

SURVEILLANCE OF ANTIMICROBIAL RESISTANT BACTERIA IN BELGIAN HOSPITALS

National report
Data up to and including 2023

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EXECUTIVE SUMMARY



Introduction

Antibiotics have been one of the most important life-saving drugs, but unnecessary and inappropriate use reduces their ability to treat infections. Some bacteria have become tolerant to certain antibiotics or have found ways to break them down. This phenomenon is called acquired antimicrobial resistance (AMR). The World Health Organization recognizes AMR as one of the top ten global health threats to humanity.

In order to follow up the national evolution of the resistance proportion and incidence of multidrug resistant organisms (MDRO) in Belgian hospitals, Sciensano collects and analyses AMR surveillance data. By Royal Decree, all Belgian acute care hospitals mandatorily have to participate in the surveillance of methicillin-resistant *Staphylococcus aureus* (MRSA) and multiresistant Gram-negative bacilli (MRGN). The surveillance of vancomycin-resistant enterococci (VRE) is one of four additional programs from which hospitals must choose one for participation.

This report presents the 2023 findings from the MRSA, MRGN, and VRE surveillance programs, highlighting trends in AMR across Belgian acute and chronic care hospitals.

Methods

Surveillance data for 2023 were retrospectively collected in 2024 by the microbiology laboratories and/or infection prevention and control teams of the participating hospitals. The data, aggregated at the hospital level, included either annual or semester-specific figures, except for the VRE surveillance, which required annual data exclusively.

Data from acute and chronic care hospitals were analyzed and presented separately. Acute care hospitals with an average length of stay of ≥ 16 days were reclassified as chronic care hospitals.

Following microorganisms and resistances were explored:

- o *Staphylococcus aureus* (*S. aureus*) resistant to methicillin or oxacillin
- o *Escherichia coli* (*E. coli*) and *Klebsiella pneumoniae* (*K. pneumoniae*) resistant to 3rd generation cephalosporins (3GC-R) and/or resistant to meropenem (mero-R)
- o Mero-R in *Acinetobacter baumannii* (*A. baumannii*)
- o Multidrug-resistant (MDR) *Pseudomonas aeruginosa* (*P. aeruginosa*), i.e. resistant to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin or levofloxacin), aminoglycosides (gentamicin, tobramycin or amikacin), carbapenems (meropenem or imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime or cefepime)
- o *Enterococcus* (*E.*) *faecalis* and *E. faecium* resistant to vancomycin (vanco-R)

Only hospitals that provided de-duplicated data, ensuring each patient was counted only once per hospitalization period (type D data), were included in the analyses. Unless otherwise specified (see MRSA details below), this report is based exclusively on data from clinical samples. Both invasive and non-invasive sample types (e.g., blood, urine) were included, yet faecal samples were considered as screening specimen and therefore excluded from the category of clinical samples.

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The potential healthcare-associated character was assessed for MRSA only. Healthcare-associated (HA-) MRSA was defined as either colonization or infection with MRSA considered to be acquired in the hospital (first positive sample for MRSA collected more than 48 hours after admission), not present on admission and not known from the patient's history (in the past 12 months).

For each species, the resistance proportion, incidence (number of cases per 1 000 hospitalisations) and/or incidence density (cases per 1 000 patient-days) were calculated.

Historical data were used to present the evolution of resistance proportions and incidence (densities). We fitted a negative binomial regression model with hospital as cluster and year as fixed effect to explore and assess statistically significant ($p < 0.05$) changes in the incidence. The result was expressed as incidence rate ratio (IRR) and its 95% confidence interval (CI). To assess whether trends observed in resistance proportions were statistically significant ($p < 0.05$), we used linear regression with hospital as cluster.

Data were analysed in STATA 17 (StataCorp LP, College Station, Texas, USA) and presented by region and level of specialty care within the hospital.

Results

The 2023 surveillance of antimicrobial resistance (AMR) in Belgian acute care hospitals presents both encouraging trends and areas of concern. Table 1 highlights resistance proportions and incidences per 1 000 hospitalisations for key bacteria under observation.

Table 1. Resistance proportion and incidence per 1 000 hospitalisations of the bacteria included in the surveillance of antimicrobial resistance (clinical samples only), Belgian acute care hospitals, 2023

		2023			
		Resistance proportion (%)		Incidence per 1 000 hospitalisations	
		Crude	Median	Crude	Median
<i>Staphylococcus aureus</i>	Methicillin R	8.8	8.4	1.36	1.20
Healthcare-associated <i>Staphylococcus aureus</i>	Methicillin R	24.1*	23.1*	0.33	0.23
<i>Enterococcus faecium</i>	Vancomycin R	1.89	0.00	0.091	0.000
<i>Enterococcus faecalis</i>	Vancomycin R	0.05	0.00	0.011	0.000
<i>Escherichia coli</i>	3GC-R	8.4	8.3	4.05	4.12
	Meropenem R	0.08	0.00	0.037	0.000
<i>Klebsiella pneumoniae</i>	3GC-R	17.6	16.8	2.00	1.80
	Meropenem R	1.07	0.35	0.121	0.044
<i>Acinetobacter baumannii</i>	Meropenem R	6.47	0.00	0.029	0.000
<i>Pseudomonas aeruginosa</i>	MDR	4.2	2.2	0.43	0.24

*Proportion healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) on total number of MRSA; R = resistant, 3GC = 3rd generation cephalosporins, MDR = resistance to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin or levofloxacin), aminoglycosides (tobramycin or amikacin), carbapenems (meropenem or imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime or cefepime)

Nearly all acute care hospital groups (97.1%, n=99/102) participated in the MRSA and MRGN surveillance, with an impressive 96.1% also contributing to the optional VRE surveillance.

A long-term decline in MRSA resistance proportions (-1.27% annually since 2004) and incidence (IRR=0.918; $p < 0.001$) reflects the success of interventions like targeted screening, decolonisation and hand hygiene

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campaigns. However, 2023 saw a reversal of this trend, with resistance proportions rising nationally, particularly in Wallonia and Brussels. Alarming, the proportion of HA-MRSA cases among all MRSA cases increased for the first time since 2010, from 16.1% in 2022 to 19.2% in 2023.

A total of 164 VRE cases were reported across all participating hospitals, with cases originating from 10 hospitals (9.3%). While resistance proportions show a gradual decline (-0.13% annually; $p=0.048$), incidence trends remain statistically nonsignificant.

In 2023, 8.4% of *E. coli* isolates were 3GC-R, with a crude incidence of 4.05 cases per 1 000 hospitalisations. A notable resistance proportion reduction has been observed since 2019 (-0.36% annually; $p<0.001$). However, no significant trends emerged over the entire surveillance period (2014–2023).

Reports of meropenem-resistant *E. coli* remained rare (0.08%) in 2023, with 67 cases across 35.2% of hospitals.

Resistance proportions of 3GC-R *K. pneumoniae* stood at 17.6% in 2023, with a crude incidence of 2.00 cases per 1 000 hospitalisations. A significant decline in resistance (-1.45% annually; $p<0.001$) and incidence (IRR=0.928; $p<0.001$) has been observed since 2018.

Cases of mero-R *K. pneumoniae* were reported in over half of hospitals (53.7%), with resistance proportion at 1.07% in 2023. Both resistance (-0.09% annually; $p=0.043$) and incidence (IRR=0.938; $p<0.001$) have significantly decreased since the start of surveillance.

In 2023, 21.3% of hospitals reported at least one case of mero-R *A. baumannii*, with resistance proportion at 6.47%. Although resistance trends remain unchanged, incidence has significantly decreased (IRR=0.942; $p=0.009$) since 2015.

Evolving definitions (2017–2023) complicate trend interpretation for MDR *P. aeruginosa*. In 2023, the resistance proportion was 4.2%, with a crude incidence of 0.43 cases per 1 000 hospitalisations.

Table 2. Resistance proportion and incidence density per 1 000 patient-days of the bacteria included in the surveillance of antimicrobial resistance (clinical samples only), Belgian chronic care hospitals, 2023

		2023			
		Resistance proportion (%)		Incidence per 1 000 patient-days	
		Crude	Median	Crude	Median
<i>Staphylococcus aureus</i>	Methicillin R	10.8	7.1	0.07	0.07
Healthcare-associated <i>Staphylococcus aureus</i>	Methicillin R	61.9*	33.3*	0.05	0.02
<i>Enterococcus faecium</i>	Vancomycin R	0.00	0.00	0.000	0.000
<i>Enterococcus faecalis</i>	Vancomycin R	0.00	0.00	0.000	0.000
<i>Escherichia coli</i>	3GC-R	10.5	8.4	0.26	0.23
	Meropenem R	0.07	0.00	0.002	0.000
<i>Klebsiella pneumoniae</i>	3GC-R	26.7	20.8	0.22	0.16
	Meropenem R	0.85	0.00	0.007	0.000
<i>Acinetobacter baumannii</i>	Meropenem R	0.00	0.00	0.000	0.000
<i>Pseudomonas aeruginosa</i>	MDR	2.9	0.0	0.02	0.00

*Proportion healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) on total number of MRSA; R = resistant, 3GC = 3rd generation cephalosporins, MDR = resistance to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin or levofloxacin), aminoglycosides (tobramycin or amikacin), carbapenems (meropenem or imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime or cefepime)

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Table 2 presents the resistance proportion and incidence density per 1 000 patient-days for bacteria under surveillance in Belgian chronic care hospitals in 2023. However, with only 13 or fewer hospitals participating, these findings should be interpreted with caution.

Recommendations

The 2023 report on AMR in Belgium presents findings from three national surveillance programs on MRSA, VRE, and MRGN, reflecting both progress and ongoing challenges.

While sustained declines in MRSA since 2004 indicate the general success of infection prevention and control (IPC) measures, a rise in resistance proportions and healthcare-associated cases in 2023 highlights the need for continued monitoring. Promising reductions in both 3GC-R *E. coli* and *K. pneumoniae*, as well as carbapenem-resistant *K. pneumoniae* demonstrate the effectiveness of IPC and stewardship programs, but maintaining these gains will require vigilance.

The BELMAP 2024 report underscores the importance of a One Health approach, addressing the interconnected roles of human, animal, and environmental health in AMR. Environmental factors - including hygiene and infection control practices across healthcare and agricultural settings as well as antimicrobial use in humans and animals - are highlighted as key contributors to the emergence and spread of resistance.

Surveillance gaps, particularly the lack of molecular data or clonal relatedness, are identified as limitations to a comprehensive response to carbapenem-resistant bacteria. Reintroducing carbapenemase-producing *Enterobacterales* (CPE) into national AMR surveillance is a critical priority, supported by advancements in diagnostic capabilities that now allow for more reliable detection. Surveillance specifically targeting CPE is essential, as reliance solely on carbapenem-resistant *Enterobacterales* (CRE) can lead to underdetection. For instance, OXA-48-producing strains may appear susceptible to meropenem, escaping identification if monitoring is based only on phenotypic resistance profiles rather than confirmed carbapenemase production.

Expanding the use of whole-genome sequencing (WGS) is another central focus. A proposed action for the 2025–2029 National Action Plan (NAP) AMR prioritizes integrating genome-based surveillance into national efforts, supported by platforms like be.Prepared. These systems will link genomic and epidemiological data, enabling cluster detection, outbreak response, and cross-sectoral collaborations. Such advancements are expected to enhance infection prevention, antimicrobial stewardship, and outbreak management across sectors.

The BELMAP report also calls for closing surveillance gaps by including data from other healthcare settings, such as primary care and long-term care facilities. Initiatives like the carriage study of multidrug resistant organisms (MDRO) in nursing homes, set for 2024–2025, aim to provide valuable insights into AMR trends in vulnerable populations. Enhancing participation from private laboratories in the Belgian branch of the European Antimicrobial Resistance Surveillance Network (EARS-BE) and conducting targeted studies are highlighted as short-term priorities for achieving more comprehensive national surveillance.

In conclusion, while Belgium has made significant progress in combating AMR, continued vigilance and adaptive strategies are essential to address emerging challenges. Strengthening surveillance, enhancing infection prevention and control and antimicrobial stewardship, and integrating genomic or spectrometric technologies to assess clonal relatedness and document transfer pathways (e.g. horizontal gene transfer) will be crucial in the fight against antimicrobial resistance in the coming years. The One Health approach remains pivotal in ensuring a comprehensive response across all sectors.

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ABBREVIATIONS



3GC	Third generation cephalosporins
3GC-R	Resistance to third generation cephalosporines
4GC	Fourth generation cephalosporins
<i>A. baumannii</i>	<i>Acinetobacter baumannii</i>
AMR	Antimicrobial resistance
AST	Antimicrobial susceptibility testing
CLSI	Clinical and Laboratory Standard Institute, USA
CPE	Carbapenemase-producing <i>Enterobacterales</i>
CRE	Carbapenem-resistant <i>Enterobacterales</i>
<i>E. coli</i>	<i>Escherichia coli</i>
<i>E. faecalis</i>	<i>Enterococcus faecalis</i>
<i>E. faecium</i>	<i>Enterococcus faecium</i>
EARS-BE	European Antimicrobial Resistance Surveillance in Belgium
EARS-Net	European Antimicrobial Resistance Surveillance Network
ESBL	Extended spectrum beta-lactamase
EUCAST	European Committee on Antimicrobial Susceptibility Testing
I	Susceptible, increased exposure (the former intermediate susceptibility category)
IPC	Infection prevention and control
IQR	Interquartile Range
IRR	Incidence Rate Ratio
I/R	Non-susceptible (intermediate susceptible or resistant)
<i>K. pneumoniae</i>	<i>Klebsiella pneumoniae</i>
MDR	Multidrug-resistant
Mero-R	Resistance to meropenem
MIC	Minimal inhibitory concentration
MRGN	Multiresistant Gram-negative bacteria
MRSA	Methicillin-resistant <i>Staphylococcus aureus</i>
NAP	National action plan
NGS	Next-generation sequencing
<i>P. aeruginosa</i>	<i>Pseudomonas aeruginosa</i>
R	Resistant or non-susceptible
<i>S. aureus</i>	<i>Staphylococcus aureus</i>
Type D	Data collection method with de-duplication of data: per period of hospitalisation and bacteria each patient is counted only once
Vanco-R	Resistance to vancomycin
VRE	Vancomycin-resistant enterococci
WGS	Whole-genome sequencing

INTRODUCTION



Antibiotics have revolutionized medicine, saving countless lives. However, their overuse and misuse undermine their effectiveness in treating infections. Over time, some bacteria have adapted to survive certain antibiotics or developed mechanisms to neutralize them, a phenomenon known as acquired antimicrobial resistance (AMR). The World Health Organization identifies AMR as one of the top ten global health threats to humanity. In addition to its significant health consequences, such as prolonged illness, disability, and increased mortality, AMR imposes a substantial economic burden. This includes costs associated with longer hospital stays and the use of more expensive treatments.¹

The service “Healthcare-associated infections and antimicrobial resistance” of Sciensano organizes, collects and analyzes AMR surveillance data originating from Belgian hospitals. The Royal Decree of [25 April 2002](#) on the establishment and liquidation of the budget of financial resources of hospitals, Art 56, Par 2, amended on [8 January 2015](#) and [10 September 2020](#), stipulates that all Belgian general hospitals - with the exception of Sp hospitals for palliative care – mandatorily have to participate in the surveillance of methicillin-resistant *Staphylococcus aureus* (MRSA) and multiresistant Gram-negative bacteria (MRGN). In addition, these hospitals have to participate in at least one of four optional surveillance programs: vancomycin-resistant enterococci (VRE), *Clostridioides difficile* infections, surgical site infections, or healthcare-associated infections in intensive care units. *Note:* Due to the COVID-19 pandemic, hospitals were exempt from mandatory MRSA and MRGN surveillance in 2020 and 2021, which impacted participation rates and potentially affected the surveillance data for 2019 and 2020.

The first national surveillance program for MRSA was initiated in 1994. This resistant Gram-positive bacterium causes difficult to treat infections, such as skin and soft tissue infections, surgical site infections, catheter-related infections, bloodstream infections and pneumonia. Initially voluntary, participation in this surveillance became mandatory in 2006.

The second MRGN surveillance was set up in the late 1990s following the emergence of antimicrobial resistance in a wide range of *Enterobacteriaceae* as well as in nonfermenting Gram-negative bacteria (e.g. *Pseudomonas aeruginosa*, *Acinetobacter baumannii*). Multiresistant *Enterobacter aerogenes* (later reclassified as *Klebsiella aerogenes*) was the first within the family of *Enterobacteriaceae* to be monitored (started in 2000, stopped in 2011) due to major healthcare-associated outbreaks with a subsequent endemic character in many Belgian hospitals. Because of the increased prevalence and incidence of extended-spectrum beta-lactamases (ESLBs) reported locally by several Belgian hospitals, this surveillance program was subsequently extended to several other *Enterobacteriaceae* species, including *Escherichia coli* (2005), *Klebsiella pneumoniae* (2005) and *Enterobacter cloacae* (2009, stopped in 2017), as well as to nonfermenting Gram-negative bacteria (*Pseudomonas aeruginosa* and *Acinetobacter baumannii*). In 2015, with the rise of carbapenem-resistant and carbapenemase-producing *Enterobacteriaceae* (CRE and CPE), participation in the MRGN surveillance became mandatory.

The third program, VRE, was initiated in 2014 after multiple Belgian hospitals reported VRE outbreaks.

The primary objective of the three epidemiological AMR surveillance programs is to monitor trends in resistance proportions and the incidence of (multi)drug-resistant bacteria in Belgian hospitals, thereby establishing comprehensive national data on these microorganisms. A secondary objective is to encourage participating hospitals to track and analyse their own results over time, including benchmarking their performance. However, data collection is not an end in itself. The ultimate goal is to guide and support targeted interventions to prevent and control antimicrobial resistance based on these insights.

The aim of this report is to present the 2023 results of the three AMR surveillance programs and to describe trends in AMR in Belgian acute and chronic care hospitals.

METHODOLOGY



The surveillance results were collected and reported by the microbiology laboratories and/or the infection prevention and control teams of the participating hospitals to the service “Healthcare-associated infections and antimicrobial resistance” of Sciensano. The detailed modalities of the data collection for the AMR surveillance can be found in the study protocol.²

The data (year 2023) were collected retrospectively in the following year and were aggregated at hospital level. Hospitals could either provide annual figures or data for one semester, except for the VRE surveillance for which only annual data were allowed.

Following microorganisms and resistances were explored:

- o **MRSA** ***Staphylococcus aureus*** (*S. aureus*) resistant to methicillin or oxacillin (determined as resistant to ceftazidime according to EUCAST)

- o **MRGN** 1) *Enterobacterales*:
 Escherichia coli (*E. coli*) and ***Klebsiella pneumoniae*** (*K. pneumoniae*)
 - a) Resistance (R) to 3rd generation cephalosporines (cefotaxime, ceftriaxone, or ceftazidime) (3GC-R)
 - b) Resistance to meropenem (mero-R)

- 2) Mero-R ***Acinetobacter baumannii*** (*A. baumannii*):

- 3) Multidrug-resistant (MDR) ***Pseudomonas aeruginosa*** (*P. aeruginosa*):
Resistance (R) to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin or levofloxacin), aminoglycosides (tobramycin or amikacin), carbapenems (meropenem or imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, cefepime)

- o **VRE** ***Enterococcus faecalis*** (*E. faecalis*) and ***Enterococcus faecium*** (*E. faecium*) resistant to vancomycin (vanco-R)

Note: In 2019, EUCAST (the European Committee on Antimicrobial Susceptibility Testing) revised the definition of the intermediate (I) category in antimicrobial susceptibility testing. Previously, “I” stood for “intermediate,” implying uncertain clinical efficacy. However, the updated definition reinterprets “I” as “Susceptible, Increased exposure”, indicating that the infection can still be treated effectively if the antimicrobial agent is used at a higher dose, increased frequency, or through optimized delivery to achieve sufficient exposure at the infection site. This change aims to improve clinical decision-making by encouraging the use of optimized dosing regimens rather than defaulting to broader-spectrum or last-resort antibiotics. It can however also have implications for surveillance, as shifts in susceptibility reporting may affect trend analyses and interpretation of resistance data over time.

All sample types (e.g. blood, urine) had to be included. For MRSA and VRE, a distinction had to be made between clinical samples (i.e. all samples taken for diagnostic purposes) and screening samples (i.e. samples taken - in the absence of clinical signs/symptoms - to detect colonization with resistant bacteria). **Faecal samples could not be considered as clinical samples in the MRGN and VRE surveillance programs**, but had to be considered as screening samples.

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There were five possibilities for data collection:

- Type A: every positive sample was counted (screening samples and duplicates included)
- Type B: every positive clinical sample was counted (duplicates included)
- Type C: each sample originating for a different infection site was counted only once
- Type D: each patient was counted only once per period of hospitalisation (de-duplication)
- Type E: other

Duplicates were defined as isolates of the same species from the same patient with indistinguishable antibiograms or with the same resistance mechanism, regardless of the purpose for which the sample was taken.

Only hospitals providing Type D data (with de-duplication) were included in the analyses reported here.

The healthcare-associated character was explored for MRSA only. Healthcare-associated (or nosocomial) MRSA was defined as colonization or infection with MRSA, considered to be acquired in the hospital and not present on admission (first positive sample collected more than 48h after admission) or known in the patient's history (past 12 months).

Results are presented by hospital type (acute or chronic care hospitals), by region (Flanders, Wallonia or Brussels), and by level of specialty care within the hospital site (not of the merger). The latter is defined as follows:

Level of specialty care	Definition ECDC ³	Definition FPS ⁴
Primary	- Often referred to as 'district hospital' or 'first-level' referral - Few specialities (mainly internal medicine, obstetrics-gynaecology, paediatrics, general surgery or only general practice) - Limited laboratory services for general, but not specialised, pathological analysis - Often corresponds to general hospital without teaching function	- Algemeen ziekenhuis - Hôpital général - Allgemein Krankenhaus
Secondary	- Often referred to as 'provincial hospital' or 'second-level referral' - The hospital is highly differentiated by function with five to ten clinical specialities, such as haematology, oncology, nephrology, ICU - Takes some referrals from other (primary) hospitals - Often corresponds to general hospital with teaching function/mission	- Algemeen ziekenhuis met universitair karakter - Hôpital général à caractère universitaire - Algemeen ziekenhuis met universitair karakter - Hôpital général à caractère universitaire
Tertiary	- Often referred to as 'central', 'regional' or 'tertiary-level' hospital - Highly specialised staff and technical equipment (ICU, haematology, transplantation, cardio-thoracic surgery, and neurosurgery) - Clinical services are highly differentiated by function - Specialised imaging units - Provides regional services and regularly takes referrals from other (primary and secondary) hospitals - Often a university hospital or associated to a university	- Universitair ziekenhuis - Hôpital universitaire - Universitair ziekenhuis - Hôpital universitaire
Specialised	- Single clinical specialty, possibly with sub-specialties - Highly specialised staff and technical equipment	- Gespecialiseerd ziekenhuis - Geriatrisch- & Specialised - Hôpital spécialisé - Psychiatrisch ziekenhuis - Hôpital psychiatrique

ECDC = European Centre for Disease Prevention and Control; FPS = Federal Public Service Health, Food Chain Safety and Environment, ICU: intensive care unit

For each bacterium, the resistance proportion was calculated by dividing the total number of resistant isolates by the total number of isolates reported by the hospital during the surveillance period. In addition, the incidence (number of cases per 1 000 hospitalisations) and incidence density (cases per 1 000 patient-days) were calculated

METHODOLOGY

for each resistant bacteria under surveillance and this by dividing the total number of resistant isolates by the total number of hospitalisations or patient-days reported by the hospital during the surveillance period.

Denominator data (hospitalisations and patient-days) are the same for all surveillances coordinated by the service “Healthcare-associated infections and antimicrobial resistance” of Sciensano. These data are collected via a separate module on the Healthdata platform. For this purpose, the official definitions from the Belgian hospital administrations nomenclature (*résumé hospitalier minimal/minimale ziekenhuisgegevens -RHM/MZG*) are used. Nonetheless, in this system, hospitalisations are recorded based on discharge rather than admission, which impacts the registration of denominator data previously collected differently. Additionally, RHM/MZG operates on a biannual registration basis, while denominator data for surveillance are recorded monthly. Therefore, the RHM/MZG figures must be broken down by month to which they relate. More detailed information is available elsewhere.⁵

Following summary statistics were used in this report:

- Crude:
 - Crude resistance proportion: total number of bacterium X with resistance Y divided by the total number of bacterium X multiplied by 100
 - Crude incidence: total number of bacterium X with resistance Y divided by the total number of hospitalisations multiplied by 1 000
 - Crude incidence density: total number of bacterium X with resistance Y divided by the total number of patient-days multiplied by 1 000
- Mean: The sum of all scores (i.e. crude resistance proportions or crude incidences) divided by the number of scores
- Median (or P50): the middle score (i.e. crude resistance proportion or crude incidence) when scores are ranked in ascending/descending order
- P25 (or Q1, first quartile): the 25th percentile is the score (i.e. crude resistance proportion or crude incidence) below which 25% of the cases fall
- P75 (or Q3, third quartile): the 75th percentile is the score (i.e. crude resistance proportion or crude incidence) below which 75% of the cases fall
- Between P25 and P75 lies half of all scores (= interquartile range (IQR) = P75 - P25)

Because the median is less affected by outliers (e.g. hospitals experiencing an outbreak) and skewed data (e.g. many hospitals reporting zero resistance cases) than the mean, we recommended hospitals to use the median as the preferred measure of central tendency for benchmarking.

