7	0.7	0.8	0.8	0.9
Probable CLABSI								
N*	459	601	742	610	475	637	582	541
mean incidence per 10,000 pd	0.6	0.7	0.8	0.6	0.6	0.7	0.7	0.8
Possible CLABSI								
N*	424	465	459	439	477	505	474	549
mean incidence per 10,000 pd	0.6	0.5	0.5	0.4	0.6	0.6	0.6	0.8
Total CLABSI								
N*	1,502	1,834	2,119	1,788	1,517	1,874	1,753	1,706
mean incidence per 10,000 pd	2.1	2.1	2.2	1.8	1.9	2.1	2.0	2.6

CLABSI, central line-associated bloodstream infection; N, number; pd, patient-days

Note:

* Includes only those episodes for which a denominator is available

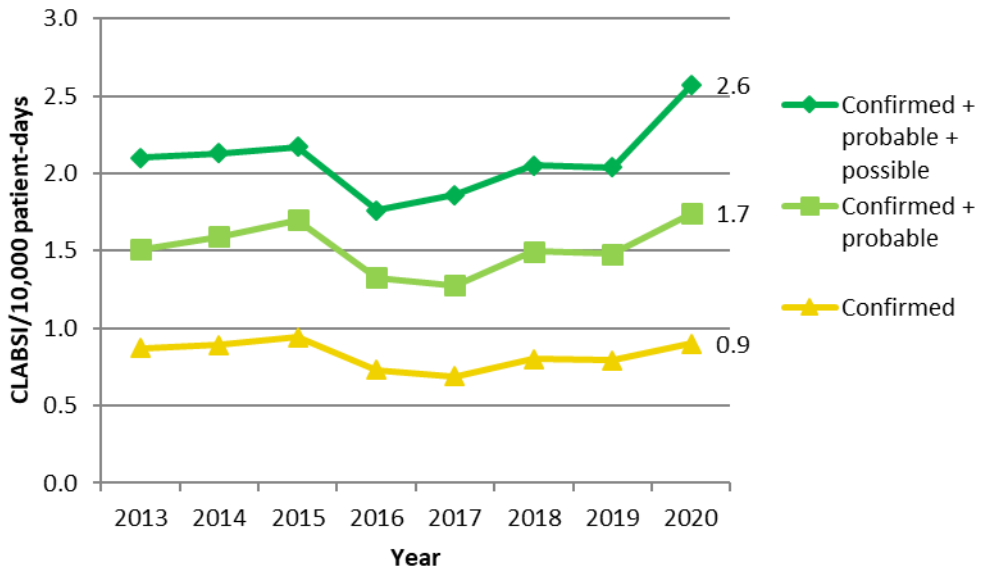


Figure 6: Mean incidence of central line-associated bloodstream infections (confirmed, probable, and possible), hospital-wide, Belgium 2013-2020 (CLABSI, central line-associated bloodstream infections)

In 2020, the median number of hospital-wide CLABSI (including confirmed, probable and possible cases) was 4 (IQR 1-11) episodes per quarter.

3.1.1.3 MICROORGANISM SPECIFIC HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS, 2000-2020

MO specific incidences of HABSI since 2000 for the most common MO are given in Figure 7. This graph illustrates long-term time trends of an increase in *E. coli*, *K. pneumoniae* and *E. faecium*[19]. The incidence of HABSI with *S. aureus* did not change substantially over time. Since 2000, the incidence of HABSI with *E. coli* as causal MO more or less doubled and with *K. pneumonia* as causal MO almost tripled. Since 2013, we notice the same as the latter regarding the incidence of HABSI with *E. faecium*.

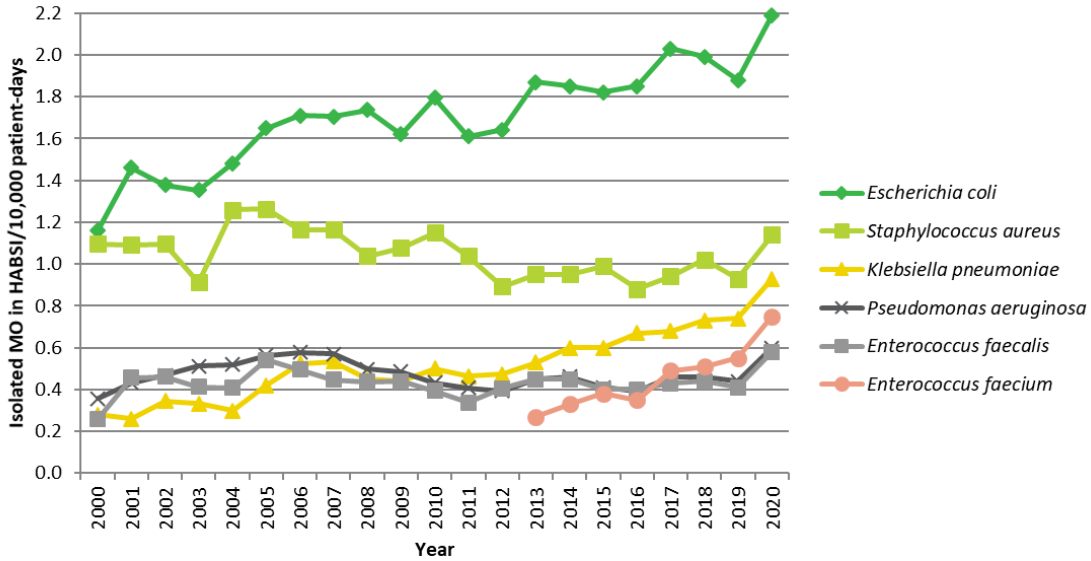


Figure 7: Mean incidence of hospital-associated bloodstream infections per microorganism, Belgium 2000-2020 (HABSI, hospital-associated bloodstream infection; MO, microorganism)

3.1.1.4 MICROORGANISM SPECIFIC CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS, 2013-2020

MO specific incidences of CLABSI since 2013 for the most common MO are given in Figure 8. Since 2013, the incidence of CLABSI caused by these most common MO did not change substantially over time.

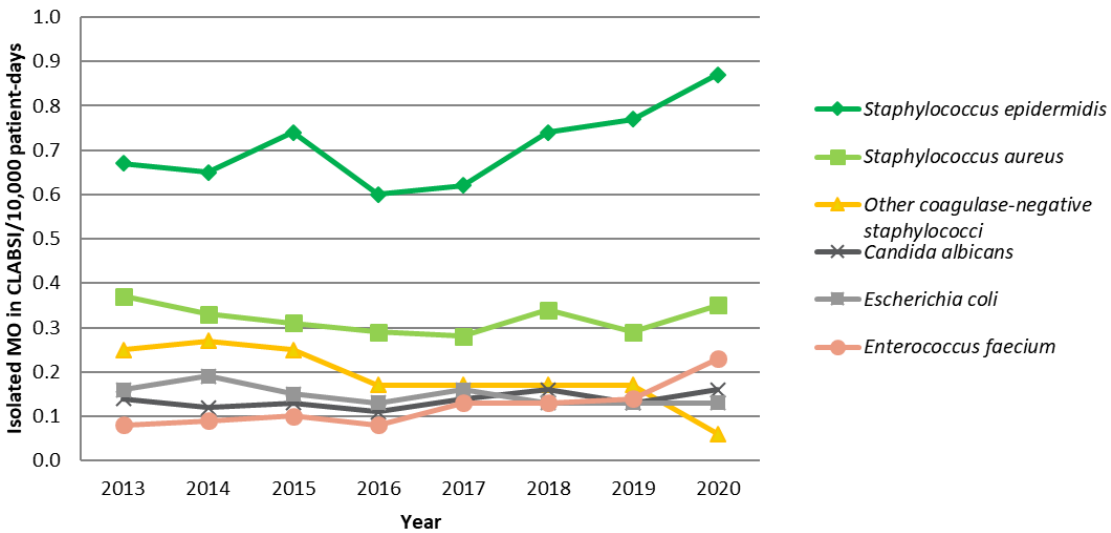


Figure 8: Mean incidence of central line-associated bloodstream infections per microorganism, Belgium 2013-2020 (CLABSI, central line-associated bloodstream infection; MO, microorganism)

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

3.1.1.5 INCIDENCES OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS AT HOSPITAL LEVEL, 2020

In 2020, similar to previous years, there was a large variability in the reported incidence of HABSI between hospitals as shown in the boxplot[20] and funnel plot[21] below (Figures 9 and 11). In both graphs several outliers are noticed. Incidence is compared with general hospitals without university characteristics higher in university hospitals and in general hospitals with university characteristics and compared with Flanders and Wallonia higher in Brussels (Figure 10), however within group-variability seems larger than between group-variability.

It would be useful to examine the outliers (extreme values) more in-depth to find and understand the reason of these values and their variability.

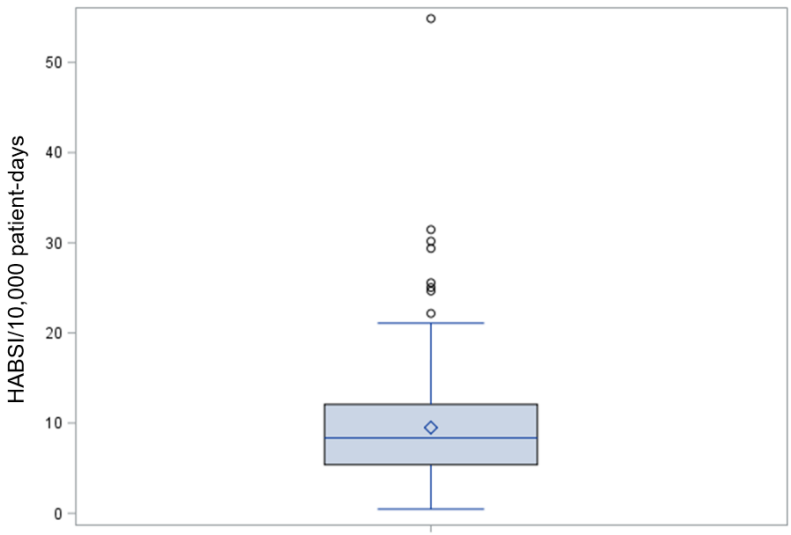


Figure 9: Hospital-associated bloodstream infections: incidence distribution across hospitals, Belgium 2020 (HABSI, hospital-associated bloodstream infection)

[20] 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.

[21] Funnel plots are a graphical aid for institutional comparisons. An estimate of the parameter is plotted against a measure of its precision, here number of HABSI per 10,000 patient-days against size of the hospital (number of patient-days). Funnel plots give a visual identification of outliers – curved lines (above or below 2SD (95%) and 3 SD (99.7%)) - and are used to assess outliers and validate data.

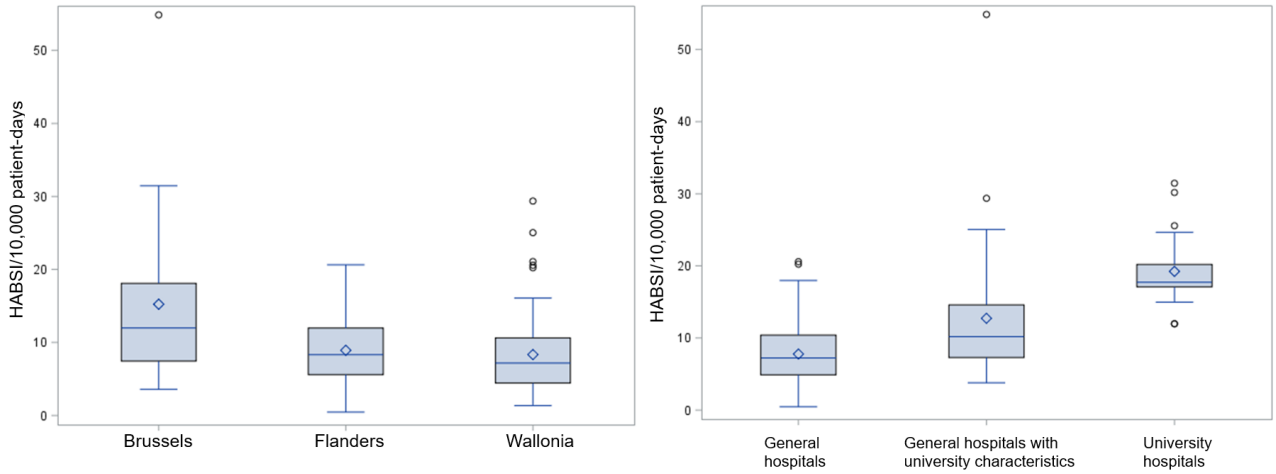


Figure 10: Hospital-associated bloodstream infections: incidence distribution across hospitals, by region and by hospital type[22], Belgium 2020 (HABSI, hospital-associated bloodstream infection)

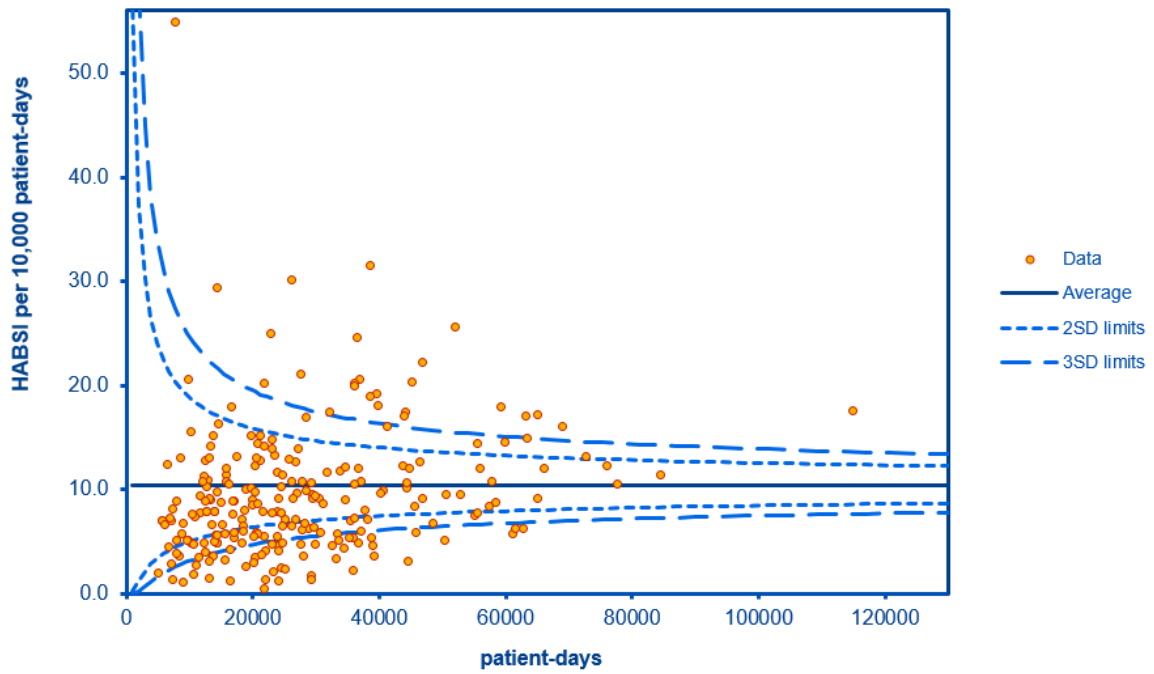


Figure 11: Variability in reported incidence of hospital-associated bloodstream infections between hospitals, Belgium 2020 (HABSI, hospital-associated bloodstream infection; SD, standard deviation)

The funnel plot gives a visual identification of outliers; above or below 2SD (95%) and 3SD (99.7%).

[22] 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 2020: Adressenlijst ziekenhuizen 12/2020 - Liste d'adresses des hôpitaux 12/2020.

3.1.2 INTENSIVE CARE UNIT

Calculation and analysis of incidences per patient-days and per admissions include only the ICU-associated BSI with matching ICU-denominator data. In 2020, 1,958 ICU-associated BSI were registered in the surveillance of which 1,612 (82%) had matching ICU-denominator data. To calculate HABSI 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. In total we had ICU-associated BSI data with matching ICU-denominator data for 433 quarters.

3.1.2.1 INTENSIVE CARE UNIT-ASSOCIATED BLOODSTREAM INFECTIONS, 2013-2020

The incidence of ICU-associated BSI in Belgium at national level did not change much between 2013 and 2019 but increased clearly from 2019 to 2020 (Table 6 and Figure 12). As previous years, regional data for 2020 shows the highest incidence in Brussels and the lowest in Flanders.

At national and regional level, there is no trend in the incidence of ICU-associated BSI per 10,000 patient-days between 2013 and 2019 and an increase from 2019 to 2020 (Figure 12). Comparing 2013 with 2019, none of the change in incidence per 10,000 patient-days at national or regional level was statistically significant. Comparing 2019 with 2020, all observed increases are statistically significant. In Belgium the incidence of ICU-associated BSI per 10,000 patient-days increased from 32.4 in 2019 to 50.0 in 2020 (incidence rate ratio 1.43 with 95% CI [1.26-1.62]). For Brussels we observed an increase from 39.8 in 2019 to 75.0 in 2020 (incidence rate ratio 1.75 with 95% CI [1.33-2.30), for Flanders this was 29.2 in 2019 and 40.7 in 2020 (incidence rate ratio 1.27 with 95% CI [1.06-1.52]) and for Wallonia 32.1 in 2019 and 51.9 in 2020 (incidence rate ratio 1.60 with 95% CI [1.32-1.96]) (Figure 12).

Table 6: Incidence of intensive care unit-associated bloodstream infections, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N hospitals included in calculation of incidence*	55	62	67	67	77	96	92	89
N ICU-associated BSI	692	776	792	850	799	1,264	1,248	1,612
Cumulative incidence per 1,000 admissions								
mean**	14.3	14.1	13.6	14.8	13.9	15.5	16.4	27.6
median***	13.6	11.5	10.8	12.2	11.7	12.3	15.1	22.5
Incidence density per 10,000 patient-days								
mean**	32.2	31.8	29.9	31.9	29.5	31.1	32.4	50.0
median***	24.3	23.5	23.1	25.1	25.1	25.2	27.4	40.2

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

Notes:

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

** Total ICU-associated BSI/total denominator

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

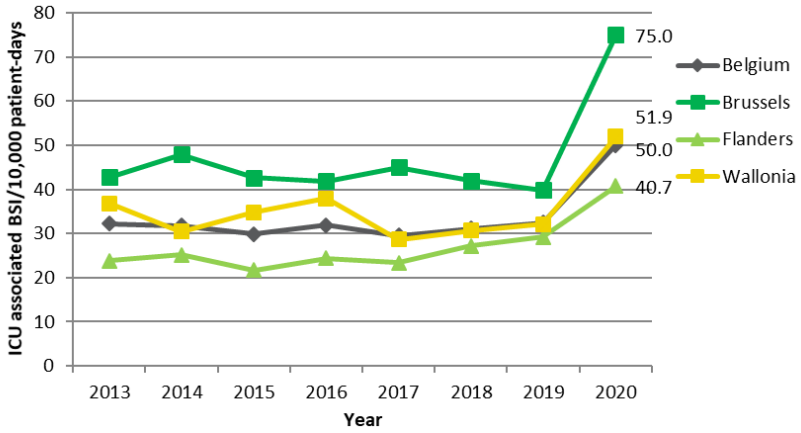


Figure 12: Mean incidence of intensive care unit-associated bloodstream infections, by region, Belgium 2013-2020 (BSI, bloodstream infections; ICU, intensive care unit)

In 2020, the median number (IQR) of ICU-associated BSI was 3 (IQR 1-5) episodes per quarter.[23]

3.1.2.2 INTENSIVE CARE UNIT-ASSOCIATED CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS, 2013-2020

Each of the different CLABSI classifications in ICU is represented by a similar proportion of about 1/3 of the total ICU-associated CLABSI (Annex 7, Table 32).

Between 2013 and 2019, the total CLABSI incidence at ICU per 10,000 pd (three classifications together) shows no trend (Table 7 and Figure 13). Comparing 2013 with 2019, there is no statistically significant difference in the number of ICU-associated CLABSI (three classifications together) per 10,000 pd. However, the observed increase of this incidence from 11.6 in 2019 to 18.0 in 2020 is statistically significant (incidence rate ratio 1.47 with 95% CI [1.24-1.74]).

In 2020, the mean CLABSI incidence in ICU per 10,000 patient-days for the three classifications together was 18.0; almost seven times higher than the hospital-wide incidence.

Table 7: Mean incidence of central line-associated bloodstream infections in intensive care units according to classification, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Confirmed CLABSI								
N*	101	105	97	94	88	149	150	215
mean incidence per 10,000 pd	4.7	4.3	3.7	3.5	3.3	3.7	3.9	6.7
Probable CLABSI								
N*	65	60	67	69	80	154	137	154
mean incidence per 10,000 pd	3.0	2.5	2.5	2.6	3.0	3.8	3.6	4.8
Possible CLABSI								
N*	111	96	90	98	86	157	159	212
mean incidence per 10,000 pd	5.2	3.9	3.4	3.7	3.2	3.9	4.1	6.6
Total CLABSI								
*N**	277	261	254	261	254	460	446	581
mean incidence per 10,000 pd	12.9	10.7	9.6	9.8	9.4	11.3	11.6	18.0

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

[23] Includes only those episodes for which a denominator is available.

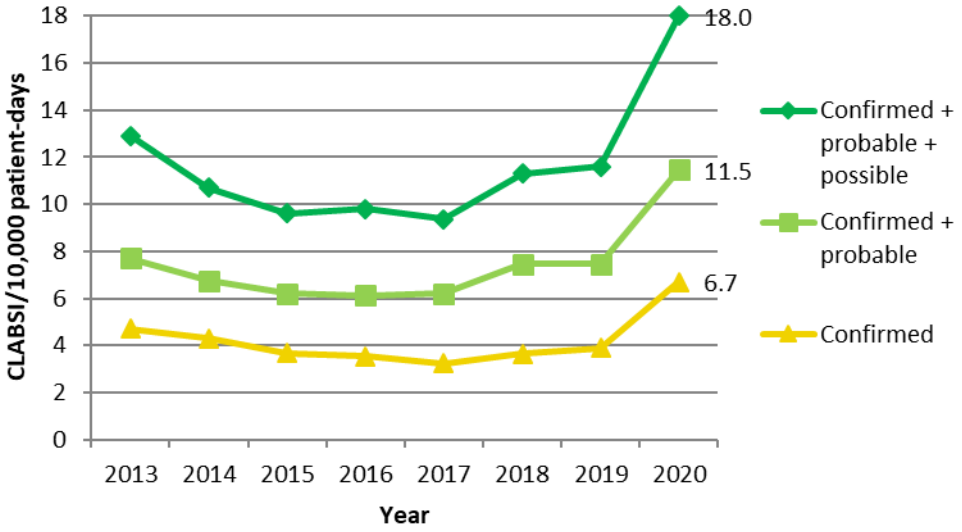


Figure 13: Mean incidence of central line-associated bloodstream infections (confirmed, probable, and possible) in intensive care units, Belgium 2013-2020 (CLABSI, central line-associated bloodstream infections)

In 2020, the median (IQR) number of ICU-associated CLABSI was 1 (0-2) episodes per quarter[24].

3.1.2.3 INCIDENCES OF INTENSIVE CARE UNIT-ASSOCIATED BLOODSTREAM INFECTIONS AT INTENSIVE CARE UNIT LEVEL, 2020

Similar to our observation at hospital-level, boxplots show variability in the reported incidence of ICU-associated BSI between regions and type of hospitals but also large in-group-variability of the reported incidence of ICU-associated BSI (Figure 14 and 15). However, the funnel plot shows less outliers than what we found at hospital-level (Figure 16).

We found that in 2020, 81 (19%) of the 433 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.

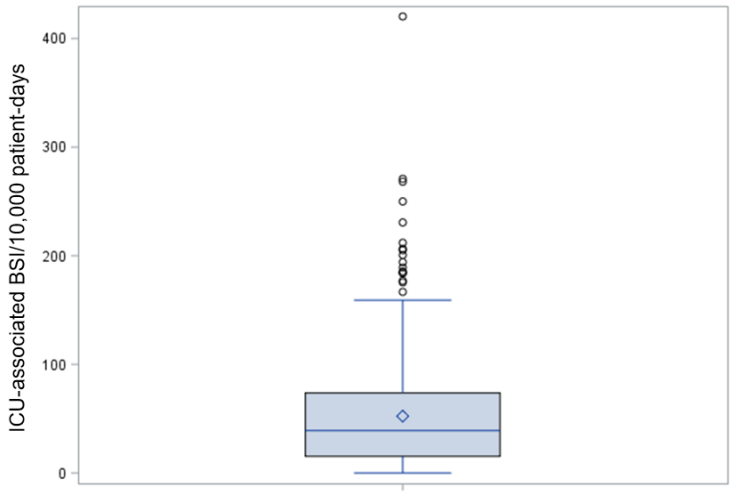


Figure 14: Intensive care unit-associated bloodstream infections: incidence distribution across intensive care units, Belgium 2020 (BSI, bloodstream infection; ICU, intensive care unit)

[24] Includes only those episodes for which a denominator is available.

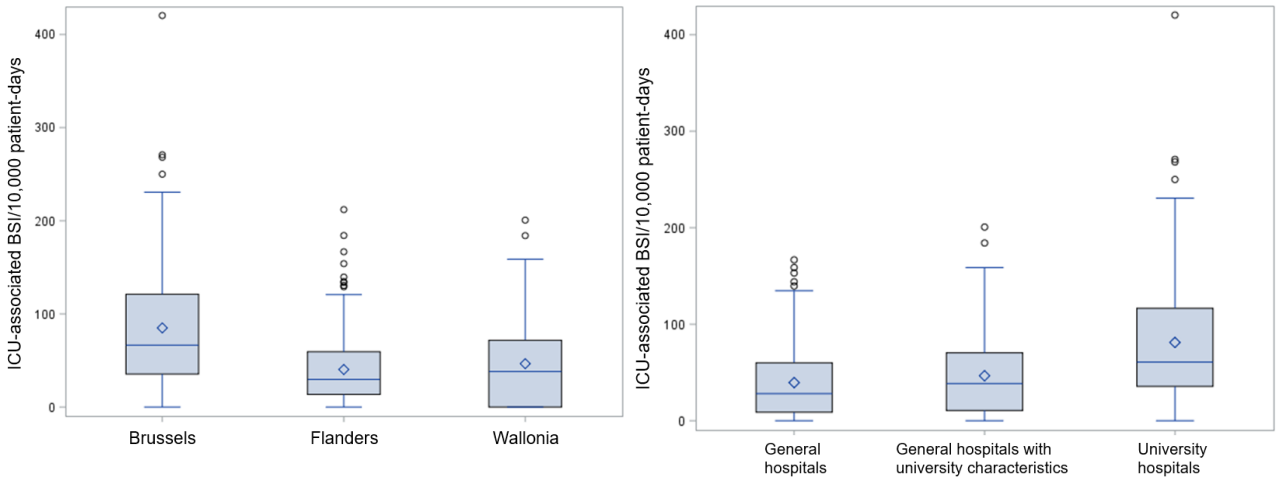


Figure 15: Intensive care unit-associated bloodstream infections: incidence distribution across hospitals, by region and by hospital type[25], Belgium 2020 (BSI, bloodstream infection; ICU, intensive care unit)

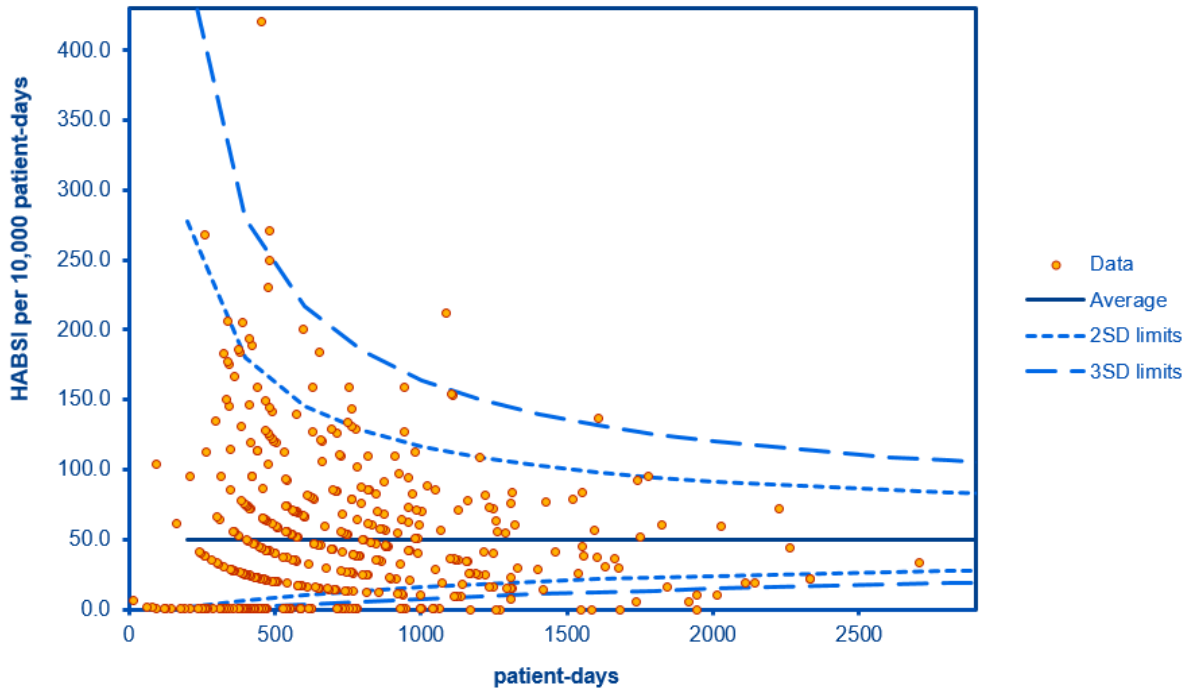


Figure 16: Variability in reported incidence of intensive care unit-associated bloodstream infections between hospitals, Belgium 2020 (BSI, bloodstream infection; ICU, intensive care unit; SD, standard deviation)

[25] 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 2020: Adressenlijst ziekenhuizen 12/2020 - Liste d'adresses des hôpitaux 12/2020.

3.2 CHARACTERISTICS OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTION, 2020

3.2.1 HOSPITAL-WIDE

In 2020, 97 hospitals registered together 8,818 BSI of which 7,138 were reported as HABSI. None of the 238 quarters with available denominator data had zero episode of HABSI reported.

3.2.1.1 DEPARTMENT WHERE THE HOSPITAL-ASSOCIATED BLOODSTREAM INFECTION WAS DIAGNOSED

Thirty percent of all HABSI were diagnosed at ICU (Table 8). Of these ICU diagnosed BSI, 1,958 (92%) were ICU-associated BSI (see chapter 3.2.2 ICU findings).

In summer 2020, to assess the impact of the COVID-19 crisis, '*COVID-19 general department*' and '*COVID-19 ICU*' were introduced as possible departments where HABSI occurred. According to our findings only few HABSI occurred at these COVID-19 dedicated wards (Table 8). This clearly seems a problem of underreporting. Only 13 hospitals use the COVID-19 department registration codes. Probably other hospitals were not aware of the availability of these codes and encoded HABSI that occurred at a COVID-19 department at another department.

Table 8: Department of hospital-associated bloodstream infection diagnosis, Belgium 2020

Department	N	%
Medical department	1,698	24
Gastro-enterology	*471*	*7*
Cardiology	*230*	*3*
Pneumology	*173*	*2*
COVID-19 general department	*20*	*0*
Other	*804*	*11*
ICU*	2,132	30
COVID-19 ICU	*34*	*0*
Surgery	799	11
Geriatrics	962	13
Hemato-oncology	904	13
Paediatrics	71	1
Obstetrics/gynaecology	27	0
Other	545	8
Total	**7,138**	**100**

ICU, intensive care unit; N, number
* 'Diagnosed in ICU' is different than 'ICU-associated'

3.2.1.2 SOURCE OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS

Twenty five percent of HABSI were associated with a CL (Table 9, Figure 17). This was the main single suspected source of HABSI diagnosed at ICU, oncology and the paediatric department. At the other departments, being geriatrics, the medical department, obstetrics/gynaecology, and surgery, urinary tract infection was the main suspected source (Annex 8, Table 33). 58% of all CLABSI was ***not*** diagnosed in ICU.

Forty-five percent of the clinically suspected sources were confirmed (same MO found in blood culture(s) and suspected source). The proportion of confirmation varies by source (Table 9).

Table 9: Confirmed and non-confirmed sources of hospital-associated bloodstream infections, Belgium 2020

	Hospital-associated bloodstream infections					
	Confirmed		Non-confirmed		Total	
Source	**N**	**%**	**N**	**%**	**N**	**%**
CLABSI*	642	20	1,140	29	1,782	25
Urinary tract infection	1,141	36	234	6	1,375	19
with catheter	*483*		*110*		*593*	
Gastro-intestinal infection	222	7	668	17	890	12
Pulmonary infection	678	21	300	8	978	14
with endotracheal tube/cannula	*446*		*72*		*518*	
Surgical site infection	135	4	83	2	218	3
Peripheral and other catheter	80	3	137	3	217	3
Mucosal barrier injury	19	1	243	6	262	4
Invasive manipulation	31	1	63	2	94	1
Other secondary infection**	232	7	250	6	482	7
Unknown	0	0	840	21	840	12
Total	**3,180**	**100**	**3,958**	**100**	**7,138**	**100**

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

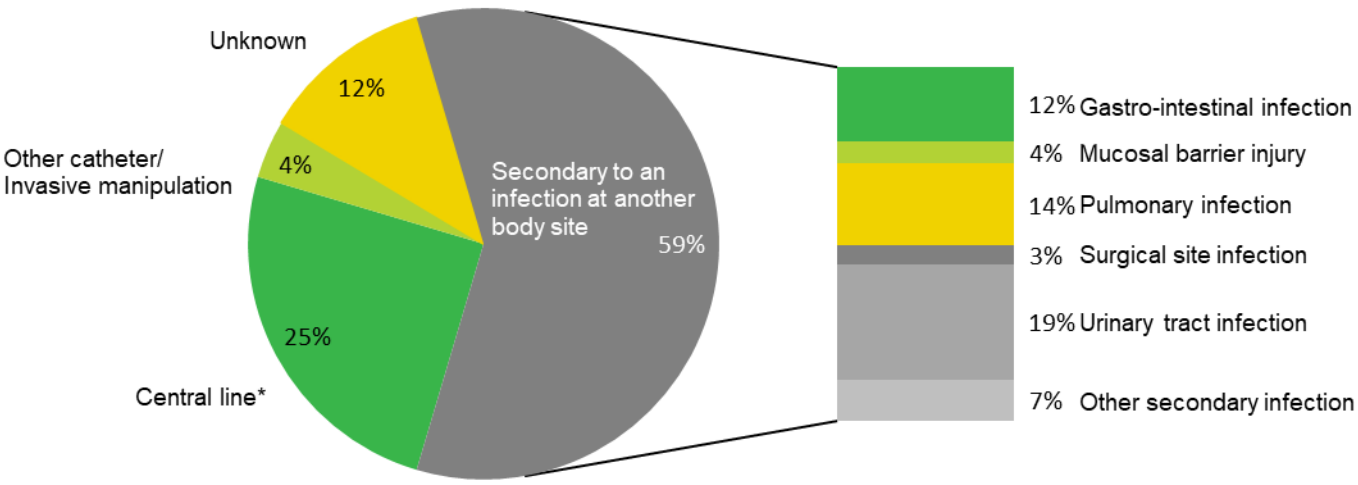


Figure 17: Sources of hospital-associated bloodstream infections, Belgium 2020 (* Includes 'confirmed', 'probable' and 'possible' central line-associated bloodstream infection)

Hospital-associated bloodstream infections associated with invasive devices

Forty four percent of all HABSI were infections associated directly or indirectly with an invasive devise among which 53% (1,651/3,110) were confirmed (Annex 9, Table 34).

Table 9 and 10 show that 593 (43%) of all HABSI with a urinary tract infection as source were catheter associated. Of these 593 cases, 483 cases (81%) were confirmed (same MO found in blood culture(s) and on device). Regarding HABSI with a pulmonary infections as suspected origin, 53% of these BSI were endotracheal tube associated of which 86% were confirmed.

In previous years the proportion of endotracheal tube associated HABSI with a pulmonary infections as suspected origin was always around 30%, so about 20% lower than what we found in 2020. This change might be due to COVID-19 causing the admission of patients with, compared to previous years, more severe pulmonary pathology.

Table 10: Hospital-associated bloodstream infections associated with invasive devices, Belgium 2020

	HABSI	
HABSI	**N**	**%**
CLABSI*	1,782	100
Confirmed (CRBSI)	642	36
Urinary tract infection	1,375	100
Urinary catheter present	593	43
Presence urinary catheter unknown	143	10
Urinary catheter as origin of HABSI is confirmed	483	35
Pulmonary infection	978	100
Endotracheal tube present	518	53
Presence endotracheal tube unknown	71	7
Endotracheal tube as origin of HABSI is confirmed	446	46
Peripheral and other catheter associated BSI	217	100
Confirmed	80	37

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

3.2.1.3 CLASSIFICATION OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS ACCORDING TO THE CASE DEFINITION

An overview of the BSI by case definition is given in Table 11.

Table 11: Bloodstream infections per case definition, Belgium 2020

Case definition	**HABSI N (%)**	**Non-HABSI N (%)**
At least one BC positive for a recognised pathogen	6,028 (84)	1,602 (95)
At least two different BC positive for the same pathogen belonging to the normal microbiota of the skin and clinical symptoms	1,069 (15)	76 (5)
Only one positive BC for a coagulase negative *Staphylococcus* (this applies only to neonatal cases)	41 (1)	2 (0.1)
Total BSI	**7,138 (100)**	**1,680 (100)**

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

3.2.1.4 TIME TO INFECTION

Median time to onset of HABSI was 13 days (IQR 6-24) after admission at the hospital.

3.2.1.5 PATIENTS' CHARACTERISTICS AND END-OF-FOLLOW-UP STATUS

Thirty eight percent of the HABSI occurred in women. The median age-group was the 70-74 years of age group (IQR 55-59 age group – 75-79 age group). The majority of the HABSI were caused by one MO; 9% of the infection episodes involved more than one MO.

The crude mortality for HABSI was 22% however, there was a substantial amount of missing data for status at end-of-follow-up (26% missing data) (Annex 10, Table 35). Our data do not allow determining a causal link between death and infection. This mortality data are very similar to the ones of previous years.

3.2.2 INTENSIVE CARE UNIT

In 2020, 1,958 (27%) of the total HABSI were ICU-associated BSI.

3.2.2.1 SOURCE OF INTENSIVE CARE UNIT-ASSOCIATED BLOODSTREAM INFECTIONS

In 2020, as in previous years, more than one third of the ICU-associated BSI were CL-associated infections. Compared to previous years, the proportion of pulmonary infections as source for ICU-associated BSI is about 10% higher (Figure 18).