Historical data were used to present the evolution of resistance proportions and incidence (densities). To assess whether trends observed in resistance proportions were statistically significant ($p < 0.05$), we used linear regression with hospital as cluster. We fitted a negative binomial regression model with hospital as cluster and year as fixed effect to explore and assess statistically significant ($p < 0.05$) changes in the incidence (density). The result was expressed as incidence rate ratio (IRR) and its 95% confidence interval (CI). An IRR of 1.20 means an 20% increase in the incidence, while a IRR of 0.80 points to a 20% decrease.

Data were analysed in STATA 17 (StataCorp LP, College Station, Texas, USA).

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Hospitals that were part of an administrative hospital group could choose to participate as one hospital or to collect data by hospital site. Results were presented separately for acute care and chronic care hospitals. **In this report, acute care hospitals with an average length of stay of more than 16 days were considered as chronic care hospitals.**

The results presented in this report can slightly differ from the numbers reported in previous reports. Some hospitals modify or correct their data after publication of a report.

PART 1: METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA)

In 2023, 97.1% (n=99/102) of all acute care hospital administrative groups (mergers) participated in the MRSA surveillance with at least one hospital site. Two hospital administrative groups were considered as chronic care hospitals (length of stay > 16 days).

Table 3 summarizes the 2023 participation in MRSA surveillance, categorized by hospital care type, region, and level of specialty care. One hospital was excluded from the analysis due to the absence of Type D data.

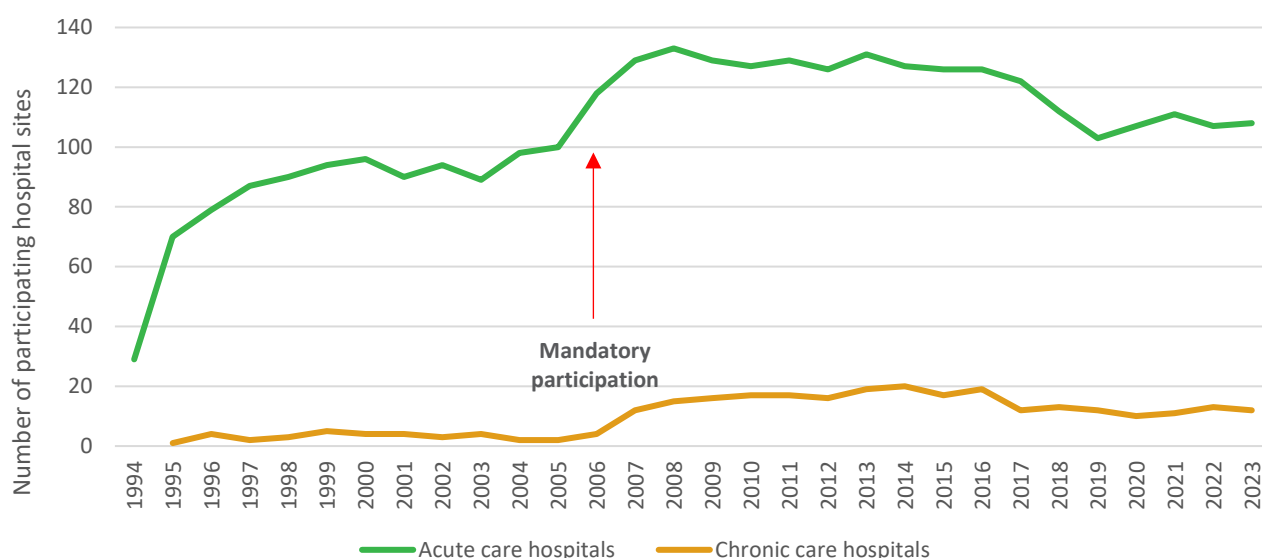
Table 3. Participation in the surveillance of methicillin-resistant *Staphylococcus aureus* D data by hospital care type, region and level of specialty care within the hospital (for acute care hospitals only), Belgian acute and chronic care hospital sites, 2023 (Type D data only)

	2023			
	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals	57	38	13	108
Primary hospitals	46	28	7	81
Secondary hospitals	8	9	3	20
Tertiary hospitals	3	1	3	7
N of chronic care hospitals	5	6	1	12

N = number

Figure 1 illustrates the number of participating hospital sites since the beginning of the surveillance (1994). Over the years, the number of participating hospital sites has decreased, primarily due to mergers resulting in site closures or hospitals opting to participate in surveillance as a merged entity. Due to the COVID-19 pandemic, hospitals were exempt from mandatory MRSA and MRGN surveillance in 2020 and 2021, which impacted participation rates for 2019 and 2020.

Figure 1. Evolution of the participation in the surveillance of methicillin-resistant *Staphylococcus aureus* (MRSA) based on the resistance proportion indicator, Belgian acute and chronic care hospital sites, 1994-2023



1. MRSA in acute care hospitals

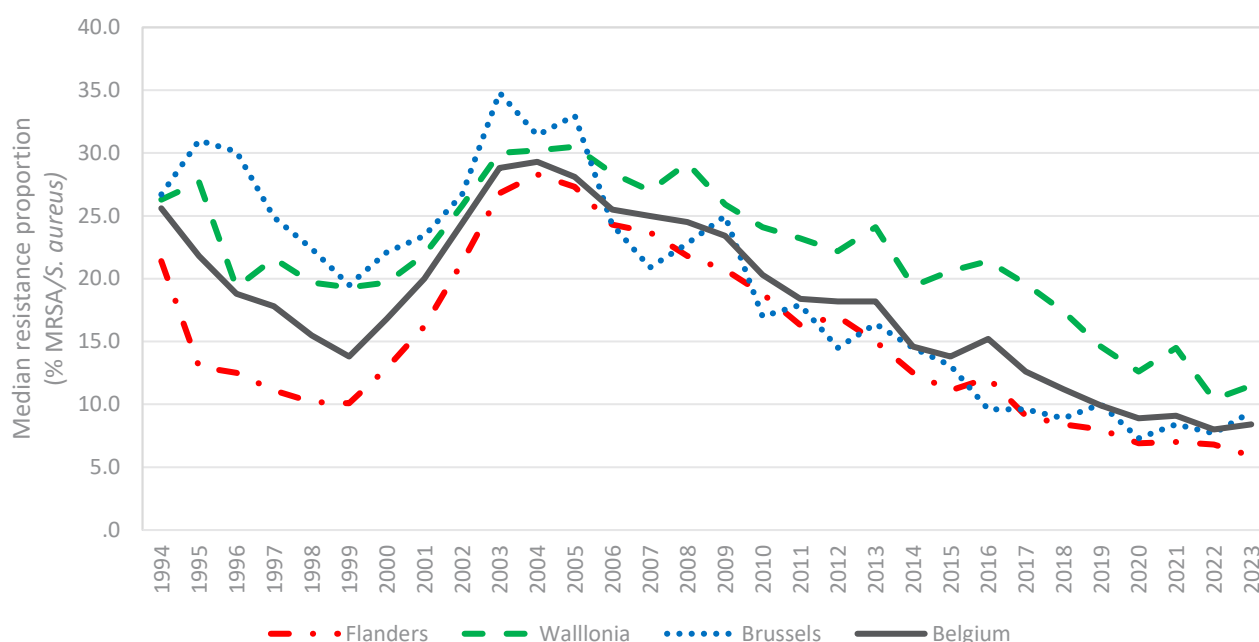
1.1 RESISTANCE IN *STAPHYLOCOCCUS AUREUS*

In 2023, 8.8% of all *S. aureus* isolates (from clinical samples only) were MRSA. The crude incidence of MRSA was 1.36 cases per 1 000 hospitalisations or 0.22 cases per 1 000 patient-days (Table 4).

Figures 2, 3, and 4 show the evolution of the median resistance proportion, incidence, and incidence density, respectively, both overall and by region. Since 2004, there has been a notable decreasing trend in both the resistance proportion (-1.27% per year; $p < 0.001$) and the incidence of MRSA (IRR=0.918, 95% CI: 0.911–0.925, $p < 0.001$).

The evolution of the median resistance proportion and incidence (per 1 000 hospitalisations) of MRSA by level of specialty care is available in the Annex (Figures A1–A2).

Figure 2. Evolution of the median proportion of methicillin-resistant *Staphylococcus aureus* (MRSA) on the total number of reported *S. aureus* by region (clinical samples only), Belgian acute care hospitals, 1994-2023



PART 1. METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA)

Table 4. Resistance proportion, incidence and incidence density of methicillin-resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2023

	n	N	MRSA (clinical samples only)			
			Crude	Mean	Median	P25 - P75
Resistance proportion (%)						
Belgium	2 485	28 349	8.8	9.3	8.4	5.4-11.7
Flanders	1 011	14 974	6.8	6.8	5.9	3.8-8.5
Wallonia	1 047	9 036	11.6	12.9	11.5	8.3-15.8
Brussels	427	4 339	9.8	10.2	9.4	8.4-10.5
Primary hospitals	1 503	17 589	8.5	9.4	8.1	5.0-11.7
Secondary hospitals	474	5 335	8.9	9.2	9.2	5.9-12.9
Tertiary hospitals	508	5 425	9.4	8.9	8.5	6.5-9.3
Incidence per 1 000 hospitalisations						
Belgium	2 485	1 821 958	1.36	1.53	1.20	0.70-1.91
Flanders	1 011	1 087 367	0.93	0.95	0.82	0.44-1.26
Wallonia	1 047	512 289	2.04	2.21	1.85	1.29-2.75
Brussels	427	222 302	1.92	2.10	1.41	0.97-2.32
Primary hospitals	1 503	1 115 909	1.35	1.54	1.18	0.65-1.91
Secondary hospitals	474	440 749	1.08	1.39	0.96	0.85-2.08
Tertiary hospitals	508	265 300	1.91	1.88	1.56	1.34-1.73
Incidence density per 1 000 patient-days						
Belgium	2 485	11 265 100	0.22	0.24	0.18	0.11-0.31
Flanders	1 011	6 313 783	0.16	0.16	0.13	0.08-0.21
Wallonia	1 047	3 290 412	0.32	0.34	0.29	0.20-0.45
Brussels	427	1 660 905	0.26	0.26	0.19	0.16-0.30
Primary hospitals	1 503	6 807 709	0.22	0.24	0.19	0.10-0.31
Secondary hospitals	474	2 664 906	0.18	0.20	0.17	0.13-0.30
Tertiary hospitals	508	1 792 485	0.28	0.28	0.25	0.16-0.29

n = total number of methicillin-resistant *Staphylococcus aureus* (MRSA) isolates, N = total number of *Staphylococcus aureus* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

PART 1. METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA)

Figure 3. Evolution of the median incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 hospitalisations by region (clinical samples only), Belgian acute care hospitals, 1994-2023

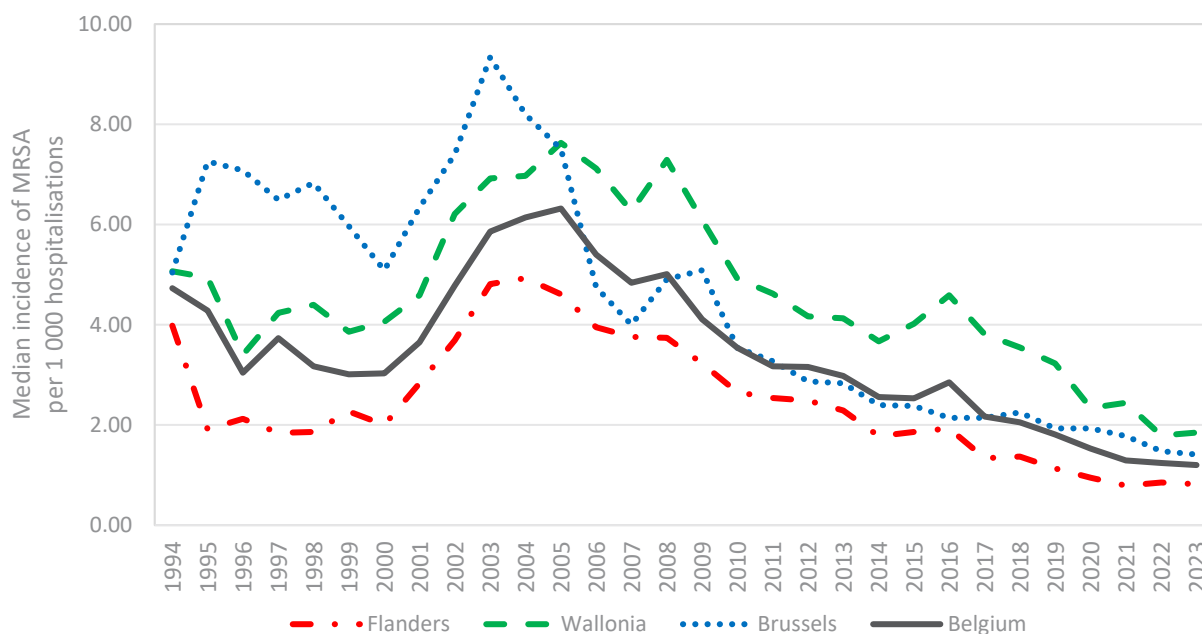
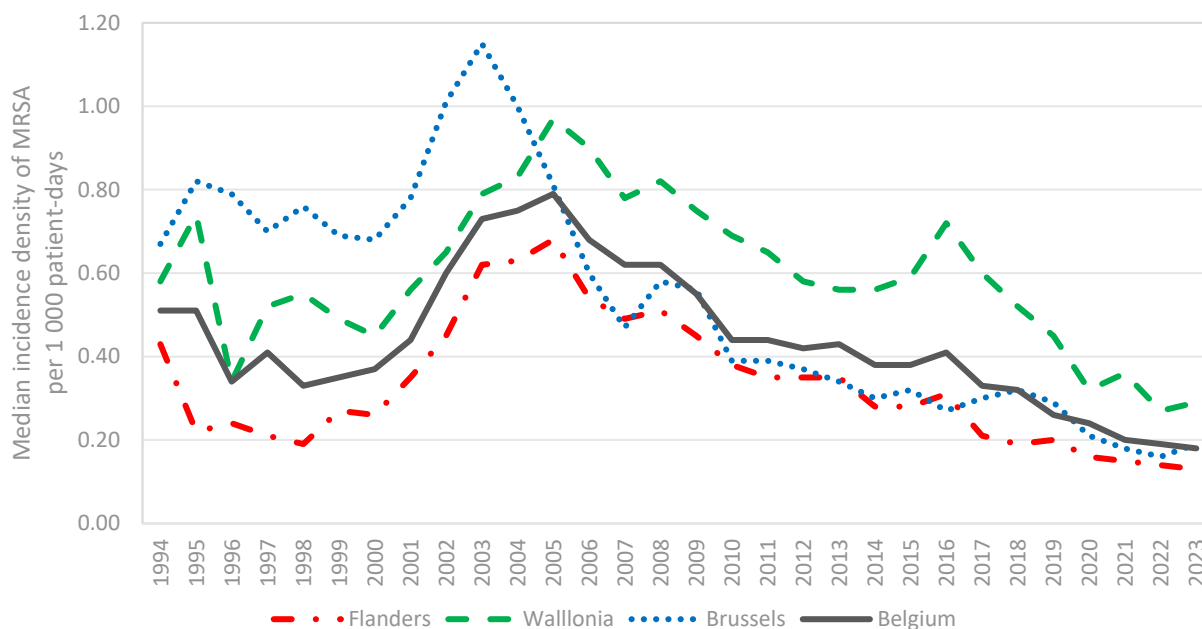


Figure 4. Evolution of the median incidence density of methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 patient-days by region (clinical samples only), Belgian acute care hospitals, 1994-2023

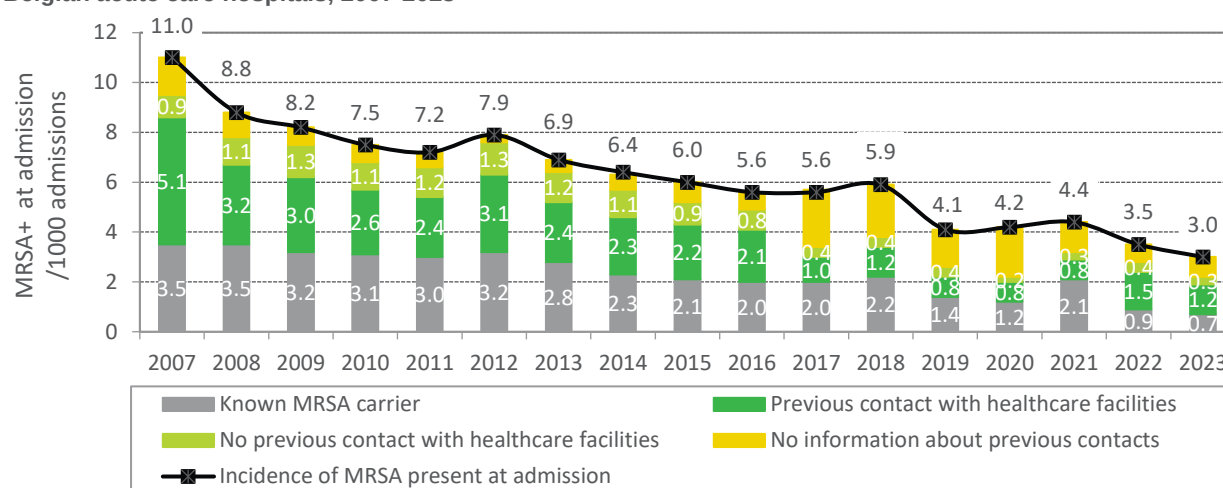


1.2 MRSA PRESENT AT ADMISSION

The incidence of patients who were MRSA-positive on admission (optional data) could only be calculated for 11 acute care hospitals in 2023. Both clinical and screening samples that tested positive for MRSA within 48 hours after admission were considered.

The crude incidence of MRSA-positive patients on admission was 3.0 cases per 1 000 hospitalisations (n=681 /228 235 hospitalisations) in 2023 (Figure 5).

Figure 5. Evolution of the crude incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) present at admission according to history of colonization and previous contact (past 12 months) with healthcare facilities, Belgian acute care hospitals, 2007-2023



In 2023, 22.0% of patients who tested MRSA-positive upon admission (n=150/681) had a known history of MRSA colonization or infection in the previous 12 months. Of the patients without such a history (n=531), 50.7% (n=269) had recently been transferred to or had a recent stay in a healthcare facility (e.g., acute care hospital, day care hospital, nursing home). For 14.7% of patients (n=78), no contact with healthcare facilities in the previous 12 months was reported, while for 34.7% (n=184), information on prior healthcare facility contact was unknown.

1.3 HEALTHCARE-ASSOCIATED MRSA

1.3.1 HEALTHCARE-ASSOCIATED MRSA IN CLINICAL SAMPLES

In 2023, 24.1% of all MRSA-positive clinical samples were collected more than 48 hours after admission from patients with no known MRSA carriage in the past 12 months, representing cases of healthcare-associated (HA-)MRSA. The crude incidence of HA-MRSA was 0.33 cases per 1 000 hospitalisations or 0.05 cases per 1 000 patient-days (Table 5).

Figures 6 and 7 show the evolution of these indicators (incidence and incidence density), respectively. Since 2004, the incidence of HA-MRSA has shown a consistent decreasing trend (IRR=0.880, 95% CI: 0.877–0.883; p<0.001). The evolution of the median incidence (per 1 000 hospitalisations) of HA-MRSA by level of specialty care is shown in the Annex (Figure A3).

PART 1. METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA)

Table 5. Proportion, incidence and incidence density of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2023

	Healthcare-associated MRSA (clinical samples only)					
	n	N	Crude	Mean	Median	P25 - P75
Proportion healthcare-associated MRSA/MRSA (%)						
Belgium	599	2 485	24.1	25.9	23.1	13.9-35.7
Flanders	217	1 011	21.5	24.2	21.4	12.5-33.3
Wallonia	263	1 047	25.1	25.4	26.2	14.3-35.0
Brussels	119	427	27.9	34.9	30.0	15.4-52.8
Primary hospitals	323	1 503	21.5	24.4	20.6	13.6-33.3
Secondary hospitals	173	474	36.5	33.7	30.2	20.5-49.2
Tertiary hospitals	103	508	20.3	21.2	17.8	14.6-25.0
Incidence per 1 000 hospitalisations						
Belgium	599	1 821 958	0.33	0.36	0.23	0.13-0.45
Flanders	217	1 087 367	0.20	0.18	0.16	0.10-0.24
Wallonia	263	512 289	0.51	0.53	0.42	0.24-0.68
Brussels	119	222 302	0.54	0.67	0.60	0.34-0.78
Primary hospitals	323	1 115 909	0.29	0.32	0.20	0.12-0.42
Secondary hospitals	173	440 749	0.39	0.51	0.41	0.22-0.59
Tertiary hospitals	103	265 300	0.39	0.36	0.34	0.23-0.43
Incidence density per 1 000 patient-days						
Belgium	599	11 265 100	0.05	0.06	0.04	0.02-0.07
Flanders	217	6 313 783	0.03	0.03	0.03	0.02-0.04
Wallonia	263	3 290 412	0.08	0.08	0.07	0.04-0.10
Brussels	119	1 660 905	0.07	0.09	0.07	0.04-0.09
Primary hospitals	323	6 807 709	0.05	0.05	0.04	0.02-0.07
Secondary hospitals	173	2 664 906	0.06	0.07	0.06	0.04-0.09
Tertiary hospitals	103	1 792 485	0.06	0.05	0.05	0.04-0.06

n = total number of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) isolates, N = total number of MRSA isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

Figure 6. Evolution of the median incidence of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 hospitalisations by region (clinical samples only), Belgian acute care hospitals, 1994-2023

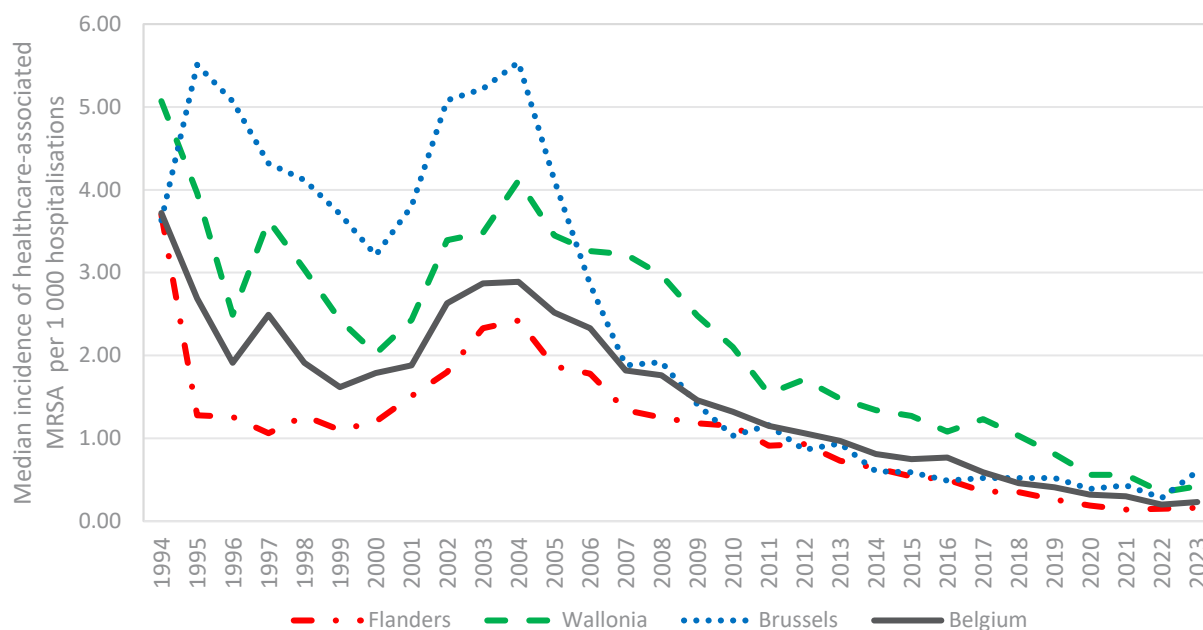


Figure 7. Evolution of the median incidence density of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 patient-days by region (clinical samples only), Belgian acute care hospitals, 1994-2023