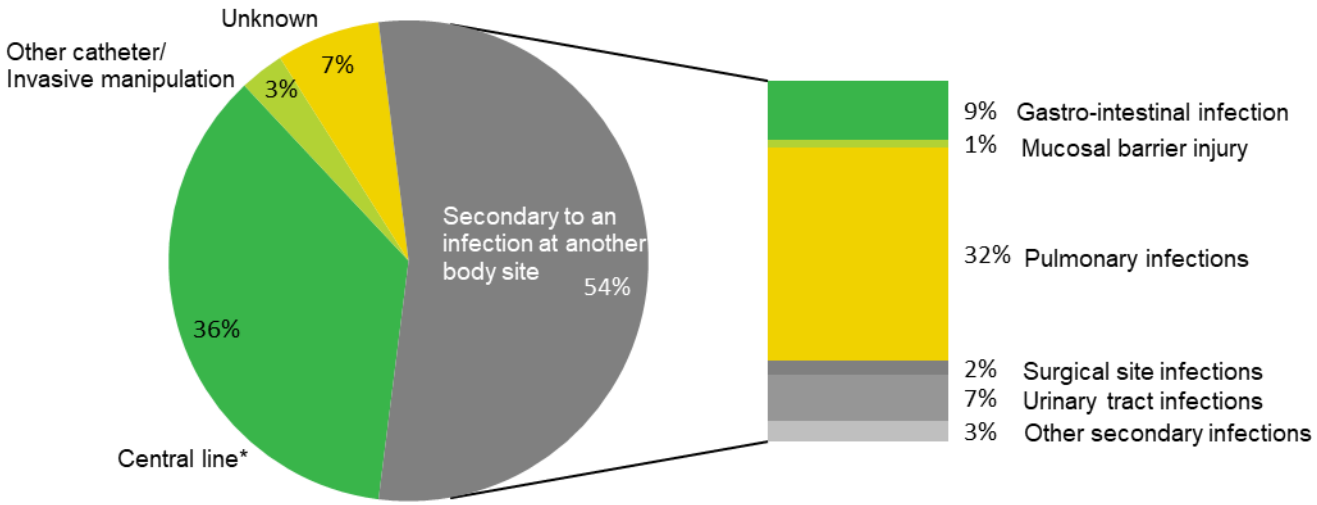


Figure 18: Sources of intensive care unit-associated bloodstream infections, Belgium 2020 (* Includes 'confirmed', 'probable' and 'possible' central line-associated bloodstream infections)

ICU-associated bloodstream infections associated with invasive devices

The proportion of ICU-associated BSI associated directly or indirectly with invasive devices is higher compared to the proportions of these kind of BSI found hospital-wide. In 2020, as mentioned above, 44% (3,115) of all hospital-wide HABSI were directly or indirectly associated with invasive devices compared to 69% (1,349) of all ICU-associated BSI (Table 12).

Table 12: Intensive care unit-associated bloodstream infections associated with invasive devices, Belgium 2020

ICU-associated BSI	ICU-associated BSI N	ICU-associated BSI %
CLABSI*	**712**	**100**
Confirmed (CRBSI)	247	35
Urinary tract infection	**135**	**100**
Urinary catheter present	105	78
Presence urinary catheter unknown	14	10
Urinary catheter as origin of HABSI is confirmed	92	68
Pulmonary infection	**626**	**100**
Endotracheal tube present	482	77
Presence endotracheal tube unknown	46	7
Endotracheal tube as origin of HABSI is confirmed	417	67
Peripheral and other catheter associated BSI	**50**	**100**
Confirmed	16	32

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

In 2020, 42% of CLABSI (all case definitions together) were diagnosed in ICU (Annex 8, Table 33).

3.2.2.2 TIME TO INFECTION

In 2020, ICU-associated BSI appeared with a median delay of 11 days (IQR 6-20 days) after admission at ICU.

3.2.2.3 PATIENTS' CHARACTERISTICS AND END-OF-FOLLOW-UP STATUS

Thirty three percent of patients with ICU-associated BSI died. However, status at end-of-follow-up was missing for 25% of the infection episodes. This is comparable with our findings regarding this indicator for previous years. Our data do not allow determining a causal link between death and infection.

3.3 IDENTIFIED CAUSAL MICROORGANISMS AND THEIR ANTIMICROBIAL RESISTANCE PROFILE, 2013-2020

3.3.1 HOSPITAL-WIDE

3.3.1.1 IDENTIFIED MICROORGANISMS, 2020

In 2020, 7,790 MO were identified as etiological agent for 7,138 HABSI, 1,897 MO for 1,782 CLABSI and 1,814 MO for 1,680 non-HABSI (Table 13). Table 13 gives the data for the MO that caused at least 50 in the surveillance registered HABSI episodes in 2020 (for data on MO with less than 50 episodes see Annex 11, Table 36). *Enterobacteriaceae* and Gram-positive cocci were the most frequently isolated MO-families.

In summer 2020 the SNOMED code for SARS-CoV-2 '*840533007 - Severe acute respiratory syndrome coronavirus 2*' was added. In 2020, no SARS-CoV-2 related BSI were reported in the surveillance.

The most frequent found MO by source are given in Annex 12, Table 37 and were:

- *E. coli* in BSI secondary to urinary tract (47%), gastro-intestinal (29%) infection, MBI (27%) and surgical site (22%) infection,
- *S. epidermidis* in CLABSI (27%),
- *S. aureus* in BSI with as source a peripheral or other catheter or invasive manipulation (22%), and
- *K. pneumoniae* in BSI secondary to pulmonary infection (15%).

Table 13: Microorganisms isolated from bloodstream infections, Belgium 2020

	HABSI		CLABSI		Non-HABSI	
Microorganisms	**N**	**%**	**N**	**%**	**N**	**%**
Enterobacteriaceae	**3,316**	**43**	**352**	**19**	**971**	**54**
Escherichia coli	1,512	19	71	4	687	38
Klebsiella pneumoniae	649	8	110	6	117	6
Enterobacter cloacae	257	3	41	2	21	1
Klebsiella oxytoca	159	2	26	1	19	1
Proteus mirabilis	137	2	14	1	44	2
Serratia marcescens	132	2	25	1	13	1
Klebsiella aerogenes	99	1	15	1	4	0
Morganella morganii	65	1	7	0	5	0
Citrobacter koseri	51	1	3	0	7	0
Other/not identified*	255	3	40	2	54	3
Gram-positive cocci	**3,126**	**40**	**1,218**	**64**	**632**	**35**
Staphylococcus aureus	788	10	186	10	209	12
Staphylococcus epidermidis	745	10	518	27	47	3
Enterococcus faecium	512	7	144	8	31	2
Enterococcus faecalis	402	5	108	6	62	3
Staphylococcus hominis	115	1	88	5	24	1
Staphylococcus haemolyticus	79	1	56	3	5	0
Staphylococcus, coagulase negative (others or not specified)	57	1	37	2	3	0
Other/not identified*	428	5	81	4	251	14
Non-fermenting Gram-negative bacilli	**631**	**8**	**118**	**6**	**87**	**5**
Pseudomonas aeruginosa	411	5	58	3	45	2
Genus *Acinetobacter* (others or not specified)	59	1	18	1	1	0
Other/not identified*	161	2	42	2	41	2
Fungi	**424**	**5**	**176**	**9**	**13**	**1**
Candida albicans	219	3	95	5	6	0
Candida glabrata	92	1	32	2	5	0
Other/not identified*	113	1	49	3	2	0
Anaerobic bacilli	**214**	**3**	**14**	**1**	**85**	**5**
Bacteroides fragilis	71	1	2	0	26	1
Other/not identified*	143	2	12	1	59	3
Gram-positive bacilli	**39**	**1**	**13**	**1**	**10**	**1**
Gram-negative cocci	**20**	**0**	**1**	**0**	**10**	**1**
Other and not identified	**20**	**0**	**5**	**0**	**6**	**0**
Total	**7,790**	**100**	**1,897**	**100**	**1,814**	**100**

BSI, bloodstream infection; HABSI, hospital-associated bloodstream infection; n, number

Note:

* Other includes microorganisms causing among the HABSI reported in the 2020 surveillance <50 episodes of HABSI/year

3.3.1.2 TRENDS IN ANTIMICROBIAL RESISTANCE FOR SELECTED MICROORGANISMS AND SELECTED ANTIBIOTICS, 2013-2020

In line with ECDC recommendations, for a set of selected MO and selected antibiotics(markers) resistance to these antibiotics(markers) was tested (9, 10).

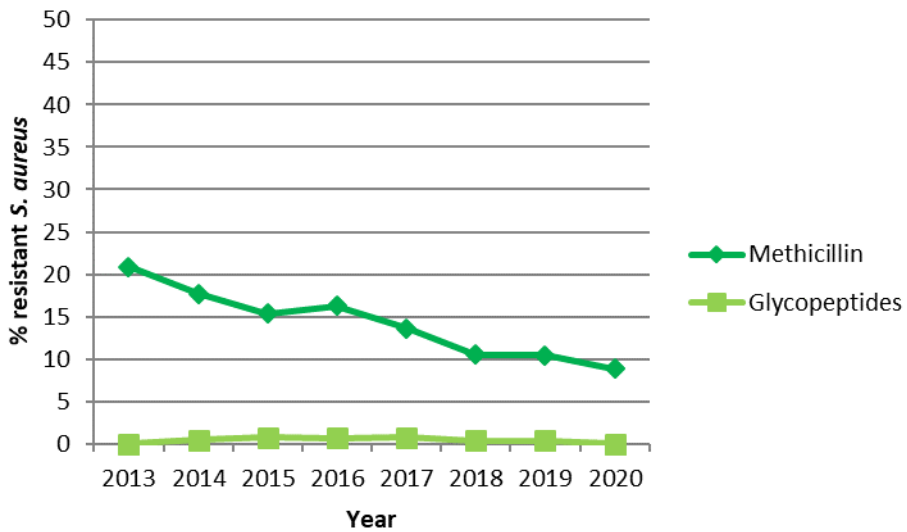
Tables 14 to 19 give for *S. aureus, E. coli, K. pneumoniae, E. cloacae, P. aeruginosa*, and *E. faecium*, the number and proportion of resistant MO isolated from HABSI, the mean incidence of HABSI with a resistant MO per 10,000 patient-days and the number and proportion of hospitals in which at least one HABSI with a resistant MO was identified, from 2013 till 2020.

More hospitals reported at least one HABSI with a third generation cephalosporin resistant *E. coli, K. pneumoniae* or *E. cloacae* strain than with a methicillin resistant *S. aureus.*

1. Staphylococcus aureus

Table 14: Antimicrobial resistance in* S. aureus *strains isolated from hospital-associated bloodstream infections, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N strains	681	813	964	893	890	971	813	788
N hospitals**	87	96	103	103	102	101	98	97
Methicillin								
nR	142	144	148	145	121	102	85	70
%R	20.9	17.7	15.4	16.2	13.6	10.5	10.5	8.9
Mean incidence per 10,000 pd*	0.20	0.17	0.15	0.14	0.14	0.11	0.10	0.10
Hospitals with ≥ one R case	54	58	64	61	50	52	47	38
% hospitals with ≥ one R case	62	60	62	59	49	51	48	39
Glycopeptides (vancomycin, teicoplanin)								
nR	0	4	7	6	7	4	3	0
%R	0.0	0.5	0.7	0.7	0.8	0.4	0.4	0.00
Mean incidence per 10,000 pd*	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Hospitals with ≥ one R case	0	3	7	6	6	3	2	0
% hospitals with ≥ one R case	0	3	7	6	6	3	2	0



N, total number; nR, number resistant MO; pd, patient-days; R, resistant

Notes:

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

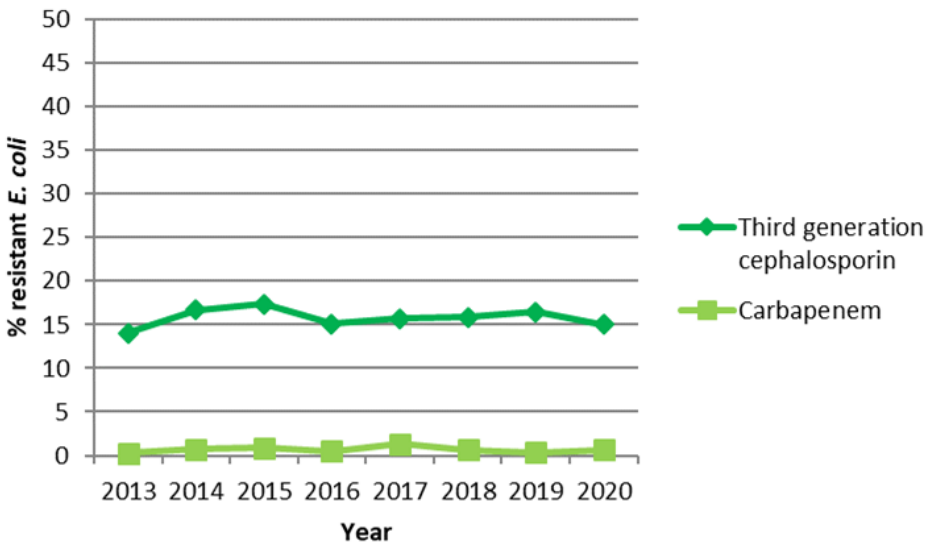
** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

The decrease in proportion of methicillin resistant *S. aureus* (MRSA) (p<0.0001) and in the incidence of HABSI with a MRSA per 10,000 pd (2020 compared to 2013, incidence rate ratio 0.49 with 95% CI [0.35-0.67]) are both statistically significant. Changes in the proportion (p=0.52) and incidence of HABSI with a *S. aureus* resistant to glycopeptides are not statistically significant.

2. *Escherichia coli*

Table 15: Antimicrobial resistance in* E. coli *strains isolated from hospital-associated bloodstream infections, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N strains	1,339	1,593	1,776	1,873	1,926	1,893	1,637	1,512
N hospitals**	87	96	103	103	102	101	98	97
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)								
nR	188	266	308	282	303	300	269	227
%R	14.0	16.7	17.3	15.1	15.7	15.8	16.4	15.0
Mean incidence per 10,000 pd*	0.26	0.31	0.32	0.28	0.32	0.32	0.31	0.32
Hospitals with ≥ one R case	61	68	74	75	71	76	70	64
% hospitals with ≥ one R case	70	71	72	73	70	75	71	66
Carbapenems (imipenem, meropenem)								
nR	4	11	16	9	26	12	6	10
%R	0.3	0.7	0.9	0.5	1.3	0.6	0.4	0.7
Mean incidence per 10,000 pd*	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Hospitals with ≥ one R case	4	10	12	8	11	12	6	9
% hospitals with ≥ one R case	5	10	12	8	11	12	6	9



N, total number; nR, number resistant MO; pd, patient-days; R, resistant

Notes:

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

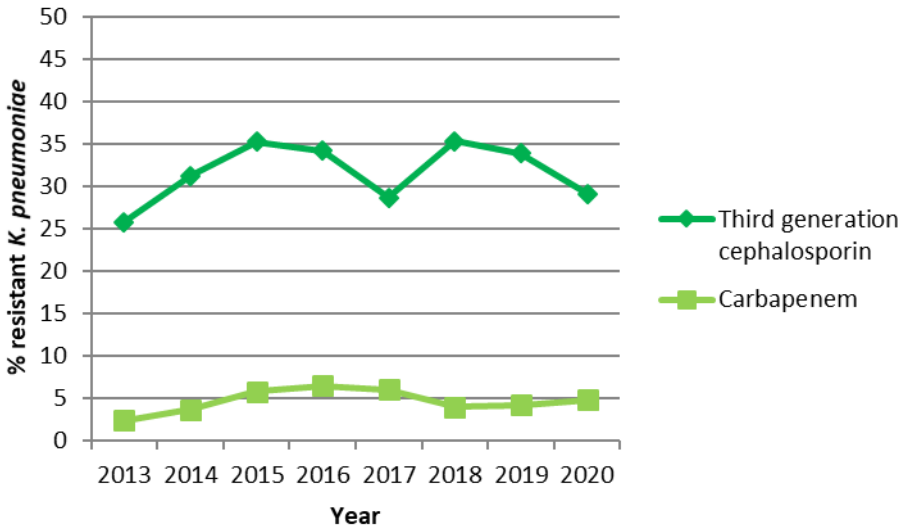
** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

Changes in proportion of *E. coli* resistant to third generation cephalosporins (p=0.96) and to carbapenems (p=0.81) are not statistically significant. Comparing 2020 with 2013, there is no statistically significant change in the incidence of HABSI with an *E. coli* resistant to third generation cephalosporins or carbapenems per 10,000 pd.

3. *Klebsiella pneumoniae*

Table 16: Antimicrobial resistance in* K. pneumoniae *strains isolated from hospital-associated bloodstream infections, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N strains	380	513	585	682	667	737	644	649
N hospitals**	87	96	103	103	102	101	98	97
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)								
nR	98	160	206	233	191	260	218	189
%R	25.8	31.2	35.2	34.2	28.6	35.3	33.9	29.1
Mean incidence per 10,000 pd*	0.14	0.19	0.21	0.23	0.19	0.27	0.25	0.27
Hospitals with ≥ one R case	38	51	56	61	61	63	55	52
% hospitals with ≥ one R case	44	53	54	59	60	62	56	54
Carbapenems (imipenem, meropenem)								
nR	9	19	34	44	40	29	27	31
%R	2.4	3.7	5.8	6.5	6.0	3.9	4.2	4.8
Mean incidence per 10,000 pd*	0.01	0.02	0.03	0.04	0.04	0.03	0.03	0.05
Hospitals with ≥ one R case	9	11	18	22	24	17	17	17
% hospitals with ≥ one R case	10	11	17	21	24	17	17	18



N, total number; nR, number resistant MO; pd, patient-days; R, resistant

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.

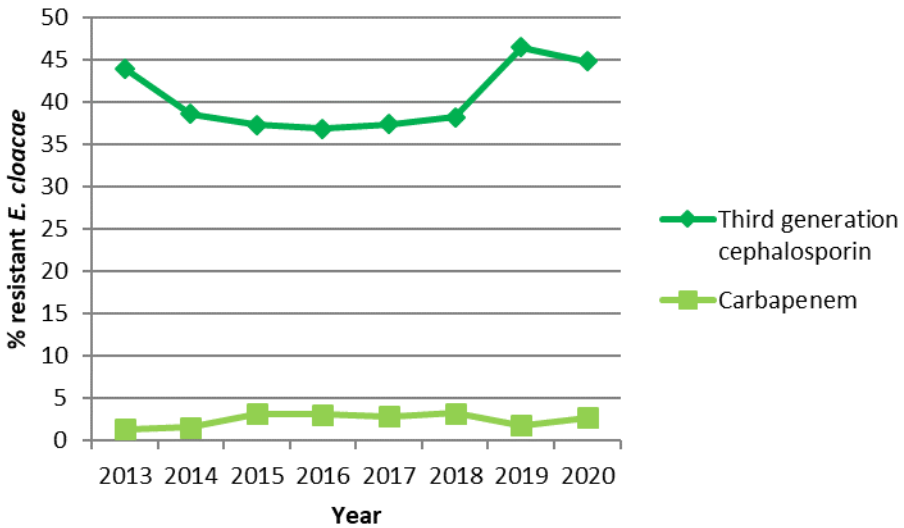
Changes in the incidence of HABSI with *K. pneumoniae* resistant to third generation cephalosporins per 10,000 pd (2020 compared to 2013, incidence rate ratio 2.00 with 95% CI [1.45-2.75]) are statistically significant.

Changes in proportion of *K. pneumoniae* resistant to third generation cephalosporins (p=0.17) and to carbapenems (p=0.47) and in incidence of HABSI with *K. pneumoniae* resistant to carbapenems per 10,000 pd (2013 compared to 2020) are not statistically significant.

4. *Enterobacter cloacae*

Table 17: Antimicrobial resistance in* E. cloacae *strains isolated from hospital-associated bloodstream infections, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N strains	223	249	311	323	316	306	280	257
N hospitals**	87	96	103	103	102	101	98	97
Third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime)								
nR	98	96	116	119	118	117	130	115
%R	43.9	38.6	37.3	36.8	37.3	38.2	46.4	44.7
Mean incidence per 10,000 pd*	0.14	0.11	0.12	0.12	0.12	0.12	0.15	0.15
Hospitals with ≥ one R case	41	40	52	54	53	48	46	40
% hospitals with ≥ one R case	47	42	50	52	52	48	47	41
Carbapenems (imipenem, meropenem)								
nR	3	4	10	10	9	10	5	7
%R	1.3	1.6	3.2	3.1	2.8	3.3	1.8	2.7
Mean incidence per 10,000 pd*	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Hospitals with ≥ one R case	3	4	9	8	7	10	3	5
% hospitals with ≥ one R case	3	4	9	8	7	10	3	5



N, total number; nR, number resistant MO; pd, patient-days; R, resistant

Notes:

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

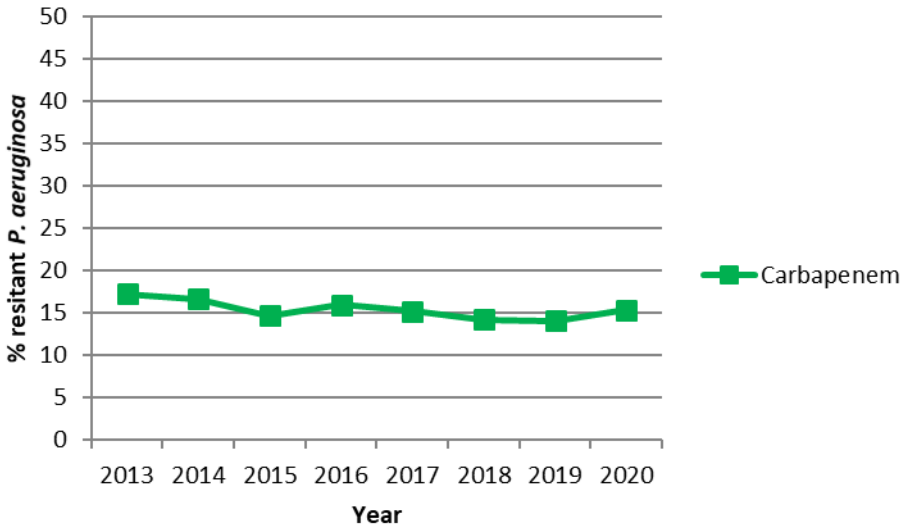
** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

None of the changes in the proportion of *E. cloacae* resistant to third generation cephalosporins (p=0.16) or to carbapenems (p=0.50) and in the incidence of HABSI with *E. cloacae* resistant to third generation cephalosporins or carbapenems per 10,000 pd (2020 compared to 2013) are found to be statistically significant.

5. *Pseudomonas aeruginosa*

Table 18: Antimicrobial resistance in* P. aeruginosa *strains isolated from hospital-associated bloodstream infections, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N strains	319	396	401	395	421	443	384	411
N hospitals**	87	96	103	103	102	101	98	97
Carbapenems (imipenem, meropenem)								
nR	55	66	59	63	64	63	54	63
%R	17.2	16.7	14.7	15.9	15.2	14.2	14.1	15.3
Mean incidence per 10,000 pd*	0.08	0.08	0.06	0.06	0.06	0.07	0.06	0.09
Hospitals with ≥ one R case	27	39	36	33	30	32	21	30
% hospitals with ≥ one R case	31	41	35	32	29	32	21	31



N, total number; nR, number resistant MO; pd, patient-days; R, resistant

Notes:

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

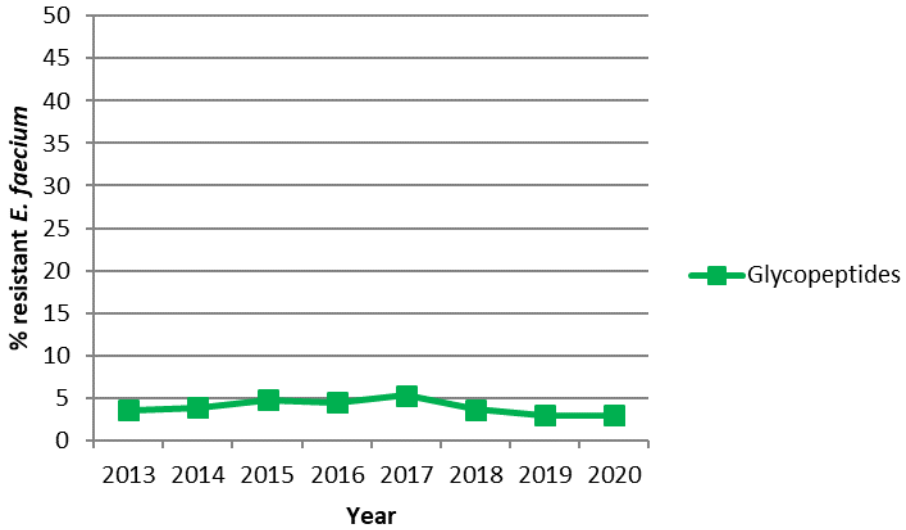
** Hospitals participate 1, 2, 3 or 4 quarters. Specialised hospitals not included.

Since 2013, neither changes in the proportion of *P. aeruginosa* resistant to carbapenems (p=0.23) nor in the incidence of HABSI with *P. aeruginosa* resistant to carbapenems per 10,000 pd are found to be statistically significant.

6. *Enterococcus faecium*

Table 19: Antimicrobial resistance in* E. faecium *strains isolated from hospital-associated bloodstream infections, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
N strains	197	285	377	357	454	496	480	512
N hospitals**	87	96	103	103	102	101	98	97
Glycopeptides (vancomycin, teicoplanin)								
nR	7	11	18	16	24	18	14	15
%R	3.6	3.9	4.8	4.5	5.3	3.6	2.9	2.9
Mean incidence per 10,000 pd*	0.01	0.01	0.02	0.02	0.03	0.02	0.02	0.02
Hospitals with ≥ one R case	5	10	14	10	14	13	8	13
% hospitals with ≥ one R case	6	10	14	10	14	13	8	13



N, total number; nR, number resistant MO; pd, patient-days; R, resistant

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.

Changes in the proportion of *E. faecium* resistant to glycopeptides (p=0.19) and in the incidence of HABSI with *E. faecium* resistant to glycopeptides per 10,000 pd (2020 compared to 2013) are not statistically significant.

Additional data on MO isolated from the HABSI and their resistance profile are given in Annex 13 Table 38, 39 and 40. We found that compared to HABSI, and for most MO, resistance is lower in BSI when acquired outside the hospital (defined as non-HABSI) (Annex 13, Table 40). However, because of the low numbers for some of the MO for BSI acquired outside the hospital this finding has to be considered with care.

3.3.1.3 ANTIMICROBIAL RESISTANCE BY REGION, 2020

Table 20 gives for each region for the set of selected MO and selected antibiotics(markers), the number and proportion of resistant MO isolated from HABSI in 2020. Across the three regions, for most of the tested resistance patterns, more or less the same resistance proportions are found. Due to the small sample size, we should also be caution to interpret and formulate conclusions based on the identified differences in resistance patterns.

For *S. aureus, E. coli*, *K. pneumoniae*, *E. cloacae* and *P. aeruginosa* which have larger sample sizes, we further explored statistically significance in the regional differences identified with following outcomes:

- There is no statistically significant difference for the proportion of MRSA in HABSI when comparing the three regions.
- The proportion of *E. coli* resistance to third generation cephalosporins is statistically significant higher in Brussels (p=0.001) compared with the proportion in Flanders. There is no statistically significant difference for these proportions when comparing Brussels with Wallonia (p=0.09) and Flanders with Wallonia (p=0.24).
- The proportion of *K. pneumoniae* resistance to third generation cephalosporins is statistically significant lower in Flanders compared with the proportion in Wallonia (p<0.001) and in Brussels (p=0.03) and statistically significant lower in Brussels compared with the proportion in Wallonia (p=0.01).
- There is no statistically significant difference in the proportion of *E. cloacae* resistance to third generation cephalosporins when comparing the three regions.
- There is no statistically significant difference in the proportion of *P. aeruginosa* resistance to carbapenems when comparing the three regions.

The number and proportion per region for the set of selected MO resistant to selected antibiotics(markers) from non-HABSI and the number and proportion of hospitals with at least one case of a BSI with a resistant MO are given in Annex 14, Table 41 and 42.

Table 20: Resistance in microorganisms isolated from hospital-associated bloodstream infections by region, Belgium 2020

		Brussels			Flanders			Wallonia		
Microorganisms	**Antibiotics**	**N**	**n**	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Gram-positive cocci										
S. aureus	Meti	156	11	7.1	425	35	8.2	207	24	11.6
	Gly	156	0	0.0	425	0	0.0	207	0	0.0
All Enterococcus spp.	Gly	221	3	1.4	474	12	2.5	234	8	3.4
E. faecalis	Gly	102	1	1.0	196	3	1.5	104	1	1.0
E. faecium	Gly	118	2	1.7	272	8	2.9	122	5	4.1
Enterobacteriaceae	C3G	863	188	21.8	1,595	320	20.1	858	210	24.5
	CAR	863	26	3.0	1,595	20	1.3	858	24	2.8
E. coli	C3G	361	68	18.8	786	102	13.0	365	57	15.6
	CAR	361	4	1.1	786	4	0.5	365	2	0.5
K. pneumoniae	C3G	195	60	30.8	259	57	22.0	195	72	36.9
	CAR	195	12	6.2	259	5	1.9	195	14	7.2
E. cloacae	C3G	87	30	34.5	98	50	51.0	72	35	48.6
	CAR	87	5	5.7	98	1	1.0	72	1	1.4
P. mirabilis	C3G	29	0	0.0	79	1	1.3	29	0	0.0
	CAR	29	0	0.0	79	0	0.0	29	0	0.0
K. oxytoca	C3G	37	5	13.5	89	18	20.2	33	7	21.2
	CAR	37	0	0.0	89	2	2.2	33	0	0.0
K. aerogenes	C3G	33	10	30.3	42	22	52.4	24	9	37.5
	CAR	33	2	6.1	42	0	0.0	24	0	0.0
Serratia spp.	C3G	39	4	10.3	62	22	35.5	36	17	47.2
	CAR	39	1	2.6	62	1	1.6	36	5	13.9
Non-fermenting Gram-negative bacilli										
P. aeruginosa	CAR	115	22	19.1	172	26	15.1	124	15	12.1
A. baumannii	CAR	8	0	0.0	11	0	0.0	8	0	0.0
Acinetobacter spp.	CAR	18	0	0.0	56	0	0.0	24	0	0.0

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 resistant MO; R, resistant; spp., species; %, percent resistant MO

The proportion MRSA and the proportion of third generation cephalosporins resistant *E. coli* and *K. pneumoniae* strains isolated from HABSI by province is given in the three maps below (Figure 19 to 21)[26].

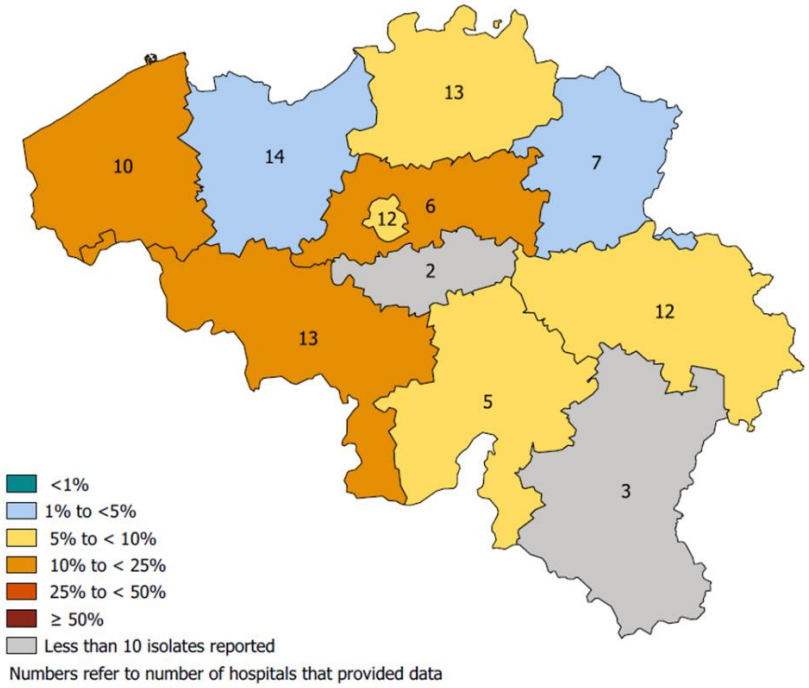


Figure 19: Percent of methicillin resistant* S. aureus *strains isolated from hospital-associated bloodstream infections, by province, Belgium 2020

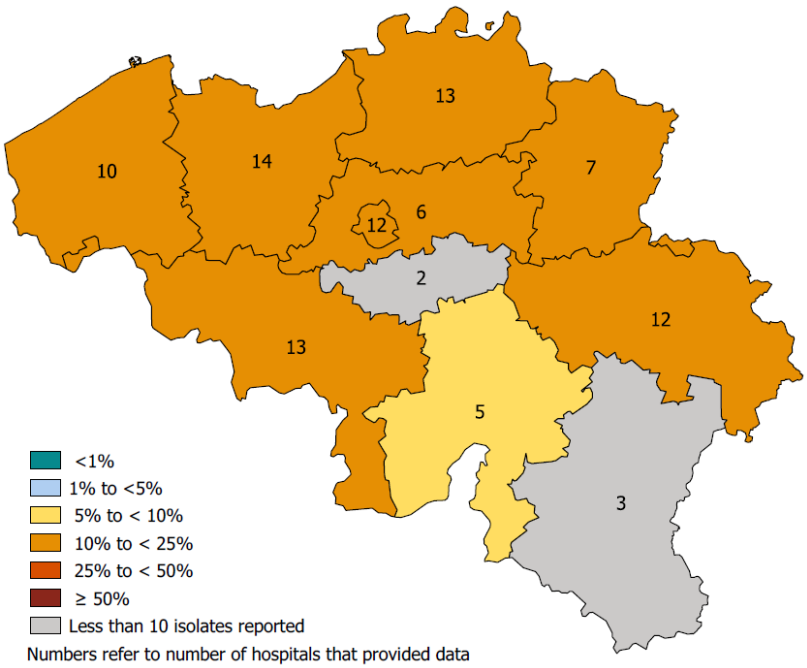


Figure 20: Percent of* E. coli *strains resistant to third generation cephalosporins isolated from hospital-associated bloodstream infections, by province, Belgium 2020

[26] The colour scale used in the maps is similar to those used by ECDC. See e.g. ECDC report: '*Surveillance of antimicrobial resistance in Europe. Annual report of the European Antimicrobial Resistance Surveillance Network (EARS-Net). 2019*.'

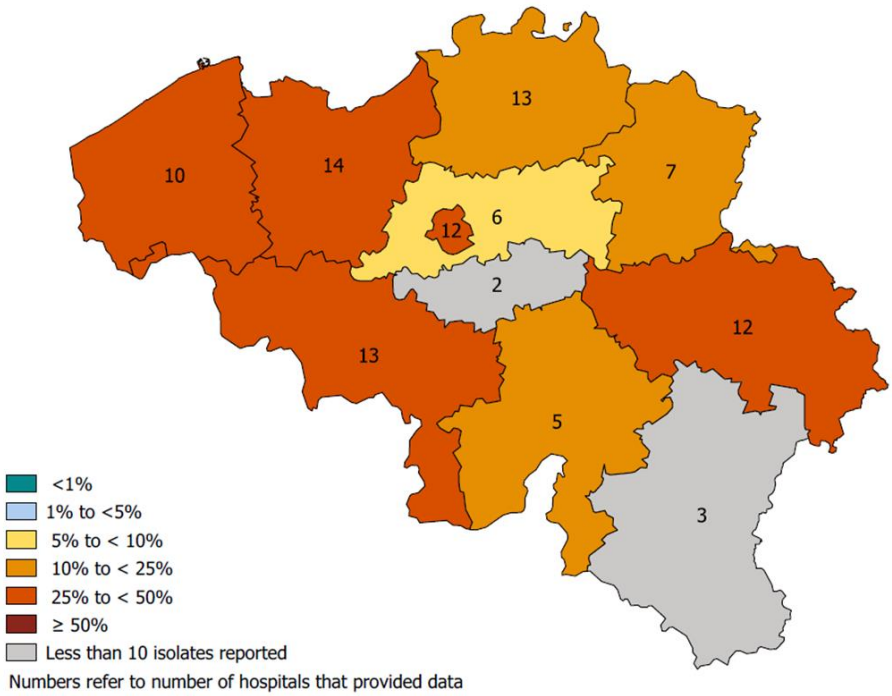


Figure 21: Percent of* K. pneumoniae *strains resistant to third generation cephalosporins isolated from hospital-associated bloodstream infections, by province, Belgium 2020

3.3.2 INTENSIVE CARE UNIT

3.3.2.1 IDENTIFIED MICROORGANISMS, 2020

A total of 2,143 MO were identified as etiological agent for 1,958 ICU-associated BSI (Table 21). *K. pneumonia*, *S. epidermidis* and *E. coli* and were the most frequent identified MO.

Table 21: Microorganisms isolated from intensive care unit-associated bloodstream infections, Belgium 2020

	ICU-associated BSI	
Microorganisms	**n**	**%**
Enterobacteriaceae	786	37
Klebsiella pneumoniae	207	10
Escherichia coli	197	9
Enterobacter cloacae	78	4
Serratia marcescens	63	3
Klebsiella aerogenes	51	2
Klebsiella oxytoca	46	2
Proteus mirabilis	25	1
Other/not identified*	119	6
Gram-positive cocci	919	43
Staphylococcus epidermidis	242	11
Staphylococcus aureus	186	9
Enterococcus faecium	180	8
Enterococcus faecalis	147	7
Staphylococcus hominis	33	2
Staphylococcus, coagulase negative (others or not specified)	25	1
Other/not identified*	106	5
Non-fermenting Gram-negative bacilli	223	10
Pseudomonas aeruginosa	173	8
Other/not identified*	50	2
Fungi	147	7
Candida albicans	82	4
Candida glabrata	35	2
Other/not identified*	30	1
Anaerobic bacilli	52	2
Gram-positive bacilli	11	1
Gram-negative cocci	4	0
Other and not identified	1	0
Total	**2,143**	**100**

BSI, bloodstream infection; n, number

Note:

* Other includes microorganisms causing <25 episodes of ICU-associated BSI/year

3.3.2.2 ANTIMICROBIAL RESISTANCE DATA FOR SELECTED MICROORGANISMS AND SELECTED ANTIBIOTICS, 2020

For a set of selected MO and selected antibiotics(markers) (9, 10), number and proportion of resistant MO among the MO isolated from the ICU-associated BSI are given in Table 22. The proportions of resistant strains isolated from the ICU-associated BSI are similar to the proportions found hospital-wide.

Table 22: Resistance in microorganisms isolated from ICU-associated bloodstream infections, Belgium 2020

		Microorganisms			ICUs with >= one resistant case of ICU-associated BSI*- N=228	
	Antibiotics	N	n	%	n	%
Gram-positive cocci						
S. aureus	Meti	186	15	8	14	6
	Gly	186	0	0	0	0
All Enterococcus spp.	Gly	331	9	3	8	4
E. faecalis	Gly	147	0	0	0	0
E. faecium	Gly	180	8	4	8	4
Enterobacteriacea	C3G	786	213	27	99	43
	CAR	786	27	3	20	9
E. coli	C3G	197	40	20	28	12
	CAR	197	3	2	3	1
K. pneumoniae	C3G	207	76	37	45	20
	CAR	207	15	7	10	4
E. cloacae	C3G	78	32	41	28	12
	CAR	78	2	3	2	1
P. mirabilis	C3G	25	0	0	0	0
	CAR	25	0	0	0	0
K. oxytoca	C3G	46	4	9	3	1
	CAR	46	1	2	1	0
K. aerogenes	C3G	51	20	39	19	8
	CAR	51	0	0	0	0
Serratia spp.	C3G	65	20	31	14	6
	CAR	65	3	5	1	0
Non-fermenting Gram-negative bacilli						
P. aeruginosa	CAR	173	39	23	30	13
A. baumannii	CAR	9	0	0	0	0
Acinetobacter spp.	CAR	11	0	0	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 or total number of ICUs; n, number resistant MO or number of ICUs; spp., species; %, percent resistant MO

Notes:

* ICUs participate 1, 2, 3 or 4 quarters

4 Comparison between different sources of Belgian data

4.1 MINIMUM HOSPITAL DATA (MINIMALE ZIEKENHUISGEGEVENS/ RÉSUMÉ HOSPITALIER MINIMUM – MZG/RHM)

In Belgium, data of each hospital admission has to be reported at the Belgian federal public service for health, food chain safety and environment (MZG/RHM – 'minimale ziekenhuisgegevens'/'résumé hospitalier minimum'). Until 2014, for this reporting, diagnoses were coded using ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification), since 2016 ICD-10-CM (International Classification of Diseases, 10th Revision, Clinical Modification) is used (11). Due to transition from ICD-9-CM to ICD-10-CM coding, data on diagnosis is not available for 2015.