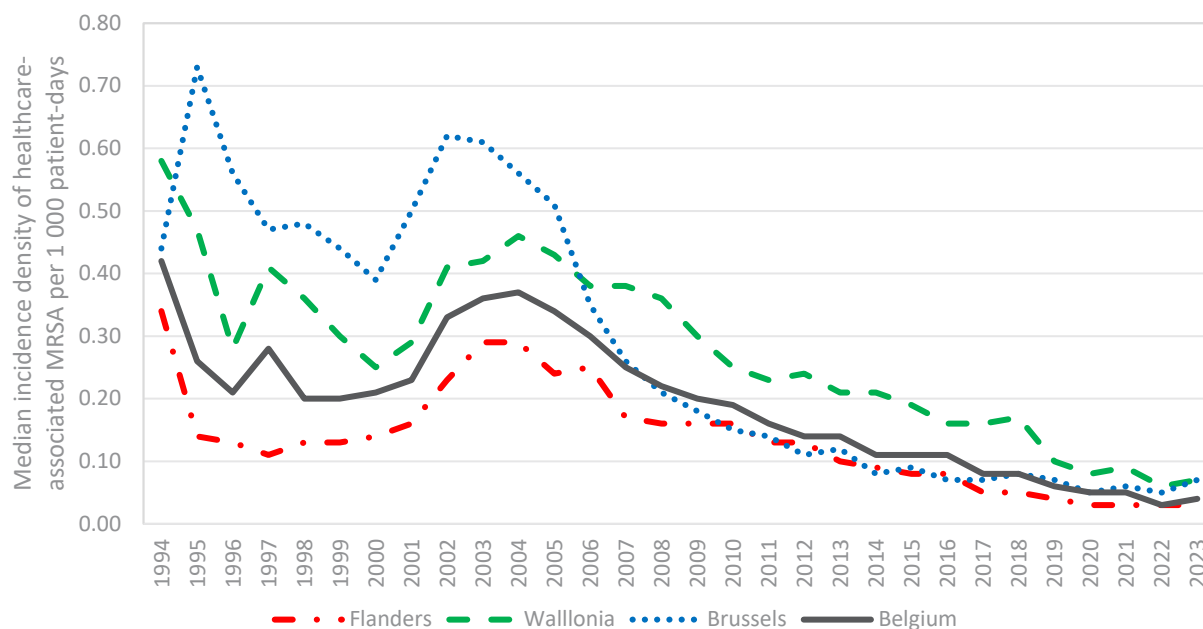
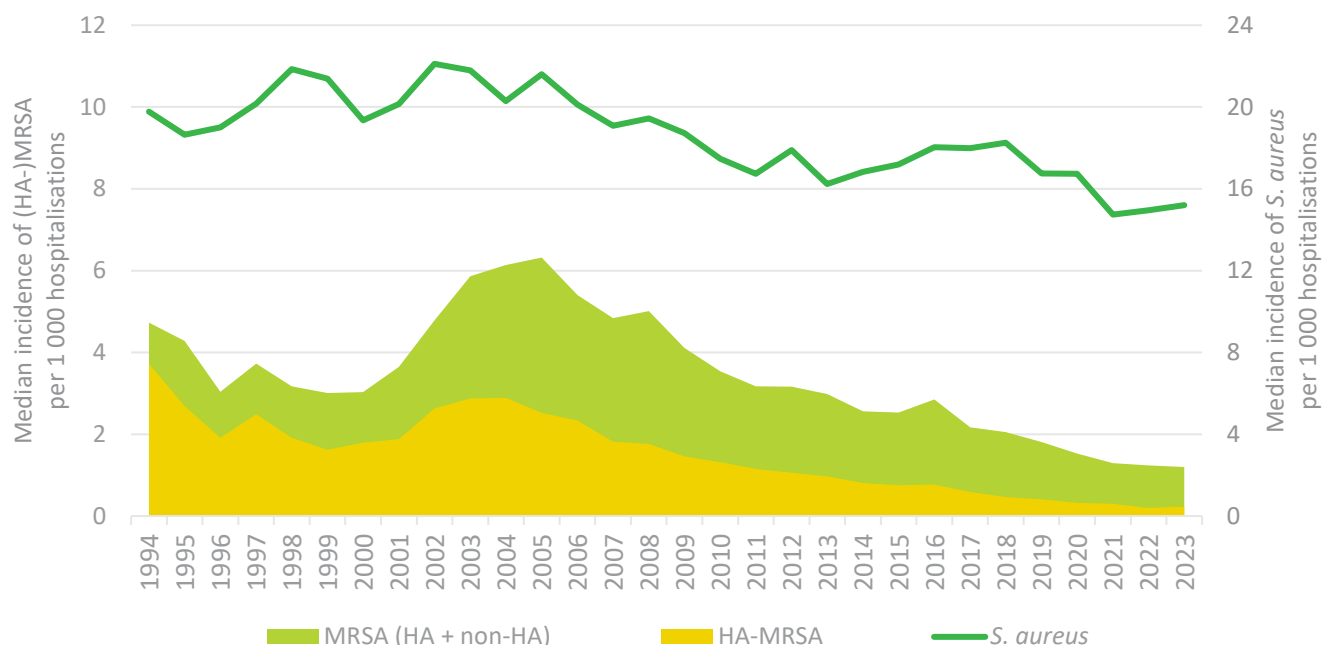


Figure 8 illustrates the overall evolution of the median incidence of *S. aureus*, MRSA, and HA-MRSA. Thanks to the combined efforts of infection prevention and control teams, as well as a range of actions—including recommendations for preventing MRSA transmission, more targeted screening policies, decolonisation and consecutive hand hygiene campaigns—the proportion of HA-MRSA among all MRSA cases decreased from 78.8% in 1994 (when surveillance began) to 39.8% in 2005 (the peak year for MRSA incidence) and 43.1% in 2006 (the year the surveillance became mandatory). Nonetheless, for the first time since 2010, this proportion increased again, rising from 16.1% in 2022 to 19.2% in 2023.

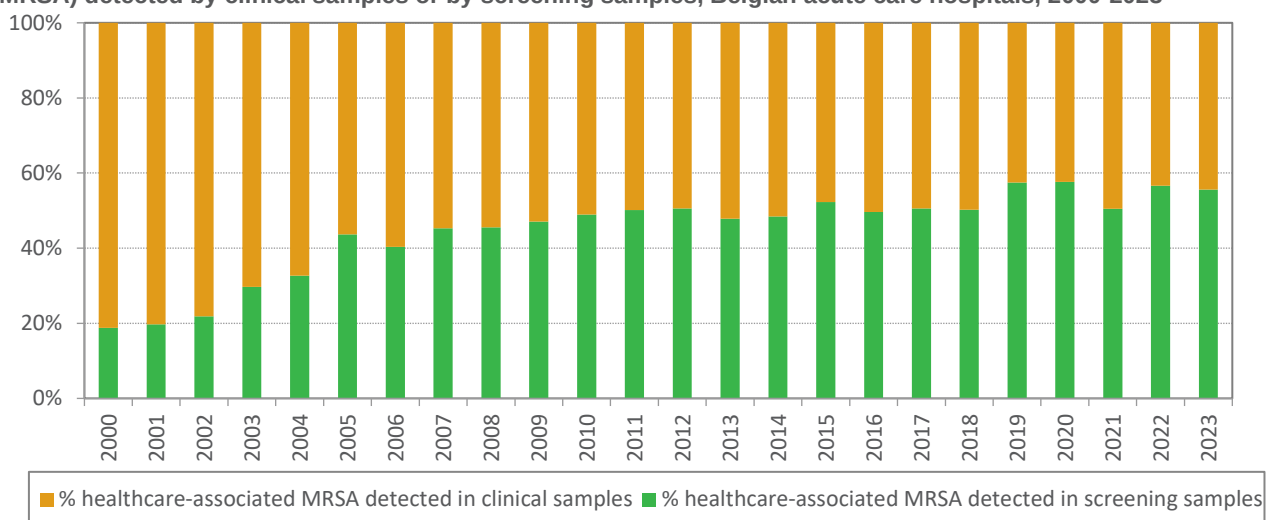
Figure 8. Evolution of the median incidence of *Staphylococcus (S.) aureus*, methicillin-resistant *S. aureus* (MRSA) and healthcare-associated (HA-)MRSA per 1 000 hospitalisations (clinical samples only), Belgian acute care hospitals, 1994-2023



1.3.2 HEALTHCARE-ASSOCIATED MRSA IN SCREENING SAMPLES

In 2023, 750 screening samples were reported as MRSA-positive more than 48 hours after admission. The proportion of HA-MRSA cases detected through screening (55.6%) was similar to the proportion found in 2022 (56.6%) (Figure 9).

Figure 9. Evolution of the crude proportion of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) detected by clinical samples or by screening samples, Belgian acute care hospitals, 2000-2023



2. MRSA in chronic care hospitals

2.1 RESISTANCE IN *STAPHYLOCOCCUS AUREUS*

The crude proportion of MRSA on the total number of reported *S. aureus* was 10.8% in 2023 (Table 6).

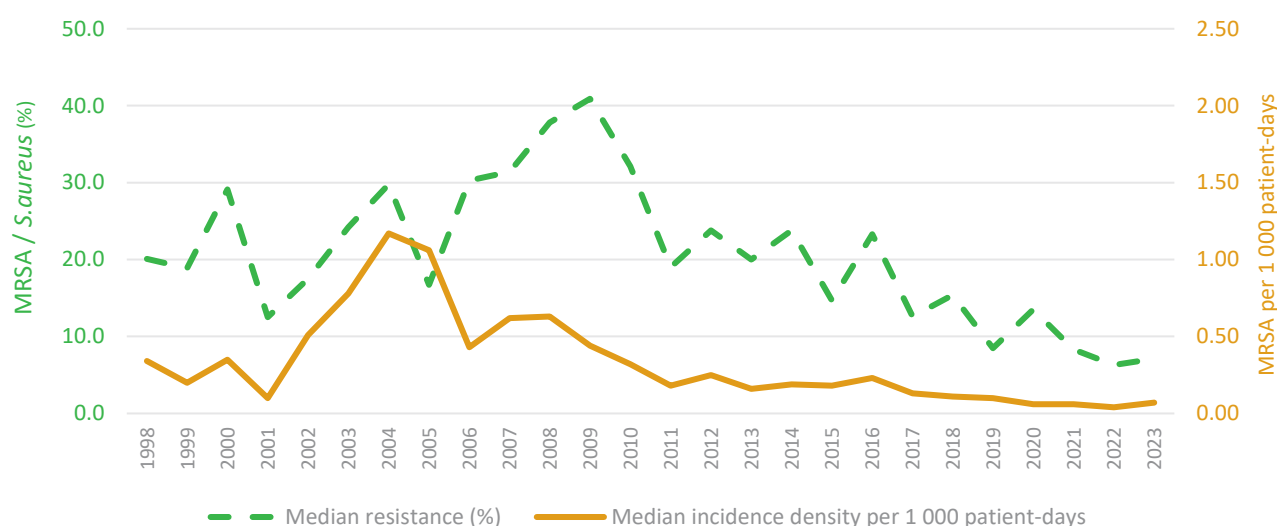
Table 6. Resistance proportion, incidence and incidence density of methicillin-resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region, Belgian chronic care hospitals, 2023

	n	N	MRSA (clinical samples only)			
			Crude	Mean	Median	P25 - P75
Resistance proportion (%)						
Belgium	43	398	10.8	12.4	7.1	1.7-17.8
Flanders	11	125	8.8	12.6	5.3	3.4-11.4
Wallonia	28	262	10.7	8.3	7.1	0.0-14.6
Brussels	4	11	36.4	-	-	-
Incidence per 1 000 hospitalisations						
Belgium	43	18 229	2.36	2.33	2.18	0.00-3.78
Flanders	11	5 770	1.91	2.06	2.23	0.66-3.45
Wallonia	28	11 738	2.39	1.98	1.61	0.00-2.48
Brussels	4	721	5.55	-	-	-
Incidence density per 1 000 patient-days						
Belgium	43	585 108	0.07	0.08	0.07	0.01-0.14
Flanders	11	202 903	0.05	0.06	0.05	0.02-0.10
Wallonia	28	343 963	0.08	0.09	0.08	0.00-0.19
Brussels	4	38 242	0.10	-	-	-

n = total number of methicillin-resistant *Staphylococcus aureus* (MRSA) isolates, N = total number of *Staphylococcus aureus* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

The overall evolution of the median MRSA resistance proportion and incidence density is shown in Figure 10.

Figure 10. Evolution of the median resistance proportion and incidence density per 1 000 patient-days of methicillin-resistant *Staphylococcus aureus* (MRSA; clinical samples only), Belgian chronic care hospitals, 1998-2023



2.2 HEALTHCARE-ASSOCIATED MRSA

In 2023, 61.9% of all MRSA isolated from clinical samples were classified as healthcare-associated (Table 7). The crude incidence density of HA-MRSA was 0.05 cases per 1 000 patient-days.

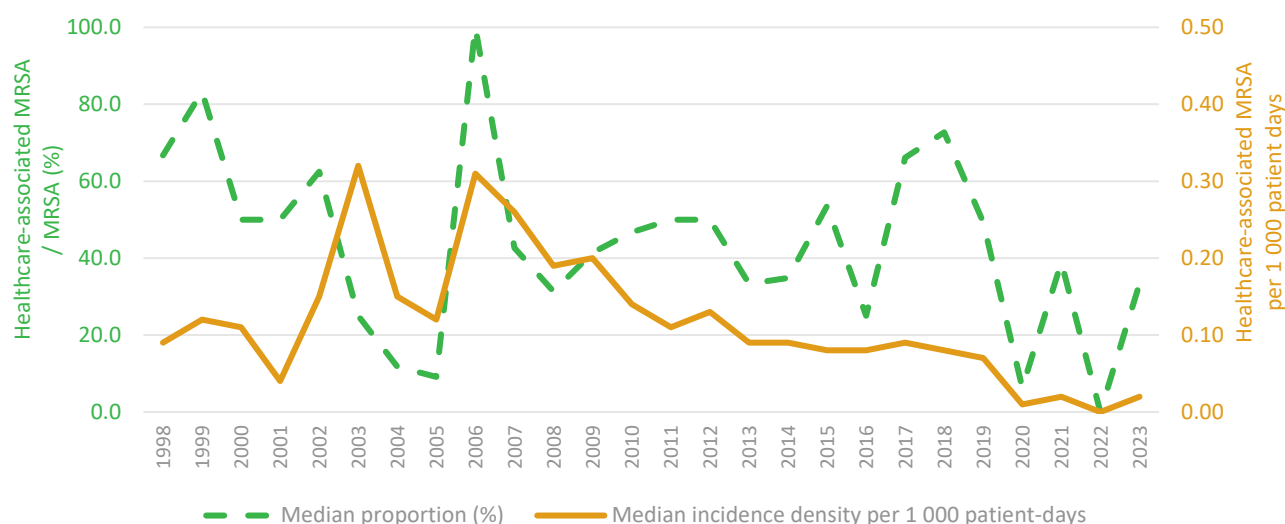
Table 7. Resistance proportion, incidence and incidence density of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) (clinical samples only) by region, Belgian chronic care hospitals, 2023

	Healthcare-associated MRSA (clinical samples only)					
	n	N	Crude	Mean	Median	P25 - P75
Proportion healthcare-associated MRSA/MRSA (%)						
Belgium	26	42	61.9	39.5	33.3	0.0-76.9
Flanders	6	10	60.0	33.3	16.7	0.0-66.7
Wallonia	16	28	57.1	33.5	33.3	0.0-57.1
Brussels	4	4	100.0	-	-	-
Incidence per 1 000 hospitalisations						
Belgium	26	16 862	1.54	1.52	0.44	0.00-3.78
Flanders	6	4 403	1.36	1.05	0.22	0.00-2.11
Wallonia	16	11 738	1.36	1.16	0.47	0.00-1.24
Brussels	4	721	5.55	-	-	-
Incidence density per 1 000 patient-days						
Belgium	26	523 535	0.05	0.05	0.02	0.00-0.10
Flanders	6	141 330	0.04	0.04	0.02	0.00-0.07
Wallonia	16	343 963	0.05	0.05	0.02	0.00-0.11
Brussels	4	38 242	0.10	-	-	-

n = total number of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) isolates, N = total number of MRSA isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

The overall evolution of these indicators (median proportion and incidence density) is presented in Figure 11.

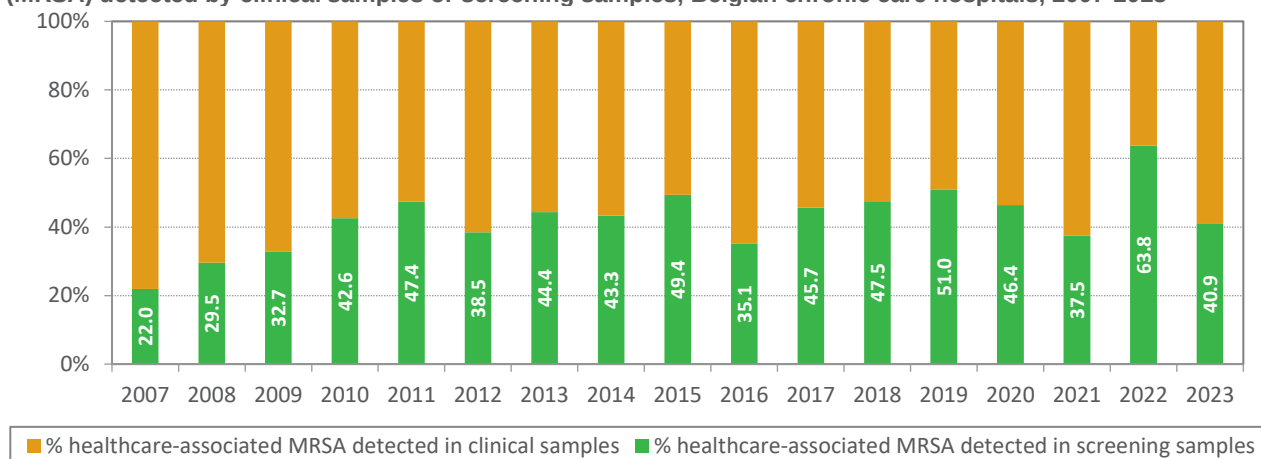
Figure 11. Evolution of the median proportion and incidence density per 1 000 patient-days of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA; clinical samples only), Belgian chronic care hospitals, 1998-2023



PART 1. METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA)

In addition, 18 cases (40.9%) of HA-MRSA were detected through screening in 2023 (Figure 12).

Figure 12. Evolution of the crude proportion of healthcare-associated methicillin-resistant *Staphylococcus aureus* (MRSA) detected by clinical samples or screening samples, Belgian chronic care hospitals, 2007-2023



PART 2. VANCOMYCIN-RESISTANT ENTEROCOCCI (VRE)

Although participation in the VRE surveillance was optional, 96.1% (n=98/102, i.e. one less than the mandatory MRSA surveillance) of all Belgian acute care hospital administrative groups (mergers) participated with at least one hospital site in 2023.

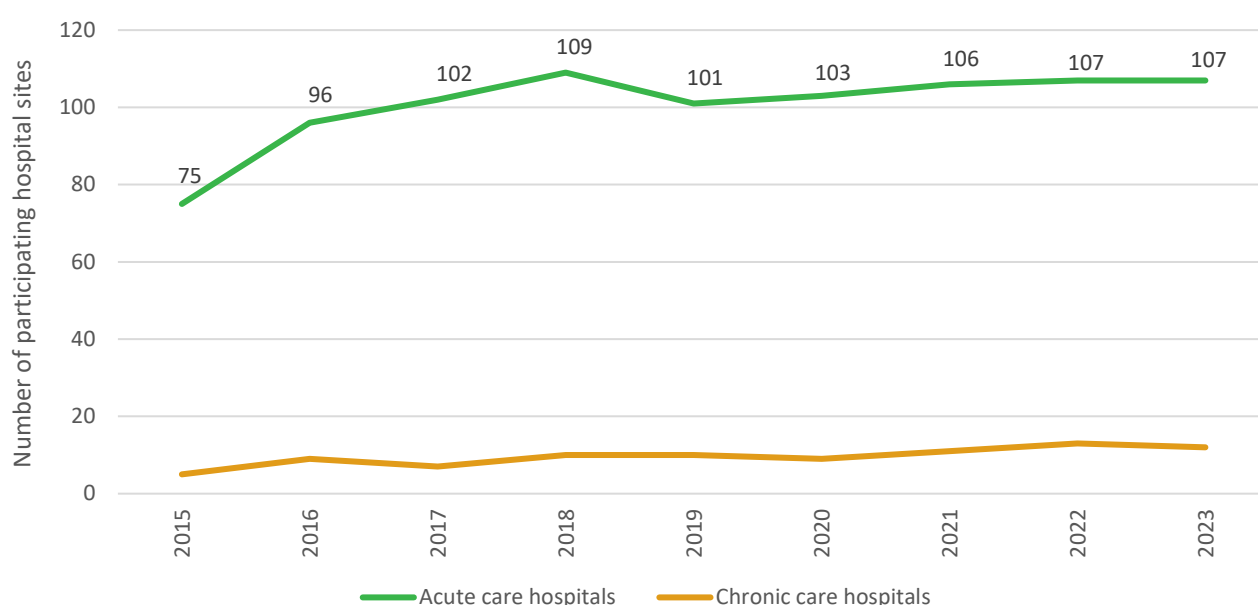
Table 8 presents the 2023 participation in the VRE surveillance by hospital care type, region and level of specialty care within the hospital. One hospital did not provide optimal cleaned (Type D) data and was therefore excluded from further analyses. Figure 13 shows the number of participating hospital sites since the surveillance began in 2014.

Table 8. Participation in the surveillance of vancomycin-resistant enterococci by hospital care type, region and level of specialty care within the hospitals (for acute care hospitals only), Belgian acute and chronic care hospitals, 2023 (Type D data only)

	2023			
	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals	57	37	13	107
Primary hospitals	46	27	7	80
Secondary hospitals	8	9	3	20
Tertiary hospitals	3	1	3	7
N of chronic care hospitals	5	6	1	12

N = number

Figure 13. Evolution of the participation in the surveillance of vancomycin-resistant enterococci based on the resistance proportion indicator, Belgian acute and chronic care hospital sites, 1994-2023



1. VRE in acute care hospitals

1.1 ENTEROCOCCUS FAECIUM

There were 8 679 *E. faecium* (median: 57 isolates per hospital; IQR: 27-103) isolated from clinical samples (excluding faeces samples) reported in 2023. Among these, 164 cases of vanco-R *E. faecium* were reported by 10 acute care hospitals (9.3%), with a range of 1 to 33 isolates per hospital site. The crude resistance proportion and incidence of vanco-R *E. faecium* were 1.89% and 0.091 cases per 1 000 hospitalisations, respectively (Table 9).

Table 9. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) vancomycin-resistant *Enterococcus faecium* (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2023

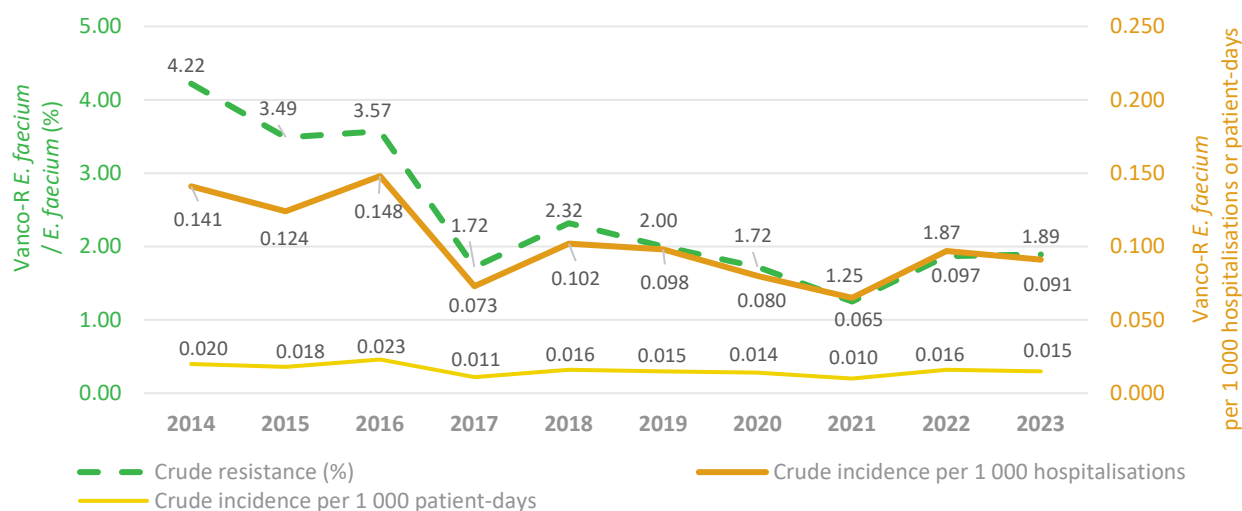
	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)						
Belgium	164	8 679	1.89	1.80	0.00	0.00-1.55
Flanders	38	5 300	0.72	0.46	0.00	0.00-0.00
Wallonia	87	2 374	3.66	3.64	0.43	0.00-2.70
Brussels	39	1 005	3.88	2.49	0.00	0.00-4.73
Primary hospitals	79	4 800	1.65	1.44	0.00	0.00-1.16
Secondary hospitals	41	1 896	2.16	2.92	0.00	0.00-2.19
Tertiary hospitals	44	1 983	2.22	2.73	1.78	0.79-5.41
Incidence per 1 000 hospitalisations						
Belgium	164	1 811 064	0.091	0.094	0.000	0.000-0.068
Flanders	38	1 083 614	0.035	0.023	0.000	0.000-0.000
Wallonia	87	505 148	0.172	0.172	0.029	0.000-0.152
Brussels	39	222 302	0.175	0.187	0.000	0.000-0.197
Primary hospitals	79	1 105 015	0.071	0.070	0.000	0.000-0.049
Secondary hospitals	41	440 749	0.093	0.165	0.000	0.000-0.080
Tertiary hospitals	44	265 300	0.166	0.172	0.127	0.078-0.197
Incidence density per 1 000 patient-days						
Belgium	164	11 200 676	0.015	0.014	0.000	0.000-0.011
Flanders	38	6 287 140	0.006	0.004	0.000	0.000-0.000
Wallonia	87	3 252 631	0.027	0.025	0.004	0.000-0.029
Brussels	39	1 660 905	0.023	0.024	0.000	0.000-0.035
Primary hospitals	79	6 743 285	0.012	0.010	0.000	0.000-0.008
Secondary hospitals	41	2 664 906	0.015	0.025	0.000	0.000-0.015
Tertiary hospitals	44	1 792 485	0.025	0.024	0.019	0.011-0.035

n = total number of vancomycin-resistant *Enterococcus faecium* isolates, N = total number of *Enterococcus faecium* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

A decreasing trend in the resistance proportion (-0.13% per year; p=0.048) and incidence (IRR=0.973, 95%CI: 0.940-1.008; p=0.127) of vanco-R *E. faecium* can be observed (Figure 14).

The evolution of the crude resistance proportion and incidence (per 1 000 hospitalisations) of vanco-R *E. faecium* by region and by level of specialty care can be found in Annex (Figure A4 – A7).

Figure 14. Evolution of the crude resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of vancomycin resistance in *Enterococcus faecium* (clinical samples only), Belgian acute care hospitals, 2014-2023



Note: Prior to 2016, vancomycin resistance was separated under vancomycin resistance (defined as vanco-R and susceptible to teicoplanin or susceptibility unknown) and glycopeptide resistance (defined as vanco-R and teicoplanin resistant). Since 2017, vancomycin resistance is questioned independently from the susceptibility to teicoplanin.

In total, 19 cases of *E. faecium* resistant to linezolid (linezolid-R) were reported by 12 acute care hospitals (n=12/105; 11.4%), with a range of 1 to 3 isolates per hospital site. The crude resistance proportion and incidence of linezolid-R *E. faecium* were 0.22% and 0.011 cases per 1 000 hospitalisations, respectively.

1.2 ENTEROCOCCUS FAECALIS

A total of 25 572 *E. faecalis* (median: 166 isolates per hospital; IQR: 77-284) isolated from clinical samples (excluding faeces samples) were reported in 2023. Among these, 14 cases of vanco-R *E. faecalis* were reported by 8 acute care hospitals (7.5%; min-max: 1-5 isolates per hospital site). The crude resistance proportion and incidence of vanco-R *E. faecalis* were 0.05% and 0.008 cases per 1 000 hospitalisations, respectively.

A total of 54 cases of linezolid-R *E. faecalis* were reported by 33 acute care hospitals (n=33/104; 31.7%), with a range of 1 to 7 isolates per hospital site. The crude resistance proportion and incidence were 0.21% and 0.031 cases per 1 000 hospitalisations, respectively.

1.3 OUTBREAKS

In 2021, during the COVID-19 pandemic, only 4.1% of participating hospitals reported an outbreak of vanco-R or linezolid resistant enterococci (i.e., at least one new secondary case within the same ward and within one month). In 2023, the proportion of hospitals reporting at least one cluster increased to 13.8%. Table 10 presents the number of clusters reported and the number of patients involved between 2014 and 2023.

PART 2. VANCOMYCIN-RESISTANT ENTEROCOCCI (VRE)

Table 10. Evolution of the number of outbreaks with vancomycin or linezolid resistant enterococci reported in the national surveillance in Belgian acute care hospitals, 2014-2023

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hospitals reporting an outbreak (%)	3/40 (7.5)	7/75 (9.3)	7/95 (7.4)	13/98 (13.3)	13/96 (13.5)	16/91 (17.6)	7/88 (8.0)	4/97 (4.1)	11/97 (11.3)	12/91 (13.8)
Hospitals with no answer	0	0	1	4	13	10	14	9	10	16
Total N of reported clusters (min-max N of clusters reported by hospital)	3 (1-1)	11 (1-4)	12 (1-3)	21 (1-6)	28 (1-13)	19 (1-3)*	7 (1-2)*	3 (1-2)*	14 (1-3)*	26 (1-9)*
Patients involved	68	140	247	166	164	268	27	10	244	377
% patients colonised	79.4	87.7	88.8	89.8	88.4	94.4	77.8	90.0	87.3	92.3
% patients infected	20.6	12.3	11.2	10.2	11.6	5.6	22.2	10.0	12.7	7.7

*data missing for two (2020, 2021, 2022, 2023) or three (2019) hospitals

2. VRE in chronic care hospitals

In 2023, a total of 131 *E. faecium* (median: 6 per hospital; IQR: 3.5-19) and 532 *E. faecalis* isolates (median: 42.5 per hospital; IQR: 16.5-68.5) were reported from clinical samples (excluding faeces samples). No cases of vanco-R *E. faecium* or *E. faecalis* were noted.

There were no outbreaks with vanco-R enterococci reported by the participating chronic care hospitals between 2014 and 2023.

PART 3. RESISTANCE IN GRAM-NEGATIVE BACTERIA

Similar to the MRSA surveillance, 97.1% (n=99/102) of all acute care hospital administrative groups (mergers) participated in the MRGN surveillance with at least one hospital site in 2023.

The number of hospital sites participating in 2023 can be found in Table 11 by hospital care type, region and level of specialty care within the hospital. One hospital did not provide Type D data and was therefore excluded from further analyses.

Table 11. Participation in the surveillance of multiresistant gram-negative bacteria (MRGN) by hospital care type, region and level of specialty care within the hospital (for acute care hospitals only), Belgian acute and chronic care hospital sites, 2023 (Type D data only)

	2023			
	Flanders	Wallonia	Brussels	Belgium
N of acute care hospitals	57	38	13	108
Primary hospitals	46	28	7	81
Secondary hospitals	8	9	3	20
Tertiary hospitals	3	1	3	7
N of chronic care hospitals	5	6	1	12

N = number

1. Resistant Gram-negative bacteria in acute care hospitals

1.1 RESISTANCE IN *ESCHERICHIA COLI*

In 2023, 8.4% of all *E. coli* isolated from clinical samples were resistant to 3rd generation cephalosporins (3GC-R). The crude incidence was 4.05 per 1 000 hospitalisations or 0.65 per 1 000 patient-days (Table 12).

Between 2019 and 2023, the resistance proportion of 3GC-R *E. coli* significantly decreased by -0.36% per year; $p < 0.001$). However, no significant trend can be observed from the beginning of the surveillance in 2014 to 2023 (-0.03% per year; $p = 0.605$). The incidence of 3GC-R *E. coli* also decreased in the same time periods: for 2020-2023, the IRR was 0.976 (95%CI: 0.945-1.009; $p = 0.152$), and for 2014-2023, it was 0.975 (95%CI: 0.965-0.984; $p < 0.001$) (Figure 15).

The evolution of the median resistance proportion and incidence (per 1 000 hospitalisations) of 3GC-R *E. coli*, by region and by level of specialty care, can be found in Annex (Figure A8 – A11).

A total of 67 cases of meropenem-resistant (mero-R) *E. coli* (0.08%) were reported by 38 (35.2%) acute care hospitals (range: 1-14 isolates per hospital). The crude incidence and incidence density of mero-R *E. coli* was 0.037 cases per 1 000 hospitalisations and 0.006 per 1 000 patient-days, respectively (Table 12).

Between 2015 and 2023, no significant trends were observed in the resistance proportion (-0.00% per year; $p = 0.596$) or incidence (IRR=0.971, 95%CI: 0.937-1.007; $p = 0.117$).

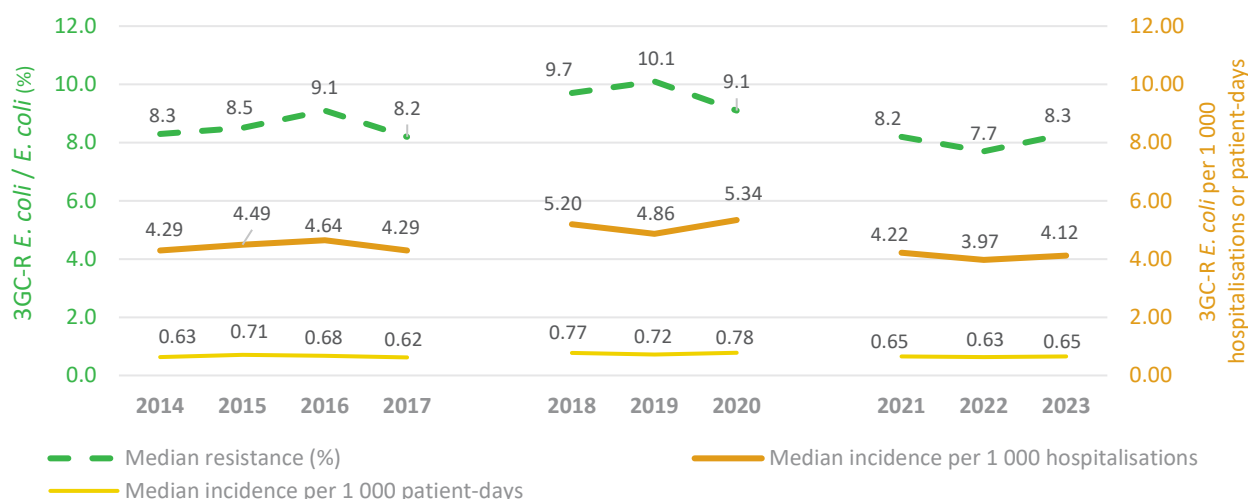
Table 12. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Escherichia coli* resistant to third generation cephalosporins or meropenem (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2023

	<i>Escherichia coli</i> (clinical samples only)											
	Resistance to third generation cephalosporins						Resistance to meropenem					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	7 356	87 371	8.4	8.6	8.3	7.0-9.7	67	87 371	0.08	0.07	0.00	0.00-0.09
Flanders	4 355	54 602	8.0	7.7	7.2	6.4-8.8	32	54 602	0.06	0.05	0.00	0.00-0.07
Wallonia	2 158	24 693	8.7	9.2	8.9	7.4-10.4	25	24 693	0.10	0.08	0.00	0.00-0.09
Brussels	843	8 076	10.4	11.1	11.1	9.3-13.3	10	8 076	0.12	0.17	0.00	0.00-0.28
Primary hosp	4 808	59 881	8.0	8.4	7.8	6.8-9.4	24	59 881	0.04	0.05	0.00	0.00-0.05
Secondary hosp	1 360	15 310	8.9	9.1	9.1	7.4-10.6	11	15 310	0.07	0.11	0.00	0.00-0.20
Tertiary hosp	1 188	12 180	9.8	9.9	9.3	7.5-13.3	32	12 180	0.26	0.22	0.13	0.05-0.40
Incidence per 1 000 hospitalisations												
Belgium	7 356	1 818 205	4.05	4.27	4.12	2.65-5.30	67	1 818 205	0.037	0.030	0.000	0.000-0.042
Flanders	4 355	1 083 614	4.02	4.13	3.98	2.74-5.08	32	1 083 614	0.030	0.022	0.000	0.000-0.033
Wallonia	2 158	512 289	4.21	4.58	4.57	2.60-5.52	25	512 289	0.049	0.035	0.000	0.000-0.049
Brussels	843	222 302	3.79	4.03	4.11	2.74-4.58	10	222 302	0.045	0.047	0.000	0.000-0.108
Primary hosp	4 808	1 112 156	4.32	4.42	4.11	2.74-5.32	24	1 112 156	0.022	0.021	0.000	0.000-0.033
Secondary hosp	1 360	440 749	3.09	3.69	3.79	2.14-4.85	11	440 749	0.025	0.036	0.000	0.000-0.055
Tertiary hosp	1 188	265 300	4.48	4.26	4.41	2.53-4.90	32	265 300	0.121	0.110	0.035	0.025-0.181
Incidence density per 1 000 patient-days												
Belgium	7 356	11 238 457	0.65	0.68	0.65	0.48-0.82	67	11 238 457	0.006	0.004	0.000	0.000-0.007
Flanders	4 355	6 287 140	0.69	0.70	0.65	0.51-0.84	32	6 287 140	0.005	0.004	0.000	0.000-0.006
Wallonia	2 158	3 290 412	0.66	0.70	0.67	0.44-0.87	25	3 290 412	0.008	0.005	0.000	0.000-0.009
Brussels	843	1 660 905	0.51	0.51	0.53	0.32-0.67	10	1 660 905	0.006	0.006	0.000	0.000-0.013
Primary hosp	4 808	6 781 066	0.71	0.71	0.67	0.51-0.82	24	6 781 066	0.004	0.003	0.000	0.000-0.005
Secondary hosp	1 360	2 664 906	0.51	0.56	0.52	0.32-0.81	11	2 664 906	0.004	0.005	0.000	0.000-0.010
Tertiary hosp	1 188	1 792 485	0.66	0.63	0.58	0.46-0.76	32	1 792 485	0.018	0.015	0.006	0.004-0.026

Hosp = hospital; n = total number of *Escherichia coli* isolates resistant to 3rd generation cephalosporins or meropenem, N = total number of *Escherichia coli* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

PART 3. RESISTANCE IN GRAM-NEGATIVE BACTERIA

Figure 15. Evolution of the median resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Escherichia coli* resistant to third generation cephalosporins (clinical samples only), Belgian acute care hospitals, 2014-2023



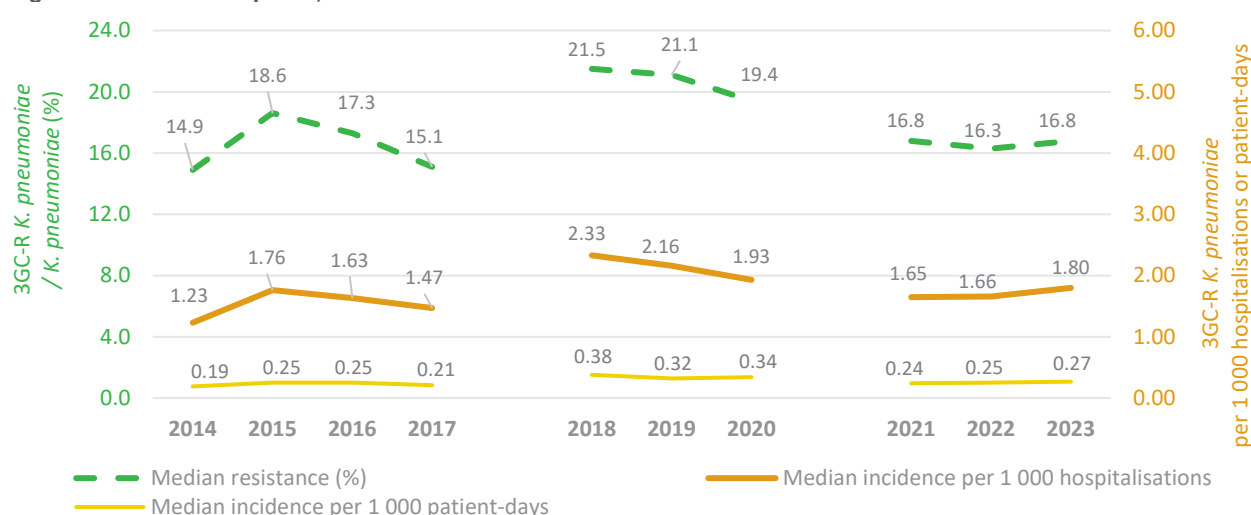
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

1.2 RESISTANCE IN *KLEBSIELLA PNEUMONIAE*

In 2023, the crude resistance proportion 3GC-R *K. pneumoniae* was 17.6%, with a crude incidence of 2.00 cases per 1 000 hospitalisations or 0.32 cases per 1 000 patient-days (clinical samples only; Table 13).

Between 2014 and 2023, no significant trend was observed in the resistance proportion (-0.16% per year; $p=0.295$) or incidence (IRR=0.990, 95%CI: 0.979-1.001; $p=0.085$) of 3GC-R *K. pneumoniae*. However, since 2018, a significant decrease has been observed in both the resistance proportion (-1.45% per year; $p<0.001$) and incidence (IRR=0.928, 95%CI: 0.911-0.945; $p<0.001$) (Figure 16).

Figure 16. Evolution of the median resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to third generation cephalosporins (clinical samples only), Belgian acute care hospitals, 2014-2023



3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Table 13. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to third generation cephalosporins or meropenem (clinical samples only) by region and specialty care level within the hospital, Belgian acute care hospitals, 2023

	<i>Klebsiella pneumoniae</i> (clinical samples only)											
	Resistance to third generation cephalosporins						Resistance to meropenem					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	3 628	20 556	17.6	18.1	16.8	11.2-24.0	220	20 556	1.07	1.11	0.35	0.00-1.53
Flanders	1 446	11 121	13.0	12.2	11.9	8.1-14.9	70	11 121	0.63	0.52	0.00	0.00-0.72
Wallonia	1 628	6 663	24.4	25.5	24.3	20.3-30.0	97	6 663	1.46	1.87	1.16	0.00-2.20
Brussels	554	2 772	20.0	22.2	23.3	17.2-25.8	53	2 772	1.91	1.43	1.33	0.00-2.61
Primary hosp	2 094	12 805	16.4	17.5	15.2	10.6-23.9	117	12 805	0.91	1.09	0.00	0.00-1.43
Secondary hosp	849	4 104	20.7	20.2	20.1	14.5-25.4	32	4 104	0.78	0.89	0.75	0.00-1.34
Tertiary hosp	685	3 647	18.8	18.7	18.3	15.0-22.6	71	3 647	1.95	1.90	2.01	1.40-2.63
Incidence per 1 000 hospitalisations												
Belgium	3 628	1 818 205	2.00	2.22	1.80	0.92-2.86	220	1 818 205	0.121	0.140	0.044	0.000-0.177
Flanders	1 446	1 083 614	1.33	1.32	1.02	0.75-1.58	70	1 083 614	0.065	0.063	0.000	0.000-0.074
Wallonia	1 628	512 289	3.18	3.44	2.96	1.92-4.29	97	512 289	0.189	0.235	0.135	0.000-0.251
Brussels	554	222 302	2.49	2.56	2.39	2.09-2.75	53	222 302	0.238	0.195	0.160	0.000-0.299
Primary hosp	2 094	1 112 156	1.88	2.20	1.53	0.86-2.91	117	1 112 156	0.105	0.141	0.000	0.000-0.160
Secondary hosp	849	440 749	1.93	2.18	1.92	0.98-2.42	32	440 749	0.073	0.087	0.062	0.000-0.129
Tertiary hosp	685	265 300	2.58	2.59	2.46	1.48-3.38	71	265 300	0.268	0.267	0.228	0.139-0.411
Incidence density per 1 000 patient-days												
Belgium	3 628	11 238 457	0.32	0.34	0.27	0.16-0.46	220	11 238 457	0.020	0.021	0.007	0.000-0.027
Flanders	1 446	6 287 140	0.23	0.22	0.19	0.13-0.27	70	6 287 140	0.011	0.010	0.000	0.000-0.013
Wallonia	1 628	3 290 412	0.49	0.52	0.48	0.32-0.70	97	3 290 412	0.029	0.037	0.019	0.000-0.038
Brussels	554	1 660 905	0.33	0.31	0.26	0.25-0.38	53	1 660 905	0.032	0.025	0.019	0.000-0.037
Primary hosp	2 094	6 781 066	0.31	0.33	0.25	0.14-0.46	117	6 781 066	0.017	0.022	0.000	0.000-0.027
Secondary hosp	849	2 664 906	0.32	0.33	0.27	0.18-0.41	32	2 664 906	0.012	0.012	0.010	0.000-0.018
Tertiary hosp	685	1 792 485	0.38	0.37	0.41	0.26-0.48	71	1 792 485	0.040	0.038	0.030	0.025-0.060

Hosp = hospital; n = total number of *Klebsiella pneumoniae* isolates resistant to 3rd generation cephalosporins or meropenem, N = total number of *Klebsiella pneumoniae* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

PART 3. RESISTANCE IN GRAM-NEGATIVE BACTERIA

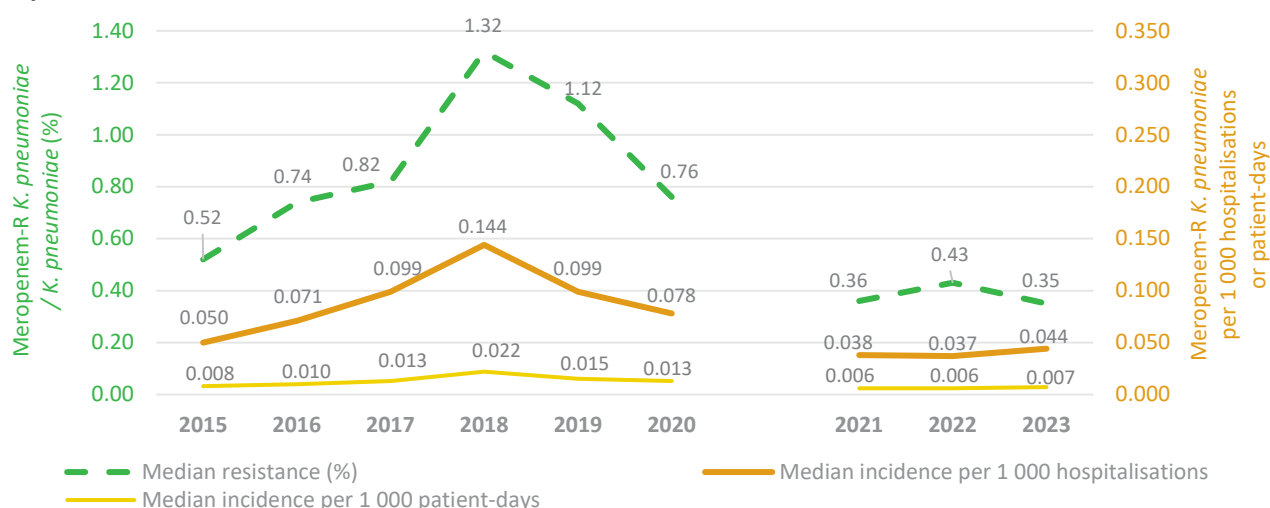
The evolution of the median resistance proportion and incidence (per 1 000 hospitalisations) of 3GC-R *K. pneumoniae*, by region and by level of specialty care, can be found in Annex (Figure A12 – A15).

Cases of mero-R *K. pneumoniae* were reported by 53.7% (n=58/108; min-max: 1-25 isolates) of the acute care hospitals. The crude resistance proportion and incidence were 1.07% or 0.121 cases per 1 000 hospitalisations in 2023 (Table 13).