Data given in Figure 22 and Table 23 was provided by the Belgian federal public service for health, food chain safety and environment (Service public fédéral santé publique, securite de la chaine alimentaire et environnement/Federale overheidsdienst volksgezondheid, veiligheid van de voedselketen en leefmilieu) and includes all hospital admissions with the exception of day-care and ambulatory care at the emergency room (MZG/RHM field: A2/Veld 14 => A2_HOSPTYPE_FAC in H, F, M and L (12)).

We analysed hospital admission data with septicaemia and bacteraemia as diagnosis (ICD-9-CM code 038:0-9 and 790.7 and ICD-10-CM code A40:0-9, A41:0-9 and R78.81) from 2000 to 2019 (most recent available data) (11). For both diagnoses the main[27] (MZG/RHM field: M1/Veld 6 => TYPE_DIAGNOSE = P) and secondary[28] (MZG/RHM field: M1/Veld 6 => TYPE_DIAGNOSE = S) diagnosis were included and for both diagnosis we also looked at those labelled as 'not present on admission', a variable introduced in 2008 (MZG/RHM field: M1/Veld 9 => M1_PRESENT_ADM: code is N) (13). An infection 'not present on admission' is the exact definition of an healthcare associated or nosocomial infection[29]. This implies that the incidence of hospital admissions with ICD-9-CM and ICD-10-CM septicaemia and bacteraemia codes that are coded as 'not present on admission' should be comparable to the incidence of HABSI found using the Belgian BSI surveillance data.

MZG/RHM data is exhaustive and therefore, the number of episodes measures the burden of HABSI in Belgium.

MZG/RHM data shows that since 2000, compared to the number of BSI as secondary diagnosis, the number of total BSI per 1,000 admissions and per 10,000 patient-days increased more (Table 23 and Figure 22). For the number of BSI not present on admission per 1,000 admissions and per 10,000 patient-days (data only available since 2008) we notice

[27] The main diagnosis is defined as the condition that is identified after examination as the main cause for admission of the patient.
[28] Secondary diagnosis is defined as a condition that has an impact on the patientcare and that was present on admission or occurred after admission.
[29] Definition world health organisation of healthcare-associated infection, also referred to as 'nosocomial' or 'hospital' infection; an infection occurring in a patient during the process of care in a hospital or other health care facility which was not present or incubating at the time of admission.

a remarkable (and unexplained) decrease for 2013 and 2014. However, since 2016 data are again higher and more in line with data found before 2013 (Table 23 and Figure 22).

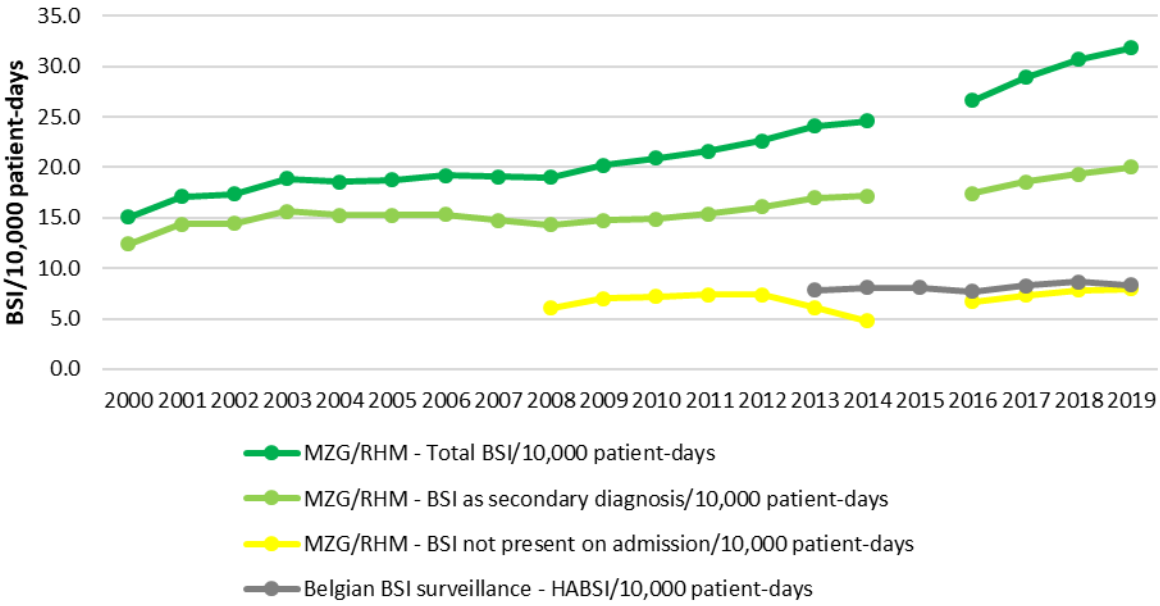


Figure 22: Incidence of bloodstream infections in Belgium, results from minimum hospital data (MZG/RHM) and Belgian bloodstream infection surveillance, 2000-2019 (BSI, bloodstream infection; HABSI, hospital-associated bloodstream infection)

Comparing the MZG/RHM incidences of BSI not present on admission per 1,000 admissions and per 10,000 patient-days with the incidences of HABSI per 1,000 admissions and per 10,000 patient-days found in the Belgium BSI surveillance, we found that incidences reported in the Belgium surveillance are higher than those reported in the MZG/RHM. However, in 2020 this difference became quite small (Table 23 and Figure 22). The lower reported incidence based on the MZG/RHM data is not exactly what we expect because, comparing the definition used in MZG/RHM (infection not present on admission) with the definition used in the Belgian BSI surveillance (infection occurring 2 days or more after admission) we would expect the opposite, meaning a higher incidence in the MZG/RHM reporting. In this context validation of data would be useful. However, for the most recent years, 2016 till 2019, for which we have data from both sources this difference in incidences is smaller than what we found in the previous years. Based on this finding it might be considered to further investigate if the objectives of the surveillance of bloodstream infections in Belgian hospitals cannot be answered by the data collected through MZG/RHM.

Table 23: Incidence of bloodstream infections in Belgium, results from minimum hospital data versus surveillance data, 2000-2019

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Minimum hospital data (minimale ziekenhuisgegevens/ résumé hospitalier minimum)																				
Total BSI[1] (n)	24,985	28,595	28,516	29,814	28,921	29,062	29,484	29,008	29,229	30,653	31,620	32,691	33,877	35,400	35,362		38,262	40,517	42,810	42,660
Total BSI/1,000 admissions[2]	13.4	15.3	15.4	16.1	15.6	15.6	15.7	15.4	15.3	15.9	16.3	16.7	17.2	18.0	17.9		19.1	20.3	21.3	21.3
Total BSI/10,000 patient-days[3]	15.0	17.1	17.3	18.8	18.6	18.8	19.2	19.1	19.0	20.2	20.9	21.6	22.6	24.1	24.6		26.6	28.9	30.7	31.8
BSI as secondary diagnosis[4] (n)	20,613	23,995	23,697	24,723	23,793	23,588	23,554	22,425	21,948	22,321	22,517	23,301	24,038	24,969	24,731		24,987	26,004	26,943	26,835
BSI as secondary diagnosis/1,000 admissions[2]	11.0	12.9	12.8	13.4	12.8	12.6	12.6	11.9	11.5	11.6	11.6	11.9	12.2	12.7	12.5		12.5	13.0	13.4	13.4
BSI as secondary diagnosis/10,000 patient-days[3]	12.4	14.4	14.4	15.6	15.3	15.2	15.3	14.8	14.3	14.7	14.9	15.4	16.1	17.0	17.2		17.4	18.5	19.3	20.0
BSI not present on admission[5] (n)									9,269	10,603	10,873	11,164	11,059	9,005	6,857		9,613	10,276	10,938	10,688
BSI not present on admission/1,000 admissions[2]									4.9	5.5	5.6	5.7	5.6	4.6	3.5		4.8	5.2	5.5	5.3
BSI not present on admission/10,000 patient-days[3]									6.0	7.0	7.2	7.4	7.4	6.1	4.8		6.7	7.3	7.8	8.0
Surveillance of bloodstream infections in Belgian hospitals data																				
HABSI/1,000 admissions														5.6	5.8	5.6	5.2	5.5	5.8	5.5
HABSI/10,000 patient-days														7.8	8.1	8.1	7.7	8.3	8.7	8.3

BSI, bloodstream infection; HABSI, hospital-associated bloodstream infection; NA, not available

Notes:

2015: Due to transition from ICD-9-CM to ICD-10-CM coding, data on diagnosis is not available for 2015

[1] 'Total BSI' includes admissions with septicaemia and bacteraemia as main and secondary diagnosis (13)

[2] 'admissions' include all admissions labelled as 'classic admissions (with overnight stay)' in MZG/RHM (see MZG/RHM: A2/Veld 14 => A2_HOSPTYPE_FAC for code H en L) (12)

[3] 'patient-days' include for each 'classic admission' total number of hospitalisation days that have to be billed (see MZG/RHM: A2/Veld 15 => A2_TOTAL_NUMBER_DAY_FAC voor alle types A2_HOSPTYPE_FAC in H, F, M, L) (12)

[4] 'BSI as secondary diagnosis' includes admissions with septicaemia and bacteraemia as secondary diagnosis (13)

[5] 'BSI not present on admission' includes admissions with septicaemia and bacteraemia as diagnosis and labelled as 'not present on admissions' (MZG/RHM: M1 / Veld 9 => M1_PRESENT_ADM: code is N) (13)

4.2 OTHER SOURCES OF BELGIAN ANTIMICROBIAL RESISTANCE DATA

We compared antimicrobial resistance results from the Belgian BSI surveillance with two other sources; *European Antimicrobial Resistance Surveillance Network* (EARS-Net) and *Surveillance of antimicrobial resistant bacteria in Belgian hospitals* (Table 24) (14, 15). EARS-Net surveillance includes data on antimicrobial resistance from blood, cerebrospinal fluid and urine samples (community and hospital-acquired) from a sample of laboratories that voluntary participate. The surveillance of antimicrobial resistant bacteria in Belgian hospitals includes resistance data from a wide variety of clinical samples[30] (e.g. urine-, sputum-, stool-, blood-, and wound-sample) from community and hospital-acquired infections.

The resistance proportions found are higher when only including hospital-associated infections. However, overall, the resistance data found by the three different surveillances are comparable and validate each other (Table 24).

[30] A clinical sample is a sample collected for diagnostic reasons in the presence of clinical signs

Table 24: Comparison of antimicrobial resistance data from three different surveillances, Belgium 2020[9]

Microorganisms	Surveillance of BSI in Belgian hospitals (N hospitals = 97)[1]						Surveillance of resistant MO in Belgian hospitals (N hospitals = 102[3])			EARS-Net Belgium (N laboratories = 32)			EARS-Net Belgium (N laboratories = 32)		
	Blood samples - HABSI			Blood samples – non-HABSI[2]			Clinical samples – all sites - from hospital-associated and other infections[4]			Blood and cerebrospinal fluid samples from hospital-associated and other infections			Urine samples from hospital-associated and other infections		
Antibiotic markers	**N**	**nR**	**%R**	**N**	**nR**	**%R**	**N**	**nR**	**%R**	**N**	**nR**	**%R**	**N**	**nR**	**%R**
S. aureus															
Meti	788	70	8.9	209	13	6.2	27,628	2,922[5]	10.6	1,580	108	6.8	NA	NA	NA
Gly R	788	0	0.0	209	1	0.5	NA	NA	NA	1,387	0[8]	0.0	NA	NA	NA
E. coli															
C3G	1,512	227	15.0	687	64	9.3	86,167	7,986[5,6]	9.3	4,632	456	9.8	107,666	6,334	5.9
CAR	1,512	10	0.7	687	1	0.1	86,167	87[5,7]	0.10	4,438	1	0.0	106,008	20	0.0
K. pneumoniae															
C3G	649	189	29.1	117	21	17.9	19,070	4,089[5,6]	21.4	987	202	20.5	14,552	1,705	11.7
CAR	649	31	4.8	117	1	0.9	19,070	334	1.8[5,7]	957	13	1.4	14,345	33	0.2
P. aeruginosa															
CAR	441	63	14.3	45	12	26.7	NA	NA	NA	514	62	12.1	5,319	222	4.2
E. faecium															
Gly R	512	15	2.9	31	1	3.2	8,100	139	1.7	533	19[8]	3.6	2,095	36[8]	1.7

BSI, bloodstream infection; C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem); Gly, glycopeptides (vancomycin, teicoplanin); EARS, European Antimicrobial Resistance Surveillance; HABSI, hospital-associated bloodstream infections; Meti, Methicillin; N, total number MO; nR, number resistant MO; NA, not available; R, resistant: %R, percent resistant MO

Notes:

[1] This surveillance includes the results of blood samples (blood cultures) of HABSI and non-HABSI. Hospitals identified by RIZIV/INAMI code.

[2] Non-HABSI are optionally reported in this surveillance.

[3] Hospitals identified by RIZIV/INAMI code

[4] This surveillance includes the results of all clinical samples (e.g. urine-, sputum-, stool-, blood-, and wound-sample) collected for diagnostic reasons in the presence of clinical signs and covers acute hospitals and long-term care facilities [16].

[5] Includes only cases from acute hospitals.

[6] Includes MO resistant to third and fourth generation cephalosporins

[7] Includes only resistance to meropenem

[8] Vancomycin resistant

[9] Results for 'Surveillance of resistant MO in Belgian hospitals' and 'EARS-Net Belgium' are preliminary

5 Effect of COVID-19 crisis on hospital-associated bloodstream infections

Regarding the 2020 BSI data, we cannot ignore the presence of the COVID-19 crisis and its possible effect on the HABSI and CLABSI incidence, on the source of these infections and on its causal microorganism.

As a reminder, in 2020 we observed two COVID-19 waves. The first one mainly situated in the second quarter with its peak in COVID-19 patients hospital occupation at the beginning of April, and a second wave mainly situated in the fourth quarter with its peak in COVID-19 patients hospital occupation beginning of November (Figure 23).

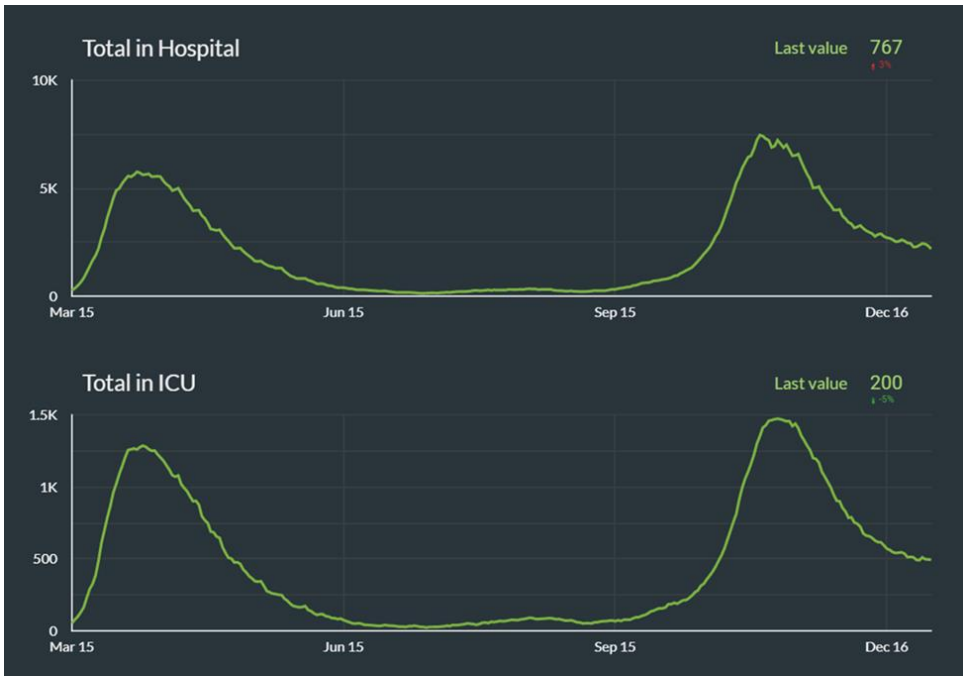


Figure 23: Total number of COVID-19 patients at hospitals and intensive care units, Belgium, 15 March – 31 December 2020[31]

[31] Data see Sciensano COVID-19 dashboard: https://datastudio.google.com/embed/reporting/c14a5cfc-cab7-4812-848c-0369173148ab/page/ZwmOB (accessed October 2021)

5.1 COVID-19 EFFECT ON THE INCIDENCE OF HOSPITAL- AND CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS

Between 2013 and 2019, as already mentioned above, we did not observe a trend or statistically significant change in HABSI and CLABSI incidence per 10,000 pd. From 2019 to 2020, we observed a statistically significant increase in the HABSI and CLABSI incidence at Belgium and at each of the regions (Figure 24). At Belgian level the HABSI incidence increase by 20% and CLABSI incidence by 26%.

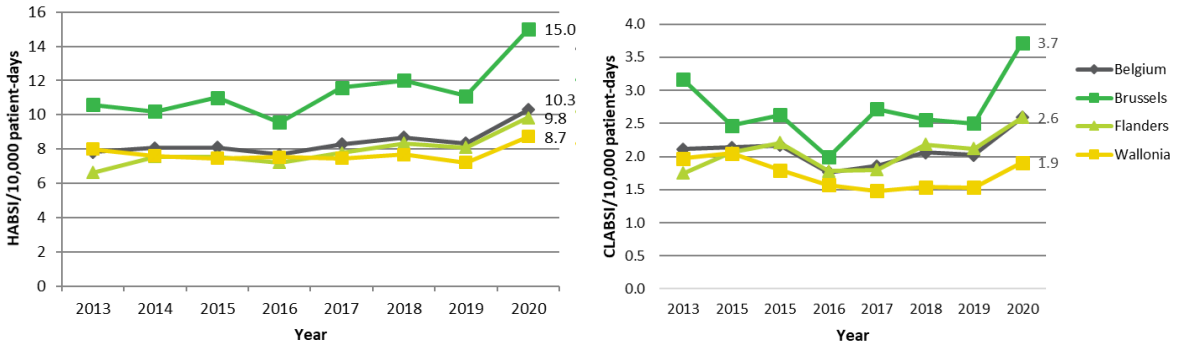


Figure 24: Mean incidence of hospital- and central line-associated bloodstream infection, hospital-wide, Belgium and by region, 2013-2020 (HABSI, hospital-associated bloodstream infection; CLABSI, central line-associated bloodstream infection)

The same is observed if assessing HABSI incidence by hospital type. In both, tertiary and other type hospitals, no trend in HABSI incidence was observed between 2013 and 2019. From 2019 to 2020, the HABSI incidence increased statistically significant (Figure 25), at Belgium level at tertiary hospitals by 26% and in other hospital by 20%.