Between 2018 and 2023, there was a significant decrease in the resistance proportion (-0.25% per year; $p=0.001$) and incidence (IRR=0.858, 95%CI: 0.820-0.898; $p<0.001$) of mero-R *K. pneumoniae*. Since the start of the surveillance in 2015, both the resistance proportion (-0.09% per year; $p=0.043$) and incidence (IRR=0.938, 95%CI: 0.914-0.963; $p<0.001$) significantly decreased (Figure 17).

The evolution of the median resistance proportion and incidence (per 1 000 hospitalisations) of mero-R *K. pneumoniae*, by region and level of specialty care, can be found in the Annex (Figures A16–A19).

Figure 17. Evolution of the median resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to meropenem (clinical samples only), Belgian acute care hospitals, 2014-2023



Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

1.3 RESISTANCE IN ACINETOBACTER BAUMANNII

A minority of acute care hospitals (n=23/108, 21.3%) reported at least one mero-R *A. baumannii* (range: 1-15 isolates) in 2023 (clinical samples only). The crude resistance proportion and incidence of mero-R *A. baumannii* in clinical samples were 6.47% and 0.029 cases per 1 000 hospitalisations, or 0.005 per 1 000 patient days, respectively (Table 14).

Figure 18 presents the evolution of the crude (median all zero values) resistance proportion and incidences of mero-R *A. baumannii*. Between 2015 and 2023, no significant trend was observed in the resistance proportion (-0.05% per year; $p=0.754$), but the incidence significantly decreased (IRR=0.942, 95%CI: 0.902-0.985; $p=0.009$) during the same time period.

The evolution of the crude resistance proportion and incidence (per 1 000 hospitalisations) of mero-R *A. baumannii*, by region and by level of specialty care, can be found in Annex (Figure A20 – A23).

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Table 14. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Acinetobacter baumannii* resistant to meropenem (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2023

	<i>Acinetobacter baumannii</i> resistant to meropenem (clinical samples only)					
	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)						
Belgium	53	819	6.47	4.75	0.00	0.00-0.00
Flanders	26	498	5.22	3.62	0.00	0.00-0.00
Wallonia	7	194	3.61	2.87	0.00	0.00-0.00
Brussels	20	127	15.75	15.21	11.11	0.00-27.27
Primary hospitals	29	406	7.14	5.17	0.00	0.00-0.00
Secondary hospitals	4	189	2.12	1.59	0.00	0.00-0.00
Tertiary hospitals	20	224	8.93	8.98	4.76	2.44-12.50
Incidence per 1 000 hospitalisations						
Belgium	53	1 818 205	0.029	0.027	0.000	0.000-0.000
Flanders	26	1 083 614	0.024	0.028	0.000	0.000-0.000
Wallonia	7	512 289	0.014	0.010	0.000	0.000-0.000
Brussels	20	222 302	0.090	0.075	0.038	0.000-0.063
Primary hospitals	29	1 112 156	0.026	0.026	0.000	0.000-0.000
Secondary hospitals	4	440 749	0.009	0.008	0.000	0.000-0.000
Tertiary hospitals	20	265 300	0.075	0.093	0.035	0.016-0.078
Incidence density per 1 000 patient-days						
Belgium	53	11 238 457	0.005	0.004	0.000	0.000-0.000
Flanders	26	6 287 140	0.004	0.004	0.000	0.000-0.000
Wallonia	7	3 290 412	0.002	0.002	0.000	0.000-0.000
Brussels	20	1 660 905	0.012	0.009	0.005	0.000-0.008
Primary hospitals	29	6 781 066	0.004	0.004	0.000	0.000-0.000
Secondary hospitals	4	2 664 906	0.002	0.001	0.000	0.000-0.000
Tertiary hospitals	20	1 792 485	0.011	0.012	0.006	0.002-0.011

n = total number of *Acinetobacter baumannii* resistant to meropenem isolates, N = total number of *Acinetobacter baumannii* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

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Figure 18. Evolution of the crude resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Acinetobacter baumannii* resistant to meropenem (clinical samples only), Belgian acute care hospitals, 2013-2023



Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

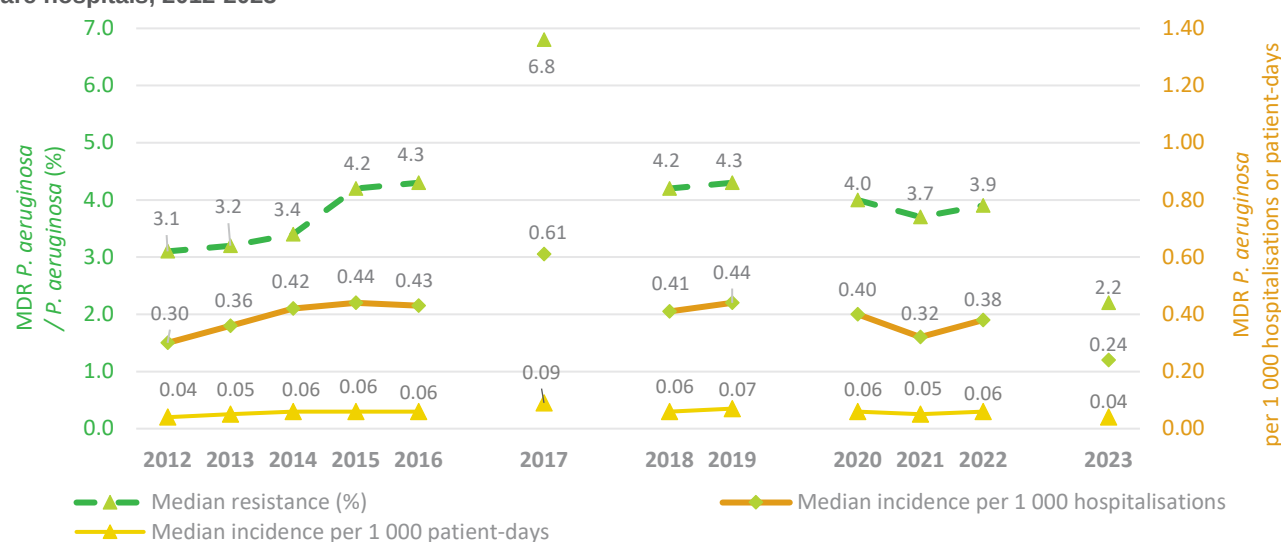
1.4 RESISTANCE IN *PSEUDOMONAS AERUGINOSA*

The crude resistance proportion of multidrug-resistant (MDR) *P. aeruginosa* was 4.2% in 2023. The crude incidence was 0.43 cases per 1 000 hospitalisations or 0.07 per 1 000 patient-days (Table 15).

Changes in definitions in 2017, 2018, 2020 and 2023 (see legend below Figure 19) make it challenging to interpret the evolution of MDR *P. aeruginosa*.

In the Annex (Figure A24 – A27), the evolution of the median resistance proportion and incidence per 1 000 hospitalisations of MDR *P. aeruginosa*, by region and by level of specialty care, can be consulted.

Figure 19. Evolution of the median resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of multidrug-resistant (MDR) *Pseudomonas aeruginosa* (clinical samples only), Belgian acute care hospitals, 2012-2023



Note: Between 2016 and 2017, the definition of MDR *P. aeruginosa* changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes: fluoroquinolones (ciprofloxacin, levofloxacin), aminoglycosides (gentamicin, tobramycin, amikacin), carbapenems (meropenem, imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, ceftepime) and anti-pseudomonas penicillins (piperacillin/tazobactam). In 2018, anti-pseudomonas penicillins (piperacillin/tazobactam) were dropped from the definition. Since 2020, only strict resistance (R - excluding susceptible, increased exposure (intermediate result)) is considered. In 2023, gentamicin was removed from the list of aminoglycosides.

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Table 15. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of multidrug-resistant (MDR) *Pseudomonas aeruginosa* (clinical samples only) by region and level of specialty care within the hospital, Belgian acute care hospitals, 2023

	multidrug-resistant (MDR) <i>Pseudomonas aeruginosa</i> (clinical samples only)					
	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)						
Belgium	778	18 422	4.2	3.8	2.2	1.1-5.0
Flanders	411	9 934	4.1	3.0	1.6	0.5-3.1
Wallonia	194	5 826	3.3	4.3	3.0	1.6-5.3
Brussels	173	2 662	6.5	6.0	5.9	3.9-7.5
Primary hospitals	285	10 688	2.7	3.3	2.0	0.8-4.5
Secondary hospitals	155	3 719	4.2	3.9	3.3	1.8-5.7
Tertiary hospitals	338	4 015	8.4	10.2	6.9	2.2-11.7
Incidence per 1 000 hospitalisations						
Belgium	778	1 818 205	0.43	0.39	0.24	0.09-0.48
Flanders	411	1 083 614	0.38	0.30	0.13	0.04-0.31
Wallonia	194	512 289	0.38	0.41	0.30	0.13-0.49
Brussels	173	222 302	0.78	0.76	0.54	0.39-0.98
Primary hospitals	285	1 112 156	0.26	0.30	0.18	0.08-0.40
Secondary hospitals	155	440 749	0.35	0.42	0.28	0.08-0.52
Tertiary hospitals	338	265 300	1.27	1.30	0.90	0.39-2.01
Incidence density per 1 000 patient-days						
Belgium	778	11 238 457	0.07	0.06	0.04	0.02-0.07
Flanders	411	6 287 140	0.07	0.05	0.02	0.01-0.05
Wallonia	194	3 290 412	0.06	0.07	0.05	0.02-0.08
Brussels	173	1 660 905	0.10	0.09	0.07	0.06-0.15
Primary hospitals	285	6 781 066	0.04	0.05	0.03	0.01-0.06
Secondary hospitals	155	2 664 906	0.06	0.06	0.04	0.02-0.08
Tertiary hospitals	338	1 792 485	0.19	0.20	0.15	0.06-0.29

Hosp = hospital; n = total number of multidrug-resistant (MDR) *Pseudomonas aeruginosa* isolates, N = total number of *Pseudomonas aeruginosa* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

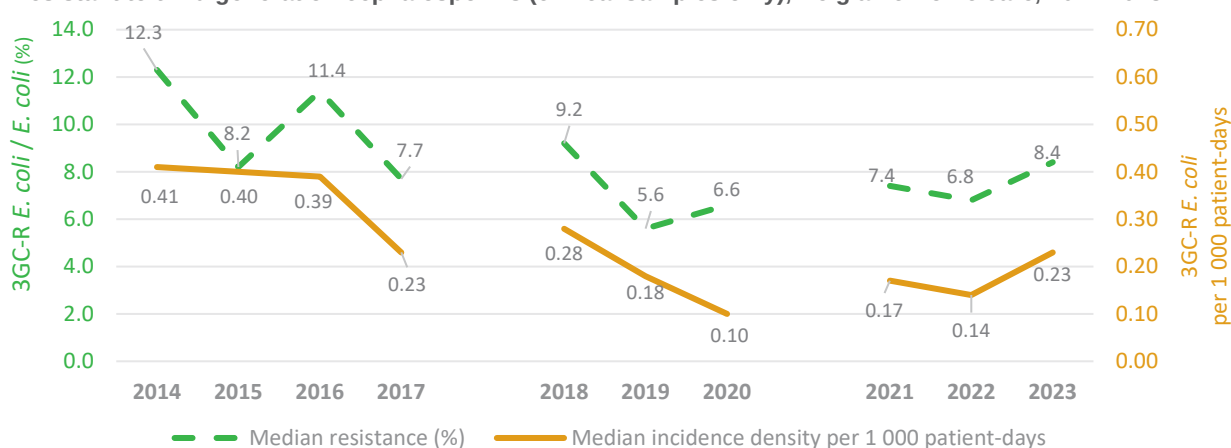
2. Resistant Gram-negative bacteria in chronic care hospitals

2.1 RESISTANCE IN *ESCHERICHIA COLI*

The crude resistance proportion was 10.5% for 3GC-R *E. coli* and 0.07% for mero-R *E. coli* (clinical samples only) in 2023. The crude incidence density was 0.26 and 0.002 per 1 000 patient-days for 3GC-R *E. coli* and mero-R *E. coli*, respectively (Table 16).

The overall evolution of the median resistance proportion and incidence density of 3GC-R *E. coli* in chronic care hospitals is shown in Figure 20.

Figure 20. Evolution of the median resistance proportion and incidence density (per 1 000 patient-days) of *Escherichia coli* resistant to third generation cephalosporins (clinical samples only), Belgian chronic care, 2014-2023



3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Table 16. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Escherichia coli* resistant to third generation cephalosporins or meropenem (clinical samples only) by region, Belgian chronic care hospitals, 2023

	<i>Escherichia coli</i> (clinical samples only)											
	Resistance to third generation cephalosporins						Resistance to meropenem					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	155	1 471	10.5	17.7	8.4	7.7-12.8	1	1 471	0.07	0.31	0.00	0.00-0.00
Flanders	70	533	13.1	12.7	8.4	8.3-13.7	0	533	0.00	0.00	0.00	0.00-0.00
Wallonia	81	808	10.0	24.4	9.6	7.8-11.9	1	808	0.12	0.62	0.00	0.00-0.00
Brussels	4	130	3.1	-	-	-	0	130	0.00	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	155	18 229	8.50	11.35	9.35	3.72-13.04	1	18 229	0.055	0.044	0.000	0.000-0.00
Flanders	70	5 770	12.13	18.17	14.08	11.33-25.60	0	5 770	0.000	0.000	0.000	0.000-0.00
Wallonia	81	11 738	6.90	6.64	7.16	1.90-10.61	1	11 738	0.085	0.087	0.000	0.000-0.00
Brussels	4	721	5.55	-	-	-	0	721	0.000	-	-	-
Incidence density per 1 000 patient-days												
Belgium	155	585 108	0.26	0.27	0.23	0.12-0.42	1	585 108	0.002	0.001	0.000	0.000-0.00
Flanders	70	202 903	0.34	0.31	0.28	0.21-0.29	0	202 903	0.000	0.000	0.000	0.000-0.00
Wallonia	81	343 963	0.24	0.27	0.19	0.05-0.55	1	343 963	0.003	0.002	0.000	0.000-0.00
Brussels	4	38 242	0.10	-	-	-	0	38 242	0.000	-	-	-

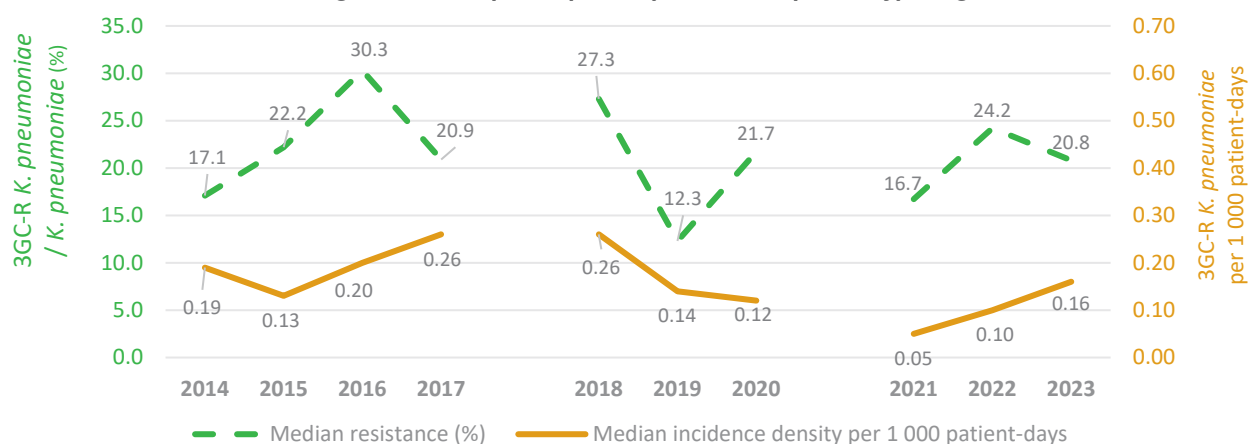
Hosp = hospital; n = total number of *Escherichia coli* isolates resistant to 3rd generation cephalosporins or meropenem, N = total number of *Escherichia coli* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

2.2 RESISTANCE IN *KLEBSIELLA PNEUMONIAE*

The crude resistance proportion of 3GC-R *K. pneumoniae* isolated from clinical samples was 26.7% in 2023. The crude incidence density was 0.22 per 1 000 patient-days (Table 17).

The overall evolution of the median resistance proportion and incidence density of 3GC-R *K. pneumoniae* in chronic care hospitals is shown in Figure 21

Figure 21. Evolution of the median resistance proportion and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to third generation cephalosporins (clinical samples only), Belgian chronic care, 2014-2023

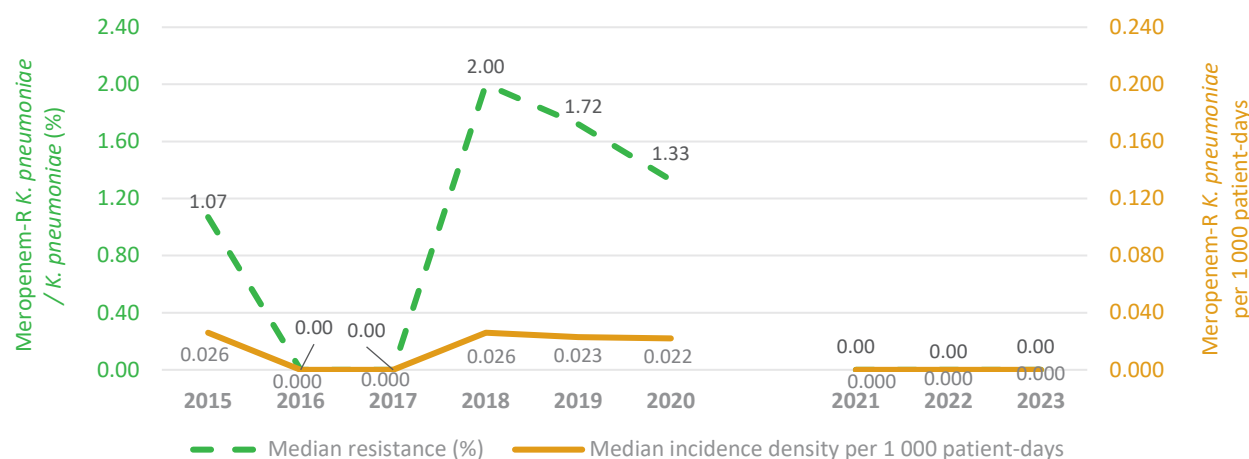


3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

The crude resistance proportion and incidence density of mero-R *K. pneumoniae* were 0.85% and 0.007 cases per 1 000 patient-days in 2023, respectively (Table 17).

The evolution of the median resistance proportion and incidence density of mero-R *K. pneumoniae* in chronic care hospitals can be seen in Figure 22

Figure 22. Evolution of the median resistance proportion and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to meropenem (clinical samples only), Belgian chronic care, 2015-2023



Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Table 17. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of *Klebsiella pneumoniae* resistant to third generation cephalosporins or meropenem (clinical samples only) by region, Belgian chronic care hospitals, 2023

	<i>Klebsiella pneumoniae</i> (clinical samples only)											
	Resistance to third generation cephalosporins						Resistance to meropenem					
	n	N	Crude	Mean	Median	P25 - P75	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)												
Belgium	126	472	26.7	27.7	20.8	12.7-34.0	4	472	0.85	0.43	0.00	0.00-0.00
Flanders	38	165	23.0	20.8	22.7	16.3-28.3	0	165	0.00	0.00	0.00	0.00-0.00
Wallonia	88	271	32.5	38.0	29.2	14.3-44.2	4	271	1.48	0.86	0.00	0.00-2.33
Brussels	0	36	0.0	-	-	-	0	36	0.00	-	-	-
Incidence per 1 000 hospitalisations												
Belgium	126	18 229	6.91	6.64	5.28	2.53-9.26	4	18 229	0.219	0.121	0.000	0.000-0.000
Flanders	38	5 770	6.59	8.27	5.43	5.12-9.82	0	5 770	0.000	0.000	0.000	0.000-0.000
Wallonia	88	11 738	7.50	6.39	5.26	2.85-8.70	4	11 738	0.341	0.241	0.000	0.000-0.622
Brussels	0	721	0.00	-	-	-	0	721	0.000	-	-	-
Incidence density per 1 000 patient-days												
Belgium	126	585 108	0.22	0.24	0.16	0.05-0.26	4	585 108	0.007	0.008	0.000	0.000-0.000
Flanders	38	202 903	0.19	0.18	0.23	0.11-0.25	0	202 903	0.000	0.000	0.000	0.000-0.000
Wallonia	88	343 963	0.26	0.32	0.14	0.05-0.77	4	343 963	0.012	0.016	0.000	0.000-0.044
Brussels	0	38 242	0.00	-	-	-	0	38 242	0.000	-	-	-

Hosp = hospital; n = total number of *Klebsiella pneumoniae* isolates resistant to 3rd generation cephalosporins or meropenem, N = total number of *Klebsiella pneumoniae* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

2.3 RESISTANCE IN *ACINETOBACTER BAUMANNII*

In 2023, the participating chronic care hospitals reported two cases of *A. baumannii* isolated from clinical samples and none of them were mero-R.

2.4 RESISTANCE IN *PSEUDOMONAS AERUGINOSA*

The crude resistance proportion and incidence density of MDR *P. aeruginosa* were 2.8% and 0.02 cases per 1 000 patient-days in 2023 in the participating chronic care hospitals, respectively (Table 18).

Table 18. Resistance proportion, incidence (per 1 000 hospitalisations) and incidence density (per 1 000 patient-days) of multidrug-resistant *Pseudomonas aeruginosa* (clinical samples only) by region, Belgian chronic care hospitals, 2023

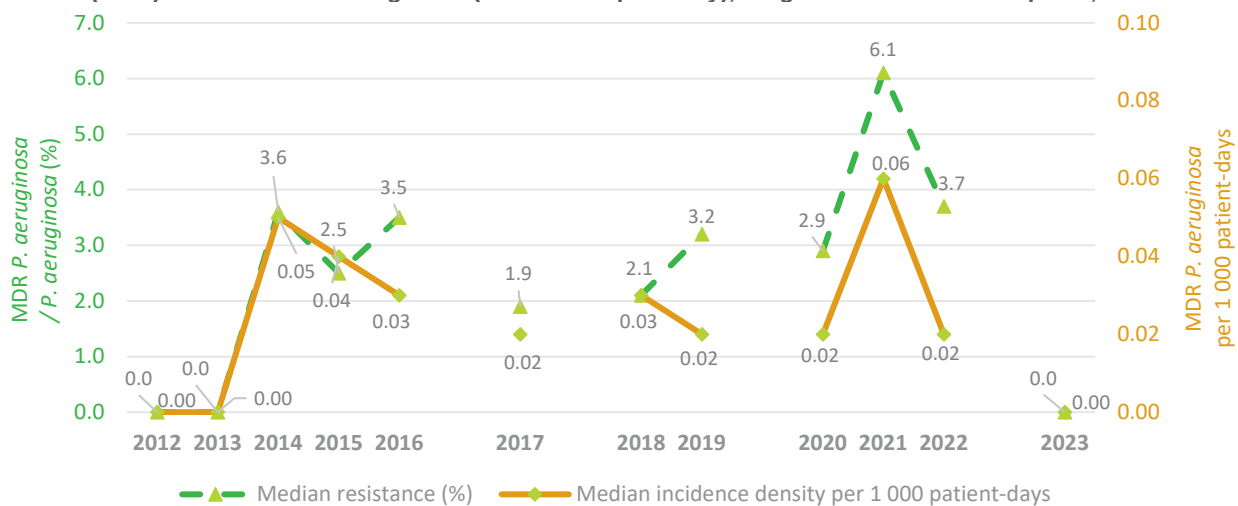
	n	N	Crude	Mean	Median	P25 - P75
Resistance proportion (%)						
Belgium	10	355	2.8	1.8	0.0	0.0-4.3
Flanders	5	133	3.8	2.6	0.0	0.0-4.9
Wallonia	5	206	2.4	1.4	0.0	0.0-3.8
Brussels	0	16	0.0	-	-	-
Incidence per 1 000 hospitalisations						
Belgium	10	18 229	0.55	0.61	0.00	0.00-0.94
Flanders	5	5 770	0.87	1.08	0.00	0.00-2.27
Wallonia	5	11 738	0.43	0.31	0.00	0.00-0.93
Brussels	0	721	0.00	-	-	-
Incidence density per 1 000 patient-days						
Belgium	10	585 108	0.02	0.02	0.00	0.00-0.04
Flanders	5	202 903	0.02	0.02	0.00	0.00-0.05
Wallonia	5	343 963	0.01	0.02	0.00	0.00-0.03
Brussels	0	38 242	0.00	-	-	-

n = total number of multidrug-resistant *Pseudomonas aeruginosa* isolates, N = total number of *Pseudomonas aeruginosa* isolates for the calculation of the resistance proportion, total number of hospitalisations for the incidence or total number of patient-days for the incidence density calculations, crude = n/N

Figure 23 presents the evolution of the median resistance proportion and incidence density of MDR *P. aeruginosa*.

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Figure 23. Evolution of the median resistance proportion and incidence density (per 1 000 patient-days) of multidrug-resistant (MDR) *Pseudomonas aeruginosa* (clinical samples only), Belgian chronic care hospitals, 2012-2023



Note: Between 2016 and 2017, the definition of MDR *P. aeruginosa* changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes to reduced susceptibility to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin, levofloxacin), aminoglycosides (gentamicin, tobramycin, amikacin), carbapenems (meropenem, imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, cefepime) and anti-pseudomonas penicillins (piperacillin/tazobactam). In 2018, anti-pseudomonas penicillins (piperacillin/tazobactam) were dropped from the definition. Since 2020, only strict resistance (R- excluding susceptible, increased exposure (intermediate result)) is considered. In 2023, gentamicin was removed from the list of aminoglycosides.

MAIN FINDINGS AND RECOMMENDATIONS

This report presents the 2023 results of three national surveillance programs on AMR: (1) MRSA, (2) VRE, and (3) MRGN. Data collected for this report were gathered retrospectively and aggregated at the hospital level. The report distinguishes between acute and chronic care hospitals, with acute care hospitals that have a length of stay of ≥ 16 days classified as chronic care hospitals. While both clinical and screening samples were collected for MRSA and VRE surveillance, only data from clinical samples are used in this report, unless otherwise stated. This approach was adopted to minimize inter-hospital variability, which could arise from differences in local screening practices.²

The 2023 AMR surveillance results highlight both successes and ongoing challenges in Belgium's fight against antimicrobial resistance. Long-term trends show encouraging reductions in resistance proportions and incidences for several key pathogens, but emerging concerns underscore the need for continued and adaptable interventions.

The continued decline in MRSA since 2004 reflects the success of national infection prevention and control measures. Strategies such as improved hand hygiene, targeted screening, decolonisation and adherence to MRSA transmission prevention guidelines have been instrumental. However, the observed increase in the MRSA resistance proportion in 2023, particularly in Wallonia and Brussels, raises concerns. Additionally, the rise in HA-MRSA cases, from 16.1% in 2022 to 19.2% in 2023, represents the first increase since 2010, prompting important questions. Could this indicate that further reductions in HA-MRSA are becoming increasingly difficult to achieve? With MRSA levels now much lower than during peak surveillance years, it is possible that the remaining cases are less preventable due to factors such as patient comorbidities. Alternatively, the increase could reflect changes in hospital practices, screening protocols and laboratory assays, hand hygiene compliance campaigns, or external pressures. Regardless of the cause, the 2023 findings emphasize the need for continued vigilance and further investigation. Monitoring trends in 2024 and beyond will be crucial to determine whether this increase is a temporary fluctuation or the start of a more persistent challenge.

The reductions in resistance proportions and incidences for both 3GC-R *E. coli* and *K. pneumoniae*, as well as for carbapenem-resistant *K. pneumoniae* since 2018/2019 are promising. These results underscore the impact of robust infection control practices and stewardship programs, though sustained vigilance is required to prevent resurgence.

AMR trends are also monitored by EARS-BE, the Belgian branch of the European Antimicrobial Resistance Surveillance Network (EARS-Net). This surveillance program retrospectively collects data from both hospital laboratories and non-hospital laboratories. EARS-BE differs from EARS-Net in the additional collection of data on antimicrobial susceptibility test (AST) results of isolates found in urine samples in addition to invasive samples, such as blood and cerebrospinal fluid (CSF).⁶

According to the most recent EARS-Net report for Belgium in 2023, which covered data from 31 hospital laboratories, 6.3% of *S. aureus* isolates from blood and CSF were resistant to methicillin (MRSA). Among invasive *E. faecium* isolates, 1.6% exhibited resistance to vancomycin, with very low resistance to linezolid (0.5%).⁷

Resistance trends in *E. coli* isolated from invasive samples in Belgium have shown an increase in resistance to 3GC from 2011 to 2014. However, this trend has since stabilized, with 10.1% of *E. coli* isolates resistant to 3GC in 2023. Carbapenem resistance remains extremely low at just 0.1%.⁷

For *K. pneumoniae*, no clear resistance trend was observed: 13.7% of isolates showed resistance to 3GC, while carbapenem resistance remained below 1% (0.5%).⁷

MAIN FINDINGS AND RECOMMENDATIONS

While the prevalence of MDR *P. aeruginosa* has notably decreased in Europe and neighboring countries, Belgium has observed a stable rate of around 6-8% MDR isolates since 2014, with 7.4% of *P. aeruginosa* isolates being MDR in 2023.⁷

Due to the limited number of *A. baumannii* isolates, it is challenging to identify any significant trends within the EARS-BE dataset. Resistance rates fluctuate year to year, though the absolute number of resistant isolates has remained relatively stable.⁷

The BELMAP 2024 report provides essential context for these findings, emphasizing the importance of a One Health approach to tackling AMR. This approach recognizes the interconnectedness of human, animal, and environmental health, noting that antimicrobial use in veterinary medicine and agriculture contributes to resistance patterns observed in human health. The report also highlights the need for proactive measures, even for pathogens with low prevalence, such as carbapenem-resistant *E. coli* and *K. pneumoniae*, due to their high-risk nature. Furthermore, environmental factors, including hospital hygiene and wastewater management, play a crucial role in the development and spread of AMR.⁸

The report calls for sustained investment in infection prevention, antimicrobial stewardship, and expanded surveillance systems to address emerging challenges. These efforts must extend beyond acute care hospitals to include other healthcare settings, such as primary care and long-term care facilities, including nursing homes.

To close surveillance gaps across all clinical settings, the development of targeted AMR surveillance programs is crucial. In the short term, this can be achieved by increasing the participation of private laboratories in EARS-BE or through targeted studies. One such initiative is the MDRO carriage study in nursing homes, which will be conducted nationally for the fourth time in 2024–2025. This study represents an important effort to better understand and address resistance in these vulnerable populations.⁹

A significant challenge remains the lack of detailed molecular or clonal relatedness surveillance for carbapenem-resistant bacteria and their epidemiological mapping across the aforementioned sectors. The proportion of carbapenemase-producing *Enterobacterales* (CPE) among carbapenem-resistant *Enterobacterales* (CRE) is currently unknown, as some CPE types are often susceptible to carbapenems (e.g., 80% of the prevalent OXA-48-like CPE are meropenem-susceptible).⁸

A critical priority for the future is therefore the reintroduction of CPE into national AMR surveillance. CPE were included in surveillance from 2015 to 2017, but data reliability issues—stemming from challenges in detecting carbapenemase production across participating laboratories—led to their removal. Today advancements in diagnostic capabilities ensure that laboratories can reliably detect CPE, making their re-inclusion feasible and necessary. CPE represent a significant public health threat due to their resistance to last-line antibiotics, such as carbapenems, leaving few treatment options for infected patients. The reintroduction of CPE surveillance will provide crucial insights into its epidemiology, enabling timely interventions to prevent outbreaks and limit its spread. A strong surveillance program is vital to detecting emerging CPE cases, monitoring trends, and supporting infection control efforts across healthcare settings.

An exciting opportunity for the next phase of AMR surveillance in Belgium lies in leveraging whole-genome sequencing (WGS) and next-generation sequencing (NGS), combined with high end spectrometric techniques. While traditional phenotypic analysis of isolates has provided valuable information, genomic technologies offer transformative potential for understanding resistance mechanisms, transmission dynamics, and outbreaks. The Technical Commission – Multidrug-Resistant Organisms (MDRO), in collaboration with other stakeholders, has proposed an action plan for the 2025–2029 National Action Plan (NAP) AMR. This plan aims to establish real-time genome-based surveillance as a cornerstone for infection prevention and control, antimicrobial stewardship, and outbreak management. It includes providing funding and resources for WGS-based analyses to National Reference Centers (NRCs), National Reference Laboratories (NRLs), and peripheral labs. Centralized data platforms like be.Prepared will integrate genomic and epidemiological data, supporting automated cluster detection and cross-sectoral collaborations to link human, food, and environmental data.

MAIN FINDINGS AND RECOMMENDATIONS

These systems will enable the rapid identification of outbreaks, emerging resistant clones, and their transmission routes, providing actionable insights for local, regional, and international health authorities.

This report acknowledges several limitations, including voluntary participation in some surveillance components and variability in reporting practices. Changes in surveillance definitions over time, especially for multidrug-resistant *P. aeruginosa*, complicate long-term trend analysis. Future efforts should focus on harmonizing definitions and increasing participation across hospital types.

In conclusion, while Belgium has made significant progress in combating AMR, continued vigilance and adaptive strategies are essential to address emerging challenges. Strengthening surveillance, enhancing infection prevention and control and antimicrobial stewardship, and integrating genomic technologies will be crucial in the fight against antimicrobial resistance in the coming years. The One Health approach remains pivotal in ensuring a comprehensive response across all sectors.

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ANNEX

Figure A1. Evolution of the median proportion of methicillin-resistant *Staphylococcus aureus* (MRSA) on the total number of reported *S. aureus* by level of specialty care (clinical samples only), Belgian acute care hospitals, 1994-2023

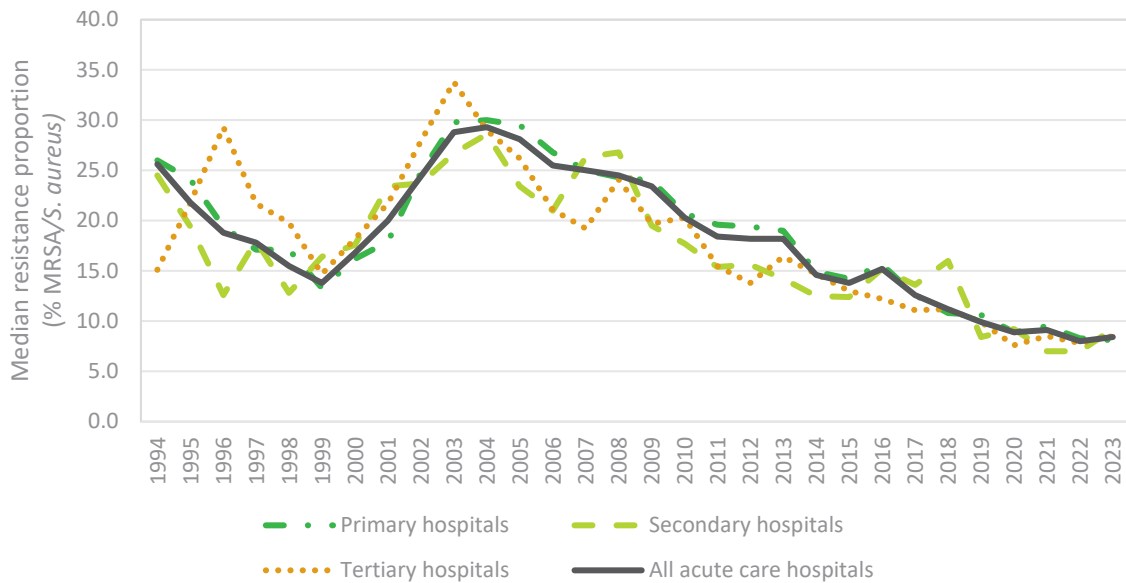


Figure A2. Evolution of the median incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 hospitalisations by level of specialty care (clinical samples only), Belgian acute care hospitals, 1994-2023

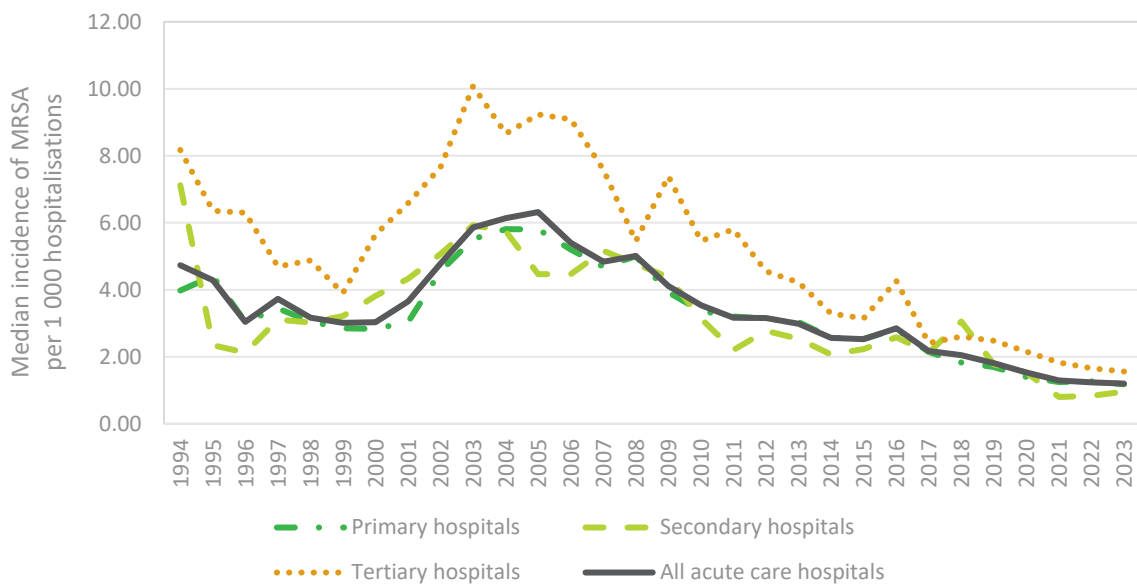


Figure A3. Evolution of the median incidence of healthcare-associated (HA-) methicillin-resistant *Staphylococcus aureus* (MRSA) per 1 000 hospitalisations by level of specialty care (clinical samples only), Belgian acute care hospitals, 1994-2023

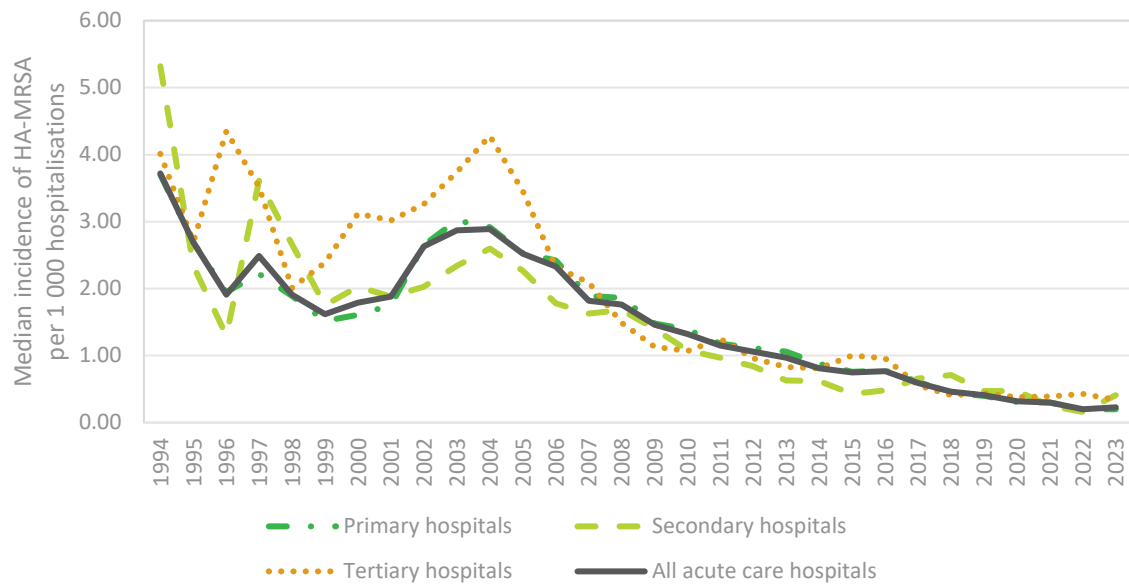


Figure A4. Evolution of the crude resistance proportion of vancomycin resistance in *Enterococcus faecium* by region (clinical samples only), Belgian acute care hospitals, 2014-2023

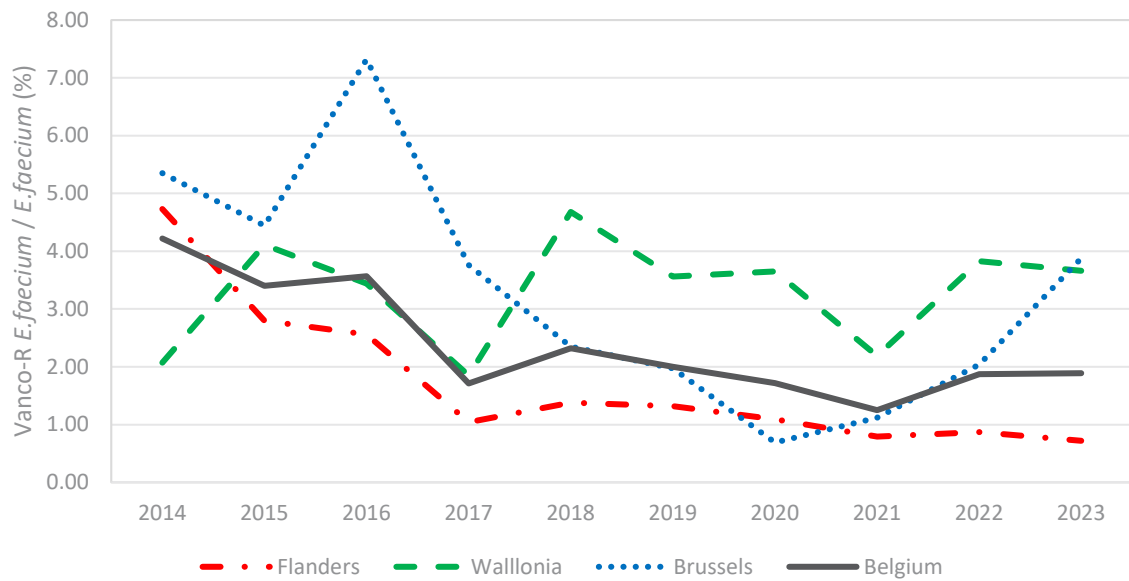


Figure A5. Evolution of the crude resistance proportion of vancomycin resistance in *Enterococcus faecium* by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2023

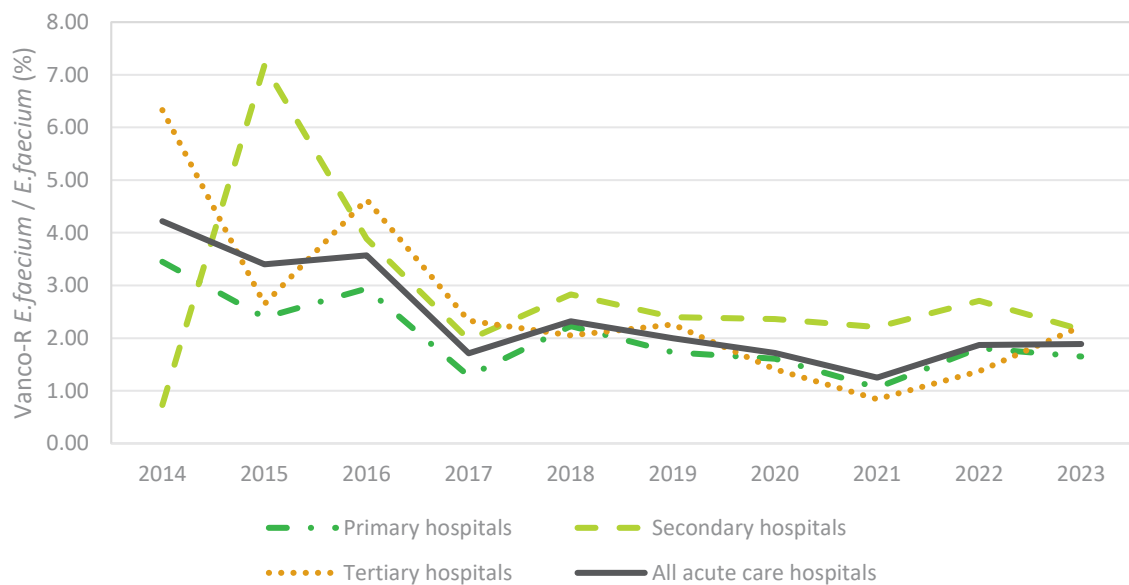


Figure A6. Evolution of the crude incidence (per 1 000 hospitalisations) of vancomycin resistance in *Enterococcus faecium* by region (clinical samples only), Belgian acute care hospitals, 2014-2023

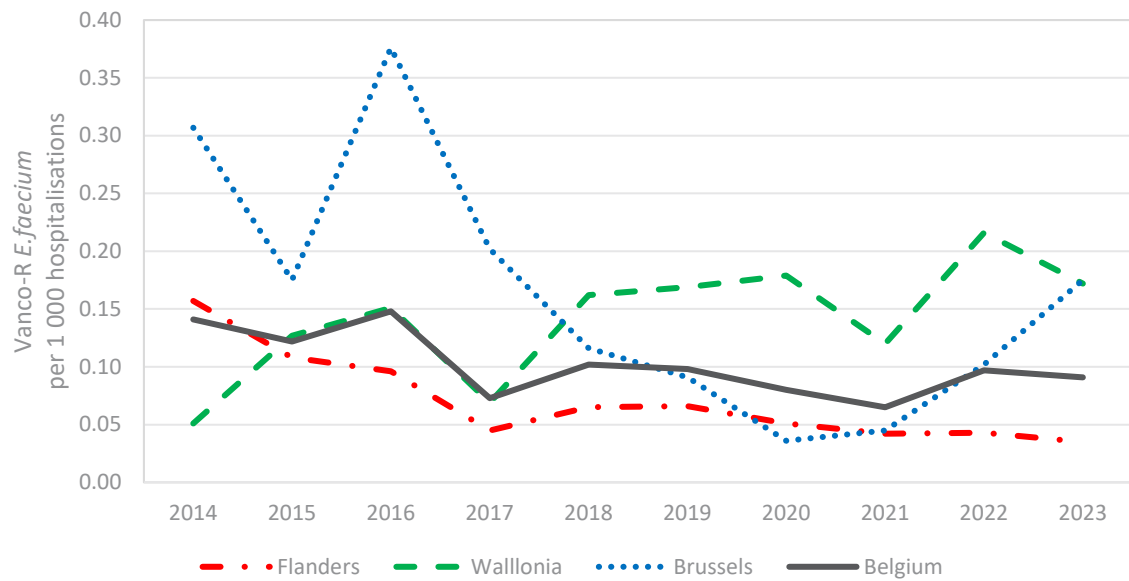


Figure A7. Evolution of the crude incidence (per 1 000 hospitalisations) of vancomycin resistance in *Enterococcus faecium* by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2023