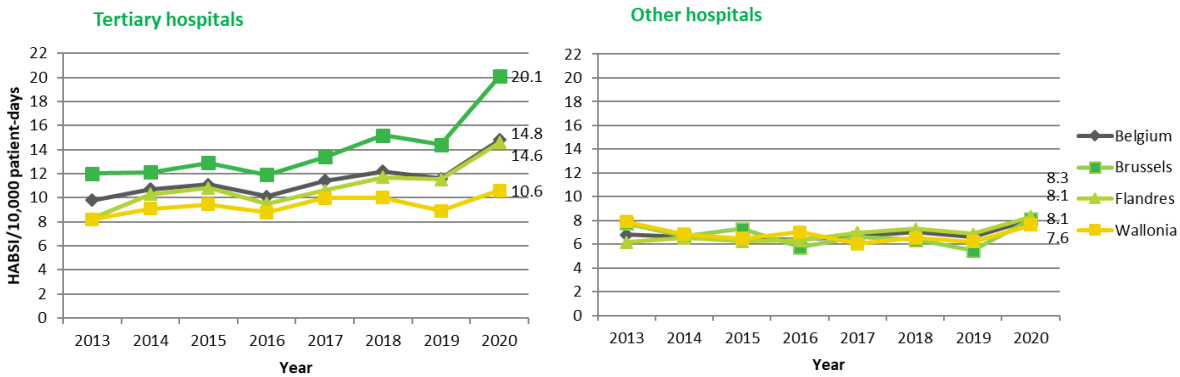


Figure 25: Mean incidence of hospital-associated bloodstream infection in tertiary and other hospitals, Belgium and by region, 2013-2020 (HABSI, hospital-associated bloodstream infection)

Figure 26 gives the HABSI and CLABSI incidence between 2013 and 2020 by quarter. This figure shows that the increase in HABSI and CLABSI incidence observed between 2019 and 2020 is due to the increase in infections observed during the second and fourth quarter of 2020, being the quarters of the first and second COVID-19 wave (Figure 23). Between 2019 and 2020, HABSI and CLABSI increased only slightly during the first quarter and did not increased in the third quarter.

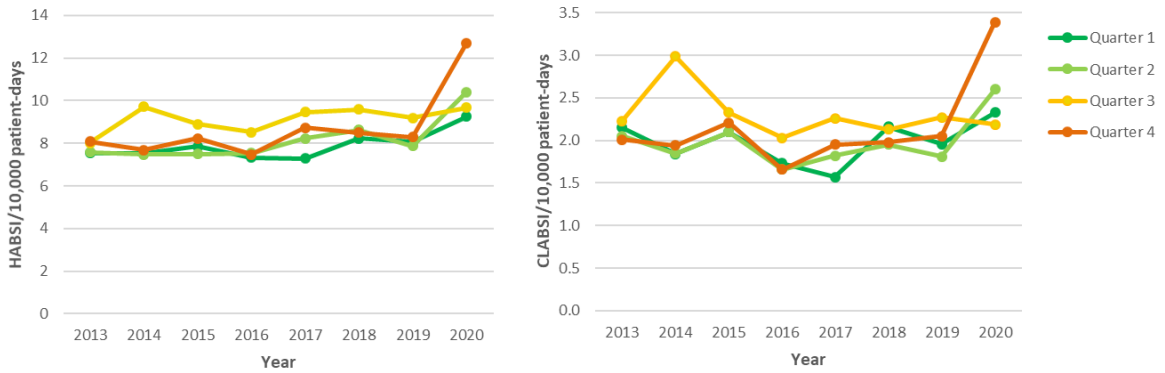


Figure 26: Mean incidence of hospital- and central line-associated bloodstream infection by quarter, hospital-wide, Belgium, 2013-2020 (HABSI, hospital-associated bloodstream infection; CLABSI, central line-associated bloodstream infection)

5.2 COVID-19 EFFECT ON SOURCE OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTION AND CAUSAL MICROORGANISM

In 2020, compared to previous years, we found proportional more HABSI with source pulmonary infection (at hospital level: 2019, 11% - 2020, 14% and at ICU level: 2019, 23% - 2020, 32%) and more with endotracheal tube present (2019, 34% - 2020, 53%). In 2020, proportional more HABSI occurred at ICU (2019, 20% - 2020, 27%). These findings suggest that compared with previous years there were proportionally more critical ill patients with a HABSI.

In 2020, we did not observe a change in trend of MO specific HABSI incidences and antimicrobial resistance profile of selected causal MO. Also the 2020 crude mortality for HABSI (22%) remained similar to previous years.

5.3 CONCLUSION COVID-19 EFFECT ON HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS

Several recent publications observed similar findings regarding the impact of COVID-19 on HABSI and CLABSI incidence (16-21).

Among others a paper by Weiner-Lastinger *et al*., looking at the impact of COVID-19 on healthcare-associated infections in 2020 based on data reported to the National Healthcare Safety Network, reported during the last three quarters of 2020 a significant increase in the CLABSI standardized infection ratios. From 2015 to 2019, they found a consistent significant reductions in this ratio for CLABSI (21). Another paper by LeRose *et al.* comparing the CLABSI incidence in a university hospital during the first months of 2019 with the incidence of 2020, found in 2020, from March onwards a significant higher CLABSI incidence (Figure 27) (18).

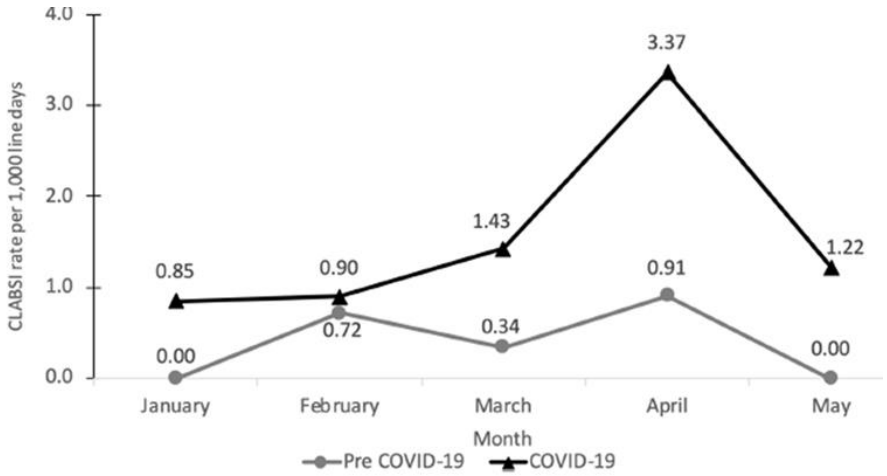


Figure 27: LeRose et al., central line-associated bloodstream infection per 1,000 central line-days between Jan and May, 2019 (pre COVID-19) and 2020 (COVID-19) (CLABSI, central line-associated bloodstream infection)

Possible hypotheses for this increase in incidence are, as also stated in the two studies above, that during the COVID-19 crisis the heavy working conditions and the fact that many COVID-19 patients are critical ill on admission, might be a reason why infection prevention and control measure (including CLABSI bundle requirements) were not or could not be implemented as they should, leading to an increase in CLABSI and HABSI incidence.

Another hypothesis is that during the COVID-19 crisis, due to the periodically setting on-hold of routine care and planned admission at the hospitals and due to the fact that people for whatever reason waited longer to consult a medical doctor or go to the hospital, the hospital patient population profile changed considerable, having proportionally more severely ill and weaker patients in the hospital than normally, meaning patients with a weaker immune system, making them more susceptible to develop HABSI and as such leading to an increased HABSI incidence.

6 General comments

2013 to 2019 data given in the 2021 report may differ slightly from those in the 2020 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 2021 report.

Although data entry for the bloodstream infection surveillance can be done throughout the year, some hospitals prefer to enter data and fulfil their obligation just before the data submission deadline which is the 31st of March of the year following the reporting year. For 2020, the extension of the deadline for submitting data was individually discussed with hospitals for whom data was missing. We implemented this approach due to the COVID-19 crisis to provide infection prevention and control teams additional time to submit their data.

As extensive described in the main findings and the dedicated section on the impact of COVID-19 on HABSI and CLABSI incidence, the effect of the pandemic on HABSI and CLABSI occurrence in Belgian hospital is already very clear for the reporting year 2020.

7 Detailed recommendations

7.1 RECOMMENDATIONS FOR POLICY MAKERS

- Continue to support and enable infection prevention and control teams at hospitals in their responsibilities and tasks to decrease HABSI. More focus on infection prevention and control in pre-service training (medical and nursing schools) would be useful.
- As part of broader quality of care improvement initiatives, enhance the creation of a general culture of good quality of care practice at hospital level. This includes the creation of a supportive, safe, secure and not judging hospital environment in which internal quality audits conducted by the hospital infection prevention and control teams can be implemented.
- Support the organisation of BSI surveillance data validation. This validation can be conducted by Sciensano.
- Continue to support a national organised surveillance of HABSI to assess changes in HABSI incidence at national and hospital level. Especially in the frame of the COVID-19 crisis it is very important to continue this surveillance, this to assess the impact of the COVID-19 crisis on the occurrence of HABSI and to be able to formulate, if needed, measures, guidelines and actions to strengthen quality of care and infection prevention and control management in times of a health crisis (lessons learned).
- The present COVID-19 crisis stresses the importance to enhance a sound infection prevention and control policy at national and hospital level.

7.2 RECOMMENDATIONS FOR HOSPITALS

- Assess if there is still room for decrease of HABSI and, if needed, implement actions and activities to establish HABSI decrease. The organisation of internal HABSI audits conducted by the local infection prevention and control team is suggested.
- Continue recording and reporting HABSI data in the national BSI surveillance to be able to evaluate the HABSI situation at hospital level over time and evaluate the impact of locally implemented activities to decrease HABSI incidences and of locally occurred events on this HABSI incidence. Especially in the frame of the COVID-19 crisis it is very important to continue this reporting and recording, this to assess the impact of the COVID-19 crisis on the occurrence of HABSI and to be able to formulate, if needed, measures, guidelines and actions to strengthen quality of care and infection prevention and control management in times of a health crisis (lessons learned).

7.3 RECOMMENDATIONS FOR THE SCIENTISTS IN CHARGE OF THE SURVEILLANCE (SCIENSANO)

- Validation of surveillance data. Comparing data from the surveillance with data received through the MZG/RHM could be a first step in this validation.
- Assess why there was between 2013 and 2019, no decline in HABSI incidence in Belgian hospitals at national level. This can be done by assessing if same hospitals have consistently better or worse HABSI incidences and if so, assess through an additional study why this is the case. Or, by comparing hospitals with a low HABSI incidence with similar hospitals with a high incidence and assess reasons for this difference.
- Assess if the in the BSI surveillance asked antibiotic resistance data should be updated to be streamlined with international recommendations.

RECOMMENDATION

- Streamline between the other Sciensano surveillances the collection of antibiotic resistance data to avoid same data are asked several times.
- Continue implementing the surveillance of BSI in Belgian hospitals which includes a yearly update of protocol and data collection tool.
- Further improve the Healthdata data collection and reporting tool (Healthstat).
- Assess if data recording and reporting cannot be further simplified and streamlined in the future. It would be useful to assess if data collected through other channels (e.g. MZG/RHM) could serve to timely answer the objectives of the surveillance of BSI in Belgian hospitals

8 References

1. Blot SI, Depuydt P, Annemans L, Benoit D, Hoste E, De Waele JJ *et al*.: **Clinical and economic outcomes in critically ill patients with nosocomial catheter-related bloodstream infections.** *Clin Infect Dis* 2005, **41:** 1591-1598.

2. Ista E, van der Hoven B, Kornelisse RF, van der Starre C, Vos MC, Boersma E *et al*.: **Effectiveness of insertion and maintenance bundles to prevent central-line-associated bloodstream infections in critically ill patients of all ages: a systematic review and meta-analysis.** *Lancet Infect Dis* 2016, **16:** 724-734.

3. Schreiber PW, Sax H, Wolfensberger A, Clack L, Kuster SP: **The preventable proportion of healthcare-associated infections 2005-2016: Systematic review and meta-analysis.** *Infect Control Hosp Epidemiol* 2018, **39:** 1277-1295.

4. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ: **Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs.** *Infect Control Hosp Epidemiol* 2011, **32:** 101-114.

5. Vrijens F, Hulstaert F, Devriese S, van de Sande S: **Hospital-acquired infections in Belgian acute-care hospitals: an estimation of their global impact on mortality, length of stay and healthcare costs.** *Epidemiol Infect* 2012, **140:** 126-136.

6. NSIH. National surveillance of hospital associated bloodstream infections (hospital-wide). http://www.nsih.be/surv_sep/beschrijving_en.asp, http://www.nsih.be/surv_sep/beschrijving_nl.asp, http://www.nsih.be/surv_sep/beschrijving_fr.asp. [assessed June 2019]

7. Duysburgh E. *Surveillance des Septicémies dans les Hôpitaux Belges, Protocole 2019, avril 2019*. http://www.nsih.be/download/BSI%20surv%20protocol_FR_April2019.pdf. 2019. Brussels, Belgium, NSIH - Sciensano.

8. Duysburgh E. *Surveillance Bloedstroominfecties in Belgische Ziekenhuizen, Protocol 2019, mei 2019.* http://www.nsih.be/download/BSI%20surv%20protocol_NL_April2019.pdf. 2019. Brussels, Belgium, NSIH-Sciensano.

9. European Centre for Disease Prevention and Control (ECDC). *Point prevalence survey of healthcareassociated infections and antimicrobial use in European acute care hospitals - protocol version 5.3*. 2016. Stockholm, Sweden, ECDC.

10. European Centre for Disease Prevention and Control (ECDC*). Surveillance of healthcare-associated infections and prevention indicators in European intensive care units. HAI-Net ICU protocol, version 2.2.* 2017. Stockholm, Sweden, ECDC.

11. WHO. ICD10 classification. http://apps.who.int/classifications/icd10/browse/2010/en [assessed September 2018]

12. Belgian federal public service for health, food chain safety and environment. *MZG: Domein 3 - Administratieve gegevens / RHM: Domaine 3 - Données administratives*. 2017. https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/richtlijnen_domein_3_administratieve_gegevens_a_2017.pdf, https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/direc

tives_domaine_3_donnees_administratives_a_2017.pdf. Brussels, Belgium, Federal Public Service Health, Food Chain Safety and Environment.

13. Belgian federal public service for health, food chain safety and environment. *MZG: Domein 5 - Medische gegevens / RHM: Domaine 5 - Données médicales.* 2017. https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/richtlijnen_domein_5_medische_gegevens_m_2017_12.pdf, https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/directives_domaine_5_donnees_medicales_m_2017_12.pdf. Brussels, Belgium, Federal Public Service Health, Food Chain Safety and Environment.

14. Latour K. *Surveillance of antimicrobial resistant bacteria in Belgian hospitals,* preliminary results 2019 (oral communication), NSIH - Sciensano.

15. Mertens K. *European Antimicrobial Resistance Surveillance Network (EARS-Net Belgium),* preliminary results 2019 (oral communication), NSIH - Sciensano.

16. Baccolini V, Migliara G, Isonne C, Dorelli B, Barone LC, Giannini D, et al. **The impact of the COVID-19 pandemic on healthcare-associated infections in intensive care unit patients: a retrospective cohort study**. Antimicrob Resist Infect Control. 2021 Dec;10(1):87.

17. Fakih MG, Bufalino A, Sturm L, Huang R-H, Ottenbacher A, Saake K, et al. **Coronavirus disease 2019 (COVID-19) pandemic, central-line–associated bloodstream infection (CLABSI), and catheter-associated urinary tract infection (CAUTI): The urgent need to refocus on hardwiring prevention efforts**. Infect Control Hosp Epidemiol. 2021 Feb 19;1–6.

18. LeRose J, Sandhu A, Polistico J, Ellsworth J, Cranis M, Jabbo L, et al. **The impact of coronavirus disease 2019 (COVID-19) response on central-line–associated bloodstream infections and blood culture contamination rates at a tertiary-care center in the Greater Detroit area**. Infect Control Hosp Epidemiol. 2021 Aug;42(8):997–1000.

19. McMullen KM, Smith BA, Rebmann T. **Impact of SARS-CoV-2 on hospital acquired infection rates in the United States: Predictions and early results**. Am J Infect Control. 2020 Nov;48(11):1409–11.

20. Patel PR, Weiner-Lastinger LM, Dudeck MA, Fike LV, Kuhar DT, Edwards JR, et al. **Impact of COVID-19 pandemic on central-line–associated bloodstream infections during the early months of 2020, National Healthcare Safety Network**. Infect Control Hosp Epidemiol. 2021 Mar 15;1–4.

21. Weiner-Lastinger LM, Pattabiraman V, Konnor RY, Patel PR, Wong E, Xu SY, et al. **The impact of coronavirus disease 2019 (COVID-19) on healthcare-associated infections in 2020: A summary of data reported to the National Healthcare Safety Network.** Infect Control Hosp Epidemiol. 2021 Sep 3;1–14.

9 Annexes

1. CALCULATION OF INCIDENCES

Table 25: Calculation of mean incidences, surveillance of bloodstream infections in Belgian hospitals

Incidences	NUMERATOR	DENOMINATOR
Hospital-wide		
Mean cumulative incidence HABSI/1,000 admissions	∑ N BSI ≥2 days in hospital	∑ Total admissions
Mean incidence density HABSI/10,000 patient-days		∑ Total patient-days
ICU		
Mean cumulative incidence ICU-associated BSI/1,000 admissions ICU	∑ N BSI ≥2 days in ICU	∑ Total admissions ICU
Mean incidence density ICU-associated BSI/10,000 patient-days ICU		∑ Total patient-days ICU

HABSI, hospital-associated bloodstream infection; ICU, intensive care unit; 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 admissions 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. PARTICIPATION BY REGION

In 2020, in Brussels half, in Flanders a bit less than half and in Wallonia one third of the hospitals participated in the BSI-surveillance the whole year.