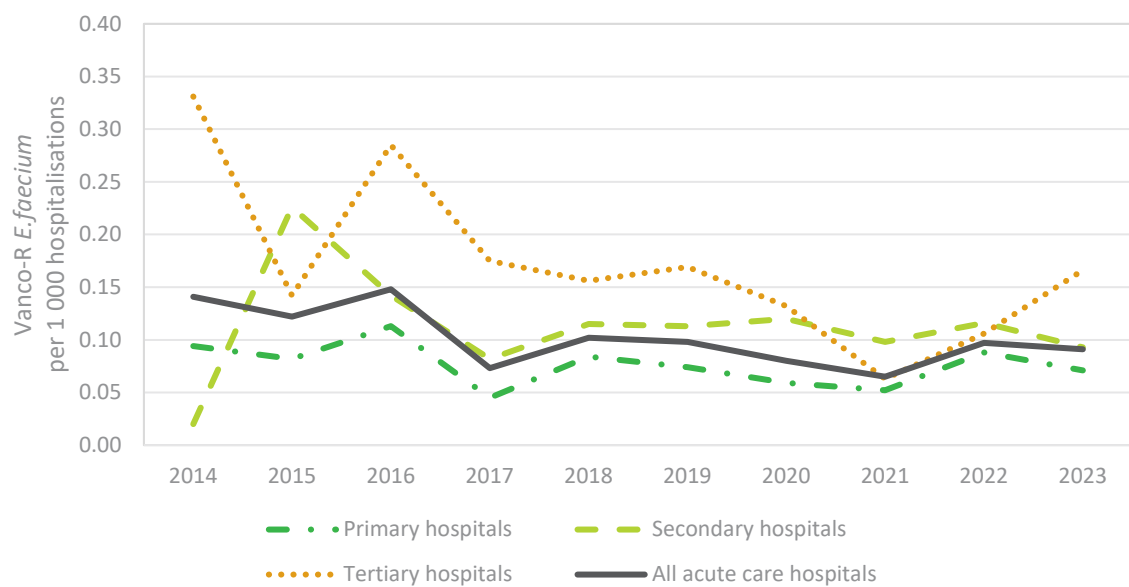
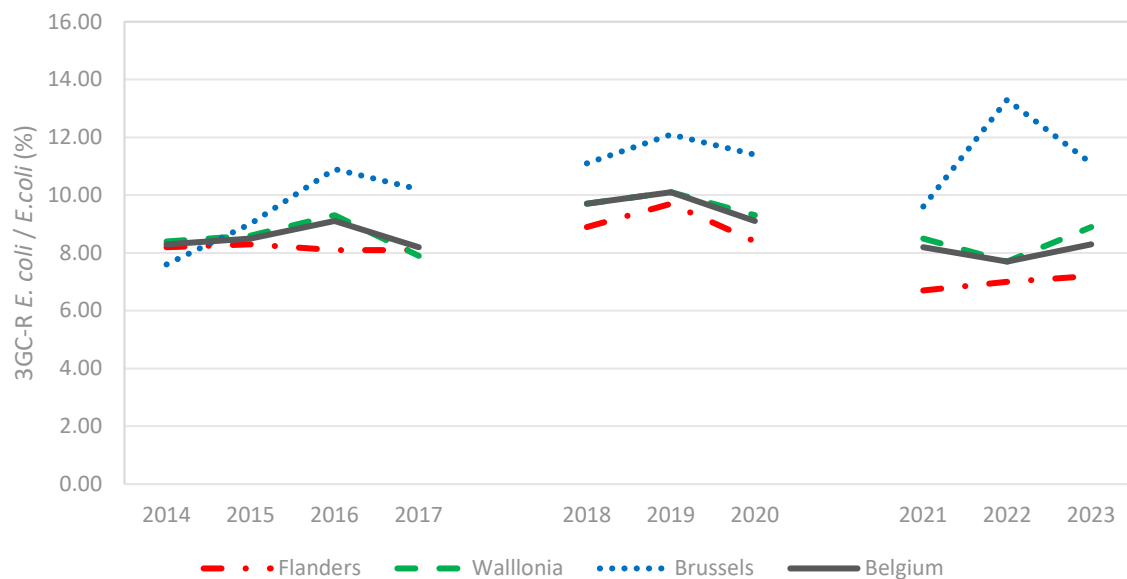
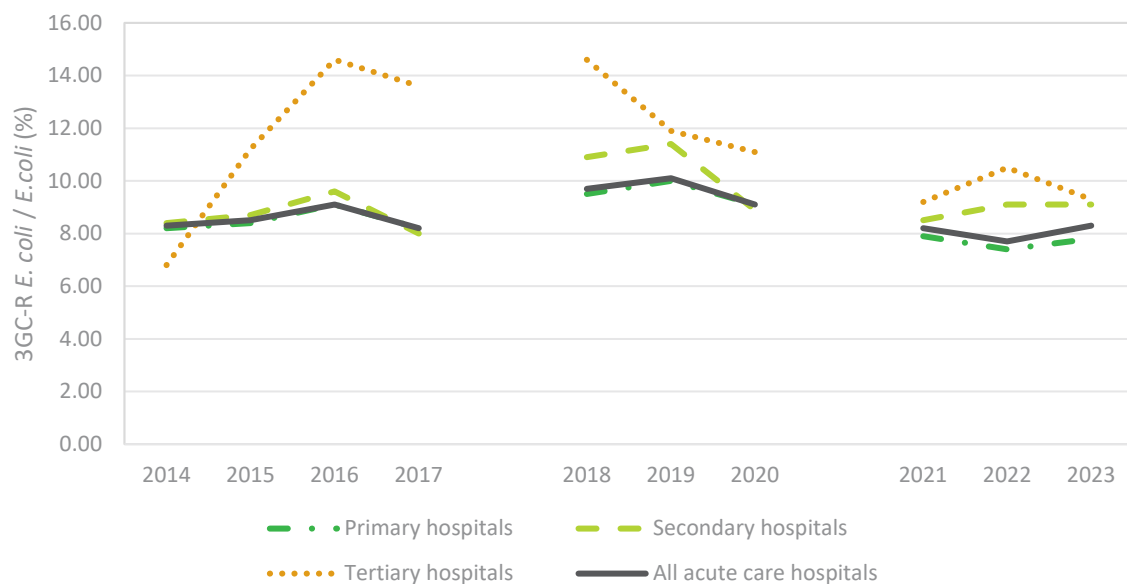


Figure A8. Evolution of the median resistance proportion of *Escherichia coli* resistant to third generation cephalosporins by region (clinical samples only), Belgian acute care hospitals, 2014-2023



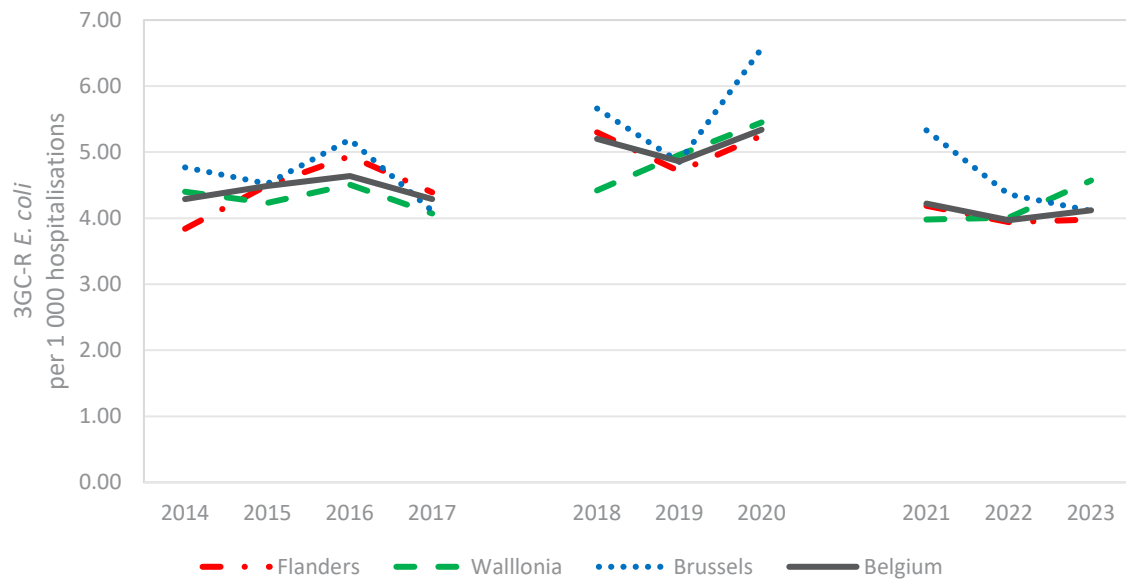
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A9. Evolution of the median resistance proportion of *Escherichia coli* resistant to third generation cephalosporins by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2023



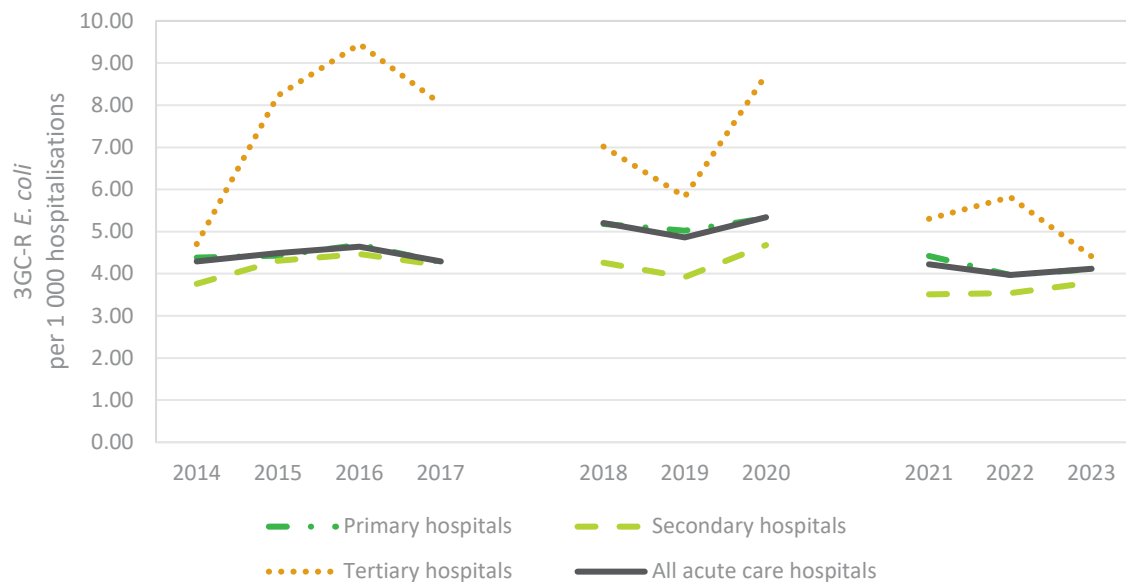
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A10. Evolution of the median incidence (per 1 000 hospitalisations) of *Escherichia coli* resistant to third generation cephalosporins by region (clinical samples only), Belgian acute care hospitals, 2014-2023



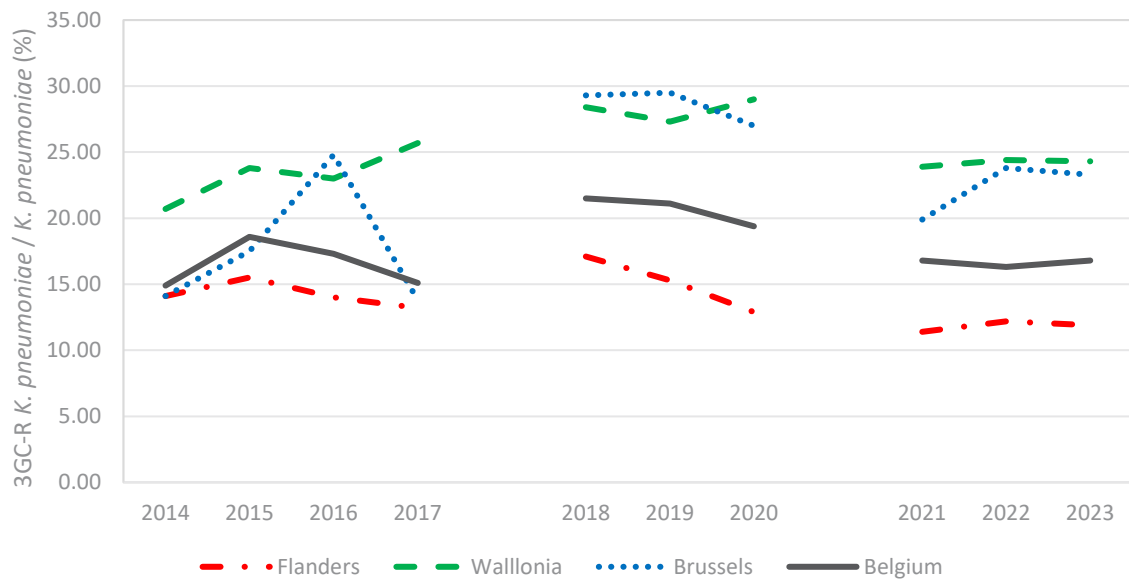
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A11. Evolution of the median incidence (per 1 000 hospitalisations) of *Escherichia coli* resistant to third generation cephalosporins by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2023



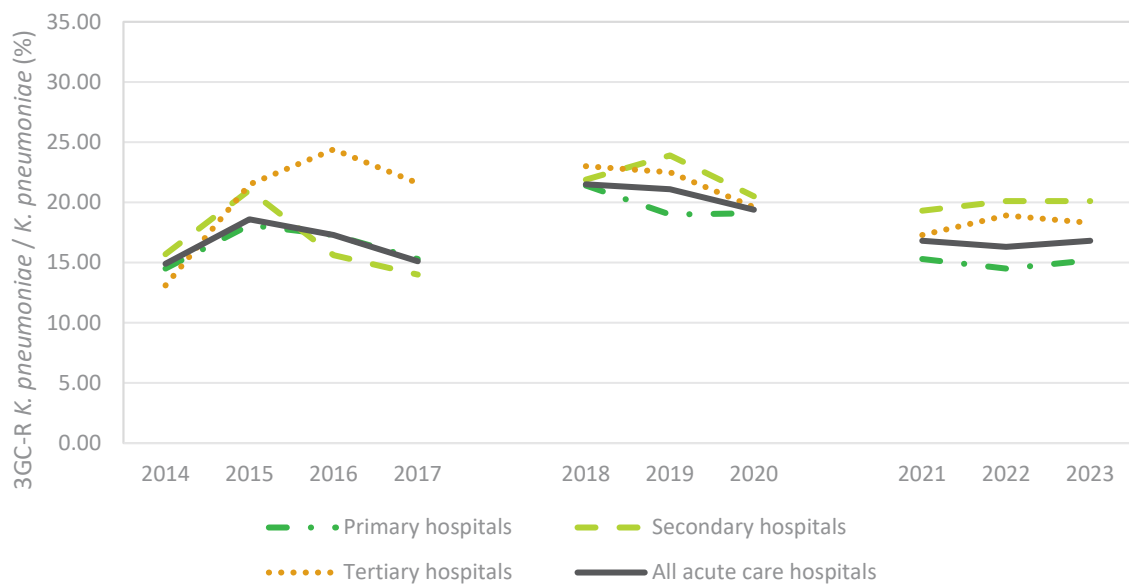
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A12. Evolution of the median resistance proportion of *Klebsiella pneumoniae* resistant to third generation cephalosporins by region (clinical samples only), Belgian acute care hospitals, 2014-2023



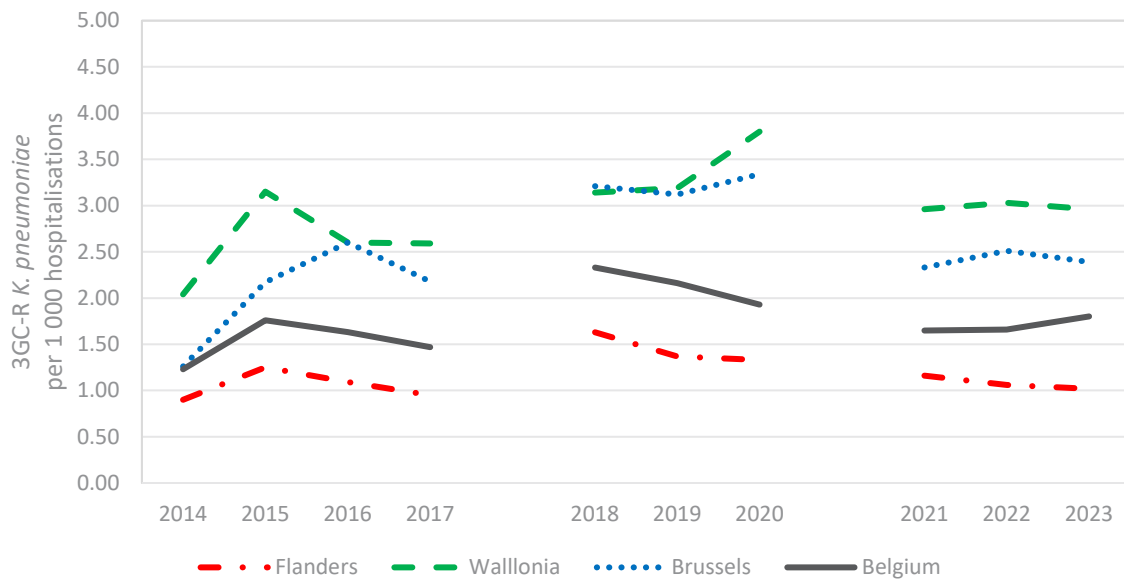
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A13. Evolution of the median resistance proportion of *Klebsiella pneumoniae* resistant to third generation cephalosporins by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2023



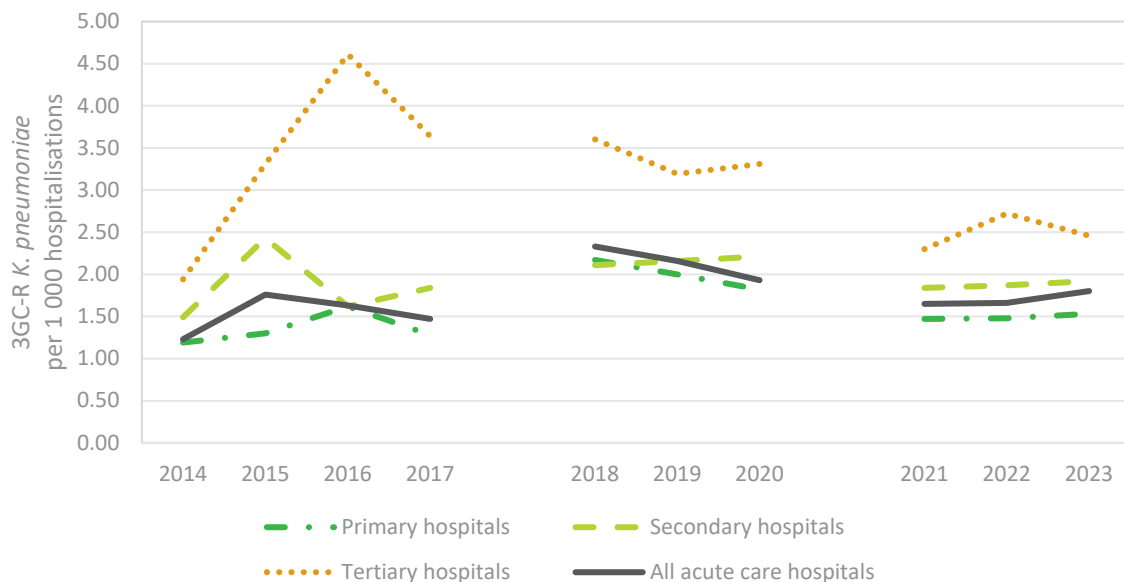
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A14. Evolution of the median incidence (per 1 000 hospitalisations) of *Klebsiella pneumoniae* resistant to third generation cephalosporins by region (clinical samples only), Belgian acute care hospitals, 2014-2023



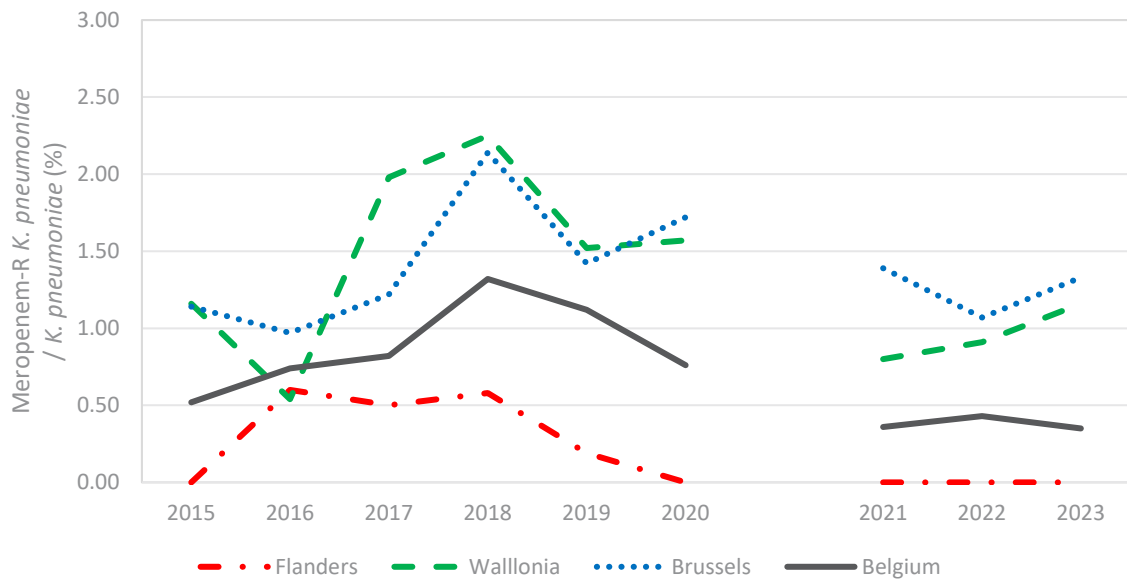
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A15. Evolution of the median incidence (per 1 000 hospitalisations) of *Klebsiella pneumoniae* resistant to third generation cephalosporins by level of specialty care (clinical samples only), Belgian acute care hospitals, 2014-2023



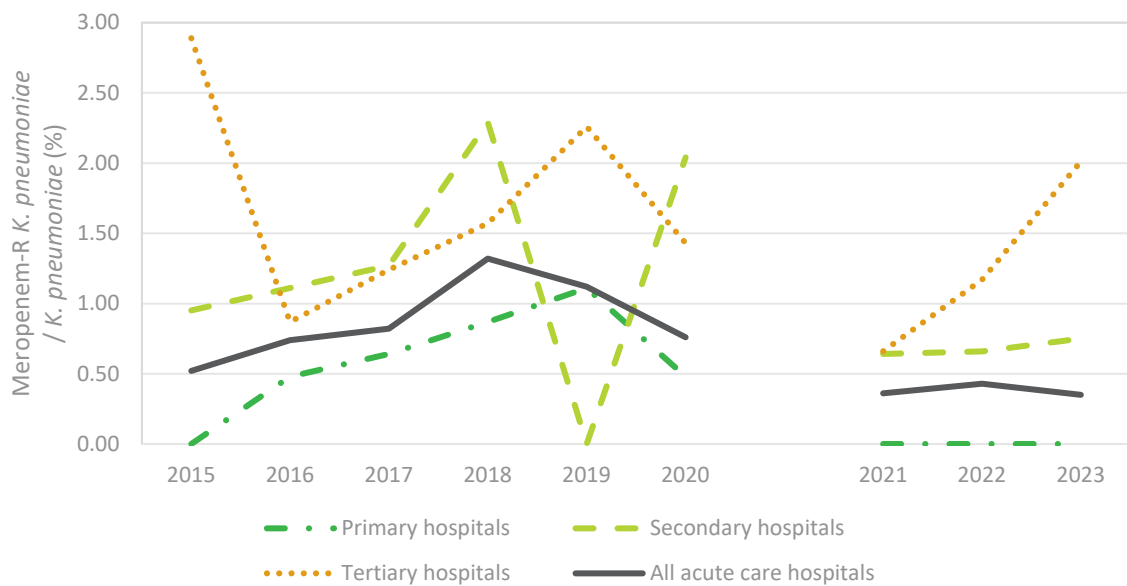
3GC-R = resistant to 3rd cephalosporins; **note:** prior to 2018 non-susceptibility to 4th generation cephalosporins was included, prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A16. Evolution of the median resistance proportion of *Klebsiella pneumoniae* resistant to meropenem by region (clinical samples only), Belgian acute care hospitals, 2015-2023



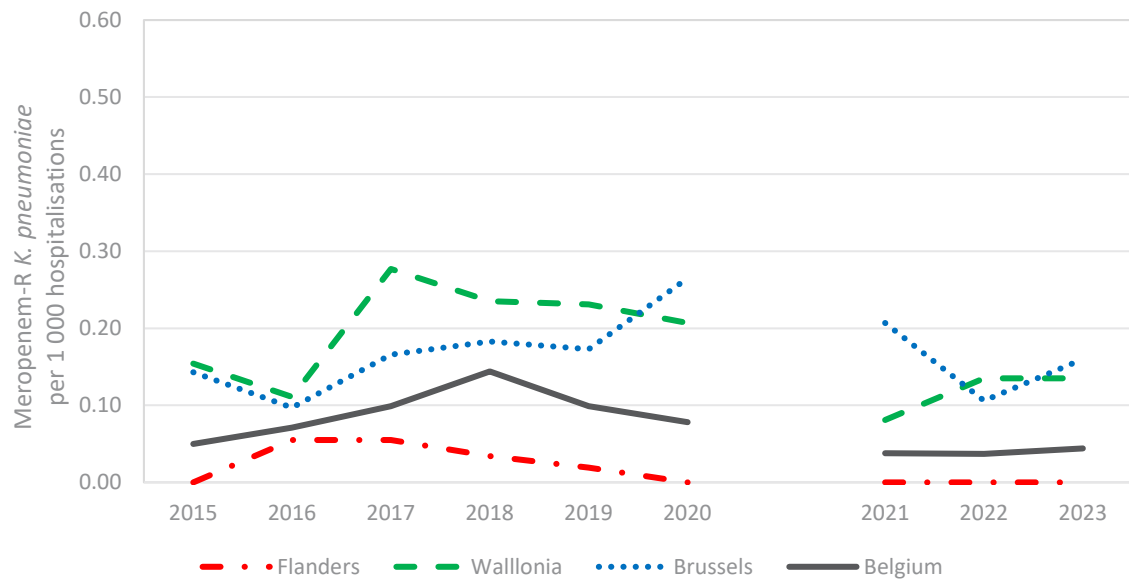
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A17. Evolution of the median resistance proportion of *Klebsiella pneumoniae* resistant to meropenem by level of specialty care (clinical samples only), Belgian acute care hospitals, 2015-2023