Table 26: Participation in the surveillance of bloodstream infections in Belgian hospitals by region, 2020

N participating quarters	N hospitals participating (% of hospitals on total number of hospitals that should participate: Brussels N=14, Flanders N=52, Wallonia N=38)*		
	Brussels	Flanders	Wallonia
At least 1 quarter	**12 (86)**	**50 (96)**	**35 (92)**
1 quarter	5 (36)	18 (35)	16 (42)
2 quarters	0 (0)	5 (9)	3 (8)
3 quarters	0 (0)	3 (6)	4 (10)
4 quarters (whole year)	7 (50)	24 (46)	12 (32)

N, number

Note: *Hospitals as identified by their RIZIV/INAMI number

3. INCIDENCE OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS BY REGION

Table 27: Incidence of hospital-associated bloodstream infections by region, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Brussels								
N hospitals included in calculation of incidence*	11	11	12	12	10	12	12	11
N HABSI	1,586	1,686	1,741	1,635	1,485	1,591	1,540	1,543
Cumulative incidence per 1,000 admissions								
mean**	7.8	7.4	7.8	7.0	8.2	8.3	7.5	10.1
median***	8.1	6.8	8.1	7.2	7.6	8.1	5.5	9.8
Incidence density per 10,000 patient-days								
mean**	10.6	10.2	11.0	9.6	11.6	12.0	11.1	15.0
median***	9.4	9.3	11.3	9.2	8.8	11.2	7.8	12.0
Flanders								
N hospitals included in calculation of incidence*	44	51	53	53	49	51	50	49
N HABSI	2,450	3,634	4273	4,242	3,676	4,353	3,974	3,726
Cumulative incidence per 1,000 admissions								
mean**	4.6	5.3	5.1	4.7	5.0	5.5	5.1	6.2
median***	4.3	4.2	4.3	4.3	4.5	4.5	4.5	5.3
Incidence density per 10,000 patient-days								
mean**	6.6	7.6	7.5	7.2	7.8	8.3	8.1	9.8
median***	6.2	6.5	6.4	6.5	6.8	7.2	7.2	8.3
Wallonia								
N hospitals included in calculation of incidence*	31	34	37	38	34	37	36	34
N HABSI	1,548	1,606	1,861	1,914	1,594	1,965	1,725	1,553
Cumulative incidence per 1,000 admissions								
mean**	6.0	5.8	5.3	5.4	5.3	5.1	5.2	6.4
median***	5.8	5.1	5.4	5.2	4.5	4.6	4.6	5.4
Incidence density per 10,000 patient-days								
mean**	8.0	7.6	7.5	7.5	7.5	7.7	7.2	8.7
median***	8.0	7.0	7.0	6.7	6.7	6.9	6.3	7.2

HABSI, hospital-associated BSI; N, number

Notes:

* Hospitals included when denominator of the participating quarter was available

** Total hospital-associated BSI/total denominator

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

4. INCIDENCE OF HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS IN TERTIARY AND NON-TERTIARY HOSPITALS

Table 28: Incidence of hospital-associated bloodstream infections in tertiary and non-tertiary hospitals, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Non-tertiary hospital								
N hospitals included in calculation of incidence*	67	74	78	79	73	77	75	73
N HABSI	3,207	3,663	4,035	4,307	3,609	4,318	3,704	3,579
mean incidence 1,000 admissions**	4.9	4.7	4.4	4.4	4.5	4.6	4.3	5.3
mean incidence 10,000 patient-days**	6.8	6.6	6.4	6.4	6.7	7.0	6.6	8.1
Tertiary hospital								
N hospitals included in calculation of incidence*	19	22	24	24	20	23	23	21
N HABSI	2,377	3,263	3,840	3,484	3,146	3,591	3,535	3,243
mean incidence 1,000 admissions**	7.0	7.9	7.9	6.7	7.4	8.3	7.9	10.0
mean incidence 10,000 patient-days**	9.8	10.7	11.1	10.1	11.4	12.2	11.6	14.8

HABSI, hospital-associated BSI; N, number

Notes:

* Hospitals included when denominator of the participating quarter was available

** Total HABSI/total denominator

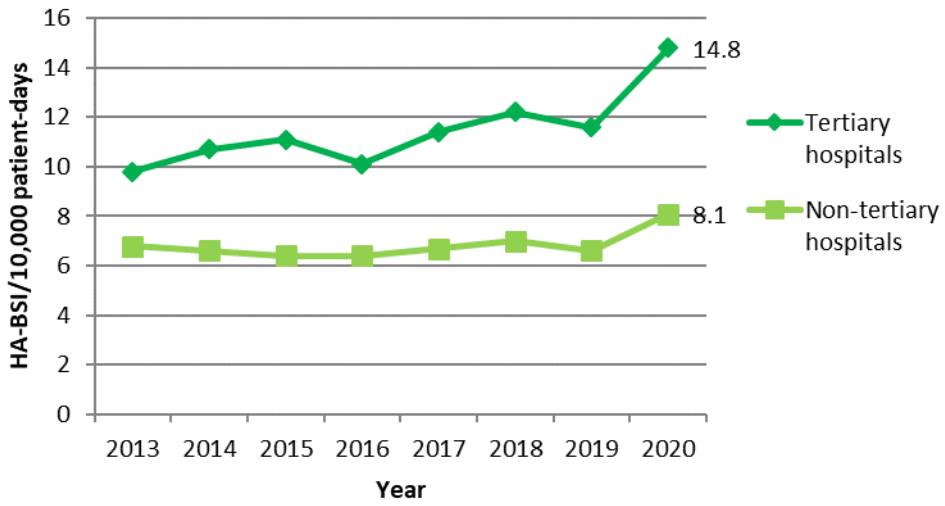


Table 29: Incidence of hospital-associated bloodstream infections in tertiary and non-tertiary hospitals by region, Belgium 2016-2020[32]

	Brussels					Flanders					Wallonia				
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2016**	**2017**	**2018**	**2019**	**2020**	**2016**	**2017**	**2018**	**2019**	**2020**
Non-tertiary hospital															
N hospitals included in calculation of incidence*	6	5	6	6	6	45	44	44	43	42	28	24	27	26	25
N HABSI	371	224	312	284	353	2,689	2,564	2,894	2,492	2,391	1,238	821	1,112	928	835
*mean incidence 1,000 admissions***	3.9	4.2	4.3	3.5	5.4	4.3	4.6	4.8	4.3	5.2	5.0	4.3	4.3	4.5	5.6
*mean incidence 10,000 patient-days***	5.8	6.6	6.4	5.5	8.1	6.3	7.0	7.3	6.9	8.3	7.0	6.0	6.5	6.2	7.6
Tertiary hospital															
N hospitals included in calculation of incidence*	6	5	6	6	5	8	5	7	7	7	10	10	10	10	9
N HABSI	1,264	1,261	1,279	1,256	1,190	1,544	1,112	1,459	1,482	1,335	676	773	853	797	718
*mean incidence 1,000 admissions***	9.1	9.8	10.7	10.0	13.7	5.7	6.0	8.0	7.5	9.3	6.3	7.0	6.6	6.4	7.7
*mean incidence 10,000 patient-days***	11.9	13.4	15.2	14.4	20.1	9.5	10.6	11.7	11.5	14.6	8.8	10.0	10.0	8.9	10.6

HABSI, hospital-associated BSI; N, number

Notes:

* Hospitals included when denominator of the participating quarter was available

** Total HABSI/total denominator

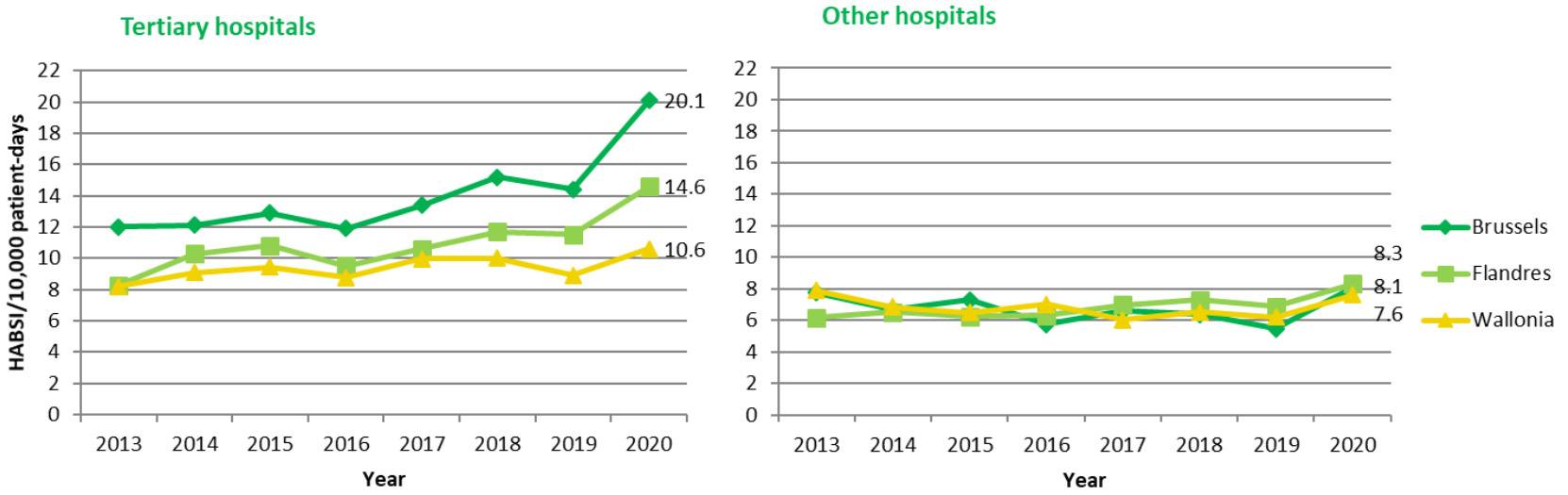


Figure 28: Mean incidence of hospital-associated bloodstream infections in tertiary and non-tertiary hospitals by region, Belgium 2013-2020 (HABSI, hospital-associated bloodstream infection)

[32] Because of readability of the table, data from only five last years are given. See 2020 report for 2013-2015 data: http://www.nsih.be/surv_sep/docs/BSI_Report_Sciensano_2020.pdf.

5. HOSPITAL-WIDE CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS BY CLASSIFICATION

Table 30: Central line-associated bloodstream infections, hospital-wide, according to classification (proportions)*, Belgium 2013-2020

Year	2013		2014		2015		2016		2017		2018		2019		2020	
CLABSI	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Confirmed	623	41	768	42	920	43	739	41	666	37	774	39	699	40	642	36
Probable	459	30	601	33	742	35	610	34	613	34	652	33	582	33	563	32
Possible	425	28	465	25	463	22	439	25	537	30	557	28	476	27	577	32
Total	**1,507**	**100**	**1,834**	**100**	**2,125**	**100**	**1,788**	**100**	**1,816**	**100**	**1,983**	**100**	**1,757**	**100**	**1,782**	**100**

CLABSI, central line associated bloodstream infection; N, number

Note:

* Includes all CLABSI episodes (also those without denominator)

6. INCIDENCE OF CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS IN TERTIARY AND NON-TERTIARY HOSPITALS

Table 31: Incidence of central line-associated bloodstream infections* in tertiary and non-tertiary hospitals, Belgium 2013-2020

Year	2013	2014	2015	2016	2017	2018	2019	2020
Non-tertiary hospital								
N hospitals included in calculation of incidence**	67	74	78	79	73	77	75	73
N CLABSI	714	806	919	794	700	886	801	800
mean incidence 10,000 patient-days***	1.5	1.5	1.5	1.2	1.3	1.4	1.4	1.8
Tertiary hospital								
N hospitals included in calculation of incidence**	19	22	24	24	20	23	23	21
N CLABSI	788	1,028	1,200	995	817	988	952	906
mean incidence 10,000 patient-days***	3.3	3.4	3.5	2.9	3.0	3.4	3.1	4.1

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

7. INTENSIVE CARE UNIT-ASSOCIATED CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS BY CLASSIFICATION

Table 32: Intensive care unit-associated central line-associated bloodstream infections according to case definition (proportions)*, Belgium 2013-2020

Year	2013		2014		2015		2016		2017		2018		2019		2020	
CLABSI	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Confirmed	177	37	202	40	222	39	185	35	173	34	218	35	204	36	247	35
Probable	128	27	133	26	189	33	173	33	159	31	188	30	168	30	199	28
Possible	170	36	170	34	158	28	173	33	174	34	217	35	192	34	266	37
Total	**475**	**100**	**505**	**100**	**569**	**100**	**531**	**100**	**506**	**100**	**623**	**100**	**564**	**100**	**712**	**100**

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

Note:

* Includes all CLABSI episodes (also those without denominator)

8. HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS BY SOURCE AND SPECIALITY

Table 33: Hospital-associated bloodstream infections by source and speciality, Belgium 2020

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**	108	11	757	36	318	19	2	7	316	35	32	45	168	21	81	15	1,782	25
Urinary tract infection	377	39	151	7	370	22	10	37	86	10	6	8	189	24	185	34	1,374	19
Gastro-intestinal infection	101	10	215	10	274	16	4	15	92	10	9	13	123	15	73	13	891	12
Pulmonary infection	61	6	649	30	143	8	0	0	40	4	5	7	38	5	42	8	978	14
Surgical site infection	18	2	54	3	27	2	1	4	2	0	1	1	85	11	30	6	218	3
Peripheral and other catheter	27	3	53	2	76	4	0	0	21	2	1	1	20	3	19	3	217	3
MBI	4	0	16	1	20	1	0	0	203	22	6	8	7	1	6	1	262	4
Invasive manipulation	8	1	5	0	32	2	0	0	17	2	0	0	18	2	14	3	94	1
Other secondary infections***	78	8	67	3	157	9	8	30	52	6	8	11	73	9	39	7	482	7
Unknown	180	19	165	8	281	17	2	7	75	8	3	4	78	10	56	10	840	12
Total	**962**	**100**	**2,132**	**100**	**1,698**	**100**	**27**	**100**	**904**	**100**	**71**	**100**	**799**	**100**	**545**	**100**	**7,138**	**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

9. INVASIVE DEVICE-ASSOCIATED HOSPITAL-ASSOCIATED BLOODSTREAM INFECTIONS

Table 34: Hospital-associated bloodstream infections associated with invasive devices, Belgium 2020

Invasive device	Confirmed		Non-confirmed		Total HABSI	
	N	% total HABSI	N	% total HABSI	N	% total HABSI
CLABSI	642	20	1,140	29	1,782	25
Urinary tract infection with catheter	483	15	110	3	598	8
Pulmonary infection with ET/cannula	446	14	72	2	518	7
Peripheral/other catheter	80	3	137	3	217	3
Total invasive device associated HABSI	**1,651**	**52**	**1,459**	**37**	**3,110**	**44**
Total HABSI	**3,180**	**100**	**3,958**	**100**	**7,138**	**100**

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

Note:

* Includes 'probable' and 'possible' CLABSI

10. END-OF-FOLLOW-UP STATUS

Table 35: End-of-follow-up status of patients with diagnosed hospital-associated bloodstream infections, Belgium 2020

End-of-follow-up status	N	%
Died*	1,536	22
Still admitted	639	9
Discharged	3,113	44
Unknown	1,850	26

N, number

Note:

* Causality between death and HABSI cannot be implied

11. EXHAUSTIVE LIST OF MICROORGANISMS ISOLATED FROM BLOODSTREAM INFECTIONS, BELGIAN ACUTE CARE HOSPITALS

Table 36: Microorganisms isolated as etiological agents for bloodstream infections, exhaustive list, Belgium 2020

	HABSI		CLABSI		Non-HABSI	
Microorganism	**N**	**%**	**N**	**%**	**N**	**%**
Escherichia coli	1,512	19	71	4	687	38
Staphylococcus aureus	788	10	186	10	209	12
Staphylococcus epidermidis	745	10	518	27	47	3
Klebsiella pneumoniae	649	8	110	6	117	6
Enterococcus faecium	512	7	144	8	31	2
Pseudomonas aeruginosa	411	5	58	3	45	2
Enterococcus faecalis	402	5	108	6	62	3
Enterobacter cloacae	257	3	41	2	21	1
Candida albicans	219	3	95	5	6	0
Klebsiella oxytoca	159	2	26	1	19	1
Proteus mirabilis	137	2	14	1	44	2
Serratia marcescens	132	2	25	1	13	1
Staphylococcus hominis	115	1	88	5	24	1
Enterobacter aerogenes	99	1	15	1	4	0
Candida glabrata	92	1	32	2	5	0
Staphylococcus haemolyticus	79	1	56	3	5	0
Bacteroides fragilis	71	1	2	0	26	1
Morganella morganii	65	1	7	0	5	0
Genus *Acinetobacter* (others or not specified)	59	1	18	1	1	0
Staphylococcus, coagulase negative (others or not specified)	57	1	37	2	3	0
Citrobacter koseri	51	1	3	0	7	0
Enterobacter cloacae complex	49	1	10	1	6	0
Staphylococcus capitis	47	1	29	2	7	0
Stenotrophomonas maltophilia	45	1	13	1	4	0
Streptococcus pneumoniae	43	1	1	0	56	3
Genus *Klebsiella* (others or not specified)	41	1	8	0	11	1
Citrobacter freundii	41	1	5	0	7	0
Candida parapsilosis	41	1	22	1	0	0
Streptococcus mitis group	34	0	8	0	12	1
Genus *Streptococcus* (others or not specified)	32	0	1	0	25	1
Genus *Candida* (others or not specified)	30	0	12	1	0	0
Streptococcus agalactiae	28	0	3	0	39	2
Candida tropicalis	28	0	10	1	1	0
Streptococcus anginosus	27	0	4	0	17	1
Genus *Clostridium* (others or not specified)	27	0	1	0	4	0
Acinetobacter baumannii	27	0	11	1	3	0
Streptococcus, viridans group	27	0	2	0	1	0
Genus *Bacteroides* (others or not specified)	26	0	2	0	10	1
Genus *Enterobacter* (others or not specified)	25	0	2	0	2	0
Streptococcus dysgalactiae	20	0	4	0	20	1
Streptococcus gallolyticus	16	0	0	0	6	0
Genus Morganella	16	0	1	0	3	0
Gram-positive coccus (others or not specified)	16	0	4	0	2	0
Genus *Citrobacter* (others or not specified)	16	0	1	0	2	0
Gram-negative bacillus (not specified)	15	0	1	0	5	0

Microorganism	HABSI		CLABSI		Non-HABSI	
	N	%	N	%	N	%
Genus *Staphylococcus* (not specified)	15	0	3	0	4	0
Genus *Enterococcus* (others or not specified)	15	0	2	0	3	0
Streptococcus bovis group	14	0	2	0	7	0
Streptococcus oralis	14	0	3	0	3	0
Genus Bacillus	13	0	5	0	1	0
Anaerobic bacteria (others or not specified)	12	0	2	0	15	1
Clostridium perfringens	12	0	1	0	7	0
Genus Pseudomonas	11	0	5	0	3	0
Streptococcus constellatus	11	0	3	0	3	0
Hafnia alvei	11	0	2	0	3	0
Enterococcus avium	11	0	1	0	1	0
Proteus vulgaris	11	0	0	0	0	0
Haemophilus influenzae	10	0	0	0	7	0
Genus *Fusobacterium*	10	0	1	0	6	0
Genus *Prevotella*	10	0	2	0	4	0
Genus *Lactobacillus*	10	0	2	0	1	0
Genus *Aeromonas*	9	0	0	0	7	0
Genus *Corynebacterium*	9	0	3	0	3	0
Staphylococcus warneri	8	0	3	0	2	0
Enterococcus gallinarum	8	0	0	0	2	0
Clostridium ramosum	8	0	0	0	0	0
Genus *Providencia*	7	0	1	0	3	0
Genus *Campylobacter*	7	0	0	0	3	0
Streptococcus sanguis group	7	0	2	0	2	0
Bacteroides thetaiotaomicron	7	0	0	0	2	0
Fusobacterium nucleatum	7	0	0	0	1	0
Streptococcus pyogenes	6	0	0	0	11	1
Aerococcus urinae	6	0	0	0	4	0
Acinetobacter lwoffi	6	0	4	0	2	0
Genus *Achromobacter*	6	0	4	0	1	0
Raoultella ornithinolytica	6	0	3	0	1	0
Genus *Actinomyces*	6	0	2	0	1	0
Candida krusei	6	0	1	0	1	0
Streptococcus salivarius group	5	0	1	0	2	0
Eggerthella lenta	5	0	0	0	1	0
Family *Pseudomonadaceae* (others or not specified)	5	0	0	0	1	0
Acinetobacter calcoaceticus	5	0	3	0	0	0
Kingdom Fungus (others or not specified)	5	0	3	0	0	0
Genus *Moraxella* (others or not specified)	5	0	1	0	0	0
Burkholderia cepacia	5	0	0	0	0	0
Genus *Salmonella* (others or not specified)	4	0	0	0	5	0
Bacteroides vulgatus	4	0	1	0	4	0
Pantoea agglomerans	4	0	1	0	3	0
Staphylococcus schleiferi	4	0	2	0	1	0
Citrobacter braakii	4	0	0	0	1	0
Genus *Neisseria* (others or not specified)	4	0	0	0	1	0
Providencia rettgeri	4	0	0	0	1	0
Campylobacter jejuni	3	0	0	0	2	0
Parabacteroides distasonis	3	0	0	0	2	0