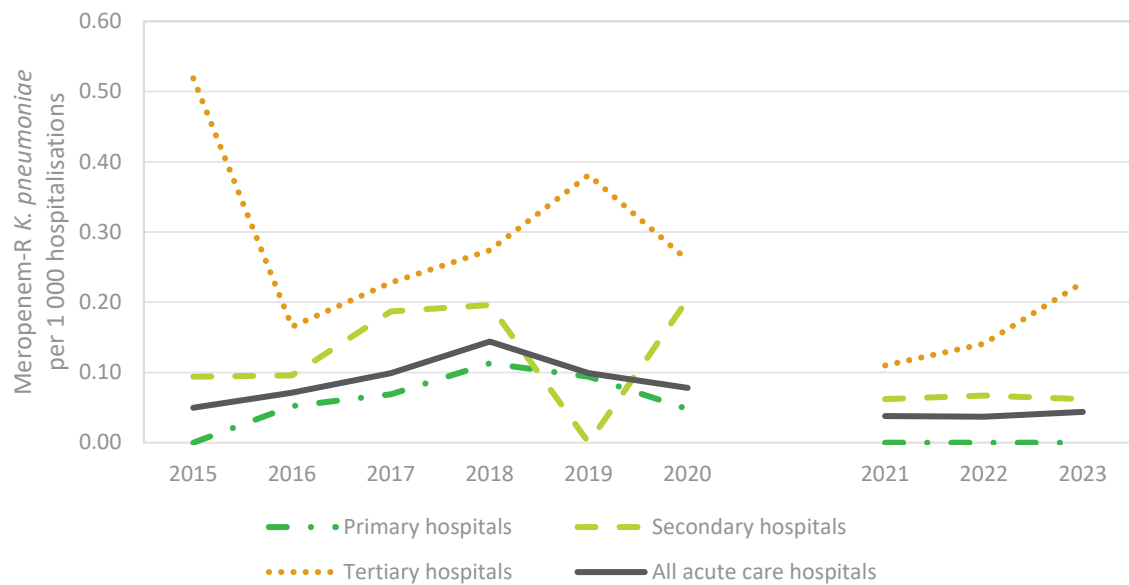
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A18. Evolution of the median incidence (per 1 000 hospitalisations) of *Klebsiella pneumoniae* resistant to meropenem by region (clinical samples only), Belgian acute care hospitals, 2015-2023



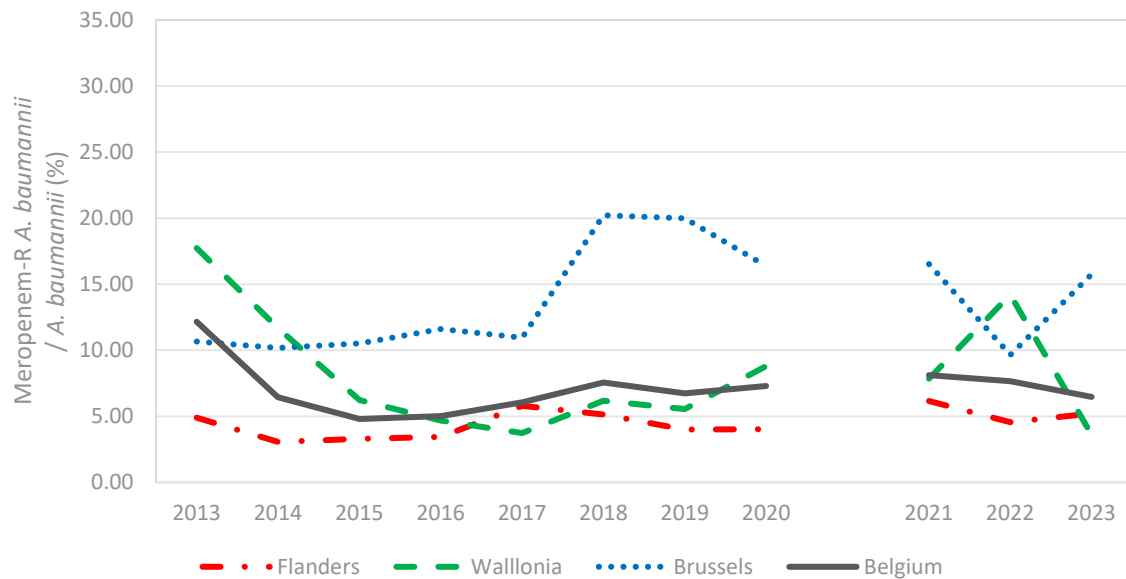
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A19. Evolution of the median incidence (per 1 000 hospitalisations) of *Klebsiella pneumoniae* resistant to meropenem by level of specialty care (clinical samples only), Belgian acute care hospitals, 2015-2023



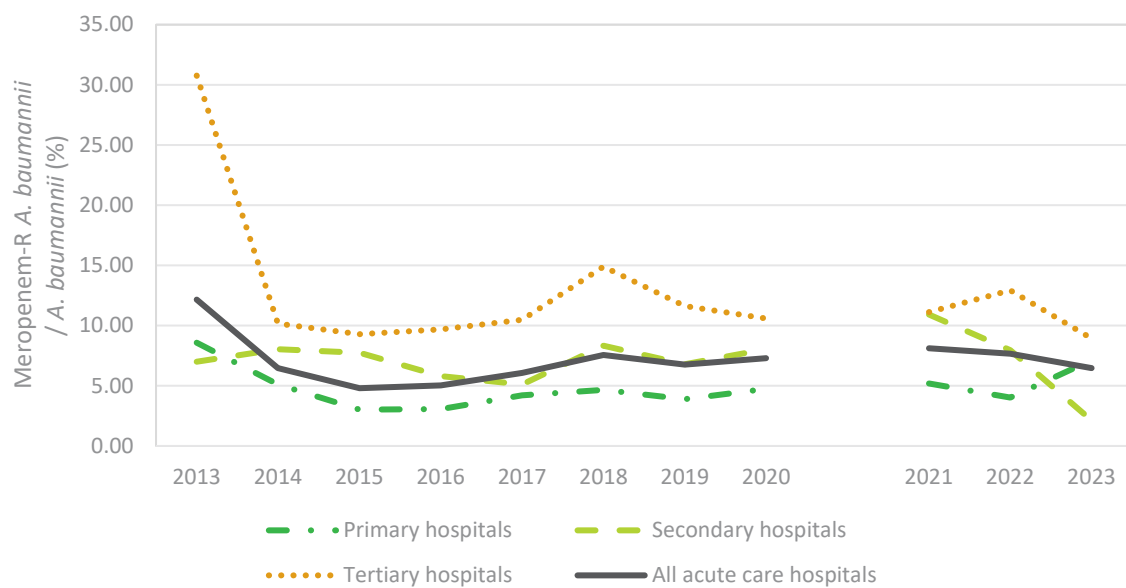
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A20. Evolution of the crude resistance proportion of *Acinetobacter baumannii* resistant to meropenem by region (clinical samples only), Belgian acute care hospitals, 2013-2023



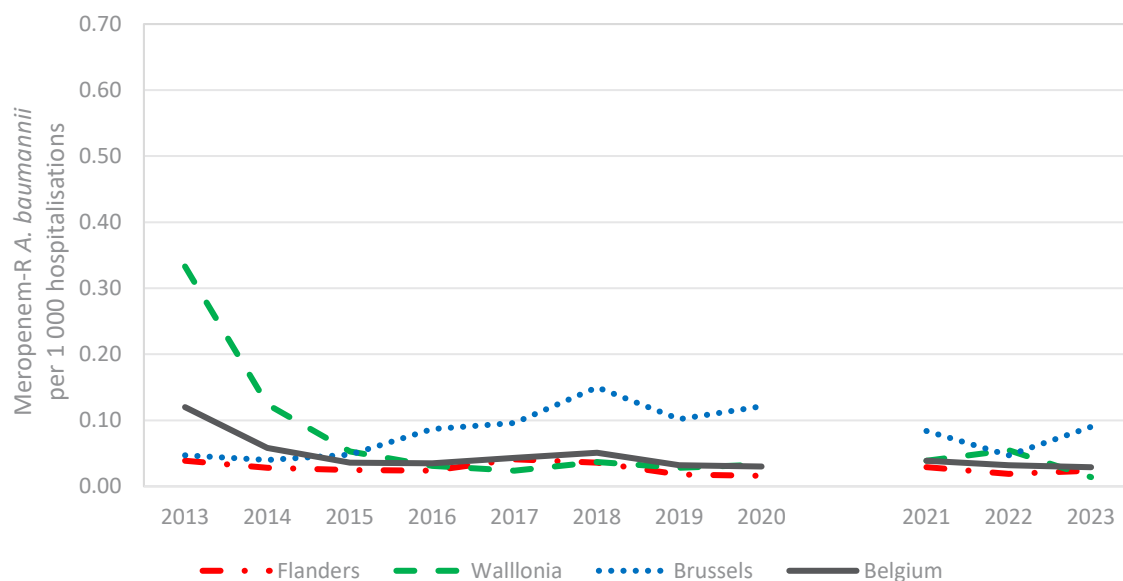
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A21. Evolution of the median resistance proportion of *Acinetobacter baumannii* resistant to meropenem by level of specialty care (clinical samples only), Belgian acute care hospitals, 2013-2023



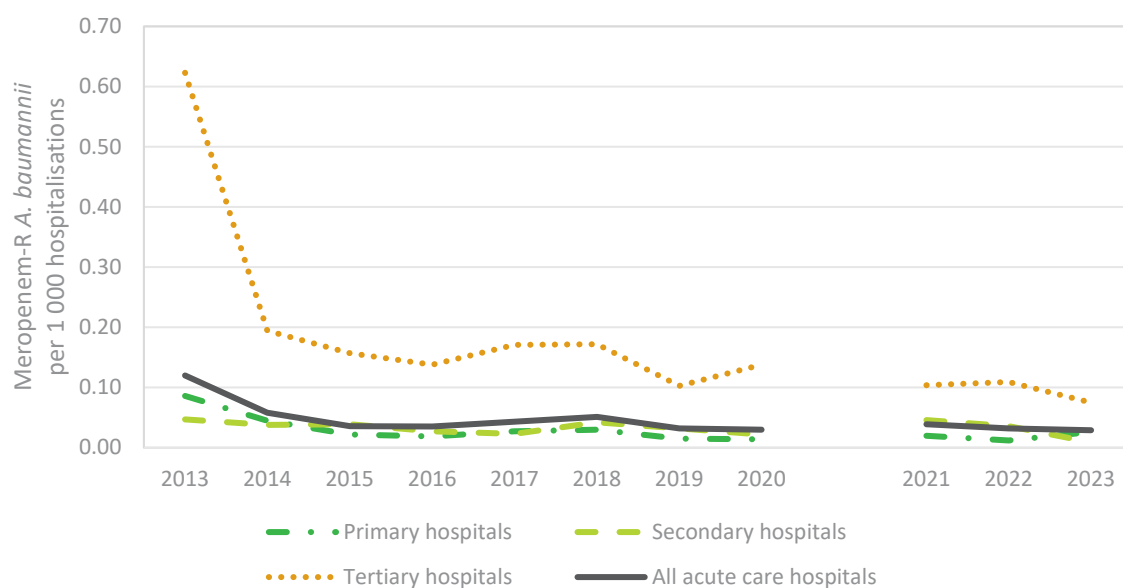
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A22. Evolution of the median incidence (per 1 000 hospitalisations) of *Acinetobacter baumannii* resistant to meropenem by region (clinical samples only), Belgian acute care hospitals, 2013-2023



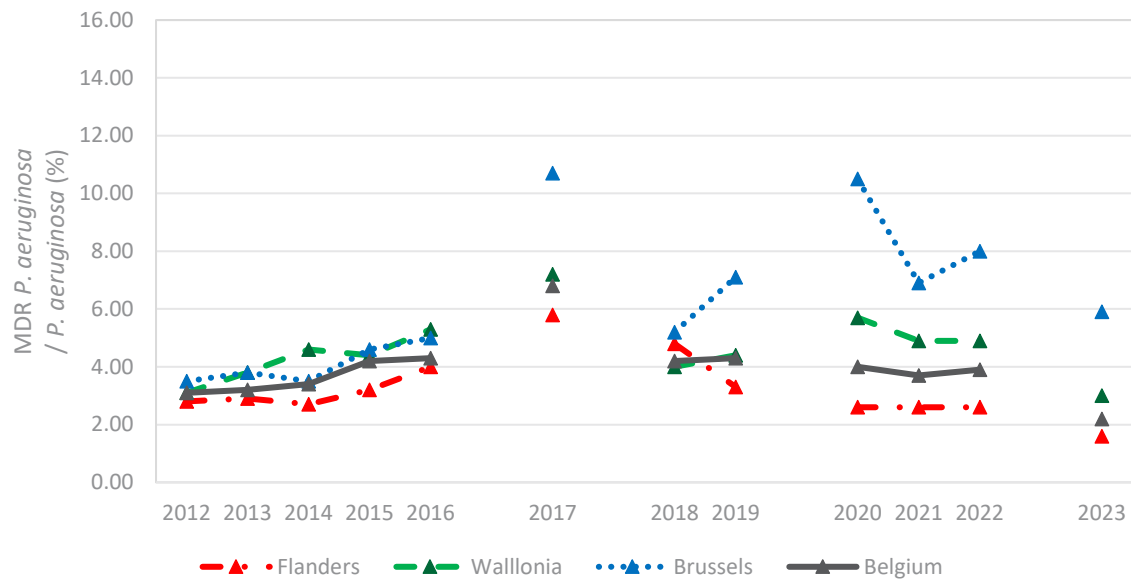
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A23. Evolution of the median incidence (per 1 000 hospitalisations) of *Acinetobacter baumannii* resistant to meropenem by level of specialty care (clinical samples only), Belgian acute care hospitals, 2013-2023



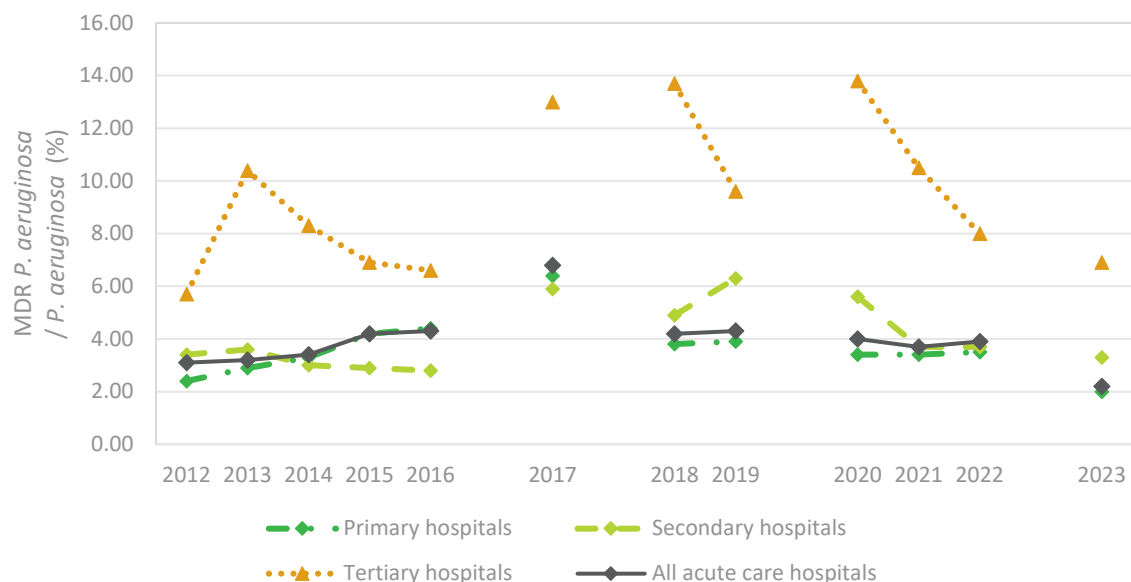
Note: prior to 2021 I/R (resistant, incl. also susceptible, increased exposure (intermediate result)) is displayed.

Figure A24. Evolution of the median resistance proportion of multidrug-resistant (MDR) *Pseudomonas aeruginosa* by region (clinical samples only), Belgian acute care hospitals, 2012-2023



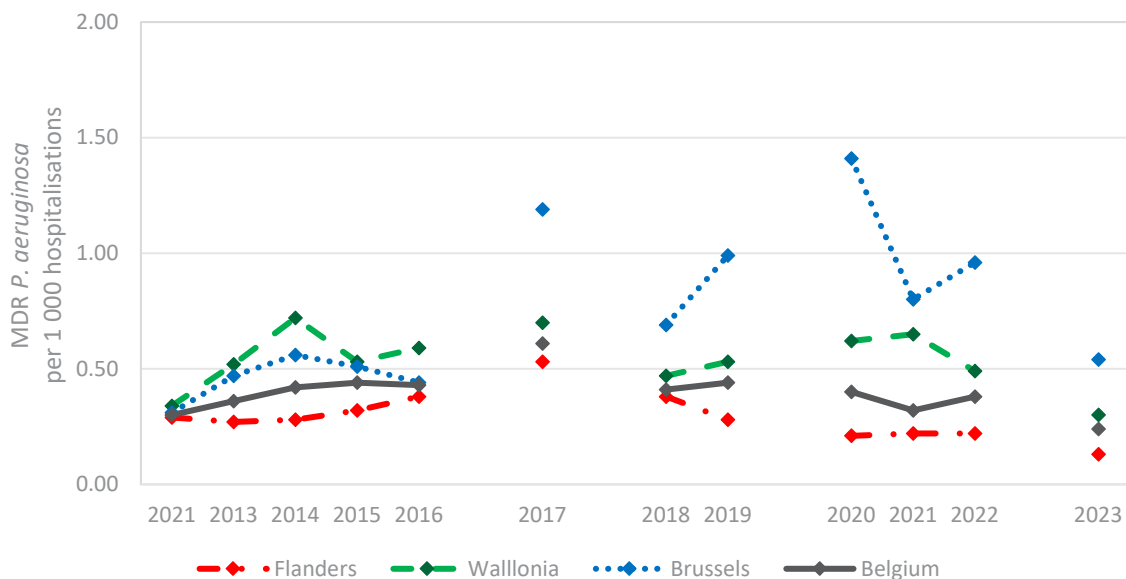
Note: Between 2016 and 2017, the definition of MDR *P. aeruginosa* changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes to reduced susceptibility to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin, levofloxacin), aminoglycosides (gentamicin, tobramycin, amikacin), carbapenems (meropenem, imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, cefepime) and anti-pseudomonas penicillins (piperacillin/tazobactam). In 2018, anti-pseudomonas penicillins (piperacillin/tazobactam) were dropped from the definition. Since 2020, only resistance (R) is considered. In 2023, gentamicin was removed from the list of aminoglycosides.

Figure A25. Evolution of the median resistance proportion of multidrug-resistant (MDR) *Pseudomonas aeruginosa* by level of specialty care (clinical samples only), Belgian acute care hospitals, 2012-2023



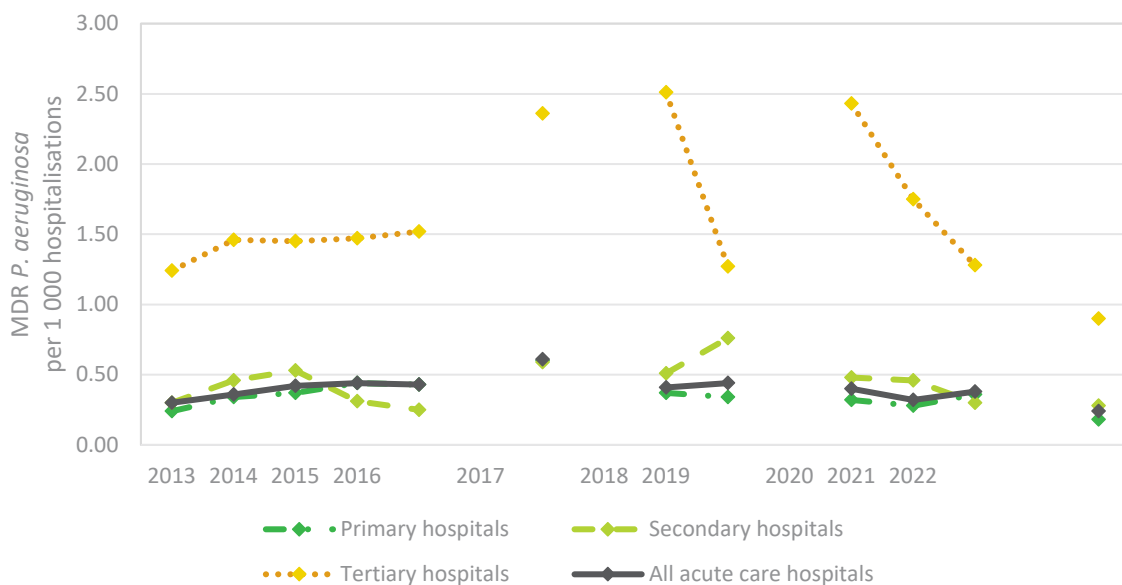
Note: Between 2016 and 2017, the definition of MDR *P. aeruginosa* changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes to reduced susceptibility to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin, levofloxacin), aminoglycosides (gentamicin, tobramycin, amikacin), carbapenems (meropenem, imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, cefepime) and anti-pseudomonas penicillins (piperacillin/tazobactam). In 2018, anti-pseudomonas penicillins (piperacillin/tazobactam) were dropped from the definition. Since 2020, only resistance (R) is considered. In 2023, gentamicin was removed from the list of aminoglycosides.

Figure A26. Evolution of the median incidence (per 1 000 hospitalisations) of multidrug-resistant (MDR) *Pseudomonas aeruginosa* by region (clinical samples only), Belgian acute care hospitals, 2012-2023



Note: Between 2016 and 2017, the definition of MDR *P. aeruginosa* changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes to reduced susceptibility to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin, levofloxacin), aminoglycosides (gentamicin, tobramycin, amikacin), carbapenems (meropenem, imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, cefepime) and anti-pseudomonas penicillins (piperacillin/tazobactam). In 2018, anti-pseudomonas penicillins (piperacillin/tazobactam) were dropped from the definition. Since 2020, only resistance (R) is considered. In 2023, gentamicin was removed from the list of aminoglycosides.

Figure A27. Evolution of the median incidence (per 1 000 hospitalisations) of multidrug-resistant (MDR) *Pseudomonas aeruginosa* by level of specialty care (clinical samples only), Belgian acute care hospitals, 2012-2023



Note: Between 2016 and 2017, the definition of MDR *P. aeruginosa* changed from reduced susceptibility (I or R) to at least one antibiotic in four out of the five following antibiotic classes to reduced susceptibility to at least three of the following antibiotic classes: fluoroquinolones (ciprofloxacin, levofloxacin), aminoglycosides (gentamicin, tobramycin, amikacin), carbapenems (meropenem, imipenem), 3rd and/or 4th generation cephalosporins (ceftazidime, cefepime) and anti-pseudomonas penicillins (piperacillin/tazobactam). In 2018, anti-pseudomonas penicillins (piperacillin/tazobactam) were dropped from the definition. Since 2020, only resistance (R) is considered. In 2023, gentamicin was removed from the list of aminoglycosides.

REPORT APPROVAL OF VARIOUS ENTITIES

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Table. Dates that the different entities have been sent and approved* this report

Entity	Received	Approved
Sciensano	NA	21/02/2025
NRC for resistant Gram-negative bacilli	14/02/2025	No comments received by the proposed deadline
NRC for resistant enterococci	14/02/2025	No comments received by the proposed deadline
NRC for <i>Staphylococcus aureus</i> and other <i>Staphylococci</i>	14/02/2025	No comments received by the proposed deadline
BAPCOC (Belgian Antibiotic Policy Coordination Committee)	21/03/2025	13/04/2025
TC-MDRO (Technical committee multidrug resistant organisms)	21/03/2025	No comments received by the proposed deadline
Regional authorities		
Flanders	21/03/2025	30/04/2025
Wallonia	21/03/2025	15/04/2025
Brussels	21/03/2025	No comments received by the proposed deadline

*includes passive approval

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