Microorganism	HABSI		CLABSI		Non-HABSI	
	N	%	N	%	N	%
Genus *Flavobacterium*	3	0	0	0	1	0
Moraxella catarrhalis	3	0	0	0	1	0
Propionibacterium acnes	3	0	0	0	1	0
Staphylococcus pettenkoferi	3	0	2	0	0	0
Family *Enterobacteriaceae* (others or not specified)	3	0	1	0	0	0
Genus *Serratia* (others or not specified)	3	0	1	0	0	0
Yeast	3	0	1	0	0	0
Genus *Nocardia*	3	0	0	0	0	0
Peptoniphilus harei	3	0	0	0	0	0
Enterococcus casseliflavus	2	0	0	0	3	0
Parvimonas micra	2	0	0	0	3	0
Serratia liquefaciens	2	0	2	0	1	0
Genus *Propionibacterium*	2	0	1	0	1	0
Listeria monocytogenes	2	0	0	0	1	0
Streptococcus intermedius	2	0	0	0	1	0
Finegoldia magna	2	0	1	0	0	0
Gram-positive bacillus (others or not specified)	2	0	1	0	0	0
Non-Enterobacteriaceae (others or not specified)	2	0	1	0	0	0
Genus *Anaerococcus*	2	0	0	0	0	0
Genus *Hafnia*	2	0	0	0	0	0
Genus *Proteus* (others or not specified)	2	0	0	0	0	0
Pasteurella multocida	2	0	0	0	0	0
Prevotella bivia	2	0	0	0	0	0
Veillonella parvula	2	0	0	0	0	0
Streptococcus, group C	1	0	0	0	11	1
Abiotrophia adjacens	1	0	1	0	1	0
Gemella morbillorum	1	0	1	0	1	0
Bacterium (others or not specified)	1	0	0	0	1	0
Bacteroides fragilis group	1	0	0	0	1	0
Genus *Mycoplasma*	1	0	0	0	1	0
Ruminococcus gnavus	1	0	0	0	1	0
Salmonella Typhi (not specified)	1	0	0	0	1	0
Bacteroides faecis	1	0	1	0	0	0
Enterobacter asburiae	1	0	1	0	0	0
Genus *Atopobium*	1	0	1	0	0	0
Acinetobacter haemolyticus	1	0	0	0	0	0
Anaerobic Gram-positive *coccus*	1	0	0	0	0	0
Atopobium parvulum	1	0	0	0	0	0
Clostridium clostridiiforme	1	0	0	0	0	0
Eikenella corrodens	1	0	0	0	0	0
Genus *Dialister*	1	0	0	0	0	0
Genus *Paenibacillus*	1	0	0	0	0	0
Gram-negative *coccus* (others or not specified)	1	0	0	0	0	0
Neisseria meningitidis	0	0	0	0	5	0
Salmonella Enteritidis	0	0	0	0	3	0
Aerococcus sanguinicola	0	0	0	0	2	0
Genus *Actinotignum*	0	0	0	0	1	0
Genus *Eubacterium*	0	0	0	0	2	0
Bacteroides caccae	0	0	0	0	1	0

Microorganism	HABSI N	HABSI %	CLABSI N	CLABSI %	Non-HABSI N	Non-HABSI %
Genus *Agrobacterium*	0	0	0	0	1	0
Genus *Pasteurella*	0	0	0	0	1	0
Genus *Veillonella*	0	0	0	0	1	0
Salmonella Paratyphi A	0	0	0	0	1	0
Unidentified	8	0	3	0	3	0
Total	**7,790**	**100**	**1,897**	**100**	**1,814**	**100**

HABSI, hospital-associated bloodstream infection; N, number

12.MICROORGANISMS BY SUSPECTED SOURCE OF THE BLOODSTREAM INFECTION

Table 37: Microorganisms isolated from hospital-associated bloodstream infection by source, Belgian acute care hospitals, 2020

		CL		Urinary tract infection		Gastro-intestinal infection		Pulmonary infection		Surgical site infection		Peripheral and other catheter and invasive manipulation		MBI		Other*		Unknown		Total	
Family MO	**MO**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Enterobacteriaceae		352	19	1,091	76	559	54	564	52	117	48	80	24	127	40	130	24	296	32	3,316	43
	Escherichia coli	71	4	684	47	293	29	121	11	54	22	34	10	85	27	53	10	117	13	1,512	19
	Klebsiella pneumoniae	106	6	141	10	81	8	165	15	14	6	9	3	19	6	21	4	47	5	603	8
	Enterobacter cloacae	41	2	45	3	48	5	46	4	15	6	7	2	12	4	10	2	33	4	257	3
	Klebsiella oxytoca	26	1	31	2	31	3	39	4	5	2	6	2	3	1	5	1	13	1	159	2
	Proteus mirabilis	14	1	76	5	9	1	14	1	2	1	3	1	1	0	8	1	10	1	137	2
	Serratia marcescens	25	1	11	1	9	1	54	5	7	3	4	1	1	0	6	1	15	2	132	2
	Klebsiella aerogenes	15	1	17	1	8	1	34	3	6	2	8	2	1	0	2	0	8	1	99	1
	Other/not identified	54	3	86	6	80	8	91	8	14	6	9	3	5	2	25	5	53	6	417	5
Gram-positive cocci		1,218	64	208	14	245	24	279	26	83	34	211	63	125	40	316	59	441	48	3,126	40
	Staphylococcus aureus	183	10	29	2	9	1	123	11	43	18	74	22	3	1	174	33	143	16	781	10
	Staphylococcus epidermidis	518	27	12	1	9	1	8	1	12	5	63	19	5	2	28	5	90	10	745	10
	Enterococcus faecium	144	8	59	4	129	13	30	3	10	4	17	5	50	16	25	5	49	5	513	7
	Enterococcus faecalis	108	6	81	6	45	4	41	4	8	3	14	4	10	3	35	7	60	7	402	5
	Other/not identified	265	14	27	2	53	5	77	7	10	4	43	13	57	18	54	10	99	11	685	9
Non-fermenting Gram-negative bacilli		118	6	99	7	66	6	181	17	14	6	20	6	20	6	36	7	77	8	631	8
	Pseudomonas aeruginosa	58	3	88	6	33	3	144	13	9	4	9	3	12	4	28	5	30	3	411	5
	Other/not identified	60	3	11	1	33	3	37	3	5	2	11	3	8	3	8	1	47	5	220	3
Fungi		176	9	42	3	50	5	43	4	11	5	20	6	15	5	24	4	43	5	424	5
	Candida albicans	95	5	27	2	21	2	25	2	3	1	7	2	4	1	14	3	23	3	219	3
	Candida glabrata	32	2	6	0	15	1	9	1	4	2	7	2	6	2	6	1	7	1	92	1
	Other/not identified	49	3	9	1	14	1	9	1	4	2	6	2	5	2	4	1	13	1	113	1
Anaerobic bacilli		14	1	0	0	96	9	8	1	19	8	1	0	19	6	22	4	35	4	214	3
Gram-positive bacilli		13	1	2	0	5	0	1	0	0	0	3	1	3	1	3	1	9	1	39	1
Gram-negative cocci		1	0	1	0	5	0	3	0	0	0	1	0	4	1	2	0	3	0	20	0
Other and not identified		2	0	1	0	1	0	3	0	0	0	0	0	1	0	2	0	10	1	20	0
Total		1,894	100	1,444	100	1,027	100	1,082	100	244	100	336	100	314	100	535	100	914	100	7,790	100

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

13.MICROORGANISMS RESISTANCE PROFILE, ADDITIONAL DATA

Table 38: Antimicrobial resistance among hospital-associated bloodstream infections, Belgium 2016-2020[33]

Microorganisms		2016			2017			2018			2019			2020		
Antibiotics		**N**	**n**	**%**	**N**	**n**	**%**	**N**	**n**	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Gram-positive cocci																
S. aureus	Meti	893	145	16.2	890	121	13.6	971	103	10.6	813	85	10.5	788	70	8.9
	Gly	893	6	0.7	890	7	0.8	971	4	0.4	813	3	0.4	788	0	0.0
All Enterococcus spp.	Gly	806	28	3.5	906	37	4.1	965	34	3.5	855	25	2.9	929	23	2.5
E. faecalis	Gly	407	1	0.2	410	2	0.5	422	3	0.7	358	2	0.6	402	5	1.2
E. faecium	Gly	357	16	4.5	454	24	5.3	496	18	3.6	480	14	2.9	512	15	2.9
Enterobacteriaceae	C3G	3,771	826	21.9	3,755	767	20.4	3,846	883	23.0	3,375	798	23.6	3,316	718	21.7
	CAR	3,771	79	2.1	3,755	93	2.5	3,846	70	1.8	3,375	59	1.7	3,316	70	2.1
E. coli	C3G	1,873	282	15.1	1,926	303	15.7	1,893	301	15.9	1,637	269	16.4	1,512	227	15.0
	CAR	1,873	9	0.5	1,926	26	1.3	1,893	12	0.6	1,637	6	0.4	1,512	10	0.7
K. pneumoniae	C3G	682	233	34.2	667	191	28.6	737	260	35.3	644	218	33.9	649	189	29.1
	CAR	682	44	6.5	667	40	6.0	737	29	3.9	644	27	4.2	649	31	4.8
E. cloacae	C3G	323	119	36.8	316	118	37.3	306	117	38.2	280	130	46.4	257	115	44.7
	CAR	323	10	3.1	316	9	2.8	306	10	3.3	280	5	1.8	257	7	2.7
P. mirabilis	C3G	162	6	3.7	150	5	3.3	176	7	4.0	133	4	3.0	137	1	0.7
	CAR	162	2	1.2	150	1	0.7	176	1	0.6	133	1	0.8	137	0	0.0
K. oxytoca	C3G	183	37	20.2	187	21	11.2	181	27	14.9	175	35	20.0	159	30	18.9
	CAR	183	3	1.6	187	3	1.6	181	1	0.6	175	2	1.1	159	2	1.3
K. aerogenes	C3G	110	57	51.8	95	50	52.6	103	68	66.0	59	29	49.2	99	41	41.4
	CAR	110	4	3.6	95	3	3.2	103	3	2.9	59	2	3.4	99	2	2.0
Serratia spp.	C3G	133	24	18.0	151	28	18.5	134	30	22.4	170	45	26.5	137	43	31.4
	CAR	133	1	0.8	151	5	3.3	134	3	2.2	170	2	1.2	137	7	5.1
Non-fermenting Gram-negative bacilli																
P. aeruginosa	CAR	395	63	15.9	421	64	15.2	443	63	14.2	384	54	14.1	441	63	14.3
A. baumannii	CAR	53	2	3.8	57	5	8.8	55	4	7.3	41	1	2.4	27	0	0.0
Acinetobacter spp.	CAR	122	3	2.5	144	8	5.6	163	7	4.3	131	2	1.5	98	0	0.0

C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem, doripenem); Gly, glycopeptides (vancomycin, teicoplanin); Meti, methicillin; n, number resistant MO; N, total number MO; spp., species; %, percent resistant MO

[33] Because of readability of the table, data from only five last years are given. See 2020 report for 2013-2015 data: http://www.nsih.be/surv_sep/docs/BSI_Report_Sciensano_2020.pdf

Table 39: Hospitals with at least one resistant microorganism isolated from hospital-associated bloodstream infections, Belgium 2013-2020[34]

		Hospitals with >= one resistant case*									
		2016 (N=103)		2017 (N=102)		2018 (N=101)		2019 (N=98)		2020 (N=97)	
Microorganisms	**Antibiotics**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Gram-positive cocci											
S. aureus	Meti	61	59	50	49	53	52	46	47	38	39
	Gly	6	6	6	6	3	3	2	2	0	0
All Enterococcus spp.	Gly	17	17	22	22	22	22	14	14	19	20
E. faecalis	Gly	1	1	2	2	3	3	2	2	5	5
E. faecium	Gly	10	10	14	14	13	13	8	8	13	13
Enterobacteriaceae	C3G	93	90	91	89	93	92	89	91	82	85
	CAR	35	34	36	35	40	40	29	30	29	30
E. coli	C3G	75	73	71	70	76	75	70	71	64	66
	CAR	8	8	11	11	12	12	6	6	9	9
K. pneumoniae	C3G	61	59	61	60	63	62	55	56	52	54
	CAR	22	21	24	24	17	17	17	17	17	18
E. cloacae	C3G	54	52	53	52	48	48	46	47	40	41
	CAR	8	8	7	7	10	10	3	3	5	5
P. mirabilis	C3G	5	5	5	5	6	6	4	4	1	1
	CAR	2	2	1	1	1	1	1	1	0	0
K. oxytoca	C3G	29	28	18	18	19	19	20	20	17	18
	CAR	3	3	3	3	1	1	2	2	2	2
K. aerogenes	C3G	34	33	31	30	33	33	20	20	23	24
	CAR	4	4	3	3	3	3	2	2	2	2
Serratia spp.	C3G	19	18	23	23	20	20	24	24	19	20
	CAR	1	1	5	5	3	3	2	2	4	4
Non-fermenting Gram-negative bacilli											
P. aeruginosa	CAR	33	32	30	29	32	32	21	21	30	31
A. baumannii	CAR	2	2	5	5	3	3	1	1	0	0
Acinetobacter spp.	CAR	3	3	7	7	6	6	2	2	0	0

C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem, doripenem); Gly, glycopeptides (vancomycin, teicoplanin); Meti, Methicillin; N, number participating hospitals; n, number of hospitals reporting at least one resistant MO; spp., species
Note: * Hospitals participate 1, 2, 3 or 4 quarters

[34] Because of readability of the table, data from only five last years are given. See 2020 report for 2013-2015 data: http://www.nsih.be/surv_sep/docs/BSI_Report_Sciensano_2020.pdf

Table 40: Antimicrobial resistance in microorganisms isolated from hospital-associated and non-hospital-associated bloodstream infections, Belgium 2020

		HABSI Microorganisms			Non-HABSI			Hospitals with >= one resistant case* - N=97	
	Antibiotics	N	n	%	N	n	%	n	%
Gram-positive cocci									
S. aureus	Meti	788	70	8.9	209	13	6.2	43	44
	Gly	788	0	0.0	209	1	0.5	1	1
All Enterococcus spp.	Gly	929	23	2.5	96	1	1.0	19	20
E. faecalis	Gly	402	5	1.2	62	0	0.0	5	5
E. faecium	Gly	512	15	2.9	31	1	3.2	13	13
Enterobacteriacea	C3G	3,316	718	21.7	971	95	9.8	85	88
	CAR	3,316	70	2.1	971	3	0.3	30	31
E. coli	C3G	1,512	227	15.0	687	64	9.3	67	69
	CAR	1,512	10	0.7	687	1	0.1	10	10
K. pneumoniae	C3G	649	189	29.1	117	21	17.9	56	58
	CAR	649	31	4.8	117	1	0.9	17	18
E. cloacae	C3G	257	115	44.7	21	4	19.0	41	42
	CAR	257	7	2.7	21	0	0.0	5	5
P. mirabilis	C3G	137	1	0.7	44	1	2.3	2	2
	CAR	137	0	0.0	44	0	0.0	0	0
K. oxytoca	C3G	159	30	18.9	19	0	0.0	17	18
	CAR	159	2	1.3	19	0	0.0	2	2
K. aerogenes	C3G	99	41	41.4	4	0	0.0	23	24
	CAR	99	2	2.0	4	0	0.0	2	2
Serratia spp.	C3G	137	43	31.4	14	2	14.3	21	22
	CAR	137	7	5.1	14	1	7.1	5	5
Non-fermenting Gram-negative bacilli									
P. aeruginosa	CAR	441	63	14.3	45	12	26.7	33	34
A. baumannii	CAR	27	0	0.0	3	0	0.0	0	0
Acinetobacter spp.	CAR	98	0	0.0	6	0	0.0	0	0

C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem, doripenem); Gly, glycopeptides (vancomycin, teicoplanin); HABSI, hospital-associated bloodstream infection; Meti, Methicillin; N, total number MO; n, number resistant MO or number of hospitals; spp., species; %, percent resistant MO

Notes:

* Hospitals participate 1, 2, 3 or 4 quarters - includes all BSI (HABSI and non-HABSI)

14. ANTIMICROBIAL RESISTANCE BY REGION, ADDITIONAL DATA

Table 41: Resistance in microorganisms isolated from non-hospital-associated bloodstream infections by region, Belgium 2020

		Brussels			Flanders			Wallonia		
Microorganisms	**Antibiotics**	**N**	**n**	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Gram-positive cocci										
S. aureus	Meti	77	6	8	66	2	3	66	5	8
	Gly	77	0	0	66	1	2	66	0	0
All Enterococcus spp.	Gly	33	0	0	29	1	3	34	0	0
E. faecalis	Gly	25	0	0	13	0	0	24	0	0
E. faecium	Gly	7	0	0	15	1	7	9	0	0
Enterobacteriaceae	C3G	328	32	10	335	25	7	308	38	12
	CAR	328	1	0	335	0	0	308	2	1
E. coli	C3G	232	18	8	252	23	9	203	23	11
	CAR	232	0	0	252	0	0	203	1	0
K. pneumoniae	C3G	45	10	22	25	0	0	47	11	23
	CAR	45	1	2	25	0	0	47	0	0
E. cloacae	C3G	7	1	14	4	0	0	10	3	30
	CAR	7	0	0	4	0	0	10	0	0
P. mirabilis	C3G	15	1	7	12	0	0	17	0	0
	CAR	15	0	0	12	0	0	17	0	0
K. oxytoca	C3G	6	0	0	8	0	0	5	0	0
	CAR	6	0	0	8	0	0	5	0	0
K. aerogenes	C3G	2	0	0	2	0	0	0	0	0
	CAR	2	0	0	2	0	0	0	0	0
Serratia spp.	C3G	3	0	0	5	1	20	6	1	17
	CAR	3	0	0	5	0	0	6	1	17
Non-fermenting Gram-negative bacilli										
P. aeruginosa	CAR	18	6	33	13	2	15	14	4	29
A. baumannii	CAR	0	0	0	0	0	0	3	0	0
Acinetobacter spp.	CAR	1	0	0	2	0	0	3	0	0

C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem, doripenem); Gly, glycopeptides (vancomycin, teicoplanin); Meti, Methicillin; N, total number MO; n, number resistant MO; neg., negative; pos., positive; spp., species; %, percent resistant MO

Table 42: Hospitals with at least one resistant microorganism isolated from hospital-associated bloodstream infection by region, Belgium 2020

		Hospitals with >= one resistant case*					
		Brussels (N=12)		Flanders (N=50)		Wallonia (N=35)	
Microorganisms	Antibiotics	n	%	n	%	n	%
Gram-positive cocci							
S. aureus	Meti	6	50	16	32	16	46
	Gly	0	0	0	0	0	0
All Enterococcus spp.	Gly	2	17	11	22	6	17
E. faecalis	Gly	1	8	3	6	1	3
E. faecium	Gly	1	8	7	14	5	14
Enterobacteriaceae	C3G	10	83	44	88	28	80
	CAR	8	67	12	24	9	26
E. coli	C3G	8	67	34	68	22	63
	CAR	3	25	4	8	2	6
K. pneumoniae	C3G	8	67	22	44	22	63
	CAR	5	42	5	10	7	20
E. cloacae	C3G	7	58	18	36	15	43
	CAR	3	25	1	2	1	3
P. mirabilis	C3G	0	0	1	2	0	0
	CAR	0	0	0	0	0	0
K. oxytoca	C3G	2	17	10	20	5	14
	CAR	0	0	2	4	0	0
K. aerogenes	C3G	4	33	13	26	6	17
	CAR	2	17	0	0	0	0
Serratia spp.	C3G	2	17	9	18	8	23
	CAR	1	8	1	2	2	6
Non-fermenting Gram-negative bacilli							
P. aeruginosa	CAR	7	58	13	26	10	29
A. baumannii	CAR	0	0	0	0	0	0
Acinetobacter spp.	CAR	0	0	0	0	0	0

C3G, third generation cephalosporins (cefotaxime, ceftriaxone, ceftazidime); CAR, carbapenems (imipenem, meropenem, doripenem); Gly, glycopeptides (vancomycin, teicoplanin); Meti, Methicillin; N, number participating hospitals; n, number of hospitals reporting at least one resistant MO; R, resistant; spp., species

Note:

* Hospitals participate 1, 2, 3 or 4 quarters - includes all BSI (HABSI and non-HABSI)

CONTACT
Els Duysburgh • els.duysburgh@sciensano.be • T +32 2 642 57 44

MORE INFORMATION

Visit our website at http://www.nsih.be/surv_sep/beschrijving_nl.asp (Dutch version) or http://www.nsih.be/surv_sep/beschrijving_fr.asp (French version) or contact me at els.duysburgh@sciensano.be

Sciensano • Rue Juliette Wytsmanstraat 14 • 1050 Brussels • Belgium • T + 32 2 642 51 11 • T press + 32 2 642 54 20 • info@sciensano.be • **www.sciensano.be**

Responsible publisher(s): <First naam Last name>, Managing director • Rue Juliette Wytsmanstraat 14 • 1050 Brussels • Belgium • <D/xxxx/xxxx/xx>